Composition and Distribution of Zooplankton in the Pasak Jolasid Reservoir, Lop Buri Province

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ABSTRACT

Composition and distribution of zooplankton in the Pasak Jolasid reservoir were studied during 2002. Samples were horizontally, obliquely and vertically drawn at two-month intervals using three mesh sizes plankton nets (22, 40 and 100 μm). A total of 119 species of zooplankton was recorded. Rotifera was the most diverse zooplankton group in this reservoir. The taxa found in decreasing order were as follow: Phylum Rotifera (24 genera, 76 species and 4 varieties), Phylum Protozoa (13 genera and 22 species), Phylum Arthropoda (12 genera, 20 species and 1 group), and Phylum Cnidaria (1 genus, 1 species). An occurrence of the freshwater jellyfish (*Craspedacusta sinensis*) was the first record in the reservoir of Thailand. Spatial and temporal variations in species number of zooplankton were relatively small; variation in number of species raning between 44 and 89. High numbers were recorded in October at one station along Pasak river ranging between 70 and 89 species, while low numbers ranging between 44-54 were recorded in April at two stations located on the bank of the reservoir.

Key Words: tropical zooplankton, composition, distribution, Pasak Jolasid reservoir, Thailand

INTRODUCTION

Reservoirs are special lacustrine environments in which physical, chemical and biological features are strongly conditioned by surface level fluctuations, due to flooding and dewatering (Thornton *et al.*, 1990). Pasak Jolasid dam was built on Pasak river at Nong Bua sub-district, Pattana Nikom district, Lop Buri province. The reservoir is capable of storing up to 960 million cubic meters of water that can be used for agriculture and consumption in adjacent areas (Royal Irrigation Department, 1999).

There have been very few studies on zooplankton composition (Royal Irrigation Department, 1993; Jinowat, 2000) in Pasak river. To update data on species composition and distribution of zooplankton, a qualitative study of this group was carried out in this reservoir. This study is a part of biological study in the project "Strategies for Sustainable Management of Fishery Resources in Pasak Jolasid Reservoir, Thailand through Ecological and Socioeconomic (SUMAFISH)" which aimed to investigate fishery resources in the reservoir for sustainable management of fisheries. The main objective of the study itself are to investigate species composition and annual fluctuation of zooplankton. Results from the study can be used as baseline information in enhancing fishery productivity through reservoir development and in developing guidelines for natural resources management and conservation in Pasak Jolasid reservoir as long as possible.

MATERIALS AND METHODS

Study sites

Pasak Jolasid reservoir (Figure 1) is located in Pasak river at latitude 14 50' 32" N and longitude 101° 05' 00" E, linking Nong Bua village, Nong Bua sub-district, Pattana Nikom district, Lop Buri province on one side with Kum Pran village, Kum Pran sub-district, Wang Moung district, Saraburi province on the other. The reservoir receives most of water from Pasak river, which is originated from Phetchaboon mountain range located in Dan Sai district, south of Loei province. The dam has been operated since September 1999 with maximum storage capacity of to 960 cubic meters. The study of the reservoir covered from the dam itself (latitude 14° 50' N) to latitude 15° 11' N (around Tadindum village, Chaibadan district, Lop Buri province.

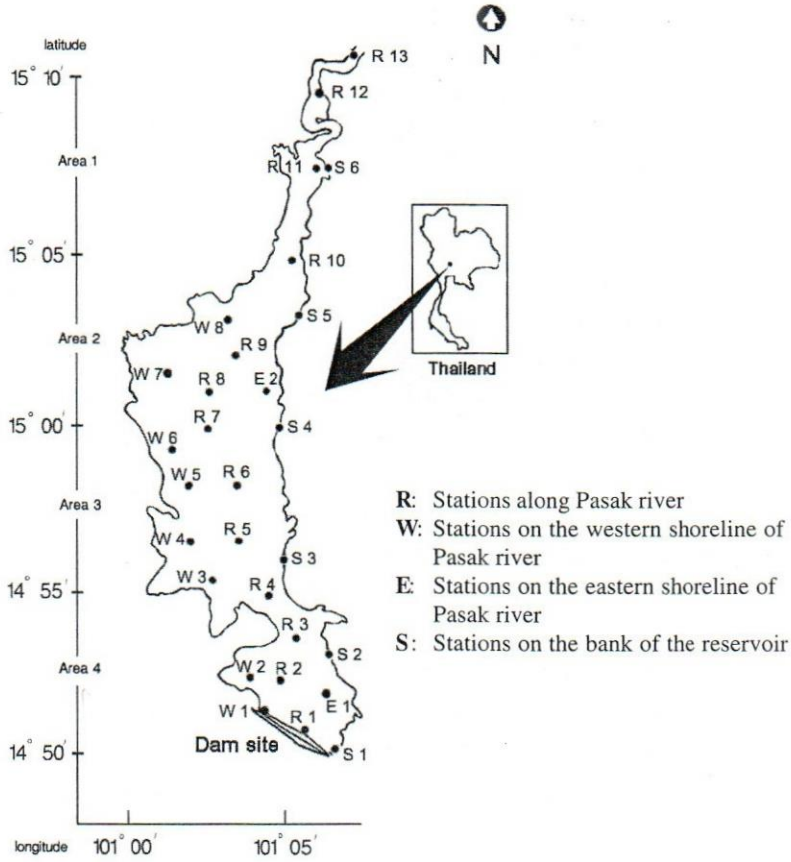

Figure 1 Pasak Jolasid reservoir and sampling stations

Methodologies

Twenty-nine sampling stations were used in the study to ensure proper coverage of the whole reservoir. These stations were located in 4 separated areas divided by different latitudes (Figure 1).

Samples were collected 6 times bimonthly in one year period from January to December 2002. Samples were obtained from plankton net with three mesh sizes 22, 40 and 100 μm using horizontal, vertical and oblique tow techniques, and were preserved with 4% formaldehyde. Taxonomic indentification of the samples was carried out using both stereomicroscope and

compound microscope. Many handbooks were used for zooplankton identification including published articles concerned in various journals. Classification of protozoans was based on documents by Jahn *et al* (1979), Charubhan and Charubhan (1986) and Wongrat (1998) while identification of rotifers can be referred by Koste (1978), Segers (1995) and Wongrat (1998). Documents by Idris (1983), Michael and Sharma (1991), Smirnov (1992, 1996), Wongrat (1998), and Sa-ardrit (2001) were used in indentifying cladocerans while that of copepods used documents of Wongrat (1998). Microphotographs of most zooplankton species were also taken. Classification system used in this paper follows the books of Kudo (1977) and Wongrat (1998). For distribution study, spatial and temporal variations in species numbers were statistically compared.

