COMPOSITION AND DISTRIBUTION OF CRUSTACEAN PLANKTON IN TWELVE INLAND WATER BODIES OF THAILAND

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ABSTRACT

Species composition and distribution of freshwater crustacean plankton in 12 Thailand water bodies were determined from samples collected from June, 1972 through March, 1976. Forty-four taxa of copepods and cladocerans were observed. The cyclopoid copepod and cladoceran components of Thai zooplankton are primarily cosmopolitan or cosmotropical. Calanoid copepods appear to be more limited in distribution and further sampling may reveal new endemic species. No distinct correlations were evident between species composition and distribution and environmental variables (eg., age of water body, depth, geographical location and water quality features). However, it is recommended that in future investigations quantitative sample be obtained from each locality at the same time of the year so that data gathered is more comparable.

The average number of species in all water bodies ranged from a winter low of 4.6 to a high of 13.0 during the rainy season. Species that occurred most frequently during the rainy season were *Microcyclops varicans* and *Diaphanosoma sarsi*. The most prevalent species during summer were *Ceriodaphnia cornuta*, *Moina micrura*, *Bosminopsis deitseri* and *Chydorus ventricosus*. Some species such as *Mesocyclops leuckarti* and *Diaphanosoma excisum* were predominant year-round.

INTRODUCTION

The purpose of this report is to provide information on the composition and geographic distribution of freshwater crustacean plankton in Thailand. Published accounts on this subject primarily concern only one or two reservoirs with identification; often only to the generic level (e.g., Boonsom, 1970; Mizuno and Mori, 1970; Sangkhakul et al., 1972; Kamolrat and Leelapatra, 1973; Sibke and Pawapootanon, 1973 Sangkhakul, 1974, 1975; Stingelin, 1906). Since the Thai fauna has not been subjected. to taxomony scrutiny some uncertainties exist on identification at the species level, Although taxonomic works from other Oriental regions are somewhat useful (Brehm 1950; Fernando, 1974), many species descriptions are scattered in the literature worldwide. Such descriptions are sometimes incomplete and usually difficult to obtain Confusing synonyms (i.e., the same species known by two or more names in different geographical regions) are potential problems. We have earnestly attempted to determine species assemblages in this study, but point out instances where taxonomy remains uncertain.

METHODS

Eleven Thailand reservoirs and one natural swampy lake were sampled for plankton once or twice between June, 1972 and March, 1976 (Fig. 1, Table 1). Five samples were collected in winter (November to February), seven in summer (March to June), and three during the rainy season (July to October). A vertical tow from near bottom to the surface was made with a 70 μm mesh plankton net. A larger net (30 cm in diameter) was used in deep reservoirs ($>$ 20 m) and a smaller net (21 cm in diameter) was employed in shallow water bodies. All samples were collected by the Fisheries Research Unit of the Department of Fisheries. Samples were preserved in 5% formalin and returned to the laboratory for examination.

Samples were analyzed qualitatively under a Bausch and Lomb stereozoom microscope at 7-140X. Those organisms requiring higher magnification were dissected, mounted in polyvinyl lactophenol, stained with lignin pink and examined at 450X under an American Optical compound microscope.

Identifications were made according to Kiefer (1932, 1933, and 1974), Brehm (1953) and Fernando (1974) for calanoid copepods and Rylov (1948), Yeatman (1959) and Dussart (1969) for cyclopoid copepods. Species in the cladoceran families Chydoridae and Moinidae were determined in Smirnov (1971) and Goulden (1968), respectively. *Eubosmina* species were identified according to Deevey and Deevey (1971). Assistance in identifying *Diaphanosoma*, *Latonopsis*, *Daphnia*, and *Scapholeberis* was obtained in Fernando (1974). The remaining Cladocera were determined according to Brooks (1959).

RESULTS AND DISCUSSION

Composition

Seven calanoid copepod species of the family Diaptomidae were identified from several geographically wide-spread reservoirs (Table 2). All are new records for Thailand. Most were collected from Chulabhorn Reservoir during February and March. Undoubtedly, more species of calanoid copepods and expanded temporal and geographic distributions will be discovered through a more intensive sampling program.

