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A review of the zooplankton in Singapore waters

Claire Schmoker[1, 2*], Mohamed-Sofiane Mahjoub[1], Albert Calbet[2], Shih-Hui Hsiao[3], Francesca Russo[1], Ole Larsen[1], Aurore Trottet[1] & Guillaume Drillet[1]

Abstract. The island of Singapore is located between 1°09'N–1°29'N and 103°38'E–104°06'E at the confluence of the Malacca Straits and the South China Sea. To date, both the marine and freshwater zooplanktons of this area are poorly studied, and availability of taxonomic identification is scarce. Moreover, most of the studies were published between the 1950s to the beginning of the 1970s. The available data are mainly qualitative, with only a few studies on zooplankton biology and ecology. Here, the literature on zooplankton communities in Singapore waters is reviewed in order to provide a baseline for future zooplankton surveys, and to better understand the aquatic ecosystems of this area. Also included are recent data obtained from a one-year plankton monitoring in 2012 from two marine stations in Singapore. The temporal variation of the plankton groups was observed in the study to be similar to what was described in some works from the 1970s. The species richness increased in these more recent studies, probably due to changes in the sampling and preservation methods. Because of these changes, comparing between data-sets is challenging; however, similarities in species richness and seasonality between a recent study and previous data-sets were evident. Finally, it is argued that continuous marine plankton monitoring would be an asset for Singapore and the region.

Key words. Singapore, South China Sea, zooplankton, species richness, diversity

INTRODUCTION

Geographic and climatic position of Singapore. The island of Singapore is located between 1°09'N–1°29'N and 103°38'E–104°06'E at the convergence of the Malacca Straits and the South China Sea. It is separated from Malaysia in the north by the Johor Strait (1.8 km wide) and from Indonesia in the south by the Singapore Strait (16 km wide) (Fig. 1). The Johor Strait is divided into the West and East Johor Strait by the Singapore Causeway. The large Malaysian city of Johor Bahru is located on the northern shoreline of the East Johor Strait (Pang & Tkalich, 2003; Mulia et al., 2013). Because of the geographical position, along important commercial routes connecting the Indian Ocean with the South China Sea, and the deep waters allowing the passage of large commercial vessels, Singapore has become one of the biggest and busiest ports in the world (Chou, 2006). The majority of Singapore's freshwater reserves are within 17 shallow, man-made reservoirs that are highly managed, in states ranging from eutrophic to hypertrophic (Low et al., 2010).

The climate of Singapore is typically equatorial, with high temperatures and large amounts of rainfall throughout the year. The general pattern of water temperature fluctuations is characterised by a minimum during December to January (~26°C) and a maximum during April to June (~32°C) (NASA, 2013). The climate is strongly influenced by the Southeast Asian Monsoon regime, which introduces seasonal variations. The seasons are divided in four periods: two main monsoon seasons, the North-East (NE) Monsoon from November to early March and the South-West (SW) Monsoon from June to September, and two inter-monsoon periods (late March to May and October to November). Heavy

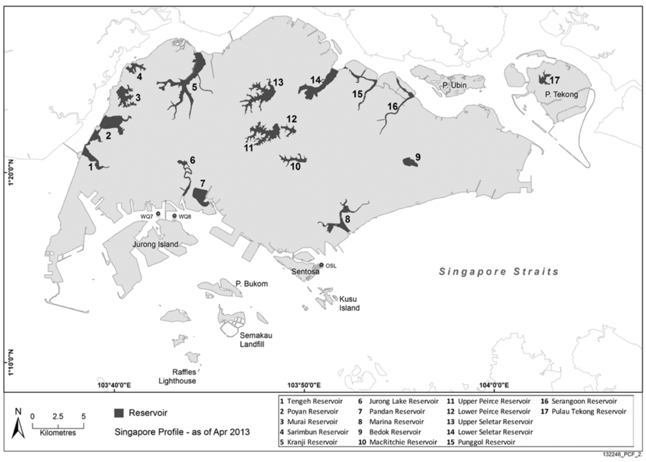

Figure 1: Map of Singapore showing the location of freshwater reservoirs and the sampled stations (DHI Singapore cartography department – GIS). WQ7 and WQ8 are the stations chosen in the frame of the MadeInPlankton project and OSL is the station from the study of Wickstead (1958).

[1]DHI-NTU Water & Environment Research Centre and Education Hub. CleanTech Loop 1, #03-05 CleanTech One, Singapore 637141; Email: claire_schmoker@yahoo.fr (*corresponding author)

[2]Institut de Ciències del Mar, CSIC. Passeig Marítim de la Barceloneta 37-49, 08003 Barcelona, Spain

[3]Department of Science Education, National Taipei University of Education, Taipei 106, Taiwan, R.O.C

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rains and winds characterise both monsoon periods, but the SW Monsoon is usually drier than the NE Monsoon. During the NE Monsoon the general direction of the currents in the South China Sea is south-west. During the SW Monsoon, the currents bring water from the Java Sea and the Malacca Strait (Behera et al., 2013). The two inter-monsoon periods are characterised by intermittent rains and weak variable winds. The transitions between the monsoon seasons occur gradually, generally over a period of two months (Pang & Tkalich, 2003; National Environment Agency, 2009; Behera et al., 2013).

Identifying major knowledge gaps on zooplankton diversity and distribution in Singapore waters. Aquatic and terrestrial ecosystems are structured in complex food webs in which different groups of organisms interact. In the photic zone, phytoplankton cells are unicellular phototrophic organisms at the base of the planktonic trophic webs. Larger heterotrophic organisms—the micro- and mesozooplankton—actively prey on phytoplankton. Microzooplankton mostly consists of unicellular protozoans, whereas mesozooplankton comprise metazoans. Within mesozooplankton, the dominant group are crustaceans belonging to the subclass Copepoda and represent around 80% of the total mesozooplanktonic biomass (Mauchline, 1998). These organisms prey on both primary producers and microzooplankton (Calbet & Saiz, 2005; Saiz & Calbet, 2011). Additionally, they comprise the main food source for the planktonic stages of commercially important species, such as other crustaceans and fish. As elsewhere, the marine plankton distribution in Singapore waters is driven by the general oceanic patterns described above. To understand the aquatic ecosystems of Singapore it is essential to first determine the planktonic assemblages and to assess their functional diversity (how organisms interact with each other). Some studies on phytoplankton communities and their taxonomy in Singapore's coastal waters exist (Tham, 1953; Chou & Chia, 1991; Gin et al., 2000, 2003), and these have recently been reviewed in a checklist of algae species (Pham et al., 2011). To date, however, zooplanktonic organisms have been poorly studied, and their taxonomic identifications are quite scarce. Most of the available literature investigating zooplankton around Singapore was published between the 1950s and the beginning of the 1970s (e.g., Tham, 1953; Wickstead, 1958; Tham, 1973; Thia-Eng, 1973); it is likely that these studies no longer reflect the present species diversity.

Due to its geographic position and to its climate, Singapore generally is very rich in species (Pham et al., 2011). It lies in a biodiversity hotspot, which is a conservation priority (Myers et al., 2000). According to estimations of Brook et al. (2003), based on both recorded and inferred data, Singapore may have lost more than one-half of its terrestrial and freshwater taxa (including more than 80% of freshwater decapods and fish) from 1819 until 2002. In addition, due to the oceanographic features characterising the waters of Singapore, anthropogenic and natural events occurring in more distant areas (i.e., Malacca Strait, South China Sea) could affect coastal ecosystems locally.

According to Yeo et al. (2011), many factors such as the construction of dams, the causeway linking Singapore to Johor Bahru (Malaysia), shoreline modifications, and species introductions may have affected native aquatic biodiversity. Moreover, the introduction of exogenous species by ballast water may have increased as a result of the growing activity in Singapore harbours. Without knowledge of the existing baseline biodiversity waters introductions of non-native species cannot be confirmed and recorded (Pham et al., 2011). Therefore, in order to plan an efficient management of Singapore waters, a thorough knowledge of plankton diversity and ecosystem functioning is needed. In this paper, a review of the existing data on zooplankton communities in Singaporean waters is used to provide a baseline for future zooplankton surveys. Due to the scarcity of data on zooplankton from fresh waters, this review mainly focuses on marine waters.

MATERIAL AND METHODS

Literature review. Data were obtained from a literature search on zooplankton studies in the area of Singapore, including freshwater and marine studies. Initially, the words "zooplankton" and "Singapore" were searched in the Aquatic Sciences and Fisheries, Abstract electronic database, then other electronic databases such as WoS, Google Scholar or JSTOR. After, the search was extended to the older references cited in the selected papers (many of these are not incorporated into the electronic databases). Several of the studies on freshwater and marine zooplankton included also Malaysian records, but did not differentiate the origin of data; therefore, those data were presented as well.

New data on zooplankton diversity. Besides the above-mentioned literature analysis, we also present new data obtained at two stations on the west coast of Singapore (Fig. 1; WQ7 – west part; 01°17.949'N, 103°42.383'E and WQ8 – east part; 01°17.694'N, 103°43.340'E). The sampling was carried out every two weeks over the course of one year, from May 2012 to May 2013. Vertical plankton hauls were conducted with a 100 µm mesh net to collect mesozooplankton. In the laboratory, the samples were fixed with 4% formaldehyde and then divided into two subsamples; one was saved for future processing, and the other was used for the taxonomic analysis of the mesozooplankton community. Around 1000 individuals were counted per sample (Omori & Ikeda, 1984) and identified, when possible, to species level following Chen & Zhang (1965), Chen et al. (1974), Nishida (1985) and Harris et al. (2000).

RESULTS AND DISCUSSION

Historical zooplankton seasonality in Singapore waters. Investigations on copepods in the Straits of Malacca started in the early 1900s with the works of Clave (1901) and Sewell (1933). The first complete available study of zooplanktonic organisms from Singaporean seawaters is dated from 1953 (Tham, 1953; see Table 1). Tham (1953) established a "plankton calendar" for the Singapore Straits, by monitoring weather, seawater conditions, and absence

Table 1. List of zooplanktonic organisms found in Singaporean and Malaysian seawaters. (1) = reference Tham, 1953; (2) = reference Wickstead, 1958; (3) = reference Tham, 1973; (4) = reference Thia-Eng, 1973; (5) = reference Gollash et al., 2000; (6) = reference Rezai et al., 2004; (7) = data from the present study, Nparks and DHIgroup; (8) = Razouls et al (2005–2012); (9) = World Register of Marine Species at http://www.marinespecies.org/aphia.php?p=taxdetails&id=220933 on 2013-01-23.