RESULTS AND DISCUSSIONS

Species composition

Samples were collected from 29 stations for a period of one year (January to December 2002) revealed 119 species from 49 genera of zooplankton. Most species belonged to Phylum Rotifera (24 genera, 76 species and 4 varieties) accounted for 64%, followed by Phylum Protozoa (13 genera and 22 species) with 18%, Phylum Arthropoda 12 genera and 20 species with 17% and Phylum Cnidaria 1 genus and 1 species. Among arthropods, the majority was cladocerans (14 species) followed by copepods (6 species) and not many specimens of ostracods. (Figure 2). High number of rotifer species in Pasak Jolasid reservoir is similar to other studies conducted in other reservoirs (Chookajorn *et al.*, 1988; Elenbaas and Grundel, 1994, Somsiri *et al.*, 1995; Sanoamuang, 1996). The most interesting species in this study was *Craspedacusta sinensis* which was first found in the Pasak Jolasid reservoir. No ichthyoplankton was observed in this study because of using small mesh size plankton nets. Additional photomicrographs of most species are provided in Plates 1-6.

Among 119 species of 49 genera found in the study, important species of zooplankton comprised of *Tintinnopsis lohmanni, Polyarthra vulgaris* and *Keratella tropica*. Fifteen common species were *Difflugia lebes, D. lithophila, D. urceolata, Anuraeopsis coelata, A. fissa, Brachionus angularis, B. diversicornis, B. falcatus, Filinia longiseta, Hexarthra intermedia, Keratella cochlearis, K. tecta, Trichocerca capucina, T. pusilla and T. similis*. These species were found in all samples throughout the year. The species that were recorded during the study period and almost all sampling stations were *Arcella vulgaris, Difflugia amphora, D. tuberculata, Coleps* sp., *Colpoda* sp., *Brachionus calyciflorus* and *B. forficula*. (Table 1).

Table 1 A species list of zooplankton in Pasak Jolasid reservoir (Jan.- Dec. 2002). Photomicrographs of the species with the symbol "*" are shown in Plates 1-6

Phylum Protozoa
Subphylum Pasmodroma
Class Sarcodina
Subclass Rhizopoda
Order Testacida
Family Arcellidae
Arcella bathystoma Ehrenberg*
A. megastoma Ehrenberg*
A. vulgaris Ehrenberg*
Family Difflugiidae
Centropyxis aculeata Stein*
Difflugia acuminata Ehrenberg*
D. amphora (Leidy)
D. corona (Leidy)
D. globulosa (Leidy)
D. lebes Penard
D. lithophila Penard*
D. tuberculata (Wallich)*
D. urceolata Carter*
Family Euglyphidae
Euglypha filifera Leidy*
Subclass Actinopoda
Order Heliozoida
Family Actinophryidae
Actinophrys sol Ehrenberg*
Actinosphaerium eichhorni Ehrenberg*
Subphylum Ciliophora
Class Ciliata
Subclass Holotricha
Order Gymnostomatida
Family Colepidae
*Coleps sp.**
Family Didiniidae
Didinium nasutum Müller
Order Trichostomatida
Family Colpodidae
Colpoda sp.
Subclass Spirotricha
Order Tintinnida
Family Codonellidae
Tintinnopsis lohmanni Laackmann*
Subclass Peritricha
Order Peritrichida
Family Acinetidae
Acineta sp.*
Family Vorticellidae
Vorticella campanula Ehrenberg*
Carchesium polypinum Linnaeus*
Phylum Cnidaria
Class Hydrozoa
Order Limnomedusae
Family Olindiadidae
Craspedacusta sinensis Gaw & Kung*
Phylum Rotifera
Class Monogononta
Order Ploima
Family Brachionidae
Anuraeopsis coelata (Beauchamp)*
A. fissa (Gosse)*
A. navicula (Rousselet)*
Brachionus angularis Gosse*
B. bidentatus (Anderson)
B. calyciflorus Pallas*
B. caudatus Barrois *and* Daday*
B. dichotomus Shephard
B. diversicornis Daday*
B. falcatus Zacharias*
B. forficula Wierzejsk*
B. quadridentatus Herman*
Colurella hindenburgi Steinecke*
C. obtusa (Gosse)
Keratella cochlearis (Gosse)*
K. lenzi (Berzine)*
K. tecta (Gosse)*
K. tropica (Apstein)*
Lepadella acuminata (Ehrenberg)
L. rhomboides (Gosse)*
Mytilina crassipes (Lucks)
M. mucronata (O.F.Müller)
M. ventralis (Ehrenberg)
M. ventralis var. brevispina (Ehrenberg)*
M. ventralis f. *diversicantha* Wulf
Plationus patulus (Müller)*
Platyias quadricornis (Ehrenberg)*
Trichotria tetractis (Ehrenberg)*
Tripleuchlanis plicata (Levander)
Family Lecanidae
Lecane aculeata (Jakubski)
L. aegana Harring
L. bulla (Gosse)*
L. closterocerca (Stchmarda)
L. curvicornis (Murray)*
L. furcata (Murray)
L. harringi (Ahlstrom)
L. hamata (Stokes)*
L. hastata (Murray)*
L. hornemanni (Ehrenberg)*
L. inopinata Harring & Myers*
L. leontina (Turner)
L. luna (O.F. Mülller)
L. lunaris (Ehrenberg)
L. papuana (Murray)*
L. signifera (Jennings)
L. stenroosi (Meissn)
L. stenroosi f. *lineata* (Meissner)*
L. stichaea Harring (Type)*
L. strandti Berzins
L. tenuiseta (Harring)
L. thienemanni (Hauer)
L. ungulata (Gosse)*

Table 1 (cont.)

Family Trichocercidae
Trichocerca capucina (Wierzejski and Zacharias)*
T. chattoni (Beauchamp)
T. cylindrica (Imhof)*
T. elongata (Gosse)
T. longiseta (Schrank)
T. pusilla (Jennings)*
T. similis (Wierzejski)*
Family Asplanchnidae
Asplanchna brightwelli (Gosse)
A. priodonta Gosse*
Family Gastropodidae
Ascomorpha agilis (Zacharias)
A. ecaudis (Perty)
A. ovalis (Berg)*
A. saltans Bartsch*
Family Synchaetidae
Polyarthra vulgaris Carlin*
Synchaeta stylata Wierzejki
Family Proalidae
Proales sp.
Order Floscullariacea
Family Testudinellidae
Filinia brachiata (Rousselet)
F. camasecla Myers*
F. longiseta (Ehrenberg)*
F. longiseta (Ehrenberg) var. *limnetica* (Zacharias)
F. novaezealandiae Shiel and Sanoamuang
F. opoliensis (Zacharias)*
Pompholyx complanata (Gosse)*
Testudinella parva (Ternetz)*
T. patina f. *intermedia* (Anderson)*
Family Hexarthridae
Hexarthra intermedia Wiszniewski*
Family Conochilidae
Conochilus sp.
Class Digononta
Family Philodinidae
Rotaria sp.
Phylum Arthropoda
Class Crustacea
Subclass Branchiopoda
Order Diplostraca
Suborder Cladocera
Family Sididae
Diaphanosoma excisum Sars*
D. modiglinai Richard
D. sarsi Richard
Family Daphnidae
Ceriodaphnia cornuta Sars*
Family Moinidae
Moina macrocopa (Straus)
M. micrura Kurz
Family Bosminidae
Bosmina longirostris (O.F. Mülller)
Bosminopsis deitersi Richard*
Family Chydoridae
Alona affinis (Leydig)
A. intermedia Sars
A. nonocantha Sars
A. pulchella King
A. verrucosa Sars*
Subclass Ostracoda
Order Podocopa
Unidentified Ostracods*
Subclass Copepoda
Order Calanoida
Family Diaptomidae
Heliodiaptomus viduus (Gurney)*
Mongolodiaptomus botulifer (Kiefer)*
Phyllodiaptomus christineae Dumont, Reddy & Sanoamuang*
Neodiaptomus blachei (Brehm)*
Order Cyclopoida
Family Cyclopidae
Mesocyclops thermocyclopoides (Harada)*
Thermocyclops crassus (Fischer) *
Order Harpacticoida
Unidentified harpacticiod copepods