Calanoids observed in previous studies in Thailand which were not identified from this study include *Heliodiaptomus kikuchii*, *Sinodiaptomus volcanoi* (Mizuno and Mori, 1970) and *Diaptomus bogalusensis* (Sangkhakul, 1974). Different species were reported in each Thailand study, probably reflecting taxonomic uncertainty rather than high diversity of the calanoid fauna. A more thorough, detailed study is urgently needed to establish both generic and specific status in this group.

Six species of cosmopolitan cyclopoid copepods were found year-round in Thailand (Table 2). *Mesocyclops leuckarti* was the most abundant species. In contrast to the calanoid copepods, cyclopoid taxonomy is relatively straightforward and previous studies in Thailand have noted all but two of the cyclopoid species that were observed in this investigation.

Twenty-eight species of cladocerans were observed in the study area, including 9 new records for Thailand (Table 3.) All of the water bodies contained at least three species. Lam Pao Reservoir had the highest number of species (19), several of which are known to inhabit the littoral zone. The average number of cladoceran species was highest during the hot rainy season and lowest in winter. *Ceriodaphnia cornuta*, *Diaphanosoma excisum*, and *Chydorus ventricosus* were the most common species.

Most cladocerans collected in this investigation were observed in previous Thai studies and are widely distributed in other geographic regions. The taxonomic status of most cladoceran species observed in Thailand is moderately advanced except for the genera *Macrothrix* and *Alona*. Many additional species will undoubtedly be added to the faunal list as littoral areas are more thoroughly sampled.

Distribution

In recently constructed Australian reservoirs, Timms (1969) conjectured that age of a reservoir and its proximity to other colonized water bodies were important factors in determining the number of limnetic species present. Other factors such as altitude, depth, turbidity, water chemistry, and presence of plankton predators may also be related to species composition and distribution.

The sampling frequency in this study was not sufficient to thoroughly determine the total number of limnetic species in any water body. However, no distinct relation between age or locality of the reservoirs and their number of species was evident with available data. Likewise, water quality variables (Table 1) did not correlate significantly with any species distributions.

There was a noticeable correlation between the time of year and the average number of species. Samples from winter, summer, and the rainy season contained an average of 4.6, 7.8, and 13.0 species, respectively. The highest number during the rainy season was primarily due to the frequency of littoral cladoceran species collected at that time.

SPECIES SYNOPSIS

Calanoid Copepods

Allodiaptomus raoi var. *membranigera* Brehm. It occurred only in Lam Pao Reservoir (Table 2).

"*Diaptomus*" *chaffonjoni Richard.* This species was found only in Chao Phya Reservoir.

"*Diaptomus*" *javanicus* Grochmalicki. It occurred only in Chulabhorn Reservoir in February. This species and the previous one have not been subjected to taxonomic revision. Consequently, an exact generic name cannot be assigned at this time.

Neodiaptomus botulifer Kiefer. It was collected in three reservoirs from February to May.

Neodiaptomus malaysianus Kiefer. This species was observed in Chulabhorn Reservoir in February and June.

Neodiaptomus mephistopheles Brehm. It was found in Chulabhorn Reservoir during June.

Phyllodiaptomus annae (Apstein). This species appeared in Chulabhorn Reservoir. It was reported to be the commonest calanoid in inland lakes of Sri Lanka (Ceylon) by Fernando (1974).

Cyclopoid Copepods

Mesocyclops crassus (Fischer). This species appeared in three reservoirs (Table 2) and was the commonest cyclopoid in Chulabhorn. It was most frequently collected during June and August. It was previously reported from Bhumipol Reservoir by Sangkhakul (1974). Rylov (1948) referred to it as a cosmopolitan, warm-water stenotherm that is common in lakes and rivers.

Mesocyclops leuckarti (Claus). This species is the predominant cyclopoid of Thailand, present or abundant at 10 of the 12 localities regardless of season (Tables 1 and 2). It was also reported as the most abundant cyclopoid in Sri Lanka (Fernando, 1974). It is a warm-water, cosmopolitan stenotherm that is common in rivers as well as lakes (Rylov, 1948). Apparently, water temperatures in Thailand are sufficient warm to allow this species to occur in the plankton year-round.

Microcyclops bicolor Sars. It appered in three reservoirs, in December, January and August (Tables 1 and 2). Its occurrence in Kaeng Kracharn Reservoir is further verified by Boonsom (1970). Rylov (1948) reported that it is a cosmopolitan species, found mainly during the warm season in shallow, weedy lakes and slow-moving rivers. In this study, however, it occurred in reservoirs with mean depths greater than 13 m and moderately high transparencies (Table 1).