PHYLUM	CLASS	ORDER	Reported scientific name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Authority	Currently accepted scientific name (Genus and lower) (8,9)	Authority for accepted name
Sarcomastigophora *(subphylum Radiolaria)*			Unidentified							+			
Ciliophora													
	Spirotrichia												
		Euploida											
			Euplotes sp.							+	Müller, 1786	*Euplotes*	Müller, 1786
	Oligotrichea												
		Oligotrichida											
			Strombidium sp.							+	Claparède & Lachmann, 1859	*Strombidium*	Claparède & Lachmann, 1859
			Tontonia sp							+	Fauré-Fremiet, 1914	*Tontonia*	Fauré-Fremiet, 1914
		Choreotrichida											
			Unidentified Tintinnina (sub-order)	+	+					+	Kofoid & Campbell, 1929		Kofoid & Campbell, 1929
	Litostomatea												
		Cyclotrichiida											
			Mesodinium sp.							+	von Stein	*Mesodinium*	von Stein
Foraminifera													
			Unidentified		+								
	Polythalamea												
		Globigerinida											
			Berggrenia cf pumilio							+	Parker, 1962	*Berggrenia pumilio*	Parker, 1962
			Streptochilus globulosus							+	Cushman, 1933	*Streptochilus globulosus*	Cushman, 1933
Cnidaria													
	Hydrozoa												
		Anthomedusae											
			Unidentified		+								
		Leptomedusae											
			Clytia sp.							+	Lamouroux, 1812	*Clytia*	Lamouroux, 1812
			Unidentified		+								
		Siphonophorae											
			Ceratocymba leuckarti							+	Huxley, 1859	*Ceratocymba leuckarti*	Huxley, 1859
			Diphyes chamissonis							+	Huxley, 1859	*Diphyes chamissonis*	Huxley, 1859
			Lensia sp.							+	Totton 1932	*Lensia*	Totton 1932
			Unidentified	+	+	+		+					

Table 1. Cont'd.

PHYLUM	CLASS	ORDER	Reported scientific name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Authority	Currently accepted scientific name (Genus and lower) (8,9)	Authority for accepted name
	Cubozoa												
		Cubomedusae											
			Unidentified		+								
Ctenophora													
			Unidentified		+								
	Tentaculata												
		Cydippidia											
			Pleurobrachia sp.							+	Fleming, 1822	*Pleurobrachia*	Fleming, 1822
Annelida													
			Unidentified		+								
	Polychaeta												
			Unidentified larvae	+	+	+				+			
Platyhelminthes													
	Turbellaria												
			Unidentified					+					
Arthropoda													
	Branchiopoda												
		Diplostraca											
		(infra order Cladocera)	*Evadne* sp.			+					Lovén, 1836	*Evadne*	Lovén, 1836
		(infra order Cladocera)	*Penilia* sp.			+					Dana, 1852	*Penilia*	Dana, 1852
	Ostracoda												
			Unidentified		+								
			Pyrocypris sp.			+					Müller, 1890	*Pyrocypris*	Müller, 1890
		Halocyprida											
			Euconchoecia sp.			+					Müller, 1890	*Euconchoecia*	Müller, 1890
			Conchoecia parvidentata							+	Müller, 1906	*Conchoecia parvidentata*	Müller, 1906
	Maxillopoda (Subclass Copepoda)												
		Calanoida											
			Acartia amboinensis						+		Carl, 1907	*Acartia* (*Odontacartia*) *amboinensis*	Carl, 1907
			Acartia erythraea						+		Giesbrecht, 1889	*Acartia* (*Odontacartia*) *erythraea*	Giesbrecht, 1889
			Acartia pacifica						+	+	Steuer, 1915	*Acartia* (*Odontacartia*) *pacifica*	Steuer, 1915

Table 1. Cont'd.

PHYLUM	CLASS	ORDER	Reported scientific name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Authority	Currently accepted scientific name (Genus and lower) (8,9)	Authority for accepted name
			Acartia plumosa					+			Scott T., 1894	*Acartia* (*Acanthacartia*) *plumosa*	Scott T., 1894
			Acartia sinijiensis							+	Mori, 1940	*Acartia* (*Acanthacartia*) *sinjiensis*	Mori, 1940
			Acartia sp.				+				Dana, 1846	*Acartia*	Dana, 1846
			Acartia sp. 1			+			+		Dana, 1846	*Acartia*	Dana, 1846
			Acartia sp. 2						+		Dana, 1846	*Acartia*	Dana, 1846
			Acartia spinicauda						+		Giesbrecht, 1889	*Acartia* (*Odontacartia*) *spinicauda*	Giesbrecht, 1889
			Acrocalanus sp.				+				Giesbrecht, 1888	*Acrocalanus*	Giesbrecht, 1888
			Acrocalanus gibber						+	+	Giesbrecht, 1888	*Acrocalanus gibber*	Giesbrecht, 1888
			Acrocalanus gracilis						+	+	Giesbrecht, 1888	*Acrocalanus gracilis*	Giesbrecht, 1888
			Acrocalanus longicornis						+		Giesbrecht, 1888	*Acrocalanus longicornis*	Giesbrecht, 1888
			Acrocalanus monachus						+		Giesbrecht, 1888	*Acrocalanus monachus*	Giesbrecht, 1888
			Bestiolina similis						+	+	Sewell, 1914	*Bestiolina similis*	Sewell, 1914
			Calanopia sp.			+					Dana, 1852	*Calanopia*	Dana, 1852
			Calanopia elliptica						+	+	Dana, 1849	*Calanopia elliptica*	Dana, 1849
			Calanopia minor						+		Scott A., 1902	*Calanopia minor*	Scott A., 1902
			Calanopia thompsoni						+		Scott A., 1909	*Calanopia thompsoni*	Scott A., 1909
			Calocalanus pavo						+		Dana, 1852	*Calocalanus pavo*	Dana, 1852
			Calocalanus styliformis						+	+	Giesbrecht, 1888	*Calocalanus styliremis*	Giesbrecht, 1888
			Calocalanus sp.						+		Giesbrecht, 1888	*Calocalanus* sp.	Giesbrecht, 1888
			Candacia sp.			+	+				Dana, 1846	*Candacia*	Dana, 1846
			Candacia bradyi						+	+	Scott A., 1902	*Candacia bradyi*	Scott A., 1902
			Candacia curta						+		Dana, 1849	*Candacia curta*	Dana, 1849
			Candacia discaudata						+		Scott A., 1909	*Candacia discaudata*	Scott A., 1909
			Candacia ethiopica						+		Dana, 1849	*Candacia ethiopica*	Dana, 1849
			Candacia pachydactyla						+		Dana, 1849	*Candacia pachydactyla*	Dana, 1849
			Canthocalanus			+					Scott A., 1909	*Canthocalanus*	Scott A., 1909
			Canthocalanus pauper						+	+	Giesbrecht, 1888	*Canthocalanus pauper*	Giesbrecht, 1888
			Centropages dorsispinatus						+		Thompson I.C. & Scott A., 1903	*Centropages dorsispinatus*	Thompson I.C. & Scott A., 1903
			Centropages furcatus		+				+		Dana, 1849	*Centropages furcatus*	Dana, 1849
			Centropages orsinii						+		Giesbrecht, 1889	*Centropages orsinii*	Giesbrecht, 1889
			Centropages sp.			+			+		Krøyer, 1849	*Centropages*	Krøyer, 1849
			Centropages tenuiremis						+	+	Thompson I.C. & Scott A., 1903	*Centropages tenuiremis*	Thompson I.C. & Scott A., 1903

Table 1. Cont'd.

