

## CURRENT STATUS OF MYSID TAXONOMY IN SOUTHEAST ASIA

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### ABSTRACT

This paper reviews the current status of mysid taxonomy in Southeast Asia, encompassing the South China Sea as far north as Hong Kong, the Andaman Sea, the Philippines, and the Indonesian seas as far south as the northern Australian waters. According to the 188 scientific papers published before 2013, 23 species in five genera of the Order Lophogastrida and 207 species in 63 genera of the Order Mysida have been recorded from these waters. This amounts to about 20 % of the recent species of these orders so far reported in the world. The occurrence records of these species were summarized in a table and a figure. On the basis of this body of information, it is suggested that there is an urgent need for research to improve our understanding of the biodiversity of mysids in this region.

**Keywords:** mysid species, taxonomy, geographical distribution, Southeast Asia

### INTRODUCTION

Mysids are important animals in coastal and estuarine ecosystems and are used as food for humans, as are *Acetes* shrimps, in Southeast Asia (Mantiri et al, 2012), India (Tattersall and Tattersall, 1951), China (Liu and Wang, 2000), China and Korea (Omori, 1978) and Japan (Tattersall and Tattersall, 1951; Murano, 1963). Therefore, species identification and ecological studies of mysids are important for increasing the use of the mysid resources in Southeast Asia.

Mysid is an animal group, formerly placed in the Suborder Lophogastrida and Suborder Mysida of the Order Mysidacea, which has recently been reclassified as two orders, Order Lophogastrida and Order Mysida (Mees and Meland, 2012). In Southeast Asia, many research cruises, including several expeditions, have been conducted and mysid species have also been described. These studies were mainly carried out by European (e.g., G. O. Sars, 1883; 1885; Hansen, 1910)

and Asian scientists (e.g., Ii, 1964; Pillai, 1973; Murano, 1970- 2010, Liu and Wang, 2000). Gordan (1957), Mauchline and Murano (1977), Mauchline (1980), Müller (1993) and Mees and Meland (2012) dealt with world mysids and their geographical distribution, also providing information on accepted names of mysid species as well as synonyms (Mees and Meland, 2012). There are several problematic species in *Siriella* because its description is made based on male specimens, so females are difficult to distinguish (Murano and Fukuoka, 2008). Mauchline (1980) devised, as a first attempt, a key to 120 genera. However, research on the biodiversity of mysids in the Southeast Asian waters and their geographical distribution has been limited.

As a basis for future research, this paper reviews the current status of taxonomy of mysids in Southeast Asian waters and documents their geographic patterns on the basis of records of their occurrence records, with a discussion on future research.

## MATERIAL AND METHODS

### Regional coverage

The Southeast Asian waters in the present study are defined as the sea areas encompassing the South China Sea as far north as Hong Kong, the Andaman Sea, the Philippine seas, and the Indonesian seas as far south as the northern Australian waters. This region is mostly included in geographical region 7 of Mauchline and Murano (1977) and Mauchline (1980).

### History and references of mysid taxonomy

As of 2004, 24 species from Southeast Asia in the Order Lophogastrida and 167 species in the Order Mysida have been described in 110 taxonomic papers (Sawamoto and Fukuoka, 2005). Among them *Paralophogaster macrops* of the Order Lophogastrida and *Parastilomysis paradoxa* of the Order Mysida should be excluded from the list. After that, genus *Siriella* (Murano and Fukuoka, 2008) and genus *Rhopalophthalmus* (Hanamura *et al.*, 2011) were revised and several new species were described, and a description of four new species (Hanamura *et al.*, 2008; Fukuoka, 2011; Bamber and Morton, 2012; Hanamura and Tsutsui, 2012) and the new occurrence of two species (Hanamura *et al.*, 2008; Hanamura *et al.*, 2012) were reported.

Recently, higher taxonomic ranks was modified; five tribes in the subfamily Mysinae were placed at a higher position, subfamily, and the former subfamily Mysinae was cancelled (Mees and Meland, 2012). Those tribes are Erythropini, Leptomysini, Mancomysini, Mysini and Heteromysini. Mees and Meland (2012) also modified *Neognathophausia* to *Gnathophausia* of the Order Lophogastrida, *Anisomysis (Pseud-anisomysis)* to *Carnegiomysis* and *Anisomysis (Javanisomysis) gutzuii* to *Javanisomysis gutzuii* of the Order Mysida. The last species *Anisomysis (Javanisomysis) gutzuii* was discussed in Murano and Fukuoka (2003) who proposed changing its name to *Javanisomysis gutzuii*, but they could not examine the type series of the species. As there were few descriptions for the other two revisions in Mees and Meland (2012), the former system was applied in the present study.

### Supplementary collection

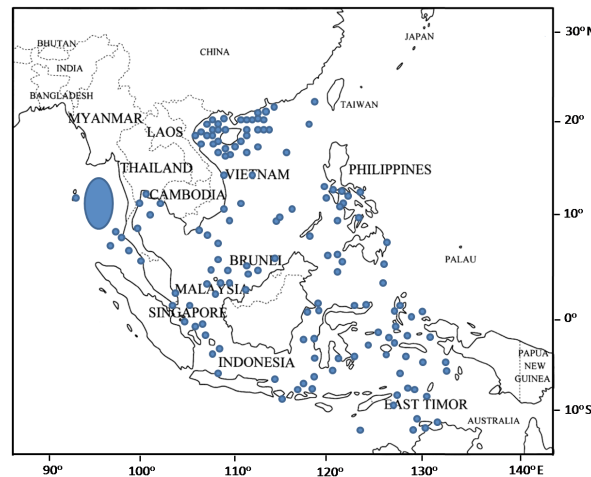
To supplement the literature records, mysids were collected with a sledge net and a hand net during the training courses of programs of the Japan Society for the Promotion of Science (JSPS). The sledge net had a rectangular mouth frame (20 cm high and 60 cm wide) and pyramidal in net shape (180 cm long with 0.1 mm mesh opening). The hand net had a round mouth frame (30 cm in diameter) and conical net shape (40 cm long with 0.1 mm mesh opening) with a handle. The specimens were collected in Malaysia (2006, 2008 and 2012) and Thailand (2009).