Microcyclops varicans (Sars). This species was present in each of the three reservoirs sampled in August as well as one which was sampled in January (Tables 1 and 2). All four of these reservoirs have mean depths less than 17 m. Rylov (1948) concluded that *M. varicans* is a warm water stenotherm found mainly in shallow waters with abundant vegetation. It is a cosmopolitan species.

Tropocyclops prasinus (Fishcher). It appeared only in Ubolratana Reservoir. It is a cosmopolitan species found in shallow waters of lakes and in macrophyte growths of slow-flowing rivers (Rylov, 1948).

Cladocerans

SIDIDAE

Diaphanosoma excisum Sars. This species was one of the most widespread and common cladocerans, occurring at six localities regardless of month or water quality (Tables 1 and 3). It was seen in samples from Borapet Lake as well as other Southeast Asian lakes by Mizuno and Mori (1970).

Diaphonosoma sarsi Richard. This species appeared only in two reservoirs, during the rainy season. It has previously been encountered in Chulabhorn Reservoir (Sibke and Pawapootanon, 1973) and is known to have a tropical distribution (Green, 1972; Stingelin, 1906).

Latonopsis australis Sars. This species occurred only in Lam Ta Kong Reservoir. It is the species reported from New South Wales (Timms, 1970) and Sri Lanka (Fernando, 1974).

DAPHNIDAE

Ceriodaphnia cornuta Sars. It was the most abundant cladoceran, occurring in seven reservoirs year-round (Table 3). The *rigaudi* form, lacking spines on the head and with a larger eye, was predominant. *Ceriodaphnia cornuta* has appeared in most of the other Thailand studies (Boonsom, 1970; Mizuno and Mori, 1970; Sangkhakul et al., 1972; Sibke and Pawapootanon, 1973; and Sangkhakul, 1974, 1975). Green (1972) regarded this species as cosmotropical. It was found most often in clear-water lakes in New South Wales (Timms, 1969), though in the present study it occurred in lakes which spanned a wide spectrum of water quality (Table 1)

Daphnia carinata King. This species was present in Chulabhorn Reservoir. It has previously been reported from the Oriental and Australian regions (Fernando, 1974; Timms, 1970).

Daphnia lumholtzi Sars. This species appeared in two reservoirs in Thailand (Table 3). It apparently has a moderately wide distribution, having been reported from Central Africa (Fryer, 1957) and Sri Lanka (Fernando, 1974). In New South Wales it was found primarily in the higher transparency lakes (Timms, 1969).

Scapholeberis kingi Sars. This cosmopolitan cladoceran was moderately common, occurring in four reservoirs during all seasons (Tables 1 and 3). Stingelin (1906) also reported it from Thailand.

Simocephalus latirostris (Koch). This species, characterized by five spines on the postabdomen (Fernando, personal communication), was rare in two Thailand reservoirs (Table 3).

MOINIDAE

Moina micrura Kurz. This was a very common cladoceran at four Thai localities during the summer months (Tables 1 and 3). Sibke and Pawapootanon (1973) also found it in Chulabhorn Reservoir. It occurs in large lakes as well as small temporary water bodies and has the widest distribution of all the *Moina* species (Goulden, 1968).

Moinodaphnia macleayii (King). This species was present only in Lam Pao Reservoir. It is not a true planktonic species but usually occurs in shallow water and is associated with vegetation (Green, 1971). It is typical of tropical areas (Stingelin, 1906).

BOSMINIDAE

Bosmina longirostris (O.F. Müller). In this investigation, *B. longirostris* appeared only in Bhumipol Reservoir, although it has been reported from many other Thai reservoirs (Boonsom, 1970; Mizuno and Mori, 1970; Kamolrat and Leelapatra, 1973; Sibke and Pawapootanon, 1973). Fernando (1974) stated that it is an introduced species in Sri Lanka.

Bosminopsis deitseri Richard. This species is a common Thailand bosminid during the summer months. Though only seen in four water bodies in this study (Table 3), it has often been noted in prior studies (Boonsom, 1970; Mizuno and Mori, 1970; Sangkhakul et al., 1972; Sangkhakul, 1974, 1975). It is a cosmotropical species that extends into some warm temperate regions (Green, 1972; Brooks, 1959).