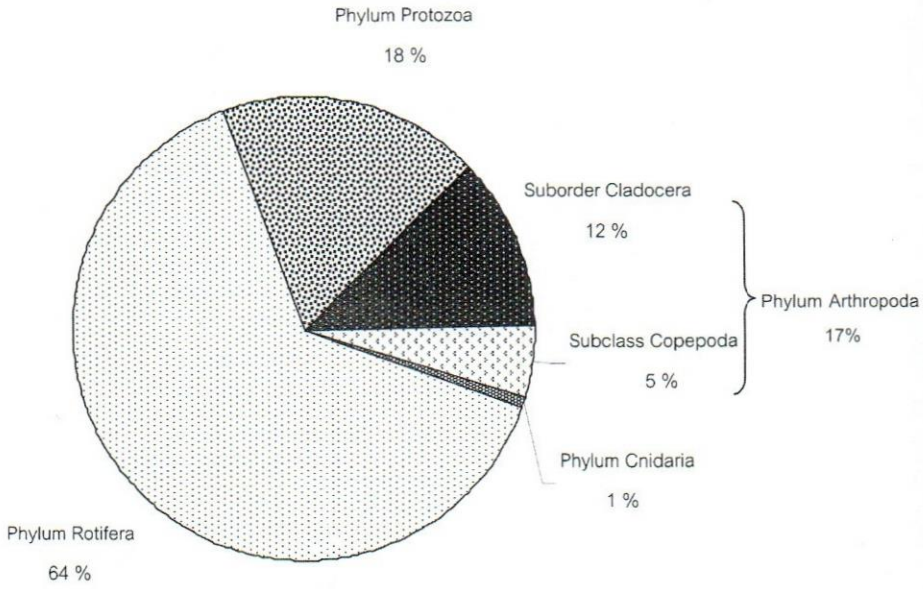

Figure 2 Species composition of zooplankton and relative percentage of each group

Distribution of zooplankton

Phylum Protozoa

Twenty-two species from 13 genera belonged to Phylum Protozoa. Large number of species were classified in Class Sarcodina, with Difflugia lebes, D. *lithophila* and D. *urceolata* as the most common species which were found in all 29 sampling stations throughout the year. *Arcella vulgaris, Difflugia amphora* and *D. tuberculata* were identified as the second most common and were found at almost every station throughout the study. The most common protozoan in Class Ciliatata was *Tintinnopsis lohmanni* which was found at all stations throughout the year, followed by *Coleps* sp. and *Colpoda* sp.

Difflugia was the genus with the highest number of species (8 species) and was mostly found on stations located along eastern and western shores of Pasak river. These stations was situated in areas where the water depth is less than 10 meters and sediments including organic matters, are discharged into the reservoir. Such finding is, therefore, consistent with Chaiubol (1998) who found many species of Sarcodina in water with high concentration of organic matters. Reservoirs with high oxidation and decomposition are often inhabited by protozoans belonged to ciliates the like of Coleps sp., Vorticella sp. and by some in Sarcodina such as *Difflugia* sp. (Charubhan and Charubhan, 1989). Identification of fewer ciliate protozoans in this study may due to identification was made on live specimens which more detailed species classification can be done. Species that were scarcely observed were *Acineta* sp., *Actinophrys sol*, and *Carchesium polypinum* that occurring only once in October or in December.

Phylum Cnidaria

Only one species of Phylum Cnidaria, *Craspedacusta sinensis,* was found in the study. This 2-6 millimeter organisms were found in 23 of 29 sampling stations (S1- S3, S5, E1-E2, W1-W 8 and R1-R9) and in the months of February, April, June, August and December (not found in October). Most was found in Februray but not found in October because of strong currents in the reservoir and high turbidity of water. Finding of this jellyfish species had been reported by Klaewkrua *et al.* (2002) in a section of Mekong river from Kok Ngiew village, Chiang Karn district to Kok Pai village, Pakchom district of Loei province. Specimens found in

the report were relatively large with umbrella diameters ranging between 1-25 millimeters. Literature reviews had found a finding on distribution of this species in Thailand as far back as 1981 (Potong, 1981). *Craspedacusta sinensis* found in Pasak Jolasid reservoir are much smaller than those found earlier in Mekong river and not a single specimen had umbrella diameter over 6 millimeters. Another species of freshwater jellyfishes, *Craspedacusta sowerbyi*, had been found in some area of Keg river (Bang Krajan and Wung Numyen) at Nong Mae Na sub-district, Khao Kor district, Phetchaboon province. The specimen exhibited umbella diameters of 1.7-3.5 centmeters and largest number of the species had been found in March and April (Klaewkrua et al. 2002). *C. sinensis* was not found in upstream areas (R10-13 and S6). It was, however, documented at every other station upper section of the reservoir (R7-9, W7-8, S4-5 and E2), the middle section (R4-6, W3-6 and S3) and at the dam site areas (R1-3, W1-2, S1-2 and E1). This is a new record of jellyfish in a reservoir of Thailand.

Dumont (1994) reviewed the distribution and ecology of freshwater medusae of the world. He strictly stated that freshwater medusae belong to three genera: *Halmomise, Craspedacusta*, and *Limnocnida*. Number of species within each genus is controversial. For Craspedacusta comprises four species, all in East Asia (Parent, 1982 cited by Domont, 1994). Among these species, two species (*C. sowerbii*, and *C. sinensinsis* are considered to have origin in the Yangtze valley by Kramp 1951 and by Parent 1981 (cited by Dumont, 1994). *C. sowerbyi* is the most abundant and widespread freshwater cnidarian. Dispersal with water plants is a factor for immigration of freshwater cnidarians. Parent (1982) found that *Elodea canadensis* may have been a vehicle for *Craspedacusta*, with a time lag of about 50 years. The numerous occurrences of *Craspedacusta* in aquaria suggest that 'escape' from aquaria may mark the beginning of the conquest of a new area. As no one knows the life cycle of *C. sinensis* (Gaw and Kung, 1939 cited by Dumont, 1994), a detailed investigation on this topic is needed.

Phylum Rotifera

Rotifera was the most diverse group in this study; seventy-six species of 24 genera were identified. Of these the most common species included *Anuraeopsis coelata, A. fissa, Brachionus angularis, B. diversicornis, B. falcatus, Filinia longiseta, Hexarthra intermedia, Keratella cochlearis, K. tecta, K. tropica, Polyarthra vulgaris, Trichocerca capucina, T. pusilla* and *T. similis*. These species were found at every station throughout the year. *Brachionus calyciflorus* and *B. forficula* were identified as the second-most common and were found at almost all stations during the entire study.