## RESULTS

### Mysid species reported in Southeast Asian waters

According to the present literature survey, at least 188 papers had been published on mysid taxonomy as of December 2012. *Promysis orientalis* was described as a new species by Dana (1852) from the specimen collected in 1842 in the South China Sea, 450 miles northeast of Singapore, during the US Exploring Expedition when the first mysid species from this region was described. Sars (1883) described the second species *Promysis (?) pusilla* (synonym of *Pseudanchialina pusilla*) based on the specimens collected from the Celebes Sea during the Challenger Expedition. After that many taxonomic studies have been carried out by European scientists such as Hansen (1910), Illig (1930), W. M. Tattersall (1922 - 1951), O. S. Tattersall (1957 - 1967) and Băcescu (1973 - 1993), and Asian scientists such as Ii (1964), Murano (1970 - 2010), Pillai (1973), Takahashi and Murano (1986), Liu and Wang (1980, 1983, 2000), Fukuoka (2011), Fukuoka and Murano (2002, 2005), Hanamura (1997, 1998), Panampunnayil (2002) and Pinkeaw *et al.* (2001).

Figure 1 summarizes the sampling stations of mysids from the literature, including those from expeditions and research cruises as well as shore samplings, including those in mangrove swamps and coral reefs. Sampling stations are scattered over most Southeast Asian waters, including some areas of extensive sampling, such as those around the Hainan Island extending to Hong Kong



**Figure 1.** Map of stations where mysid specimens were reported. The map was arranged on the sampling records of expeditions and research cruises and those of coastal and shore samplings. Circles indicate approximate positions, and an ellipse indicates research area in the Andaman Sea.

and to the Gulf of Tonkin and the Andaman Sea. Research in these areas was carried out around 1960 and 1984 – 1990 by Liu and Wang (2000) and during 2002 – 2006 by Biju and Panampunnayil (2011), respectively. Shallow to deep waters close to the Philippines and Indonesia were sampled by Murano (1988 – 2010) in 1972, and deep waters there were sampled by European scientists around 1980 to 1992. Most of the other oceanic stations were surveyed by European expeditions and Japanese research cruises before 1935. However there are few stations around the island of Borneo, especially the north-eastern and the south-western areas.

At these stations samples were mainly collected by vertical or horizontal towing of plankton nets, while dredges were also employed in other cases, such as those in the Philippine and Indonesian waters around 1912 (Tattersall, 1951). Recently, sledge nets were employed to sample mysids at shallow coastal waters to about 500 metres depth (Murano, 2010), and hand nets were also used in shallow coastal waters (Bamber and Morton, 2012).

According to Mees and Meland (2012), the Order Lophogastrida consisted of 55 recent species of 9 genera in 4 families and the Order Mysida of 1129 recent species of 167 genera in 2 families. In their list, however, a valid species *Hypererythrops suluensis* (Murano, 2010) was excluded, so the number of species of the Order Mysida should be 1130.

In the 188 scientific papers, there were 23 species of 5 genera in 3 families in the Order Lophogastrida and 207 species of 63 genera in the Order Mysida from Southeast Asian waters (Table 1). This amounts to 40 % of Order Lophogastrida and about 18 % of Order Mysida in the world. The difference between the orders appears to reflect features of the depth at which they live and their geographical distribution. The Order Lophogastrida is distributed in oceanic areas and mainly in the meso- and bathypelagic waters, while most species of Order Mysida were restricted to the coastal or epipelagic waters. On the other hand, wide geographical distribution was reported for only 15 of the 207 species of Order Mysida, while it was reported for 9 of 23 species of Order Lophogastrida.

### Geographical distribution

According to the 188 reports, including the reports referred to previously and that of Mees and Meland (2012), the mysids in Southeast Asia were tentatively grouped into 10 types on the basis of their occurrence records (Table 2). Among them six types were composed of more than 10 species; 76 species were restricted to the Southeast Asian waters (Type A), 54 species were both in those waters and in the Indian Ocean (Type D), 25 species were in four water areas (Type I), 24 species were also found in the Atlantic Ocean as well as the Indian and the Pacific Oceans (Type J), 17 species were common to East Asian waters

**Table 1.** Taxonomic list of species of Order Lophogastrida and Order Mysida recorded in the Southeast Asian waters. (Species name in parenthesis is synonym. Number with asterisk indicates a species reported from waters deeper than 200 m.)