PHYLUM	CLASS	ORDER	Reported scientific name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Authority	Currently accepted scientific name (Genus and lower) (8,9)	Authority for accepted name
			Clausocalanus arcuicornis						+		Dana, 1849	*Clausocalanus arcuicornis*	Dana, 1849
			Clausocalanus furcatus						+	+	Brady, 1883	*Clausocalanus furcatus*	Brady, 1883
			Clausocalanus jobei						+		Frost & Fleminger, 1968	*Clausocalanus jobei*	Frost & Fleminger, 1968
			Clausocalanus parapergens							+	Frost & Fleminger, 1968	*Clausocalanus parapergens*	Frost & Fleminger, 1968
			Clausocalanus pergens						+		Farran, 1926	*Clausocalanus pergens*	Farran, 1926
			Eucalanus attenuatus						+		Dana, 1849	*Pareucalanus attenuatus*	Dana, 1849
			Eucalanus crassus						+		Giesbrecht, 1888	*Subeucalanus crassus*	Giesbrecht, 1888
			Eucalanus pileatus						+		Giesbrecht, 1888	*Subeucalanus pileatus*	Giesbrecht, 1888
			Eucalanus sp.				+		+		Dana, 1852	*Eucalanus*	Dana, 1852
			Eucalanus subcrassus		+			+	+		Giesbrecht, 1888	*Eucalanus subcrassus*	Giesbrecht, 1888
			Eucalanus subtenuis			+			+		Giesbrecht, 1888	*Subeucalanus subtenuis*	Giesbrecht, 1888
			Euchaeta sp.				+				Philippi, 1843	*Euchaeta*	Philippi, 1843
			Euchaeta concinna		+				+	+	Dana, 1849	*Paraeuchaeta concinna*	Dana, 1849
			Euchaeta marinella						+		Bradford, 1974	*Euchaeta marinella*	Bradford, 1974
			Labidocera sp.		+	+					Lubbock, 1853	*Labidocera*	Lubbock, 1853
			Labidocera acuta						+		Dana, 1849	*Labidocera acuta*	Dana, 1849
			Labidocera bengalensis						+		Krishnaswamy, 1952	*Labidocera bengalensis*	Krishnaswamy, 1952
			Labidocera euchaeta						+	+	Giesbrecht, 1889	*Labidocera euchaeta*	Giesbrecht, 1889
			Labidocera kroyeri						+		Brady, 1883	*Labidocera kroyeri*	Brady, 1883
			Labidocera minuta						+		Giesbrecht, 1889	*Labidocera minuta*	Giesbrecht, 1889
			Labidocera pectinata						+		Thompson I.C. & Scott A., 1903	*Labidocera pectinata*	Thompson I.C. & Scott A., 1903
			Labidocera rotunda						+		Mori, 1929	*Labidocera rotunda*	Mori, 1929
			Labidocera sp. 1						+		Lubbock, 1853	*Labidocera*	Lubbock, 1853
			Labidocera sp. 2						+		Lubbock, 1853	*Labidocera*	Lubbock, 1853
			Lucicutia flavicornis						+	+	Claus, 1863	*Lucicutia flavicornis*	Claus, 1863
			Lucicutia gaussae						+		Grice, 1963	*Lucicutia gaussae*	Grice, 1963
			Metacalanus sp.			+			+		Cleve, 1901	*Metacalanus*	Cleve, 1901
			Nannocalanus minor						+	+	Claus, 1863	*Nannocalanus minor*	Claus, 1863
			Neocalanus gracilis							+	Dana, 1852	*Neocalanus gracilis*	Dana, 1852
			Paracalanus aculeatus						+	+	Giesbrecht, 1888	*Paracalanus aculeatus*	Giesbrecht, 1888
			Paracalanus denudatus						+	+	Sewell, 1929	*Paracalanus denudatus*	Sewell, 1929
			Paracalanus parvus					+	+	+	Claus, 1863	*Paracalanus parvus*	Claus, 1863
			Paracalanus nanus							+	Sars, 1925	*Paracalanus nanus*	Sars, 1925
			Paracalnus serrulus							+	Shen & Lee, 1963	*Paracalnus serrulus*	Shen & Lee, 1963

Table 1. Cont'd.

PHYLUM	CLASS	ORDER	Reported scientific name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Authority	Currently accepted scientific name (Genus and lower) (8,9)	Authority for accepted name
			Paracalanus sp.			+	+		+		Boeck, 1865	*Paracalanus*	Boeck, 1865
			Parvocalanus crassirostris						+	+	Dahl F., 1894	*Parvocalanus crassirostris*	Dahl F., 1894
			Parvocalanus elegans						+		Andronov, 1972	*Parvocalanus elegans*	Andronov, 1972
			Parvocalanus sp.							+	Andronov, 1970	*Parvocalanus*	Andronov, 1970
			Pontella sp. 1						+		Dana, 1846	*Pontella*	Dana, 1846
			Pontella sp. 2						+		Dana, 1846	*Pontella*	Dana, 1846
			Pontella sp. 3						+		Dana, 1846	*Pontella*	Dana, 1846
			Pontellina plumata						+		Dana, 1849	*Pontellina plumata*	Dana, 1849
			Pseudodiaptomus aurivilli						+		Cleve, 1901	*Pseudodiaptomus aurivillii*	Cleve, 1901
			Pseudodiaptomus marinus							+	Sato, 1913	*Pseudodiaptomus marinus*	Sato, 1913
			Pseudodiaptomus cf *ardjuna*							+	Brehm, 1953	*Pseudodiaptomus ardjuna*	Brehm, 1953
			Pseudodiaptomus sp.			+	+		+		Herrick, 1884	*Pseudodiaptomus*	Herrick, 1884
			Scolecithricella sp.						+		Sars G.O., 1902	*Scolecithricella*	Sars G.O., 1902
			Scolecithricella minor							+	Brady, 1883	*Scolecithricella minor*	Brady, 1883
			Subeucalanus mucronatus							+	Giesbrecht, 1888	*Subeucalanus mucronatus*	Giesbrecht, 1888
			Subeucalanus subcrassus							+	Giesbrecht, 1888	*Subeucalanus subcrassus*	Giesbrecht, 1888
			Temora sp.			+	+				Baird, 1850	*Temora*	Baird, 1850
			Temora discaudata						+	+	Giesbrecht, 1889	*Temora discaudata*	Giesbrecht, 1889
			Temora longicornis					+			Müller O.F., 1785	*Temora longicornis*	Müller O.F., 1785
			Temora plumosa										
			Temora stylifera						+		Dana, 1849	*Temora stylifera*	Dana, 1849
			Temora turbinata						+	+	Dana, 1849	*Temora turbinata*	Dana, 1849
			Tortanus sp.			+					Giesbrecht in G & Schmeil, 1898	*Tortanus*	Giesbrecht in G & Schmeil, 1898
			Undinula vulgaris		+				+		Dana, 1849	*Undinula vulgaris*	Dana, 1849
			Unidentified (Pontellidae, Scolecithricidae)										
		Cyclopoida											
			Halicyclops sp.							+	Norman, 1903	*Halicyclops*	Norman, 1903
			Oithona			+	+		+		Baird, 1843	*Oithona*	Baird, 1843
			Oithona attenuata						+	+	Farran, 1913	*Oithona attenuata*	Farran, 1913
			Oithona brevicornis						+		Giesbrecht, 1891	*Oithona brevicornis brevicornis*	Giesbrecht, 1891

Table 1. Cont'd.

PHYLUM	CLASS	ORDER	Reported scientific name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Authority	Currently accepted scientific name (Genus and lower) (8,9)	Authority for accepted name
			Oithona nana						+	+	Giesbrecht, 1893	*Oithona nana*	Giesbrecht, 1893
			Oithona oculata						+	+	Farran, 1913	*Oithona oculata*	Farran, 1913
			Oithona plumifera						+		Baird, 1843	*Oithona plumifera*	Baird, 1843
			Oithona rigida						+	+	Giesbrecht, 1896	*Oithona rigida*	Giesbrecht, 1896
			Oithona similis						+	+	Claus, 1866	*Oithona similis*	Claus, 1866
			Oithona simplex						+	+	Farran, 1913	*Oithona simplex*	Farran, 1913
			Oithona vivida							+	Farran, 1913	*Oithona vivida*	Farran, 1913
			Oithona logispina							+	Nishida, Tanaka & Omori, 1977	*Oithona longispina*	Nishida, Tanaka & Omori, 1977
			Oithona fallax							+	Farran, 1913	*Oithona fallax*	Farran, 1913
			Oithona dissimilis							+	Lindberg, 1940	*Oithona dissimilis dissimilis*	Lindberg, 1940
			Oithona aruensis							+	Früchtl, 1923	*Oithona aruensis*	Früchtl, 1923
		Poecilostomatoida											
			Copilia quadrata						+		Dana, 1849	*Copilia quadrata*	Dana, 1849
			Copilia mirabilis						+		Dana, 1852	*Copilia mirabilis*	Dana, 1852
			Corycaeus			+	+				Dana, 1845	*Corycaeus*	Dana, 1845
			Corycaeus affinis						+	+	McMurrich, 1916	*Corycaeus affinis*	McMurrich, 1916
			Corycaeus agilis						+		Dana, 1849	*Onychocorycaeus agilis*	Dana, 1849
			Corycaeus andrewsi						+	+	Farran, 1911	*Corycaeus andrewsi*	Farran, 1911
			Corycaeus asiaticus						+		Dahl F., 1894	*Corycaeus asiaticus*	Dahl F., 1894
			Corycaeus catus						+	+	Dahl F., 1894	*Onychocorycaeus catus*	Dahl F., 1894
			Corycaeus dahli						+		Tanaka, 1957	*Corycaeus dahli*	Tanaka, 1957
			Corycaeus dubius						+		Farran, 1911	*Corycaeus dubius*	Farran, 1911
			Corycaeus erythraeus						+		Cleve, 1904	*Corycaeus erythraeus*	Cleve, 1904
			Corycaeus lautus						+		Dana, 1849	*Corycaeus lautus*	Dana, 1849
			Corycaeus limbatus						+		Brady, 1883	*Corycaeus limbatus*	Brady, 1883
			Corycaeus ovalis					+			Claus, 1863	*Corycaeus ovalis*	Claus, 1863
			Corycaeus pacificus						+	+	Dahl F., 1894	*Onychocorycaeus pacificus*	Dahl F., 1894
			Corycaeus speciosus						+		Dana, 1849	*Corycaeus speciosus*	Dana, 1849
			Corycaeus subtilis						+		Dahl M., 1912	*Ditrichocorycaeus subtilis*	M.Dahl, 1912
			Corycaeus pumilus							+	Dahl, 1912	*Onychocorycaeus pumilus*	Dahl, 1912
			Corycaeus giesbrechti							+	Dahl, 1894	*Corycaeus giesbrechti*	Dahl, 1894
			Corycaeus crassiusculus							+	Dana, 1849	*Corycaeus crassiusculus*	Dana, 1849
			Farranula gibbula						+		Giesbrecht, 1891	*Farranula gibbula*	Giesbrecht, 1891

Table 1. Cont'd.