Polyarthra vulgaris and *Keratella tropica* were the two most common species and were found to distribute throughout every sampling station. These species have been classified as cosmopolitan species and can be found in large numbers in tropical (Sanoamuang, 1996.) reservoirs with high level of nutrients (Donk and Gulati, 1990).

Several species were found at particular sampling period, such as *Brachionus dichotomus, Filinia longiseta* var. *limnetica, Mytilina mucronata, Trichotria tetractis* and *Tripleuchlanis plicata Collurella hindenburgi, Lecane aegana, L. furcata* and *L. stenroosi* (August), *Collurella obtusa, Filinia brachiata, Lecane aculeata, L. closterocerca, L. inopinata, L. leontina, L. signifera, L. stichaea, L. strandti, L. tenuiseta, Lepadella rhomboides* and *Testudinella parva* (October), *Mytilina ventralis and M. ventralis* f. *diversicantha* (December).

Phylum Arthropoda

Zooplankton in Phylum Arthropoda found in the study consisted of 12 genera, 20 species and 1 group. The most common species included *Bosminopsis deitersi, Neodiaptomus blachei*

and *Thermocyclops crassus* and were found at every station throughout the year. The second-most common species were *Ceriodaphnia cornuta* and *Diaphanosoma excisum*, which were recorded at almost all stations during the entire study. Copepod larvae were observed in all samples.

Three orders of copepods were identified in this study. The first one, Order Calanoida contained 4 species: *Neodiaptomus blachei*, *Heliodiaptomus viduus, Mongolodiaptomus botulifer* and *Phyllodiaptomus christineae*. All species were found throughout the reservoir. *Phyllodiaptomus christineae* appeared only in October. According to Sanoamuang (2002) concerning ecology of copepods: *Neodiaptomus blachei, Mongolodiaptomus botulifer* and *Phyllodiaptomus christineae* are common species found in reservoirs throughout Thailand. *Neodiaptomus blachei* and *Phyllodiaptomus christineae* can be found in both temporary and permanent water bodies, *Mongolodiaptomus botulifer* mostly inhabits in permanent water bodies, such as reservoir, while *Heliodiaptomus viduus* have been found restricted to reservoirs only. The second one, Order Cyclopoida contained 2 copepod species: *Thermocyclops crassus* and *Mesocyclops thermocyclopoides*. These species distributed throughout the reservoir in which *Thermocyclops crassus* was observed in all samples. The remaining, Order Harpacticoida, was scarcly found in small number and only at stations in upstream areas in October. Data on frequency of occurrence showed that cyclopoids mostly occurred in the study area.

Crustacean species from Subclass Branchiopoda were found throughout the entire reservoir in which fourteen species of Suborder Cladocera were identified. Three of these were noted as common species; *Bosminopsis deitersi*, *Ceriodaphnia cornuta* and *Diaphanosoma excisum* while the other ten were regularly recorded or found once during the whole study. The lack of sizable population of aquatic plants in Pasak Jolasid reservoir was believed to be the main contributing factor in small number of cladoceran species which have been known to use aquatic plants as their habitats. This is consistent with Sa-ardrit (2001) who reported that cladocerans often lived near shoreline and in area with considerable aquatic vegetation, where they used as their substrates, food sources and shelters from their predators. A study by Smirnov (1974) found average biomass of cladocerans in genera Chydoridae to directly reflect amount of aquatic plants and algae and not species of the plants and algae.

Spatial and temporal variations in number of species

Spatial variation in number of species of zooplankton was relatively small, with the number of species ranging between 44-70. The largest number of species of zooplankton was recorded at one station along Pasak river (station R9) with 70 species, while the lowest was at two stations (S2 and S3) located on the bank of the reservoir with same number (44 species). Spatial variation of each group was as follows : the number of species of protozoans ranged between 9-16. Station with the largest number of species (16 species) was station R5, while the lowest (9 species) was recorded at stations E2, S4, S6 and R13. There was also increase in the number of species from station R4 to station R11. Variation of rotifers in number of species between sampling stations was found to be relatively small, with the number of species ranging between 28-43. Station with the largest number of rotifer species (43 species) was station R12, while the lowest (28 species) was recorded at stations S3 and S4. But variation of arthropods in number of zooplankton species between sampling stations was relatively large, with the number of species ranging between 4-14. Station with the largest number of arthropod species (14 species) was station R9, while the lowest (4 species) was recorded at stations S2, S3 and S4. Copepod nauplii were found in every sample. The freshwater jellyfish was found in many stations; 23 of 29 sampling stations (S1- S3, S5, E1-E2, W1-W 8 and R1-R9) (Figure 3).

Temporal variation in number of species was also relatively small. Number of species tended to be high in wet season and low in dry season; the highest (89 species) and lowest (54 species) values were in October and April, respectively. Temporal variation in species number of protozoan was very small with the number ranging between 13 and 17. The largest number of species was found in December (17 species), while the lowest was recorded in June with 13 species. Variation of rotifers in species number was relatively small with the number ranging between 31 and 60. The largest number of species was documented in October (60 species) mainly due to finding of exceptional number of species in *Lecane* genus. The lowest was recorded in April with 31 species. Variation of arthropods in species number was also relatively small with the number ranging between 9 and 14. The largest number of species was documented in October (14 species), while the lowest was recorded in April and February with 9 species. The freshwater jellyfish was mostly found in the months of dry season : February, April, June, August and December. (Figure 4).