<b>Order Lophogastrida</b>	<b>Family Mysidae</b>
<b>Family Lophogastridae</b>	<b>Subfamily Boreomysinae</b>
1. <i>Lophogaster inermis</i> Casanova, 1996	4*. <i>Boreomysis hansenii</i> Holmquist, 1956
2. <i>Lophogaster intermedius</i> Hansen, 1910	5. <i>Boreomysis kistnae</i> Pillai, 1973
3*. <i>Lophogaster manilae</i> Băcescu, 1985	6*. <i>Boreomysis plebeja</i> Hansen, 1910
4. <i>Lophogaster musorstomi</i> Băcescu, 1991	7*. <i>Boreomysis rostrata</i> Illig, 1906
5. <i>Lophogaster pacificus</i> Fage, 1940	8*. <i>Boreomysis sibogae</i> Hansen, 1910
6*. <i>Lophogaster rotundatus</i> Illig, 1930	(= <i>Boreomysis spinifera</i> Coifmann, 1936)
7*. <i>Lophogaster schmidti</i> Fage, 1940	<b>Subfamily Siriellinae</b>
8*. <i>Paralophogaster boucheti</i> Casanova, 1993	<b>Tribe Metasiriellini</b>
9. <i>Paralophogaster foresti</i> Băcescu, 1981	9. <i>Metasiriella kitaroi</i> Murano, 1986
10. <i>Paralophogaster glaber</i> Hansen, 1910	<b>Tribe Siriellini</b>
11*. <i>Paralophogaster intermedius</i> Coifmann, 1936	10. <i>Hemisiriella parva</i> Hansen, 1910
12. <i>Paralophogaster philippinensis</i> Băcescu, 1981	11. <i>Hemisiriella pulchra</i> Hansen, 1910
<b>Family Gnathophausiidae</b>	12. <i>Siriella aequiremis</i> Hansen, 1910
13*. <i>Gnathophausia elegans</i> G. Sars, 1883	13. <i>Siriella affinis</i> Hansen, 1910
14*. <i>Gnathophausia fagei</i> Casanova, 1996	14. <i>Siriella anomala</i> Hansen, 1910
(= <i>Gnathophausia elegans fagei</i> Băcescu, 1991)	15. <i>Siriella australiensis</i> Panampunnayil, 1995
15*. <i>Gnathophausia gracilis</i> W.-Suhm, 1875	16. <i>Siriella brucei</i> Murano and Fukuoka, 2008
16*. <i>Gnathophausia longispina</i> G. Sars, 1883	17. <i>Siriella chaitiamvongae</i> Murano and Fukuoka, 2008
17*. <i>Gnathophausia zoea</i> W.-Suhm, 1875	18. <i>Siriella conformalis</i> Hansen, 1910
(= <i>Gnathophausia cristata</i> Illig, 1906)	19. <i>Siriella distinguenda</i> Hansen, 1910
(= <i>Gnathophausia willemoesii</i> G. Sars, 1883)	20. <i>Siriella dubia</i> Hansen, 1910
18*. <i>Neognathophausia gigas</i> W.-Suhm, 1875	21. <i>Siriella essingtonensis</i> Murano and Fukuoka, 2008
(= <i>Gnathophausia gigas</i> W.-Suhm, 1875)	22. <i>Siriella gracilis</i> Dana, 1852
19*. <i>Neognathophausia ingens</i> (Dohrn, 1870)	23. <i>Siriella hansenii</i> W. Tattersall, 1922
(= <i>Gnathophausia calcarata</i> G. Sars, 1883)	24. <i>Siriella inornata</i> Hansen, 1910
(= <i>Gnathophausia ingens</i> G. Sars, 1883)	25. <i>Siriella izuensis</i> Murano and Fukuoka, 2008
(= <i>Lophogaster ingens</i> Dohrn, 1870)	(= <i>Siriella japonica</i> var. <i>izuensis</i> Ii, 1964)
<b>Family Eucopiidae</b>	(= <i>Siriella japonica</i> var. <i>sagamiensis</i> Ii, 1964)
20*. <i>Eucopia australis</i> Dana, 1852	(= <i>Siriella japonica</i> Sheng, Liu and Wang, 1989)
21*. <i>Eucopia panayensis</i> Băcescu, 1991	(= <i>Siriella japonica japonica</i> Liu and Wang, 2000)
22*. <i>Eucopia sculpticauda</i> Faxon, 1893	26. <i>Siriella longiarticulis</i> Murano and Fukuoka, 2008
(= <i>Eucopia intermedia</i> Hansen, 1905)	27. <i>Siriella media</i> Hansen, 1910
23*. <i>Eucopia unguiculata</i> (W.-Suhm, 1875)	28. <i>Siriella mulyadii</i> Murano and Fukuoka, 2008
(= <i>Chalaraspis unguiculata</i> W.-Suhm, 1875, partim)	29. <i>Siriella nodosa</i> Hansen, 1910
<b>Order Mysida</b>	30. <i>Siriella okadai</i> Ii, 1964
<b>Family Petalophthalmidae</b>	31. <i>Siriella plumicauda</i> Hansen, 1910
1*. <i>Ceratommysis egregia</i> Hansen, 1910	32. <i>Siriella quadrispinosa</i> Hansen, 1910
2*. <i>Parapetalophthalmus suluensis</i> Murano and Bravo, 1998	33. <i>Siriella rimata</i> Murano and Fukuoka, 2008
3. <i>Petalophthalmus liui</i> Wang, 1998	34. <i>Siriella scissilis</i> Murano and Fukuoka, 2008
	35. <i>Siriella seafdeci</i> Murano and Fukuoka, 2008
	36. <i>Siriella sinensis</i> Ii, 1964
	37. <i>Siriella singularis</i> Nouvel, 1957
	38. <i>Siriella thompsonii</i> (H. Milne Edwards, 1837)