PHYLUM	CLASS	ORDER	Reported scientific name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Authority	Currently accepted scientific name (Genus and lower) (8,9)	Authority for accepted name
			Farranula rostratus						+		Claus, 1863	*Farranula rostrata*	Claus, 1863
			Oncaea			+					Philippi, 1843	*Oncaea*	Philippi, 1843
			Oncaea clevei						+		Früchtl, 1923	*Oncaea clevei*	Früchtl, 1923
			Oncaea media						+	+	Giesbrecht, 1891	*Oncaea media*	Giesbrecht, 1891
			Oncaea paraclevei						+		Böttger-Schnack, 2001	*Oncaea paraclevei*	Böttger-Schnack, 2001
			Oncaea scottodicarloi						+		Heron & Bradford-Grieve, 1995	*Oncaea scottodicarloi*	Heron & Bradford-Grieve, 1995
			Oncaea venusta					+	+		Philippi, 1843	*Oncaea venusta*	Philippi, 1843
			Pseudomacrochiron sp.						+		Reddiah, 1969	*Pseudomacrochiron*	Reddiah, 1969
			Sapphirina angusta						+		Dana, 1849	*Sapphirina angusta*	Dana, 1849
			Sapphirina gastrica						+		Giesbrecht, 1891	*Sapphirina gastrica*	Giesbrecht, 1891
			Sapphirina intestinata					+			Giesbrecht, 1891	*Sapphirina intestinata*	Giesbrecht, 1891
			Sapphirina metallina						+		Dana, 1849	*Sapphirina metallina*	Dana, 1849
		Harpaticoida											
			Clytemnestra scutellata						+		Dana, 1849	*Clytemnestra scutellata*	Dana, 1849
			Clytemnestra sp.		+	+					Dana, 1848	*Clytemnestra*	Dana, 1848
			Distioculus minor						+		Scott T., 1894	*Distioculus minor*	Scott T., 1894
			Ectinosoma		+						Boeck, 1865	*Ectinosoma*	Boeck, 1865
			Euterpina		+	+	+				Norman, 1903	*Euterpina*	Norman, 1903
			Euterpina acutifrons						+	+	Dana, 1847	*Euterpina acutifrons*	Dana, 1847
			Macrostella			+							
			Macrostella gracilis		+			+	+	+			
			Microsetella			+					Brady & Robertson, 1873	*Microsetella*	Brady & Robertson, 1873
			Microstella norvegica						+	+			
			Microstella rosea		+			+	+	+			
			Tisbintra sp.							+	Sewell, 1940	*Tisbintra*	Sewell, 1940
			Tisbe graciloides					+			Sars G.O., 1920	*Tisbe graciloides*	Sars G.O., 1920
		Monstrilloida											
			Monstrilla longiremis					+			Giesbrecht, 1893	*Monstrilla longiremis*	Giesbrecht, 1893
	Subclass Thecostraca			+									
			Cirripedia (infra class)	+	+					+			
	Malacostraca						+						
			Mysidacea Subclass Eumalcostracea, unranked)		+						Haworth, 1825	*Mysida*	Haworth, 1825
		Euphausiacea									Dana, 1852	*Euphausiacea*	Dana, 1852
			Euphausia tenera							+	Hansen, 1905	*Euphausia tenera*	Hansen, 1905

Table 1. Cont'd.

PHYLUM	CLASS	ORDER	Reported scientific name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Authority	Currently accepted scientific name (Genus and lower) (8,9)	Authority for accepted name
			Nematoscelis sp.							+	Sars, 1883	*Nematoscelis*	Sars, 1883
			Stylocherion sp.							+	Sars, 1883	*Stylocheiron*	
			Un-indentified		+								
		Isopoda									Latreille, 1817	*Isopoda*	Latreille, 1817
			Unindentified		+								
		Amphipoda									Latreille, 1816	*Amphipoda*	Latreille, 1816
			Unindentified		+								
		Cumacea									Krøyer, 1846	*Cumacea*	Krøyer, 1846
			Unindentified		+								
		Mysida											
			Gastrosaccus pelagics							+	Ii, 1964	*Gastrosaccus pelagica*	Ii, 1964
			Siriella media							+	Hansen, 1910	*Siriella media*	Hansen, 1910
			Anisomysis sp.							+	Hansen, 1910	*Anisomysis*	Hansen, 1910
		Decapoda											
			Acetes sp.						+		Milne Edwards, 1830*Acetes*	Milne Edwards, 1830	
			Lucifer sp.	+						+	Thompson, 1829	*Lucifer*	Thompson, 1829
			Lucifer hanseni							+	Nobili, 1905	*Lucifer hanseni*	Nobili, 1905
			Lucifer intermedius							+	Hansen, 1919	*Lucifer intermedius*	Hansen, 1919
			Stylocheiron sp.							+	Sars, 1883	*Stylocheiron*	Sars, 1883
			Brachyura larvae	+						+			
			Macrura Larvae							+			
			Unidentified (larvae)	+				+					
Chaetognatha													
			Unidentified	+				+					
	Sagittoidea												
		Aphragmophora											
			Sagitta			+					Quoy & Gaimard, 1827	*Sagitta*	Quoy & Gaimard, 1827
			Sagitta enflata		+	+				+	Grassi, 1881	*Flaccisagitta enflata*	Grassi, 1881
			Sagita bedoti							+	Beraneck, 1895	*Zonosagitta bedoti*	Beraneck, 1895
			Sagitta hexaptera							+	d'Orbigny, 1836	*Flaccisagitta hexaptera*	d'Orbigny, 1836
			Sagitta lyra							+	Krohn, 1853	*Pseudosagitta lyra*	Krohn, 1853
			Sagitta minima							+	Grassi, 1881	*Mesosagitta minima*	Grassi, 1881
			Sagitta pacifica							+	Tokioka, 1940		
			Sagitta regularis							+	Aida, 1897	*Aidanosagitta regularis*	Aida, 1897
			Sagitta pseudoserratodentata							+	Tokioka, 1939	*Serratosagitta pseudoserratodentata*	Tokioka, 1939
			Sagitta crassa							+	Tokioka, 1938	*Aidanosagitta crassa*	Tokioka, 1938
			Krohnitta pacifica			+					Aida, 1897	*Krohnitta pacifica*	Aida, 1897

Table 1. Cont'd.

PHYLUM	CLASS	ORDER	Reported scientific name	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Authority	Currently accepted scientific name (Genus and lower) (8,9)	Authority for accepted name
Mollusca													
	Gastropoda												
			Unidentified		+			+					
		Pteropoda (Super Order)											
			Unidentified		+			+					
		Littorinimorpha											
			Carinaria sp.							+	Lamarck, 1801	*Carinaria*	Lamarck, 1801
			Superfamily Pterotracheoidea (Heteropoda)		+						Rafiniesque 1814	*Pterotracheoidea*	Rafinesque, 1814
	Bivalvia												
			Unidentified (larvae)	+				+		+			
		Mytiloida											
			Mytilus viridis (larvae)				+				Linnaeus, 1758	*Perna viridis*	Linnaeus, 1758
			Modiolus penelegans (larvae)				+				Iredale, 1939	*Modiolus modulaides*	Röding, 1798
Echinodermata													
			Unidentified		+								
	Echinoidea												
			Unidentified					+					
Hemichordata													
			Unidentified					+					
Chordata													
	Appendicularia												
		Copelata											
			Oikopleura cornutogastra							+	Gegenbaur, 1855	*Oikopleura* (*Coecaria*) *fusiformis cornutogastra*	Gegenbaur, 1855
			Oikopleura sp.	+	+					+	Mertens, 1830	*Oikopleura*	Mertens, 1830
			Unidentified					+					
	Pisces (Super class)												
			Unidentified					+					

or presence of the different plankton groups (Table 1). He found that copepods were present or "very common" during the whole year. Loricate ciliates, tintinnids, were observed only during January, June, November, and December. The dinoflagellates *Ceratium* sp. and *Noctiluca* sp. were very common in February. The organisms classified as larger zooplankton, such as decapod larvae, siphonophores and chaetognaths were also described during the entire year studied by the author.

Wickstead (1958) published a study on the larger zooplankton of Singapore waters (Table 1). One station located at the Outer Shoal Light Buoy (1°15′N; 103°52′E; see Fig. 1) was sampled during one year for plankton enumeration. Climatic aspects, water temperature and salinity were also described. In the protozoa group, foraminifera and cystoflagellata (currently referred to as dinoflagellates) were found. Due to the sampling method, a "25 mesh per inch net" (i.e., 700 µm pore-size mesh), Tintinnidae were seldom found. Hydrozoa, Scyphozoa and Ctenophora were recorded in the group of Coelenterata. The polychaete annelids occurred occasionally throughout the year. The crustaceans were mainly represented by copepods in the groups of Gymnoplea, Podoplea, Harpacticoida and more rarely monstrilloida. Cladocerans, ostracods, cirripedes, mysids, isopods, amphipods, euphausiids, decapods were much more uncommon (Wickstead, 1958). In this last work, the author showed a seasonal variation with almost all the planktonic groups being more abundant in the first half of the year and towards the end of the year, with the exception of copepods that only showed a peak of abundance in February/March. The author, however, points that due to the large pore size net used, copepods were likely to be underestimated. It is noteworthy that there are high numbers of Siphonophora found in the study, with this group being the most numerous during the second half of the year, as they likely preyed upon copepods.

Tham (1973) provided the general seasonal pattern of phyto- and zooplankton (Table 1). The author showed that zooplankton abundance was higher between March and November, and that the group was dominated by copepods, accounting for 40–70% of the total abundance. In his study, copepod peaked at April/May, July, and October/November. These findings partially contrast with those of Wickstead (1958), who described the highest biomass of copepods only at the beginning of the year (February/March). The little representation of copepods during the rest of the year found in Wickstead's (1958) survey could be due either to particular conditions during the sampling year or to a high predatory control of blooming siphonophores during this period, or even to a mere underestimation of the group as the author admits in his work. The other groups found were appendicularians, cirripedes, molluscs, decapod larvae, siphonophores and chaetognaths.

In that same year, Thia-Eng (1973) published an ecological study of the Ponggol Estuary (Table 1; see Fig. 1 for location of the estuary), a short, narrow and shallow mesohaline to polyhaline estuary, now transformed in a freshwater reservoir. In this particular environment, which is not comparable to the literature discussed so far, dinoflagellates, copepods and molluscs, accounted for 80% of the total zooplankton biomass.

Over the last decade, only a few studies on zooplankton from Singapore waters have been published. Rezai et al. (2004) described the spatial and temporal distribution of 117 copepod species belonging to 37 genera in the Strait of Malacca (Table 1). Among these species, 13 accounted for 70% of the total copepod abundance. No consistent seasonal patterns of individual species were observed, but the authors found differences in abundance between the northern, the central, and the southern parts of the Strait. Nakajima et al. (2008) published a study on the zooplankton community of a coral reef, which was located at the Malaysia peninsula coast (Redang Island, North East Malaysia). The authors size-fractioned the organisms and found that the 100–200 µm fraction was composed of 51.3% adult copepods and copepodites and the rest (47.1%) of copepod nauplii. In the following fraction (200–335 µm), adult copepods and copedites were also the more abundant (74.3%) of the total biomass but they also found other crustaceans, larvae and chaetognaths. They found that the larger organisms (>335 µm) were more diverse. In addition to adult copepods and copepodites, they found chaetognaths, larvae, hydrozoans, ostracods and other crustaceans.