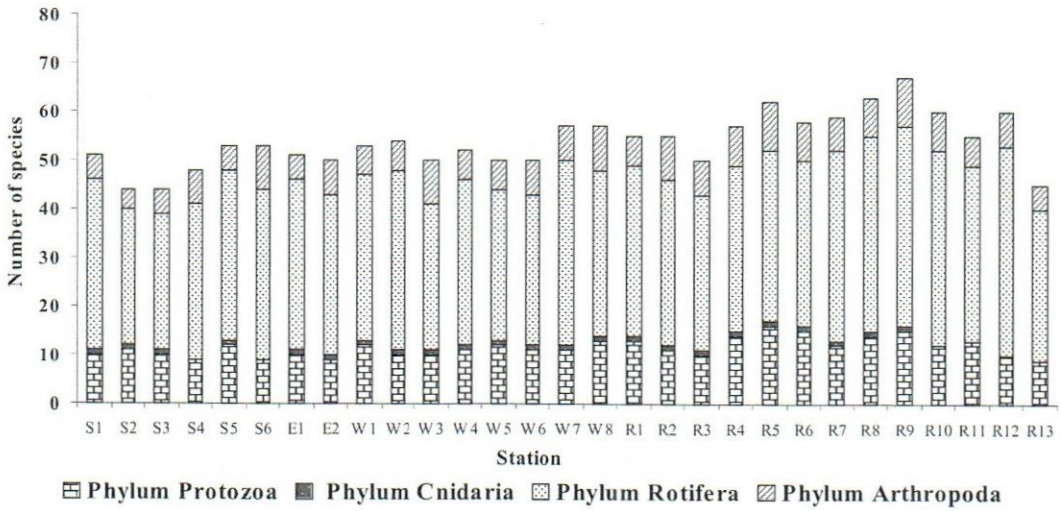

Figure 3 Spatial variations of zooplankton in Pasak Jolasid reservoir

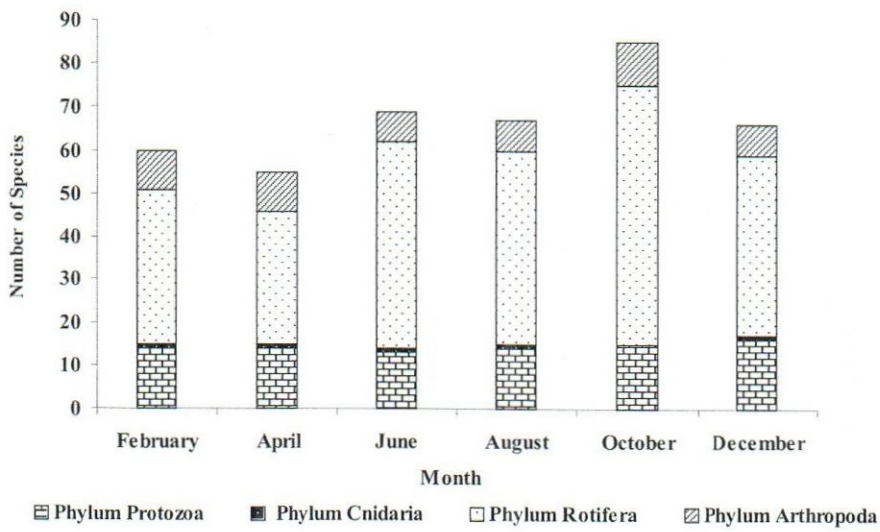

Figure 4 Temporal variations of zooplankton in Pasak Jolasid reservoir

CONCLUSIONS

We found 119 species from 49 genera of zooplankton. Phylum Rotifera was identified with the largest number of species (24 genera, 76 species and 4 varieties), accounting for 64%. This was followed by Phylum Protozoa (13 genera and 22 species) with 18 %, Phylum Arthropoda (12 genera, 20 species and one group) with 17% and Phylum Cnidaria (1 species from 1 family) with 1%. An occurrence of the freshwater jellyfish (*Craspedacusta sinensis*) was the first record in the reservoir of Thailand. The most common zooplankton species found in the study included *Difflugia lebes, D lithophila, D. urceolata, Anuraeopsis coelata, A. fissa, Brachionus angularis, B. diversicornis, B. falcatus, Filinia longiseta, Hexarthra intermedia, Keratella cochlearis, K. tecta, Trichocerca capucina, T. pusilla and T. similis*. These species were found at every sampling station throughout the year. Seven species (*Arcella vulgaris, Difflugia amphora, D. tuberculata, Coleps* sp., *Colpoda* sp., *Brachionus calyciflorus* and *B. forficula*) were identified as the second most common species and were found at almost all sampling stations during the entire study. The highest number of species in Pasak Jolasid reservoir was recorded at sampling station R9 with 70 species, while the lowest was found at stations S2 and S3 with 44 species. Throughout 2002, October was found with the highest number of species (89 species), while the lowest was documented in April with 54 species.

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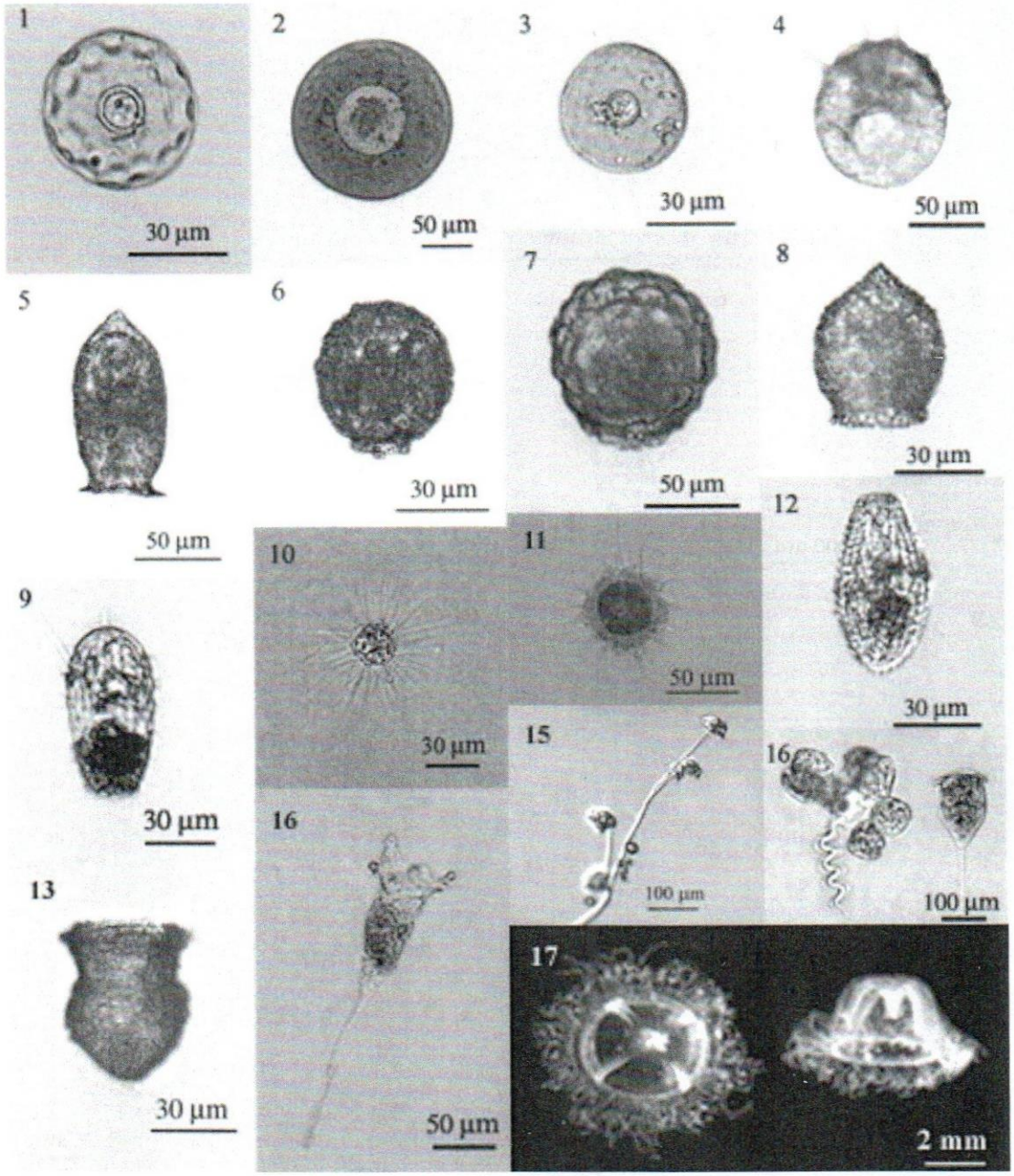
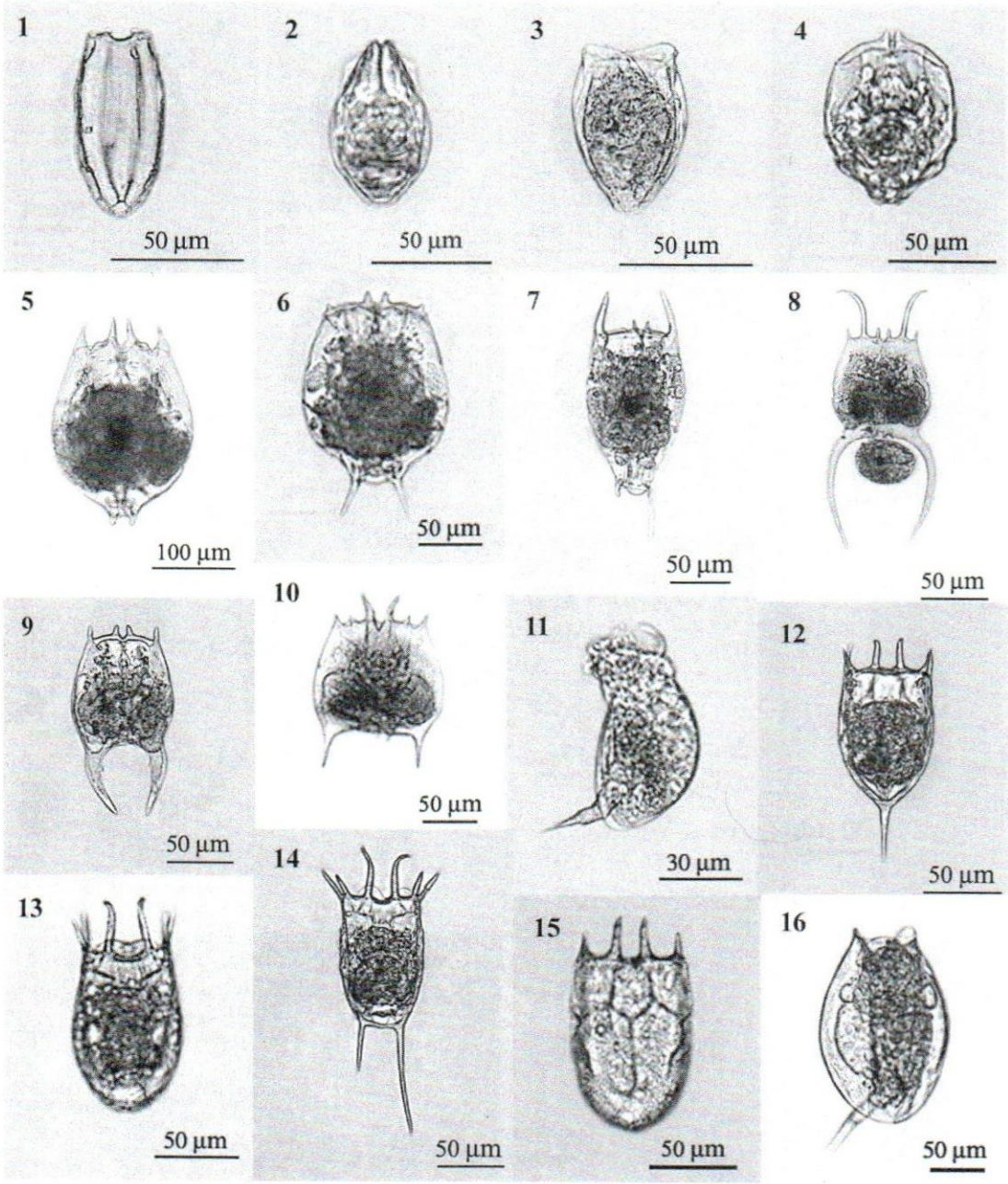
Plate 1