**Table 1. (cont.)**

(= <i>Cynthia thompsonii</i> H. Milne Edwards, 1837)	66. <i>Iiella elegans</i> (O. Tattersall, 1960)
39. <i>Siriella trispina</i> Ii, 1964	(= <i>Gastrosaccus elegans</i> O. Tattersall, 1960)
40. <i>Siriella vulgaris</i> Hansen, 1910	67. <i>Iiella formosensis</i> (Ii, 1964)
(= <i>Siriella vulgaris rostrata</i> W. Tattersall, 1951)	(= <i>Gastrosaccus formosensis</i> Ii, 1964)
41. <i>Siriella wadai</i> Ii, 1964	68. <i>Iiella hibii</i> (Ii, 1964)
<b>Subfamily Rhopalophthalminae</b>	(= <i>Gastrosaccus hibii</i> Ii, 1964)
42. <i>Rhopalophthalmus armiger</i> Hanamura and Murano, 2011	69. <i>Iiella hispida</i> Jo and Murano, 1992
(= <i>Rhopalophthalmus longipes</i> Ii, 1964)	70. <i>Iiella malayensis</i> Fukuoka, 2011
(= <i>Rhopalophthalmus macropsis</i> Pillai, 1964)	71. <i>Iiella ohshimai</i> (Ii, 1964)
43. <i>Rhopalophthalmus egregius</i> Hansen, 1910	(= <i>Gastrosaccus ohshimai</i> Ii, 1964)
(= <i>Rhopalophthalmus phyllodus</i> Murano, 1988)	72. <i>Pseudanchialina inermis</i> (Illig, 1906)
44. <i>Rhopalophthalmus hastatus</i> Hanamura, Murano and Alias, 2011	(= <i>Chlamydopleon inerme</i> Illig, 1906)
45. <i>Rhopalophthalmus kempfi</i> O. Tattersall, 1957	(= <i>Pseudanchialina sibogae</i> Nouvel, 1944)
46. <i>Rhopalophthalmus longipes</i> Ii, 1964	73. <i>Pseudanchialina pusilla</i> (G. Sars, 1883)
47. <i>Rhopalophthalmus orientalis</i> O. Tattersall, 1957	(= <i>Promysis pusilla</i> G. Sars, 1883)
(= <i>Rhopalophthalmus egregious</i> Nakazawa, 1910)	(= <i>Anchialus pusillus</i> G. Sars, 1885)
48. <i>Rhopalophthalmus philippinensis</i> Hanamura and Murano, 2011	<b>Subfamily Erythropinae</b>
<b>Subfamily Gastrosaccinae</b>	74*. <i>Arachnomysis leuckartii</i> Chun, 1887
49. <i>Anchialina dentata</i> Pillai, 1964	(= <i>Arachnomysis affinis</i> Hansen, 1910)
(= <i>Anchialina parva</i> Ii, 1964)	75*. <i>Dactylamblyops latisquamosa</i> (Illig, 1906)
50. <i>Anchialina grossa</i> Hansen, 1910	(= <i>Chalcophthalmus latisquamosus</i> Illig, 1906)
51. <i>Anchialina media</i> Ii, 1964	76*. <i>Dactylamblyops fervida</i> Hansen, 1910
52. <i>Anchialina obtusifrons</i> Hansen, 1912	77*. <i>Echinomysis chuni</i> Illig, 1905
53. <i>Anchialina penicillata</i> Zimmer, 1915	78. <i>Erythroptis minuta</i> Hansen, 1910
54. <i>Anchialina pillaii</i> Jo and Murano, 1992	79. <i>Erythroptis nana</i> W. Tattersall, 1922
55. <i>Anchialina typica orientalis</i> Nouvel, 1971	80. <i>Erythroptis phuketensis</i> Fukuoka and Murano, 2002
(= <i>Anchialina typica</i> Kröyer, 1861)	81*. <i>Erythroptis yongei</i> W. Tattersall, 1936
56. <i>Anchialina zimmeri</i> W. Tattersall, 1951	82*. <i>Euchaetomera glyphidophthalmica</i> Illig, 1906
57. <i>Archaeomysis vulgaris</i> (Nakazawa, 1910)	83*. <i>Euchaetomera oculata</i> Hansen, 1910
(= <i>Gastrosaccus vulgaris</i> Nakazawa, 1910)	84. <i>Euchaetomera typica</i> G.O. Sars, 1883
58. <i>Eurobowmaniella simulans</i> (W. Tattersall, 1915)	85*. <i>Euchaetomeropsis merolepis</i> (Illig, 1908)
(= <i>Eurobowmaniella phuketensis</i> Murano, 1995)	(= <i>Euchaetomera merolepis</i> Illig, 1908)
(= <i>Gastrosaccus simulans</i> W. Tattersall, 1915)	86*. <i>Gibbererythroptis acanthura</i> (Illig, 1906)
59. <i>Gastrosaccus dunckeri</i> Zimmer, 1915	(= <i>Erythroptis (Gibbererythroptis) acanthura</i> Illig, 1906)
60. <i>Gastrosaccus yuyu</i> Bamber and Mortensen, 2012	(= <i>Parerythroptis acanthura</i> Illig, 1906)
61. <i>Haplostylus bengalensis</i> (Hansen, 1910)	87. <i>Gymnerythroptis anomala</i> Hansen, 1910
(= <i>Gastrosaccus bengalensis</i> Hansen, 1910)	88*. <i>Holmesiella affinis</i> Ii, 1937
(= <i>Gastrosaccus philippiensis</i> W. Tattersall, 1951)	89. <i>Hypererythroptis semispinosa</i> Wang, 1998
62. <i>Haplostylus indicus</i> (Hansen, 1910)	90. <i>Hypererythroptis spinifera</i> (Hansen, 1910)
(= <i>Gastrosaccus indicus</i> Hansen, 1910)	(= <i>Erythroptis spinifera</i> Hansen, 1910)
63. <i>Haplostylus pacificus</i> (Hansen, 1912)	91*. <i>Hypererythroptis suluensis</i> Murano, 2010
(= <i>Gastrosaccus pacificus</i> Hansen, 1912)	92. <i>Hypererythroptis validisaeta</i> Fukuoka and Murano, 2002
64. <i>Haplostylus parvus</i> (Hansen, 1910)	93. <i>Hypererythroptis zimmeri</i> Ii, 1937
(= <i>Gastrosaccus parvus</i> Hansen, 1910)	94. <i>Liuiomysis longicauda</i> Wang, 1998
65. <i>Haplostylus pusillus</i> (Coifmann, 1936)	95*. <i>Marumomysis hakuhoae</i> Murano, 1999
(= <i>Gastrosaccus pusillus</i> Coifmann, 1936)	96. <i>Metamblyops philippinensis</i> (W. Tattersall, 1951)
	(= <i>Gibbererythroptis philippinensis</i> W. Tattersall, 1951)