In the study conducted as part of this paper, the station situated in the west part of the channel was observed to vary in the total abundance of copepods (orders Calanoida, Harpacticoid, and Cyclopoida, including copepodid larva) throughout the year. Two peaks in abundance in November 2012 and in March 2013 were observed. These highest abundances found in March and November and are in accordance with the work of Tham (1973). However, it was not clearly observed whether these changes in abundances occurred in the east part of the channel. Indeed, the total abundance of copepods did not draw any temporal pattern. It was only observed that an increase of the order Calanoida (which accounted for most of the total abundance of copepods) occurred in December 2012.

Different zooplankton groups of freshwater bodies from Singapore and Malaysia have also been described (Table 2). The intensive sampling was carried out during 1966–1967, and gave rise to several publications in the early eighties. The samples were collected in all types of freshwater habitats available, like ponds, lakes, marshes, reservoirs, pools, rice fields, rivers and streams in West Malaysia (a total of 503 zooplankton samples) and Singapore (a total of 38 samples). Lai & Fernando (1978) focused only on calanoid copepods, and Fernando & Ponyi (1981) studied the free-living freshwater cyclopoid copepods of Malaysia and Singapore (Table 2). In spite of extensive sampling, Fernando & Ponyi (1981) found a low number of species, which could be the result of the high human impact on the aquatic fauna. Another work, which came out of this extensive sampling, was that of Fernando & Zankai (1981) on Rotifera (Table 2). They described 165 species belonging mainly to Ploimida and Gnesiotrocha. The authors argued that the low record of Bdelloida was due to an issue in sampling methodology. Most of the species found in this study were only observed in some samples. They observed that the diversity was higher in ponds and rice fields than in open waters of reservoirs and streams. The last work is from Idris & Fernando (1981) on Cladocera (Table 2). They described 63 cladoceran species from which, 26 were recorded for the first time in that region and they provided their detailed morphological description. Similar to Idris & Fernando (1981), the highest diversity of cladocerans was found in ponds and rice fields. They found that the species composition was typical of tropical region; that *Daphnia* was extremely rare, and that families Polyphemidae, Leptodoridae, and Holopedidae were absent. More recently, Low et al. (2010) described trophic links between phytoplankton and zooplankton organisms in freshwater reservoirs from Singapore. They based their study on an historical data set over 15 years, between January 1992 and December 2006, of a monthly sampling regime in 12 shallow reservoirs. They categorised zooplanktonic organisms in six groups. Four of them, calanoids, cyclopoids, cladocerans and rotifers, were present in more than 98% of the samples. However, two groups, harpacticoids and ostracods, were rare. Their study did not provide a species-level list for zooplankton, nor their geographical and seasonal distribution.

Species richness as descriptor of diversity. For a better understanding of planktonic historical trends, the use of quantitative diversity descriptors would have been ideal; unfortunately, most of the available data are only qualitative. However, a comparison of the species richness among can be undertaken for the different studies. For freshwater habitats, unfortunately, this is not possible because the disparity of target groups amongst studies; as, each study focused on one group. Regarding marine systems, even if the data are limited it is evident that Rezai et al. (2004) found more species than all the other studies (a total of 112 species versus 8–32 species for the rest of studies). Unfortunately, the work of Rezai et al. (2004) is limited to the description of copepods, and does not include other zooplankters. This exemplifies the lack of broad-based studies considering all zooplanktonic groups at high taxonomic resolution.

The present study included an extensive plankton investigation, conducted once every two weeks during one year (Table 1). We found differences in the species richness of some groups compared to that of previous works. For instance, the species richness for cnidarians and copepods was higher than that found in studies from the fifties, but it was lower than the one described by Rezai (Rezai et al., 2004; Table 1). However, we are closer in total number of zooplankton species to the work of Rezai et al. (2004), as we found, a total of 91 species including species from all groups (Table 1). These discrepancies between the previous work and the present study may simply be result of the different geographic locations of the sampling sites. In the present study, the west coast of Singapore was studied (e.g., in the area of Jurong Island), while Rezai (Rezai et al., 2004) studied the Straits of Malacca, which covers a wide geographic area, and Nakajima et al. (2008) undertook their survey in the north-east of Malaysia. Our sampling sites have a lower water circulation rate and are more affected by human activities, which should affect the planktonic community. Nevertheless, considering the particularities of the sampling stations, it is rather surprising that the total number of zooplanktonic species found in our study is similar, or even higher, to those found in previous reports.

Among the 57 species of copepods found, 32 belong to the order Calanoida, 12 to the order Cyclopoida, eight to the Poecilostomatoida, and five to the order Haparticoida. Some copepods from our study have been described only from this region. *Acartia pacifica* Steuer, 1915, *Acartia sinijiensis* Mori, 1940 and *Bestiolina similis* (Sewell, 1914) are found only in the Pacific. Other species have a more broad distribution, such as *Acrocalanus gibber* Giesbrecht, 1888, and *Acrocalanus gracilis* Giesbrecht, 1888, which are found mainly in the Indian Ocean, but also in Pacific and Atlantic oceans. Some are cosmopolitan (found in all oceans except polar zones), like *Calocalanus styliformis* (Giesbrecht, 1888), and *Clausocalanus furcatus* (Brady, 1883). In all cases, the calanoid copepods found in the present survey all have a tropical to temperate distribution. However, cyclopoid copepods such as *Oithona similis* Claus, 1866, are cosmopolitan, including polar zones. Chaetognaths, also important components of the zooplankton in our study, have a species-dependent distribution: four of our species are found in all tropical to temperate oceans, e.g., *Flaccisagitta enflata* (Grassi, 1881), and five of our species are limited to the Indian and Pacific oceans, e.g., *Sagitta bedoti* (Beraneck, 1895). Their temporal variation showed a similar trend to that of copepods at both stations; they were present the whole year in the study of Tham (1953).

Final remarks on the need of long term plankton-monitoring programs. Data on zooplankton diversity and distribution in the area of Singapore (including combined works with Malaysia) have been mostly obtained at the beginning and the middle of the last century. It is only recently, at the beginning of the 2000s, that investigations in this field have restarted in Malaysia and only in 2013 in Singapore. This review was therefore necessary to update the information available to detect possible trends associated with climatic or anthropogenic events, and to inform an efficient water management plan for Singapore. However, because of the changes in sampling techniques and methods, the heterogeneity of sampling stations and groups studied, the comparisons are not obvious.

From a conservation biology point of view, it is important to compare the state of actual ecosystems to their description in the past. Without a proper description of biodiversity and its functioning over time, it is difficult to ensure appropriate ecosystem management. Many factors, such as the construction of dams, the causeway linking Singapore to Johor Bahru (Malaysia), shoreline modifications, and species introductions (e.g., from ballast water or aquaculture) may have affected native aquatic biodiversity. For instance, it has been shown that ballast waters are responsible for ca. 30% of bio-invasions, the risk of dispersal of exogenous species increasing yearly by approximately 3% (Gollasch, 2007;

Table 2. List of zooplanktonic organisms found in the available literature on Singaporean and Malaysian freshwaters. (1) = Fernando & Ponyi, 1981; (2) = Fernando & Zankai, 1981; (3) = Idris & Fernando, 1981; (4) = Lai & Fernando, 1978; (5) = Low et al., 2010; (6) = World Register of Marine Species at http://www.marinespecies.org/aphia.php?p=taxdetails&id=220933 on 2013-01-23.

Reported scientific name	(1)	(2)	(3)	(4)	(5)	Authority	Currently accepted scientific name (Genus and lower) (6)	Authority for accepted name
Phylum Arthropoda								
Order Cladocera					+			
Family Silidae								
Genus *Diaphanosoma*						Fisher, 1850		
Diaphanosoma modigliani			+			Richard, 1895		
Diaphanosoma excisum			+			Sars, 1885	*Diaphanosoma excisum*	Sars, 1885
Diaphanosoma sarsi			+			Richard, 1895		
Diaphanosoma aspinosum			+			Chiang, 1956		
Genus *Pseudosida*						Herrick, 1884		
Pseudosida bideniata			+			Herrick, 1884		
Genus *Latonopsis*						Sars, 1888		
Latonopsis australis			+			Sars, 1888		
Family Daphniidae								
Genus Daphnia						O.F. Muller, 1785		
Daphnia similis			+			Claus, 1876		
Genus *Ceriodaphnia*						Dana, 1853		
Ceriodaphnia cornuta			+			Sars, 1888	*Ceriodaphnia cornuta*	Sars, 1885
Genus *Scapholeberis*						Schoedler, 1853		
Scapholebris kingi			+			Sars, 1903		
Genus *Simocephalus* S						Schoedler, 1858		
Simocephalus serrulatus			+			(Koch, 1841)	*Simocephalus serrulatus*	(Koch, 1841)
Simocephalus latirostris			+			Stingelin, 1906		
Family Moinidae								
Genus *Moinodaphnia*						Herrick, 1887		
Moinadaphnia macleayii			+			(King, 1853)		
Genus *Moina*						Baird, 1850		
Moina micrura			+			Kurz, 1874	*Moina micrura*	Kurz, 1874
Family Bosminidae								
Genus *Bosminopsis*						Richard, 1895		
Bosminopsis deitersi			+			Richard, 1895		
Family Macrothricidae								
Genus *Ilyocruptus*						Sars, 1862		
Ilyocryptus spinifer			+			Herrick, 1882		
Genus *Grimaldina*						Richard, 1892		
Grimaldina brazzai			+			Richard, 1892		
Genus *Guernella*						Richard, 1892		

Table 2. Cont'd.