Eubosmina coregoni (Baird). This was rare in Vajiralongkorn Reservoir (Table 3). It is an introduced species in Sri Lanka (Fernando, 1974).

MACROTHRICIDAE

Ilyocryptus spinifer Herrick. This species was identified only from Lam Pao Reservoir. It is a cosmopolitan littoral species.

Macrothrix spp. Unidentified species of this genus occurred in three reservoirs (Table 3)

CHYDORIDAE

Alona spp. This is a common genus in Thailand (Table 3) and in need of a detailed taxonomic study. Fernando (1974) lists six species for Sri Lanka, but concludes that the taxonomy is still uncertain.

Biapertura karua (King). This species was present only in Vajiralongkorn Reservoir. Smirnov (1971) and Stingelin (1906) both reported it from Central Asia.

Biapertura verrucosa (Sars) This species appeared in Bhumipol Reservoir. Fernando (1974) noted and illustrated it from Sri Lanka.

Camptocercus rectirostris Schφdler. Vajiralongkorn Reservoir contained a few individuals of this species. Previously, Kamolrat and Leelapatra (1973) reported it in Lam Pao Reservoir. It is a cosmopolitan species (Brooks, 1959; Smirnov, 1971).

Chydorus barroisi (Richard). It was present in two Thai reservoirs (Table 3) and is cosmopolitan (Green, 1972; Stingelin, 1906).

Chydorus eurynotus Sars. This species occurred in three reservoirs (Table 3). It is a cosmotropical species (Smirnov, 1971; Green, 1972).

Chydorus sphaericus (O.F. Müller). It was collected only in Ubolratana Reservoir, although Mizuno and Mori (1970) and Stingelin (1906) found it at other Thai localities. It is a considered the commonest of all Cladocera worldwide (Brooks, 1959).

Chydorus ventricosus Daday. This species was one of the most widespread *Chydorus* in the study area, present in six reservoirs (Table 3). It was most prevalent during summer and the rainy season. It is known from East China, India, Sri Lanka, Africa and South America (Smirnov, 1971).

Dunhevedia crassa (King). It was found only in Vajiralongkorn Reservoir. Stingelin (1906) also reported it from the Bangkok area and Smirnov (1971) concluded that it has a worldwide distribution in areas south of 60° N latitude.

Euryalona orientalis (Daday). This species occurred in two reservoirs (Table 3). It was previously seen in Thailand by Stingelin (1906) and is cosmotropical (Smirnov, 1971).

Kurzia longirostris (Daday). It was collected at three localities during late summer and the rainy season (Tables 1 and 3). It is also cosmotropical (Smirnov, 1971).

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FIGURE CAPTION

Fig. 1 Map of Thailand showing location of sampled reservoirs.