**Table 1. (cont.)**

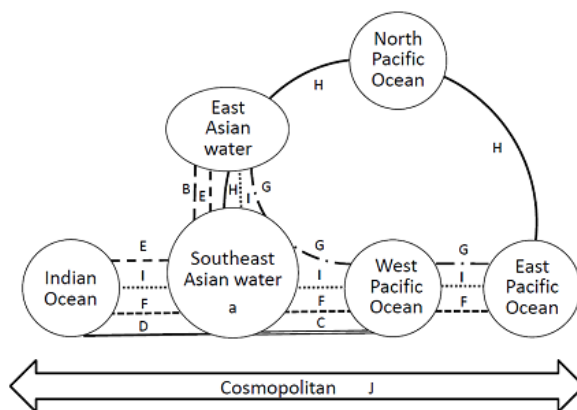
97*. <i>Meterythrops pictus</i> Holt and W. Tattersall, 1905 (= <i>Meterythrops affine</i> Coifmann, 1936) (= <i>Meterythrops indica</i> Hansen, 1910)	135. <i>Pseudoxomysis caudaensis</i> Nouvel, 1973
98. <i>Nakazawaia japonica</i> Murano, 1981	136. <i>Pseudoxomysis incisa</i> Murano, 2001
99*. <i>Paramblyops spatulicaudus</i> Murano, 2002	<b>Subfamily Mancomysinae</b>
100*. <i>Paramblyops tenuicaudus</i> Murano, 2002	137. <i>Palaumysis philippinensis</i> Hanamura and Kase, 2002
101. <i>Pleurerythrops inscita</i> Ii, 1964	<b>Subfamily Mysinae</b>
102. <i>Pleurerythrops monospinosa</i> Liu and Wang, 1986	138. <i>Acanthomysis brucei</i> Fukuoka and Murano, 2002
103. <i>Pseuderythrops abrahami</i> Biju and Panampunnayil, 2011	139. <i>Acanthomysis indica</i> (W. Tattersall, 1922) (= <i>Neomysis indica</i> W. Tattersall, 1922)
104*. <i>Pseuderythrops gracilis</i> Coifmann, 1936	140. <i>Acanthomysis longispina</i> Fukuoka and Murano, 2002
105. <i>Pseuderythrops megalops</i> Murano, 1998	141. <i>Acanthomysis ornata</i> O. Tattersall, 1965
106. <i>Pseudomma semispinosum</i> Wang, 1998	142. <i>Acanthomysis platycauda</i> (Pillai, 1964) (= <i>Lycomysis platycauda</i> : Pillai, 1964) (= not <i>Lycomysis platycauda</i> Pillai, 1961)
107. <i>Pseudomma spinosum</i> Wang, 1998	143. <i>Acanthomysis quadrispinosa</i> Nouvel, 1965
108. <i>Shenimysis cordata</i> Wang, 1998	144. <i>Acanthomysis thailandica</i> Murano, 1988
109*. <i>Synerythrops intermedia</i> Hansen, 1910	145. <i>Anisomysis (Anisomysis) bifurcata</i> W. Tattersall, 1912
110*. <i>Teratamblyops philippinensis</i> Murano, 2001	146. <i>Anisomysis (Anisomysis) brevicauda</i> Wang, 1989
111*. <i>Teratamblyops suluensis</i> Murano, 2001	147. <i>Anisomysis (Anisomysis) laticauda</i> Hansen, 1910
<b>Subfamily Leptomysinae</b>	148. <i>Anisomysis (Anisomysis) megalops</i> (Illig, 1913) (= <i>Kreagromysis megalops</i> Illig, 1913)
112. <i>Afromysis dentisinus</i> Pillai, 1957	149. <i>Anisomysis (Anisomysis) minuta</i> Liu and Wang, 1983
113. <i>Dioptromysis perspicillata</i> Zimmer, 1915	150. <i>Anisomysis (Anisomysis) quadrispinosa</i> Wang, 1989
114. <i>Dioptromysis proxima</i> Nouvel, 1964	151. <i>Anisomysis (Anisomysis) spinata</i> Panampunnayil, 1993
115. <i>Doxomysis anomala</i> W. Tattersall, 1922	152. <i>Anisomysis (Anisomysis) thurneyseni</i> Nouvel, 1973
116. <i>Doxomysis brucei</i> Murano, 1990	153. <i>Anisomysis (Paranisomysis) ijimai</i> Nakazawa, 1910
117. <i>Doxomysis longiura</i> Pillai, 1963	154. <i>Anisomysis (Paranisomysis) takedai</i> Hanamura and Tsutsui, 2012
118. <i>Doxomysis murarii</i> Băcescu, 1993	155. <i>Anisomysis (Pseudanisomysis) bipartoculata</i> Ii, 1964
119. <i>Doxomysis nicobaris</i> Panampunnayil, 2002	156. <i>Anisomysis (Pseudanisomysis) hispida</i> Pillai, 1973
120. <i>Doxomysis quadrispinosa</i> (Illig, 1906) (= <i>Doxomysis pelagica</i> Hansen, 1912) (= <i>Mysis quadrispinosa</i> Illig, 1906)	157. <i>Anisomysis (Pseudanisomysis) tattersallae</i> Pillai, 1973
121. <i>Doxomysis sanuriensis</i> Băcescu, 1993	158. <i>Anisomysis (Pseudanisomysis) xenops</i> W. Tattersall, 1943
122. <i>Doxomysis spinata</i> Murano, 1990	159. <i>Javanisomysis gutzui</i> Băcescu, 1992
123. <i>Imysis orientalis</i> (Ii, 1937) (= <i>Tenagomysis orientalis</i> Ii, 1937)	160. <i>Gangemysis assimilis</i> (Tattersall 1908) (= <i>Diamysis assimilis</i> (Tattersall, 1908)) (= <i>Potamomysis assimilis</i> Tattersall, 1908)
124. <i>Mysidopsis indica</i> W. Tattersall, 1922	161. <i>Hyperacanthomysis longirostris</i> (Ii, 1936) (= <i>Acanthomysis longirostris</i> Ii, 1936)
125. <i>Mysidopsis kempii</i> W. Tattersall, 1922	162. <i>Lycomysis spinicauda</i> Hansen, 1910 (= <i>Lycomysis pusilla</i> Zimmer, 1915)
126. <i>Neodoxomysis elongata</i> Murano, 1999	163. <i>Mesopodopsis orientalis</i> (W. Tattersall, 1908) (= <i>Macropsis orientalis</i> W. Tattersall, 1908)
127. <i>Neodoxomysis littoralis</i> (W. Tattersall, 1922) (= <i>Doxomysis littoralis</i> Tattersall, 1922)	
128. <i>Neodoxomysis sahalensis</i> Murano, 1999	
129. <i>Paraleptomysis sinensis</i> Liu and Wang, 1983	
130. <i>Paraleptomysis xenops</i> (W. Tattersall, 1922) (= <i>Leptomysis xenops</i> W. Tattersall, 1922)	
131. <i>Prionomysis aspera</i> Ii, 1937	
132. <i>Prionomysis australiensis</i> Murano, 1990	
133. <i>Prionomysis stenolepis</i> W. Tattersall, 1922	
134. <i>Promysis orientalis</i> Dana, 1852 (= <i>Uromysis armata</i> Hansen, 1910)	