Reported scientific name	(1)	(2)	(3)	(4)	(5)	Authority	Currently accepted scientific name (Genus and lower) (6)	Authority for accepted name
Guernella raphalis			+			Richard, 1892		
Genus *Streblocercus*						Sars, 1862		
Streblocercus pygmaeus			+			Sars, 1901		
Genus *Macrothrix*						Baird, 1843		
Macrothrix spinosa			+			King, 1852		
Macrothrix capensis-monodi			+			Gauthier, 1930		
Macrothrix triseralis			+			Brady, 1886		
Family Chydoridae								
Genus *Pleuroxus*						Baird, 1843		
Pleuroxus laevis			+			Sars, 1862		
Genus *Disparalona*						Fryer, 1968		
Disparalona rostrata			+			(Koch, 1841)	*Disparalona rostrata*	(Koch, 1841)
Genus *Alonella*						Sars, 1862		
Alonella nana			+			(Baird, 1850)		
Alonella excisa			+			(Fisher, 1854)		
Alonella hamulatus			+			(Birge, 1910)		
Genus *Chydorus*						Leach, 1816		
Chydorus barroisi			+			Richard, 1894		
Chydorus ventricosus			+			Daday, 1898		
Chydorus parvus			+			Daday, 1898		
Chydorus eurynotus			+			Sars, 1901		
Chydorus cf. *pubescens*			+			Sars, 1901		
Chydorus reticulatus			+			Daday, 1898		
Chydorus faviformis			+			Birge, 1893		
Genus *Pseudochydorus*						Fryer, 1968		
Pseudochydorous globosus			+			(Baird, 1893)		
Genus *Dunhevedia*						King, 1853		
Dunhevedia crassa			+			King, 1853		
Dunhevedia serrata			+			Daday, 1898		
Genus *Dadaya*						Sars, 1901		
Dadaya macrops			+			(Daday, 1898)		
Genus *Leydigia*						Kurz, 1875		
Leydigia acanthocercoides			+			(Fisher, 1854)	*Leydigia acanthocercoides*	(Fisher, 1854)
Genus Graptoleberis						Sars, 1862		
Graptoleberis testudinaria			+			(Fisher, 1851)	*Graptoleberis testudinaria*	(Fisher, 1848)
Genus Alona						Baird, 1843		
Alona quadranqularis			+			(O.F. Mueller, 1785)	*Alona quadranqularis*	(O.F. Mueller, 1776)

Table 2. Cont'd.

Reported scientific name	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Authority**	**Currently accepted scientific name (Genus and lower) (6)**	**Authority for accepted name**
Alona affinis			+			Leydig, 1860	*Alona affinis*	Leydig, 1860
Alona eximia			+			Kiser, 1948		
Alona intermedia			+			Sars, 1862		
Alona cf. *dentifera*			+			Sars, 1901		
Alona macronyx			+			Daday, 1898		
Alona davidi			+			Richard, 1895		
Alona cf. *sarasinorum*			+			Stingelin, 1900		
Alona costata			+			Sars, 1862	*Alona costata*	Sars, 1862
Alona guttata			+			Sars, 1862	*Alona guttata*	Sars, 1862
Alona cf. *karelica*			+			Stenroos		
Alona cf. *pulchella*			+			King, 1853		
Alona karua			+			(King, 1853)		
Alona monacantha			+			Sars, 1901		
Alona rectangula			+			Sars, 1862	*Alona rectangula*	Sars, 1861
Alona verrucosa			+			Sars, 1901		
Alona freyi			+			Idris & Fernando, 1980		
Genus *Kurzia*						Dybowski & Growchowski, 1894		
Kurzia longirostris			+			(Daday, 1898)		
Genus *Acroperus*						Baird, 1843		
Acroperus harpae			+			(Baird, 1834)	*Acroperus harpae*	(Baird, 1834)
Genus *Oxyurella*						Dybowski & Growchowski, 1894		
Oxyrella sinhalensis			+			(Daday, 1898)		
Genus *Euryalona*						Sars, 1901		
Euryalona orientalis			+			Baird, 1843		
Genus *Camptocercus*						Baird, 1843		
Camptocercus cf. *australis*			+			Sars, 1896		
Genus *Indialona*						Petkovski, 1966		
Indialona globulosa						(Daday, 1898)		
Order Calanoid				+				
Neodiaptomus handeli				+		Brehm, 1921	*Neodiaptomus schmackeri*	(Brehm, 1921)
Neodiaptomus blachei				+		Brehm, 1951	*Vietodiaptomus blachei*	Brehm, 1951
Neodiaptomus botulifer				+		Kiefer, 1974	*Mongolodiaptomus botulifer*	Kiefer, 1974
Neodiaptomus laii				+		Kiefer, 1974	*Neodiaptomus laii*	Kiefer, 1974
Neodiaptomus malaindosinenris				+		Lai & Fernando, 1981	*Mongolodiaptomus botulifer*	Lai & Fernando, 1977
Neodiaptomus meggitti				+		Kiefer, 1932	*Neodiaptomus meggitti*	Kiefer, 1932
Neodiaptomus mephistopheles				+		Brehm, 1933	*Mongolodiaptomus mephistopheles*	Brehm, 1933
Pseudodiaptomus dauglishi				+		Sewell, 1932	*Pseudodiaptomus dauglishi*	Sewell, 1932

Table 2. Cont'd.

Reported scientific name	(1)	(2)	(3)	(4)	(5)	Authority	Currently accepted scientific name (Genus and lower) (6)	Authority for accepted name
Pseudodiaptomus tollingerae				+		Sewell, 1924	*Pseudodiaptomus tollingerae*	Sewell, 1919
Tropodiaptomus spp.				+			*Tropodiaptomus*	Kiefer, 1932
Order Cyclopoid					+			
Cryptocyclops bicolor	+					(Sars, 1863)	*Microcyclops bicolor*	(Sars, 1863)
Eutocyclops phaleratus	+					(Koch, 1838)		
Eucyclops serrulatus	+					(Fisher, 1851)	*Eucyclops serrulatus*	(Fisher, 1851)
Macrocyclops albidus	+					(Jurine, 1820)	*Macrocyclops albidus*	(Jurine, 1820)
Macrocyclops distinctus	+					(Richard, 1887)	*Macrocyclops distinctus*	(Richard, 1887)
Macrocyclops fusus	+					(Jurine, 1820)	*Macrocyclops fusus*	(Jurine, 1820)
Mesocyclops leuckarti	+					(Claus, 1857)	*Mesocyclops leuckarti*	(Claus, 1857)
Metacyclops minutus	+					(Claus, 1863)	*Metacyclops minutus*	(Claus, 1863)
Microcyclops dengizicus	+					(Lepeschkin, 1900)	*Microcyclops dengizicus*	(Lepeschkin, 1900)
Microcyclops varicans	+					(Sars, 1863)	*Microcyclops varicans*	(Sars, 1863)
Paracyclops affinis	+					(Sars, 1863)	*Paracyclops affinis*	(Sars, 1863)
Paracyclops fimbriatus	+					(Fisher, 1853)	*Paracyclops fimbriatus*	(Fisher, 1853)
Thermocyclops crassus	+					(Fisher, 1853)	*Thermocyclops crassus*	(Fisher, 1853)
Thermocyclops cf. *schmeili*	+					(Poppe & Mrázek, 1895)	*Thermocyclops* cf. *schmeili*	(Poppe & Mrázek, 1895)
Tropocyclops prasinus	+					(Fisher, 1860)	*Tropocyclops prasinus*	(Fisher, 1860)
Phylum Rotifera					+			
Order Ploimida								
Family Ephiphanidae								
Epiphanes clavulata		+				(Ehrenberg, 1832)		
Epiphanes macrourus		+				(Barrois & Daday, 1894)	*Epiphanes macrourus*	(Barrois & Daday, 1894)
Family Brachionidae								
Anuraeopsis fissa fissa		+				(Gosse, 1851)		
Anuraeopsis navicula coelata		+				De Beauchamp, 1832		
Brachionus angularis angularis		+				Gosse, 1851	*Brachionus angularis angularis*	Gosse, 1851
Brachionus angularis f. *bidens*		+				(Plate, 1886)		
Brachionus bidentata bidentata		+				Anderson, 1889		
Brachionus budapestinensis budapestinensis		+				(Daday, 1885)		
Brachionus calyciflorus calyciflorus		+				Pallas, 1766	*Brachionus calyciflorus calyciflorus*	Pallas, 1776
Brachionus calyciflorus f. *anuraeifermis*		+				(Brehm, 1909)		
Brachionus calyciflorus f. *amphiceros*		+				(Ehrenberg, 1838)	*Brachionus calyciflorus calyciflorus*	Pallas, 1776
Brachionus caudatus		+				Barrois & Daday, 1894		
Brachionus caudatus f. *apsteini*		+				Fedeew, 1925		

Table 2. Cont'd.