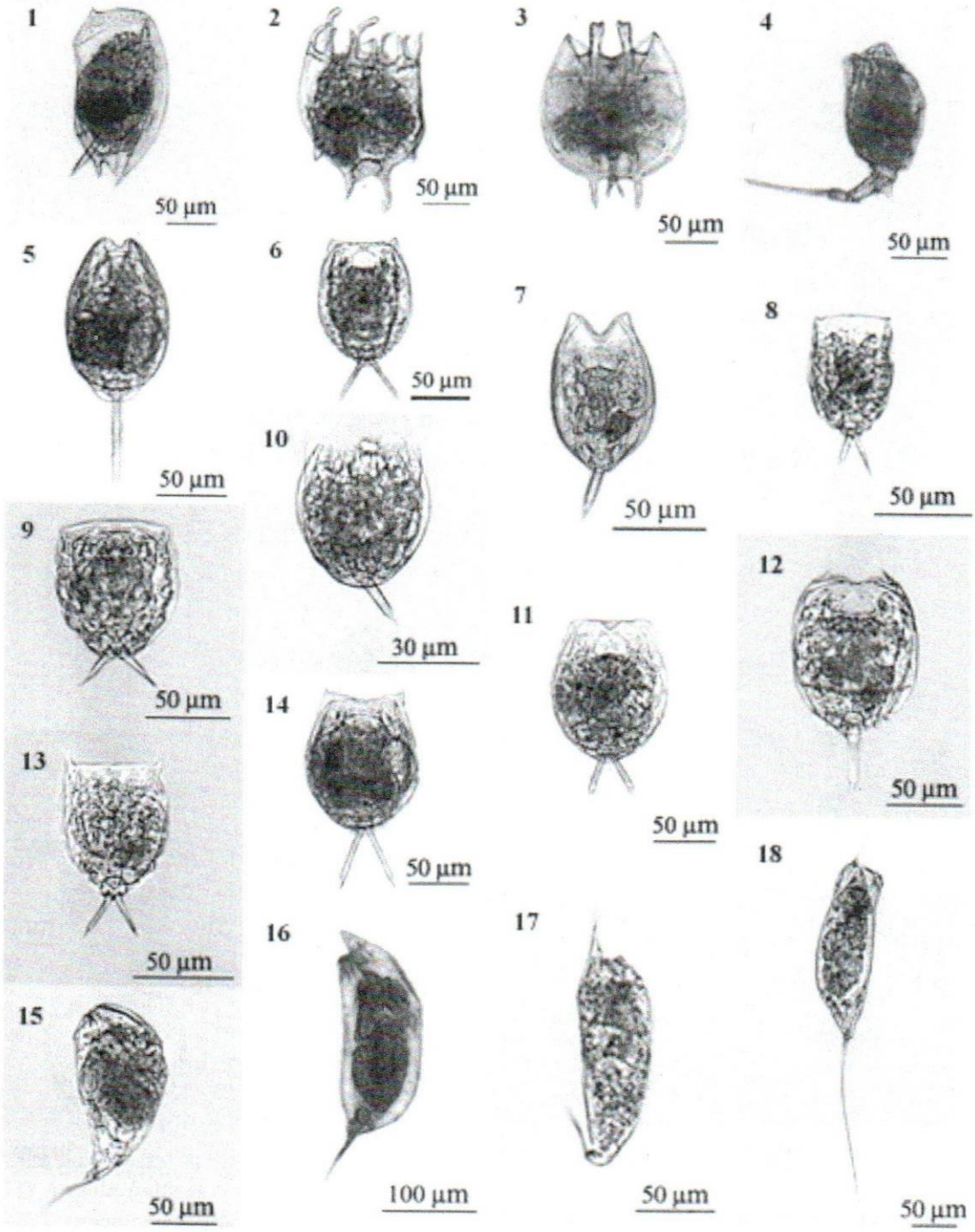
Zooplankton in the Pasak Jolasid reservoir
(1) *Arcella bathystoma*; (2) *A. megastoma*; (3) *A. vulgaris*;
(4) *Centropyxis aculeata*; (5) *Difflugia acuminata*; (6) *D. lithophila*;
(7) *D. tuberculata*; (8) *D. urceolata*; (9) *Euglypha filifera*;
(10) *Actinophrys sol*; (11) *Actinosphaerium eichhorni*; (12) *Coleps* sp.;
(13) *Tintinnopsis lohmanni*; (14) *Acineta* sp.; (15) *Carchesium polypinum*;
(16) *Vorticella campanula*; (17) *Craspedacusta sinensis*