**Table 1. (cont.)**

164. <i>Mesopodopsis tenuipes</i> Hanamura, Koizumi and Sawamoto, 2008
165. <i>Nanomysis insularis</i> Nouvel, 1957
166. <i>Nanomysis philippinensis</i> Murano, 1997
167. <i>Nanomysis siamensis</i> W. Tattersall, 1921
168. <i>Neomysis awatschensis</i> (Brandt, 1851) (= <i>Neomysis nigra</i> Nakazawa, 1910) (= <i>Mysis awatschensis</i> Brandt, 1851)
169. <i>Neomysis japonica</i> Nakazawa, 1910
170. <i>Nipponomysis patula</i> Fukuoka and Pinkaew, 2003 (= <i>Proneomysis quadrispinosa</i> Ii, 1964)
171. <i>Nipponomysis quadrispinosa</i> (Ii, 1964)
172. <i>Nipponomysis sinensis</i> (Wang, 1981) (= <i>Proneomysis sinensis</i> Wang, 1981)
173. <i>Notacanthomysis hodgarti</i> (W. Tattersall, 1922) (= <i>Acanthomysis hodgarti</i> (W. Tattersall, 1922)) (= <i>Neomysis hodgarti</i> W. Tattersall, 1922)
174. <i>Notacanthomysis laticauda</i> (Liu and Wang, 1980) (= <i>Acanthomysis laticauda</i> Liu and Wang, 1980)
175. <i>Orientomysis calida</i> Fukuoka, Pinkaew and Chalermwat, 2005
176. <i>Orientomysis crassispinosa</i> (Liu and Wang, 1980) (= <i>Acanthomysis crassispinosa</i> Liu and Wang, 1980)
177. <i>Orientomysis leptura</i> (Liu and Wang, 1980) (= <i>Acanthomysis leptura</i> Liu and Wang, 1980)
178. <i>Orientomysis meridionalis</i> (Liu and Wang, 1983) (= <i>Acanthomysis meridionalis</i> Liu and Wang, 1983)
179. <i>Orientomysis rotundicauda</i> (Liu and Wang, 1980) (= <i>Acanthomysis rotundicauda</i> Liu and Wang, 1980) (= <i>Acanthomysis longicauda</i> Murano, 1991)
180. <i>Orientomysis serrata</i> (Liu and Wang, 1980) (= <i>Acanthomysis serrata</i> Liu and Wang, 1980)
181. <i>Orientomysis tenella</i> (Liu and Wang, 1980) (= <i>Acanthomysis tenella</i> Liu and Wang, 1983)

**Subfamily Heteromysinae**

182. <i>Heteromysis gracilis</i> Murano, 1988
183. <i>Heteromysis inflaticauda</i> Wang, 1998
184. <i>Heteromysis minuta</i> O. Tattersall, 1967
185. <i>Heteromysis proxima</i> W. Tattersall, 1922
186. <i>Heteromysis singaporensis</i> O. Tattersall, 1967
187. <i>Heteromysis spinosa</i> Băcescu, 1986
188. <i>Heteromysis (Heteromysis) australica</i> Băcescu and Bruce, 1980
189. <i>Heteromysis (Heteromysis) communis</i> Băcescu, 1986
190. <i>Heteromysis (Heteromysis) gymnura</i> W. Tattersall, 1922
191. <i>Heteromysis (Olivaemysis) essingtonensis</i> Murano, 1988
192. <i>Heteromysis (Olivaemysis) meenakshiae</i> Bamber, 2000
193. <i>Heteromysis (Olivaemysis) quadrispinosa</i> Murano, 1988
194. <i>Heteromysis (Olivaemysis) sexspinosa</i> Murano, 1988
195. <i>Heteromysis (Olivaemysis) tenuispina</i> Murano, 1988
196. <i>Heteromysis (Olivaemysis) thailandica</i> Fukuoka and Murano, 2002
197. <i>Heteromysis (Olivaemysis) zeylanica</i> W. Tattersall, 1922
198. <i>Heteromysoides macrops</i> Murano, 1988
199. <i>Heteromysoides nana</i> Murano, 1998
200. <i>Heteromysoides sahalensis</i> Murano, 1998
201. <i>Pseudomysidetes cochinchensis</i> Panampunnayil, 1977
202. <i>Pseudomysidetes nudus</i> Fukuoka and Murano, 2002
<b>Subfamily Mysidellinae</b>
203. <i>Mysidella incisa</i> Wang, 1998
204*. <i>Mysidella macrophthalma</i> Murano, 2002
205. <i>Mysidella rotundincisa</i> Wang, 1998
206*. <i>Mysidella sulcata</i> Murano, 2002
207. <i>Mysidella tenuicauda</i> Wang, 1998



**Figure 2.** Tentative geographical distribution patterns of 230 species of Orders Lophogastrida and Mysida. These species were distributed in the Southeast Asian waters. Marks A to J indicated tentative distribution types and were shown in Table 2.