Reported scientific name	(1)	(2)	(3)	(4)	(5)	Authority	Currently accepted scientific name (Genus and lower) (6)	Authority for accepted name
Brachionus caudatus f. *vulgatus*		+				Ahlstrom, 1940		
Brachionus diversicornis diversicornis		+				(Daday, 1883)	*Brachionus diversicornis*	(Daday, 1883)
Brachionus falcatus falcatus		+				Zacharias, 1898		
Brachionus forficula		+				Wierzejski, 1891		
Brachionus forficula f. *minor*		+				(Voronkov, 1913)		
Brachionus leydigi var. *rotundus*		+				(Rousselet, 1907)		
Brachionus patulus patulus		+				(O.F. Mueller, 1786)		
Brachionus patulus var. macracanthus		+				(Daday, 1905)		
Brachionus plicatalis plicatalis		+				(O.F. Mueller, 1786)		
Brachionus plicatalis f. *rotundiformis*		+				(Tschugunoff, 1921)		
Brachionus plicatalis f. *longicornis*		+				(Fedeew, 1925)		
Brachionus quadridentatus quadridentatus		+				(Hermann, 1783)	*Brachionus quadridentatus quadridentatus*	Hermann, 1783
Brachionus quadridentatus f. *melheni*		+				(Barrois & Daday, 1894)		
Brachionus quadridentatus f. *brevispinus*		+				(Ehrenberg, 1832)		
Brachionus quadridentatus f. *rhenanus*		+				(Lauterborn, 1893)		
Brachionus quadridentatus var. *ancylognathus*		+				(Schmarda, 1859)		
Brachionus quadridentatus var. *cluniorbicularis*		+				(Skorikov, 1894)		
Brachionus quadridentatus mirabilis		+				(Daday, 1897)		
*Brachionus quadridentatus*zernovi		+				Voronkov, 1907		
Brachionus urceolaris		+				(O.F. Mueller, 1773)	*Brachionus urceolaris*	O.F. Mueller, 1773
Brachionus urceolaris var. *rubens*		+				(Ehrenberg, 1838)		
Brachionus urceolaris var. *sessilis*		+				(Varga, 1951)		
Brachionus urceolaris nilsoni		+				(Ahlstrom, 1940)		
Brachionus variabilis		+				Hempel, 1896		
Keratella cochlearis cochlearis		+				(Gosse, 1851)	*Keratella cochlearis cochlearis*	(Gosse, 1851)
Keratella cochlearis var. *tecta*		+				(Lauterborn, 1900)		
Keratella javana		+				Hauer, 1932		
Keratella lenzi lenzi		+				(Hauer, 1953)		
Keratella procurva procurva		+				(Thorpe, 1891)		
Keratella tropica tropica		+				(Apstein, 1907)	*Keratella tropica*	(Apstein, 1907)
Platyias quadricornis		+				(Ehrenberg, 1832)	*Platyias quadricornis*	(Ehrenberg, 1832)
Family Euchlanidae								
Beauchampiella eudactylota eudactylota		+				(Gosse, 1886)		
Dipleuchlanis propatula propatula		+				(Gosse, 1886)		
Dipleuchlanis propatula f. *macrodactyla*		+				(Hauer, 1965)		

Table 2. Cont'd.

Reported scientific name	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Authority**	**Currently accepted scientific name (Genus and lower) (6)**	**Authority for accepted name**
Euchlanis alata		+				Voronkov, 1912		
Euchlanis callysta		+				Myers, 1930		
Euchlanis contorta		+				Wulfert, 1939		
Euchlanis deflexa deflexa		+				(Gosse, 1851)		
Euchlanis dilatata dilatata		+				Ehrenberg, 1832		
Euchlanis dilatata f. *lucksiana*		+				Hauer, 1930		
Euchlanis incisa incisa		+				Carlin, 1939		
Euchlanis oropha		+				Gosse, 1887		
Family Mytilinidae								
Mytilina acanthophora		+				Hauer, 1938		
Mytilina bisulcata		+				(Lucks, 1912)		
Mytilina ventralis ventralis		+				(Ehrenberg, 1832)		
Family Trichotridae								
Macrochaetus collinsi collinsi		+				(Gosse, 1867)		
Macrochaetus sericus		+				(Thorpe, 1893)		
Trichotria pocillum		+				(O.F. Mueller, 1776)	*Trichotria pocillum*	(Müller, 1766)
Trichotria tetractis var. *similis*		+				(Stenroos, 1898)		
Family Colurellidae								
Colurella uncinata f. *bicuspidata*		+				(Ehrenberg, 1832)		
Lepadella apsicora		+				Myers, 1934		
Lepadella monodactyla f. *caudata*		+				(Koste, 1972)		
Lepadella ovalis		+				O.F. Mueller, 1786	*Lepadella ovalis*	(O.F. Muller, 1896)
Lepadella patella patella		+				O.F. Mueller, 1776		
Lepadella rhomboides rhomboides		+				Gosse, 1886		
Familly Lecanidae								
Lecane (*Lecane*) *arcula*		+				Harring, 1914	*Lecane* (*Lecane*) *arcuata*	(Bryce, 1891)
Lecane (*L.*) *aspasia*		+				Myers, 1917		
Lecane (*L.*) *crepida crepida*		+				Harring, 1914		
Lecane (*L.*) *curvicornis curvicornis*		+				(Murray, 1913)		
Lecane (*L.*) *curvicornis nitida*		+				(Murray, 1913)		
Lecane (*L.*) *doryssa*		+				Harring, 1914		
Lecane (*L.*) *hastata*		+				(Murray, 1913)	*Lecane* (*L.*) *hamata*	(Stokes, 1896)
Lecane (*L.*) *hornemanni*		+				(Ehrenberg, 1834)		
Lecane (*L.*) *inermis*		+				(Bryce, 1892)	*Lecane* (*L.*) *inermis*	(Bryce, 1892)
Lecane (*L.*) *leontina*		+				(Turner, 1893)		
Lecane (*L.*) *ludwigi ludwigi*		+				(Eckstein, 1893)		

Table 2. Cont'd.

Reported scientific name	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Authority**	**Currently accepted scientific name (Genus and lower) (6)**	**Authority for accepted name**
Lecane (*L.*) *luna luna*		+				(O.F. Mueller, 1776)		
Lecane (*L.*) *ohioensis*		+				(Herrick, 1885)		
Lecane (*L.*) *papuana*		+				(Murray, 1913)		
Lecane (*L.*) *pusilla*		+				Harring & Myers, 1914		
Lecane (*L.*) *saginata*		+				Harring & Myers, 1926		
Lecane (*L.*) *signifera ploenensis*		+				(Voigt, 1902)		
Lecane (*L.*) *cingulata ungulata*		+				(Gosse, 1887)		
Lecane (*L.*) *verecunda*		+				Harring & Myers, 1926		
Lecane (*Hemimonostyla*) *inopinata* f. *sympoda*		+				(Hauer, 1929)		
Lecane (*Monostyla*) *arcuata*		+				(Bryce, 1891)	*Lecane* (*Monostyla*) *arcuata*	(Bryce, 1891)
Lecane (*M.*) *bulla bulla*		+				(Gosse, 1886)		
Lecane (*M.*) *bulla diabolica*		+				(Hauer, 1936)		
Lecane (*M.*) *closterocerca closterocerca*		+				(Schmarda, 1859)		
Lecane (*M.*) *decipiens*		+				(Daday, 1913)	*Lecane* (*M.*) *decipiens*	(Murray, 1913)
Lecane (*M.*) *elachis*		+				Harring & Myers, 1926		
Lecane (*M.*) *lamellata thalera*		+				(Harring & Myers, 1926)		
Lecane (*M.*) *lunaris crenorta*		+				(Harring, 1913)		
Lecane (*M.*) *lunaris lunaris*		+				(Ehrenberg, 1832)		
Lecane (*M.*) *monostyla*		+				(Daday, 1897)		
Lecane (*M.*) *pyriformis*		+				(Daday, 1905)		
Lecane (*M.*) *stenroosi*		+				(Meissner, 1908)		
Lecane (*M.*) *unquitata unquitata*		+				(Fadeew, 1925)		
Family Proalidae								
Proales sp.		+				similar to Hauer's (1938)	*Proales* sp.	Gosse, 1886
Family Notommatidae								
Cephalodella gibba gibba		+				(Ehrenberg, 1838)		
Cephalodella tenuior tenuior		+				(Gosse, 1886)		
Eosphora anthadis		+				(Harring & Myers, 1922)		
Eosphora elongata		+				(Ehrenberg, 1832)		
Itura myersi		+				Wulfert, 1935		
Monommata aequalis		+				(Ehrenberg, 1832)		
Monommata maculata		+				Harring & Myers, 1924		
Monommata grandis		+				Tessin, 1890		
Notommata allantois		+				Wulfert, 1935		
Notommata copeus		+				Ehrenberg, 1834		
Notommata endoxa		+				Myers, 1933		

Table 2. Cont'd.

Reported scientific name	(1)	(2)	(3)	(4)	(5)	Authority	Currently accepted scientific name (Genus and lower) (6)	Authority for accepted name
Notommata saccigera		+				Ehrenberg, 1832		
Notommata tripus		+				Ehrenberg, 1838		
Scaridium longicaudum		+				(O.F. Mueller, 1786)		
Family Trichocercidae								
Trichocerca bicristata bicristata		+				(Gosse, 1887)		
Trichocerca cylindrica chattoni		+				(De Beauchamp, 1907)		
Trichocerca dixon-nuttali		+				(Jennings, 1903)		
Trichocerca elongata		+				(Gosse, 1886)		
Trichocerca elongata braziliensis		+				(Murray, 1913)		
Trichocerca flagella		+				Hauer, 1937		
Trichocerca jenningsis		+				Voigt, 1957		
Trichocerca myersi		+				(Hauer, 1931)		
Trichocerca pusilla		+				(Lauterborn, 1898)	*Trichocerca pusilla*	(Jennings, 1903)
Trichocerca rattus		+				(O.F. Mueller, 1776)	*Trichocerca rattus*	(Müller, 1776)
Trichocerca similis similis		+				(Wierzejski, 1893)		
Trichocerca stylata		+				(Gosse, 1851)	*Trichocerca stylata*	(Gosse, 1851)
Trichocerca tigris		+				(O.F. Mueller, 1786)		
Family Synchaetidae								
Ploesoma lenticulare		+				Herrick, 1885		
Polyarthra vulgaris vulgaris		+				Carlin, 1943		
Synchaeta pectinata		+				(Ehrenberg, 1832)	*Synchaeta pectinata*	Ehrenberg, 1832
Family Asplanchnidae								
Asplanchna brightwelli		+				Gosse, 1850	*Asplanchna brightwellii*	Gosse, 1850
Asplanchna girodi		+				(De Guerne, 1888)	*Asplanchna girodi*	De Guerne, 1888
Asplanchna sieboldi		+				(Leydig, 1856)		
Asplanchna multiceps		+				Schrank, 1793		
Harringia rousseleti		+				Herrick, 1885		
Family Dicranophoridae								
Dicranophorus caudatus caudatus		+				(Ehrenberg, 1834)		
Dicranophorus claviger		+				(Hauer, 1965)		
Dicranophorus epicharis		+				Harring & Myers, 1928		
Dicranophorus robustus		+				Harring & Myers, 1928		
Encentrum diglandula		+				(Zawodowski, 1926)		
Family Testudinellidae								
Pompholyx complanata		+				Gosse, 1851		
Pompholyx sulcata		+				Hudson, 1885	*Pompholyx sulcata*	Hudson, 1885

Table 2. Cont'd.