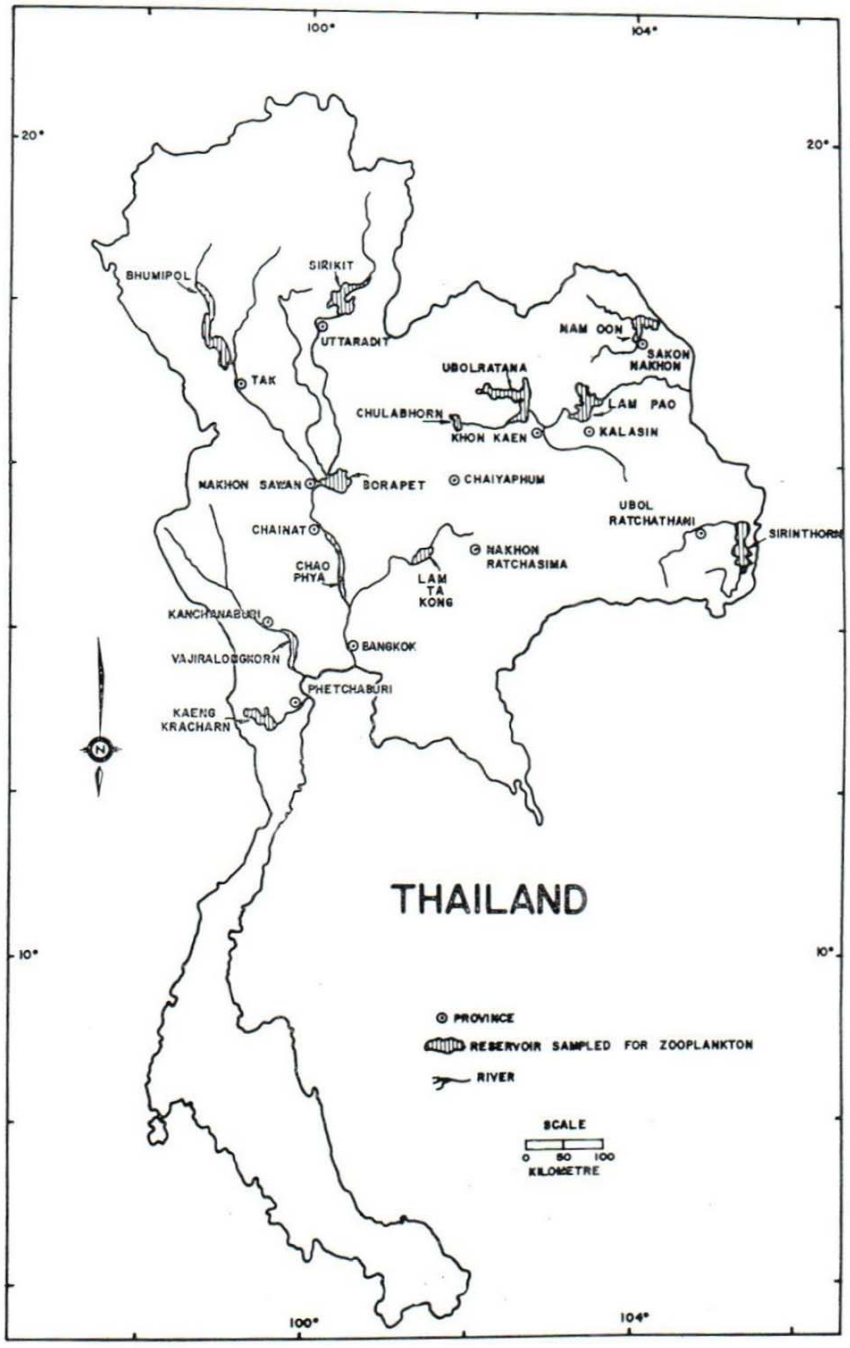


TABLE 1. INFORMATION ON TWELVE THAILAND WATER BODIES

Water Body	Province	Reservoir Completion Date	Zooplankton Samplinp Dates —	Mean Depth (m)	Tran sparency (cm)	pH	Alkalinity (ppm)
Southern Region							
Kaeng Kracharn[1]	Phetchaburi	1966	January, 1976	14	80—290	7.0—7.6	71—80
Central Region							
Vajiralongkorn[2]	Kanchanaburi	1970	May, 1976	—	23—98	8.8	—
Borapet[1]	Nakhon Sawan	Natural	March, 1976	3	15—60	6.8—7.9	80—150
Chao Phya[3]	Chainat	1957	March, 1976	—	36	7.9	—
Lam Ta Kong[1]	Nakhon Ratchasima	1968	August, 1975	16	130—200	7.7—8.4	194—221
Northwest Region							
Bhumipol[4]	Tak	1964	December, 1975; March, 1976	42	190—430	7.0—8.0	—
Sirikit[5]	Uttaradit	1975	December, 1975	37	34 – 400	6.9—7.9	92—100
Northeast Region							
Chulabhorn[6]	Chaiyaphum	1972	February, 1975; June, 1972	16	100—150	6.8—7.5	112—176
Ubolratana[7]	Khonkaen	1965	February, 1975; April, 1973	16	169—275	7.8—8.3	74—98
Lam Pao[8]	Kalasin	1968	August, 1975	6	130—480	7.4 –8.3	50—78
Nam Oon[9]	Sakon Nakhon	1975	May, 1976	6	63	7.9	70
Sirinthorn[10]	Ubol Ratchathani	1970	August, 1975	5	172—235	6.7—7.5	28—36

Sources of limnological data:

[1]Anonymous (1974)
[2]Royal Irrigation Department (1970) and Potipitak (1971)
[3]Anonymous (1969)
[4]Paewsarn and Preanyarat (1971)
[5]Waew-ngam (1973)
[6]Sibke and Pawapootanon (1973)
[7]Srisuwannataj (1970a)
[8]Srisuwannataj (1970b)
[9]Pawapootanon and Hirunyawat (1969)
[10]Srisuwannataj (1971)