**Table 2.** Geographical regions of the Southeast Asian mysids for each order. Species were tentatively grouped according to their records of occurrence and depth distribution.

Type	Order	Geographical region / distribution area or layer	Lophogastrida				Mysida				
			epipelagic	meso-pelagic	bathypelagic	total	coastal	epipelagic	meso-pelagic	bathypelagic	total
A		Restricted to SE Asia	2	2	1	5	43	19	6	3	71
B		SE Asia and E. Asia	1			1	8	7	1		16
C		SE Asia and West Pacific Ocean	2	2		4	3	4	1		8
D		SE Asia and Indian Ocean		1		1	38	13	2		53
E		SE Asia, EA and Indian Ocean				0	3	3			6
F		SE Asia, W. Pacific and Indian Ocean				0	4	3			7
G		SE Asia, W. Pacific and East Asia		2		2	3				3
H		SE Asia, East Asia and N. and E. Pacific Ocean				0	2		1		3
I		SE Asia, WP, EA and Indian Ocean	1			1	8	16	1		25
J		Cosmopolitan including SE Asia	1	3	5	9		6	6	3	15
		Total	7	10	6	23	112	71	18	6	207

(Type B) and 12 species were common to the West Pacific Ocean (Type C). The other types, Types E to H, were composed of three to seven species that have been reported in three to four water areas as shown in Fig. 2. Among them, species of Type H are distributed in the North and East Pacific Oceans.

More than two-thirds of the species of Order Lophogastrida have been reported from depths of more than 500 m, while the others were epipelagic (< 200 m) including no coastal species (Table 2). On the other hand, most species of Order Mysida were reported from coastal waters or the

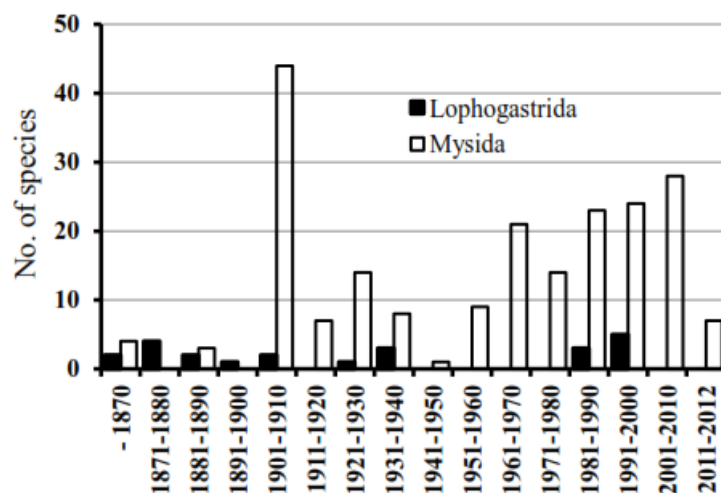
epipelagic layer. About one-third of them belong to Type A, which is followed by Type D. Meso- or bathypelagic species were included in Type A or J (Table 2).

Twenty-five species of 18 genera of Order Mysida were found in the samples from the supplementary collection (Table 3). *Anchialina typica orientalis* was the only species distributed over a wide geographical range.

### Description of new species

Only six mysid species were globally known before 1870. Owing to many expeditions such as





**Figure 3.** Number of species of Orders Lophogastrida and Mysida described as new each decade in the period from before 1870 to 2012. The species were accepted at present and were reported in the Southeast Asian waters.

Challenger (Sars, 1883, 1885), Siboga (Hansen, 1910), Deep-sea (Illig, 1905, 1906, 1908, 1913, 1930) and Dana (Fage, 1940-1942), many mysid species were described. Hansen (1910) reported about 40 species as new and a total of 62 species was known by 1910 in the world. By 1955 the number of mysid worldwide was about 520 in 106 genera (Gordan, 1957), and 765 species in middle 1970s (Mauchline and Murano, 1977). Mauchline (1980) corrected their numbers and added several species, resulting in the number increasing to 780. Müller (1992) collated the literature and the number increased to 979. At the end of 2012 the number reached 1130 (Mees and Meland, 2012).

The species of the Southeast Asian waters were summarized by Sawamoto and Fukuoka (2005). They collated 110 documents and listed 191 species of 67 genera. The number was corrected to 230 species of 68 genera in the present study. On the basis of this information, species described in each decade from before 1870 to the present (Fig. 3) were counted. Twenty-three species of Order Lophogastrida were mostly described by 1940 and eight species were in the period 1981 to 2000. On the other hand, of the 207 species of Order Mysida only seven species were described before 1890, which jumped up to 44 species due mainly to Hansen's (1910) study. After 1981, more than 20 new species were described in each decade. The

average increase rate was 2.2 species per year for the period from 1951 to 2012.

### Key to species

Mauchline (1980) collated the literature and a generic key for the first time for all 120 genera. This step followed on from Tattersall and Tattersall (1951) who explained the general morphology of mysids with figures, but their key was not accompanied by illustrations. Murano (1997) adopted a key with figures for mysid species of Japanese waters, which had been useful for species identification and promoted mysid research considerably.

## DISCUSSION

### Taxonomic problems

On the basis of the present literature survey, gaps in mysid taxonomy in Southeast Asia to be addressed in the future are listed as follows: *Siriella vulgaris* might be a complex of several species (Mauchline and Fukuoka, 2008) and examination of male specimens is expected to provide definitive identification of *Siriella* species (Ii, 1964; Mauchline and Fukuoka, 2008); type specimens for *Javanisomysis gutzui* (Bacescu, 1992) should be redescribed; *Anisomysis (Pseudanisomysis)* and *Neognathophausia* should be referred to as

**Table 3.** Mysid species collected and identified on the samples of 2004-2012 in the Southeast Asian waters. (A mark ○ indicates the species that is present in the samples.)