Reported scientific name	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**Authority**	**Currently accepted scientific name (Genus and lower) (6)**	**Authority for accepted name**
Testudinella parva		+				(Ternetz, 1892)		
Testudinella patina patina		+				(Hermann, 1783)		
Testudinella patina tribolata		+				(Anderson & Shepard, 1982)		
Testudinella tridentata curvata		+				(Wulfert, 1965)		
Family Floscularidae								
Conochilus dossuarius dossuarius		+				(Hudson, 1875)		
Conochilus dossuarius dossuarius var. coenobasis		+				(Skorikov, 1914)		
Hexarthra intermedia intermedia		+				Wisniewski, 1929		
Hexarthra mira		+				(Hudson, 1871)		
Limnias melicerta melicerta		+				Weisse, 1848		
Sinantherina spinosa		+				(Thorpe, 1893)		
Sinantherina procera		+				(Thorpe, 1893)		
Family Filinidae								
Filinia longiseta longiseta		+				(Ehrenberg, 1834)		
Filinia pejleri		+				Hutchinson, 1965		
Filinia terminalis		+				(Plate, 1886)		
Filinia opoliensis opoliensis		+				(Zacharias, 1898)		
Bdelloidea								
Rotaria rotaria		+				(Pallas, 1766)		
Rotaria neptunia		+				(Ehrenberg, 1832)		
Philodina sp.		+						
Dissotrocha sp.		+						

UNCTAD, 2012). We thus argue that a continuous monitoring of plankton communities in Singapore would be a great asset for the region. These long-term monitoring programs exist in other areas of the world and allow for continuous information on ecosystem response to environmental changes, which is especially needed in zones heavily industrialised and very sensitive to climate change events, such as Singapore.

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LITERATURE CITED

Behera MR, Chun C, Palani S & Tkalich P (2013) Temporal variability and climatology of hydrodynamic, water property and water quality parameters in the West Johor Strait of Singapore. Marine Pollution Bulletin, 77(1–2): 380–395.

Beraneck E (1895) Les chétognathes de la baie d'Amboine (voyage de MM. M. Bedot et C. Pictet dans l'archipel Malais). Revue Suisse de Zoologie et Annales du Musée d'Histoire naturelle de Genève, 3: 137–159.

Brady GS (1883) Report on the Copepoda collected by H.M.S. Challenger during the years 1873–1876. Report of the Scientific Results of the Voyage of H.M.S. Challenger (Zoology), 8: 1–142.

Brook BW, Sodhi NS & Ng PKL (2003) Catastrophic extinctions follow deforestation in Singapore. Nature, 424: 420–426.

Calbet A & Saiz E (2005) The ciliate-copepod link in marine ecosystems. Aquatic Microbial Ecology, 38: 157–167.

Chen & Zhang (1965) The planktonic copepods of the Yellow Sea and the East China Sea. I. Calanoida. Studia Marina Sinica, 7: 20–131, 53 pls [In Mandarin with English summary].

Chou LM & Chia LS (1991) The marine environment. In: Chia LS, Rahman A & Tay BH (eds.) The Biophysical Environment of Singapore. Singapore University Press for the Geography Teachers' Association of Singapore, Singapore. Pp. 155–184.

Chou LM (2006) Marine habitats in one of the world's busiest harbours. In: Wolanski E (ed.) The Environment in Asia Pacific Harbours, Springer, New York. Pp. 377–391.

Claus C (1866) Die Copepoden-Fauna von Nizza. Ein Beitrag zur Charakteristik der Formen und deren Abänderungen "im Sinne Darwin's". Schriften der Gesellschaft zur Beförderung der gesammten Naturwissenschaften zu Marburg, Supplement 1: 1–34.

Fernando & Ponyi (1981) The freeliving freshwater cyclopoid copepoda (crustacea) of Malaysia and Singapore. Hydrobiologia 78, 113–123.

Fernando CH & Zankai NP (1981) The Rotifera of Malaysia and Singapore with remarks on some species. Hydrobiologia, 78: 205–219.

Giesbrecht W (1893) Systematik und Faunistik der pelagischen Copepoden des Golfes von Neapel. Fauna Flora Golfes Neapel angrenzenden Meeresabschnitte, 19: 1–831.

Gin KYH, Lin X & Zhang S (2000) Dynamics and size structure of phytoplankton in the coastal waters of Singapore. Journal of Plankton Research, 22: 1465–1484.

Gin KYH, Zhang S & Lee YK (2003) Phytoplankton community structure in Singapore's coastal waters using HPLC pigment analysis and flow cytometry. Journal of Plankton Research, 25: 1507–1519.

Gollasch S, Lenz J, Dammer M & Andre H-G (2000) Survival of tropical ballast water organisms during a cruise from the Indian Ocean to the North Sea. Journal of Plankton Research, 22: 923–937.

Grassi GB (1881) I Chetognati. Fauna Flora Golfo Neapel Monografie V, 1-126.

Harris RP, Irigoien X, Head RN, Rey C, Hygum BH, Hansen BW, NiehoffB, Meyer-Harms B & Carlotti F (2000) Feeding growth and reproduction in the genus Calanus. ICES Journal of Marine Science, 57: 1708–1726.

Idris BAG & Fernando CH (1981) Cladocera of Malaysia and Singapore with records, redescriptions, and remarks on some species. Hydrobiologia, **77**: 233–256.

Lai HC & Fernando CH (1978) The freshwater calanoida (Crustacean: Copepod) of Singapore and Peninsular Malaysia. Hydrobiologia, 61: 113–127.

Low EW, Clews E, Todd PA, Tai YC & Ng PKL (2010) Top-down control of phytoplankton by zooplankton in tropical reservoirs in Singapore? The Raffles Bulletin of Zoology 58: 311–322.

Mauchline J (1998) The biology of calanoid copepods. Advances in Marine Biology, 33: 1–710.

Mori T (1940) Two new copepods from Japanese waters. Zoological Magazine (Dobutsugaku Zasshi), Tokyo, 52(8): 328–330, figs. 1-12.

Mulia IE, Tay H, Roopsekhar K & Tkalich P (2013) Hybrid ANN-GA model for predicting turbidity and chlorophyll-a concentrations. Journal of Hydro-environment Research, 7(4): 279–299

Myers N, Mittermeier RA, Mittermeier CG, da Fonseca GAB & Kent J (2000) Biodiversity hotspots for conservation priorities. Nature, 403: 853–858.

Nakajima R, Yoshida T, Othman BHR & Toda T (2008) Diel variation in abundance, biomass and size composition of zooplankton community over a coral-reef in Redang Island, Malaysia. Plankton & Benthos Research, 3: 216–226.

NEA (National Environment Agency) (2009) WEATHERWise Singapore, National Environment Agency, Singapore. http://app2.nea.gov.sg/data/cmsresource/20090721544571208250.pdf (Accessed 2011).

NASA (2013) Ocean Motion, Washington, USA. http://oceanmotion.org/ (Accessed 23 April 2013).

Nishida (1985) Taxonomy and distribution of the Family Oithonidae (Copepoda, Cyclopoida) in the Pacific and Indian Oceans. Bulletin of the Ocean Research Institute of the University of Tokyo, 20: 11–67.

Omori & Ikeda, 1984: Methods in Marine Zooplankton Ecology. John Wiley & Sons, New York, 332 pp.

Pang WC & Tkalich P (2003) Modeling tidal and monsoon driven currents in the Singapore Strait. Singapore Maritime & Port Journal, 2003: 151–162.

Pham MN, Tan HTW, Mitrovic S & Yeo HHT (2011) A Checklist of the Algae of Singapore. Raffles Museum of Biodiversity Research, National University of Singapore, Singapore, 100 pp.

Razouls C., de Bovée F., Kouwenberg J. et Desreumaux N., 2005–2012. – Diversity and Geographic Distribution of Marine Planktonic Copepods. Available at http://copepodes.obs-banyuls.fr/en [Accessed 23 January 2013]

Rezai, H., F. M. Yusoff, A. Arshad, Kawamura A, Nishida S & Othman Bin HJ Ross (2004) Spatial and temporal distribution of Copepods in the Straits of Malacca. Zoological Studies, 43: 486–497.

Saiz E & Calbet A (2011) Copepod feeding in the ocean: scaling patterns, composition of their diet and the bias of estimates due to microzooplankton grazing during incubations. Hydrobiologia, 666: 181–196.

Sewell SRB (1914) Notes on the surface Copepoda of the Gulf of Mannar. Spolia Zeylanica, 9: 191–262.

Sewell SRB (1933) Note on a small collection of marine copepods from the Malay States. Bulletin of the Raffles Museum, Singapore, 8: 25–31.

Steuer A (1915) Revision der Gattung Acartia Dana. Zoologischer Anzeiger, 45: 392–397.

Tham AK (1953) The plankton calendar of Singapore Straits with suggestions for a simplified methodology. Marine Biological Association of India, Special Issue: 60–73.

Tham AK (1973) Seasonal distribution of the plankton in Singapore Straits.In: Marine Biological Association of India (MBAI) Special Publication dedicated to Dr.N K Panikkar (1), Kochi, India. Pp. 60–73.

Thia-Eng C (1973) An ecological study of the Punggol estuary in Singapore. Hydrobiologia, 43: 505–533.

UNCTAD (2012) United Nation Conference on Trade and Development. Review of Maritime Transport. United Nation Publication, Geneva, Switzerland, 176 pp.

Wickstead JH (1958) A survey of the larger zooplankton of Singapore Straits. Ices Journal of Marine Science, 23(3): 340–353

Yeo DCJ, Ng PKL, Corlett RT & Tan HTW (2011) Threats to Singapore Biodiversity. In: Ng PKL, Corlett R & Tan HTW (eds.) Singapore Biodiversity: An Encyclopedia of the Natural Environment and Sustainable Development, Editions Didier Millet, Singapore. Pp 96–105.