Plate 2



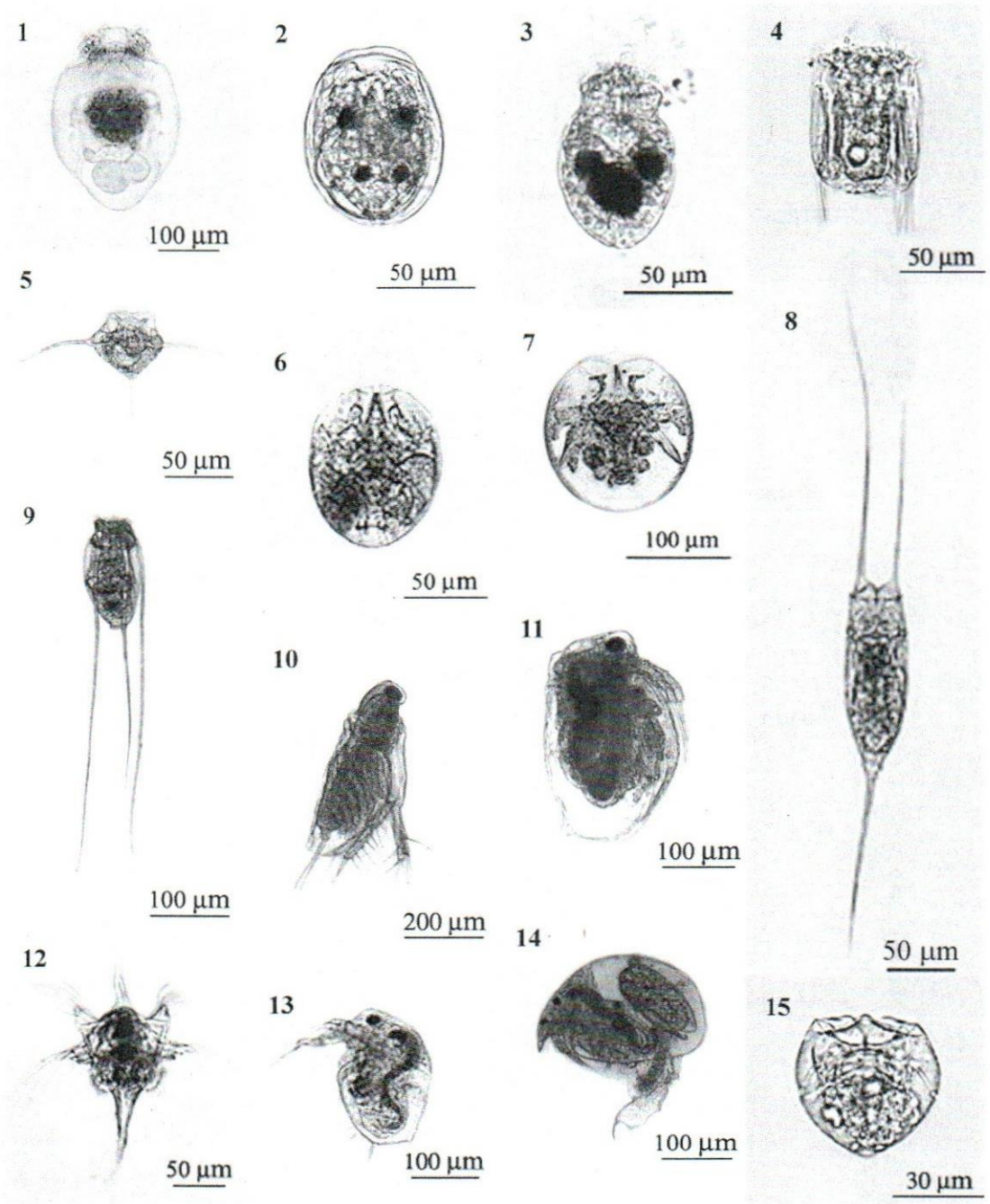
Zooplankton in the Pasak Jolasid reservoir (cont.)
(1) *Anuraeopsis coelata*; (2) *A. fissa*; (3) *A. navicula*; (4) *Brachionus angularis*;
(5) *B. calyciflorus*; (6) *B. caudatus*; (7) *B. diversicornis*; (8) *B. falcatus*;
(9) *B. forficula*; (10) *B. quadridentatus*; (11) *Colurella hindenburgi*;
(12) *Keratella cochlearis*; (13) *K. lenzi*; (14) *K. tropica*; (15) *K. tecta*;
(16) *Lepadella rhomboides*