Name of the country species / sampling year	Indonesia		Vietnam		Malaysia		Thailand		occurrence	genus
	2005	2004	2005	2006	2008	2012	2009	total	total	
Subfamily Siriellinae										
<i>Hemisiriella pulchra</i> Hansen, 1910		○							1	1
<i>Siriella gracilis</i> Dana, 1852						○			1	
<i>Siriella mulyadii</i> Murano and Fukuoka, 2008					○				1	
<i>Siriella seafdeci</i> Murano and Fukuoka, 2008					○				1	
<i>Siriella</i> spp.	○		○	○	○	○	○		6	1
Subfamily Rhopalophthalminae										
<i>Rhopalophthalmus egregius</i> Hansen, 1910			○	○					2	
<i>Rhopalophthalmus longipes</i> Li, 1964				○					1	
<i>Rhopalophthalmus</i> spp.			○	○			○		3	1
Subfamily Gastrosaccinae										
<i>Anchialina dentata</i> Pillai, 1964		○							1	
<i>Anchialina typica orientalis</i> Nouvel, 1971					○				1	
<i>Anchialina</i> spp.		○			○	○			3	1
<i>Haplostylus bengalensis</i> (Hansen, 1910)					○				1	
<i>Haplostylus indicus</i> (Hansen, 1910)	○						○		2	1
<i>Iiella elegans</i> (O. Tattersall, 1960)				○					1	
<i>Iiella malayensis</i> Fukuoka, 2011					○				1	1
<i>Haplostylus / Iiella</i> spp.			○	○	○	○			4	
<i>Pseudanchialina inermis</i> (Illig, 1906)	○		○				○		3	
<i>Pseudanchialina</i> sp.		○							1	1
Subfamily Erythropinae										
<i>Erythrope minuta</i> Hansen, 1910				○		○			2	
<i>Erythrope</i> sp.						○			1	1
<i>Gymnerythrope anomala</i> Hansen, 1910	○								1	1
Subfamily Leptomysinae										
<i>Doxomysis quadrispinosa</i> (Illig, 1906)		○							1	1
<i>Neodoxomysis</i> sp.				○					1	1
<i>Paraleptomysis xenops</i> (W. Tattersall, 1922)			○						1	1
<i>Prionomysis</i> sp.					○				1	1
<i>Pseudoxomysis caudaensis</i> Nouvel, 1973			○	○					2	1
Subfamily Mysinae										
<i>Acanthomysis indica</i> (W. Tattersall, 1922)				○					1	
<i>Acanthomysis platycauda</i> (Pillai, 1964)								○	1	
<i>Acanthomysis</i> sp.				○				○	2	1
<i>Anisomysis (Paranisomysis) ijimai</i> Nakazawa, 1910 ?	○								1	1
<i>Hyperacanthomysis</i> spp.				○					1	1
<i>Mesopodopsis tenuipes</i> Hanamura, Koizumi and Sawamoto, 2008			○			○			2	1
<i>Nipponomysis sinensis</i> (Wang, 1981)			○				○		2	
<i>Nipponomysis</i> spp.			○						1	1
<i>Notacanthomysis laticauda</i> (Liu and Wang, 1980)				○					1	1
<i>Orientomysis calida</i> Fukuoka, Pinkaew and Chalermwat, 2005			○	○					2	
<i>Orientomysis</i> spp.			○	○					2	1
total	5	5	12	15	9	9	5		25	21

*Carnegiomysis* and *Gnathophausia* respectively (Meer and Meland, 2012) and their replacement should be publicised. In addition, redescription based on male specimens are expected for *Siriella brucei*, *Anisomysis* (*Anisomysis*) *meglops* and *A. (A.) quadrispinosa*, which were based on females, and for *Gymnerythrops anomala*, which was based on immature specimens. Reexamination is needed for *Anisomysis (A.) spinata* which was closely allied to *A. (A.) bifurcate* except for a subtle difference in the process on the uropodal endopod.

### Geographical distribution

As summarized in Table 2, about one-thirds (76 species) of the present 230 species are endemic to Southeast Asia and 57% of these endemic species are comprised of coastal-water species. In addition, the rate of discovery of new species is still steadily increasing (Fig. 3), indicating a high level of potential (or hidden) species diversity of mysids in this region. These clearly indicate that the coastal water of Southeast Asia is a hotspot of mysid biodiversity at the global scale, and the importance of steady progress of basic taxonomic research in this region, now under the diverse threats to the coastal ecosystems due to human activities and climate change (Nishida et al., 2011).

In contrast to the coastal-water species, meso- and bathypelagic species generally show much wider geographic ranges (Mauchline, 1980), such as those over the Indo-Pacific or Indo-Pacific-Atlantic Oceans. This also applies in the present meso- and bathypelagic species in Type J (cosmopolitan). However, there are also meso- and bathypelagic species that belong to Type A (endemic to Southeast Asia) or some other types that are spread a little wider but still in a limited regions. Although the possibility cannot be ruled out that the geographic ranges of these species might be extended by future discoveries of new localities, these species will also be interesting models to examine processes of speciation and/or dispersion in meso- and bathypelagic zones, by integrative morphological and phylogeographical analyses.

It should be noted that currently available occurrence records of mysids, as compiled above, seem to cover the major regions of Southeast Asia rather evenly (Fig. 2), but they are still limited to

only very small portions of the total habitats of mysids, in terms of both geographic regions (e.g. remote open waters, seawater ponds in islands), depth zones (e.g. deep-sea benthopelagic zone), and microhabitats (e.g. spaces among complex structures such as corals, mangroves, seagrasses). Future research is expected into these barely investigated habitats, as well as poorly investigated geographic areas, such as the coastal waters of Borneo. In addition, it is expected that an integrative approach using genetic markers, along with conventional morphological analysis, will be applied in future studies of mysids to clarify the relationships between a set of morphological species that are difficult to distinguish, infra-morphospecific variants with unknown genetic relationships (e.g. Hanamura et al., 2008), and phylogenetic relationships among species. I hope the information presented above will be of use to these studies.

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