TABLE 2. COPEPODA OF THAILAND WATER BODIES

Species	Locality
Calanoida	
**Allodiaptomus raoi var membranigera Brehm*	Lam Pao
**"Diaptomus" chaffonjoni* Richard	Chao Phya
**"D." javanicus* Grochmalicki	Chulabhorn
**Neodiaptomus botulifer* Kiefer	Bhumipol; Sirikit; Ubolratana; Borapet
**N. malaysianus* Kiefer	Chulabhorn
**N. mephistopheles* Brehm	Chulabhorn
**Phyllodiaptomus annae* (Apstein)	Chulabhorn
Diaptomus spp.	Bhumipol; Borapet; Chao Phya; Sirinthorn; Ubolratana
Cyclopoida	
Mesocyclops crassus (Fischer)	Chulabhorn; Lam Pao; Lam Ta Kong
M. leuckarti (Claus)	Bhumipol; Borapet; Chao Phya; Lam Ta Kong; Nam Oon; Ubolratana; Vajiralongkorn
Microcyclops bicolor Sars	Kaeng Kracharn; Lam Ta Kong; Sirikit
**M. varicans* (Sars)	Kaeng Kracharn; Lam Pao; Lam Ta Kong; Sirinthorn
**Tropocyclops prasinus* (Fischer)	Ubolratana
Ergasilus sp.	Borapet; Ubolratana
Cyclopoids	Lam Pao
Harpacticoida	Lam Ta Kong; Nam Oon; Vajiralongkorn

*Previously unreported from Thailand.

TABLE 3. CLADOCERA OF THAILAND WATER BODIES

Species	Locality
Sididae	
Diaphanosoma excisum Sars	Bhumipol; Borapet; Chao Phya; Chulabhorn; Lam Pao; Ubolratana
D. sarsi Richard	Lam Ta Kong; Sirinthorn
Latonopsis australis Sars	Lam Ta Kong
Daphnidae	
Ceriodaphnia cornuta Sars	Bhumipol; Borapet; Chao Phya; Chulabhorn; Nam Oon; Sirikit; Vajiralongkorn
Ceriodaphnia sp.	Bhumipol; Lam Dome Noi; Lam Pao; Lam Ta Kong; Ubolratana
**Daphnia carinata* King	Chulabhorn
**D. lumholtzi* Sars	Chulabhorn; Lam Pao
Scapholeberis kingi Sars	Chulabhorn; Lam Pao; Nam Oon; Sirikit
**Simocephalus latirostris* (Koch)	Chulabhorn; Lam Pao
Moinidae	
Moina micrura Kurz	Borapet; Chao Phya; Chulabhorn; Lam Pao
Moina sp.	Lam Pao; Nam Oon
Moinodaphnia macleayii (King)	Lam Pao
Bosminidae	
Bosmina longirostris-(O.F. Müller)	Bhumipol
Bosminopsis deitseri Richard	Borapet; Chao Phya; Ubolratana; Vajiralongkorn
**Eubosmina coregoni* (Baird)	Vajiralongkorn
Macrothricidae	
**Ilyocryptus spinifer* Herrick	Lam Pao
Macrothrix spp.	Lam Pao; Lam Ta Kong; Sirinthorn
Chydoridae	
Alona spp.	Bhumipol; Lam Pao; Lam Ta Kong; Sirinthorn; Vajiralongkorn
Biapertura karua (King)	Vajiralongkorn
**B. verrucosa* (Sars)	Bhumipol
Camptocercus rectirostris Schϕdler	Vajiralongkorn
Chydorus barroisi (Richard)	Lam Ta Kong; Ubolratana
**C. eurynotus* Sars	Bhumipol; Sirikit; Ubolratana
C. sphaericus (O.F. Müller)	Ubolratana
**C. ventricosus* Daday	Bhumipol; Lam Pao; Lam Ta Kong; Sirinthorn; Vajiralongkorn
Dunhevedia crassa (King)	Vajiralongkorn
Euryalona orientalis (Daday)	Chao Phya; Lam Pao
**Kurzia longirostris* (Daday)	Lam Pao; Lam Ta Kong; Vajiralongkorn

*Previously unreported from Thailand.