Plate 3



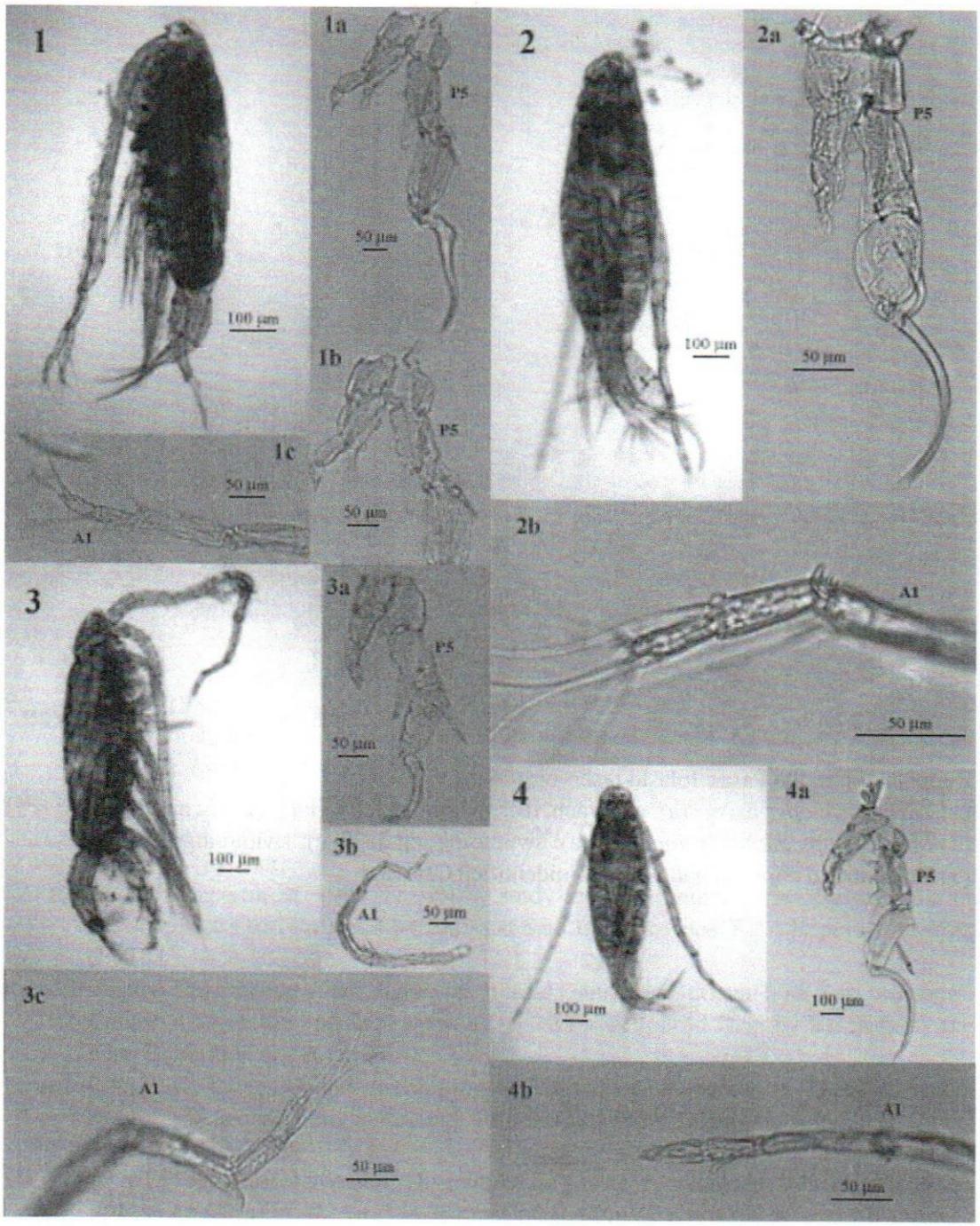
Zooplankton in the Pasak Jolasid reservoir (cont.)
(1) *Mytilina ventralis* var. *brevispina;* (2) *Plationus patulus;*
(3) *Platyias quadricornis;* (4) *Trichotria tetractis;* (5) *Lecane bulla;*
(6) *L. curvicornis;* (7) *L. hamata;* (8) *L. hastata;* (9) *L. hornemanni;*
(10) *L. inopinata;* (11) *L. papuana;* (12) *L. stenroosi* f. *lineata;* (13) *L. stichaea;*
(14) *L. ungulate;* (15) *Trichocerca pusilla;* (16) *T. capucina;* (17) *T. similis;*
(18) *T. cylindrica*

Plate 4



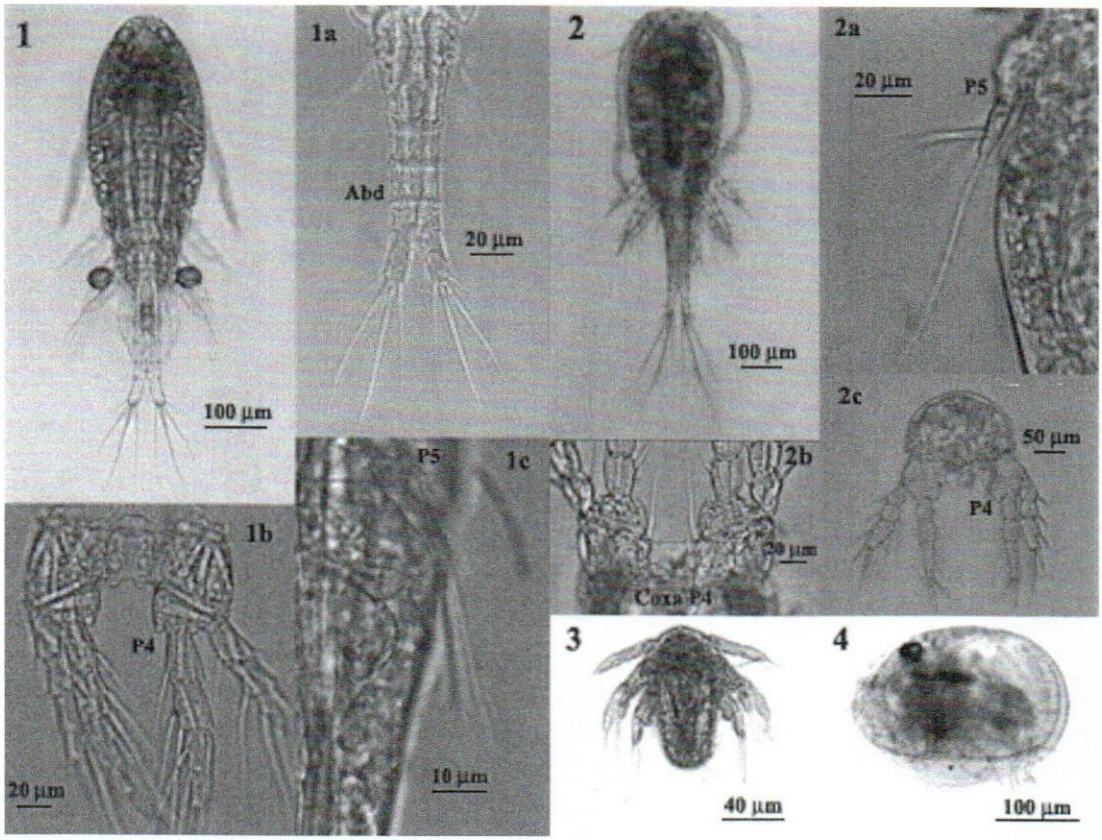
Zooplankton in the Pasak Jolasid reservoir (cont.)
(1) *Asplanchna priodonta*; (2) *Ascomorpha ovalis*; (3) *A. saltans*;
(4) *Polyarthra vulgaris*; (5) *Filinia camasecla*; (6) *Testudinella parva*;
(7) *T. patina* f. *intermedia*; (8) *F. opoliensis*; (9) *F. longiseta*;
(10) *Diaphanosoma excisum*; (11) *Ceriodaphnia cornuta*;
(12) *Hexarthra intermedia*; (13) *Bosminopsis deitersi*;
(14) *Alona verrucosa*; (15) *Pompholyx complanata*

Plate 5



Zooplankton in the Pasak Jolasid reservoir (cont.)
(1) *Heliodiaptomus viduus* (a) swimming leg 5, male; (b) swimming leg 5, female; (c) antennule;
(2) *Phyllodiaptomus christineae* (a) swimming leg 5, male; (b) antennule;
(3) *Neodiaptomus blachei* (a) swimming leg 5, male; (b,c) antennule;
(4) *Mongolodiaptomus botulifer* (a) swimming leg 5, male; (b) antennule

Plate 6



Zooplankton in the Pasak Jolasid reservoir (cont.)
(1) *Thermocyclops crassus* (a): abdomen, (b): swimming leg 4 (P4), (c): swimming leg 5 (P5);
(2) *Mesocyclops thermocyclopoides* (a): swimming leg 5, (b,c): swimming leg 4;
(3) Unidentified copepod nauplii; (4) Unidentified Ostracod