

Biodiversity Record: Fishes and other marine life observed among flotsam at Marina South

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Subjects: Tigertail seahorse, *Hippocampus comes* (Teleostei: Syngnathiformes: Syngnathidae), Fig. 3;
Great barracuda, *Sphyraena barracuda* (Teleostei: Carangiformes: Sphyraenidae), Fig. 4;
African pompano, *Alectis ciliaris* (Teleostei: Carangiformes: Carangidae), Fig. 5;
Needlefish, *Tylosurus* sp. (Teleostei: Beloniformes: Belonidae), Figs. 6 & 7;
Viviparous halfbeak, *Zenarchopterus* sp. (Teleostei: Beloniformes: Zenarchopteridae), Fig. 7;
Sailfin flying fish, *Parexocoetus* sp. (Teleostei: Beloniformes: Exocoetidae), Fig. 8;
Telkara glass perchlet, *Ambassis vachellii* (Teleostei: Mugiliformes: Ambassidae), Fig. 9;
Mullet, undetermined genus & species (Teleostei: Mugiliformes: Mugilidae), Fig. 10;
Variable fang-blenny, *Petroscirtes variabilis* (Teleostei: Blenniiformes: Blenniidae), Fig. 11;
Barred soapfish, *Diploprion bifasciatum* (Teleostei: Perciformes: Liopropomatidae), Fig. 12;
Largescale terapon, *Terapon theraps* (Teleostei: Centrarchiformes: Terapontidae), Fig. 13;
Longfin batfish, *Platax teira* (Teleostei: Acanthuriformes: Ephippidae), Fig. 14;
Silver moony, *Monodactylus argenteus* (Teleostei: Acanthuriformes: Monodactylidae), Fig. 15;
Tripletail, *Lobotes surinamensis* (Teleostei: Acanthuriformes: Lobotidae), Fig. 16;
Feathery filefish, *Chaetodermis penicilligerus* (Teleostei: Tetraodontiformes: Monacanthidae), Fig. 17;
Strapweed filefish, *Pseudomonacanthus macrurus* (Teleostei: Tetraodontiformes: Monacanthidae), Fig. 18;
Starry pufferfish, *Arothron stellatus* (Teleostei: Tetraodontiformes: Tetraodontidae), Fig. 19;
Sea-jelly, undetermined genus & species, (Cnidaria: Rhizostomeae: Mastigiidae), Fig. 20;
Sundaic paddler crab, *Varuna yui* (Arthropoda: Crustacea: Decapoda: Grapsidae), Fig. 21;
Golden bristle-worm, *Chloeia* sp. (Annelida: Polychaeta: Amphinomididae), Fig. 22;
Giant sea-hare, *Aplysia extraordinaria* (Mollusca: Gastropoda: Anaspidea: Aplysiidae), Fig. 23.

Subjects identified by: Jiayuan Lin (fishes and polychaete), Ong JunXiang Lumin (fishes, sea-jelly and polychaete), Tay Jing Xuan (fishes and polychaete), Tan Heok Hui (fishes and crab), Kelvin K. P. Lim (seahorse), Ng Yu Fei and Zick Soh Shun Hua (sea hare).

Location, dates and times: Singapore Island, Marina South beneath the Marina Coastal Expressway (area part of the Singapore Strait along the reclaimed southern coastline of Singapore Island); 30 May 2024, 1547–1720 hrs; 1 June 2024, 1530–1901 hrs; 2 June 2024, 1617–1634 hrs.

Habitat: Marine. Among massive concrete structures in an urban marine environment, during rising tides; in sunny weather (30 May 2024), under cloudy skies after rain (1 June 2024), and under an overcast sky during light rain (2 June 2024). The dense stretch of flotsam accumulated along a stretch of artificial concrete seawall was around 50 m (Figs. 1 & 2). Concentrated debris consisted of organic and inorganic materials. Organic materials included fruits and seeds, dead leaves and twigs, pieces of wood, and carcasses of dead animals. Man-made waste included plastic bags, straws and bottles, pieces of Styrofoam, rubber soles and tyres, and pieces of cardboard. The floating field of debris was not a persistent feature at the location, being present only during rising and high tides.

Observers: Jiayuan Lin on 30 May 2024. Ong JunXiang Lumin and Tay Jing Xuan on 1 June 2024. Tan Heok Hui on 2 June 2024.

Observations: Fauna was noted by the observers from a walkway along the top of the seawall from a height of about 4 m. Their images were recorded on cameras equipped with telephoto lenses. Fifteen species of fish and four large invertebrates were observed amongst the debris. Although unlikely to be associated with the debris, floating carcasses of two species of fish are also included.



Fig. 1. The dense stretch of flotsam on 1 June 2024 (Photograph by: Ong JunXiang Lumin). Fig. 2. Flotsam accumulating along the seawall on the left, on 2 June 2024 (Photograph by: Tan Heok Hui). Fig. 3. Dorso-lateral view of a *Hippocampus comes* (arrow) of about 3 cm head length among *Terapon theraps* on 2 June 2024 (Photograph by: Tan Heok Hui). Fig. 4. Lateral view of a dead *Sphyrna barracuda* of about 1 m TL on 30 May 2024 (Photograph by: Jiayuan Lin). Fig. 5. Dorsal view of three of the four juvenile *Alectis ciliaris*, each about 15 cm total length (from tip of snout to tip of caudal fin, not including dorsal and anal fin ray filaments) on 1 June 2024 (Photograph by: Ong JunXiang Lumin). Fig. 6. Dorso-lateral view of a juvenile *Tylosurus* sp. of about 8 cm TL on 1 June 2024 (Photograph by: Ong JunXiang Lumin). Fig. 7. Dorso-lateral view of another juvenile needlefish (indicated by arrow) among a small shoal of *Zenarchopterus* which possibly comprised more than one species, on 1 June 2024 (Photograph by: Tay Jing Xuan).

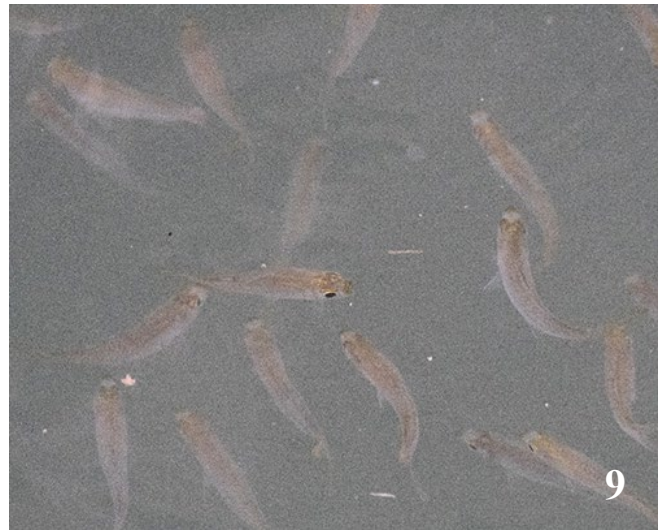


Fig. 8. Dorsal view of four juvenile *Parexocoetus* sp., the larger ones of about 2 cm total length each, on 1 June 2024 (Photograph by: Tay Jing Xuan). Fig. 9. A shoal of *Ambassis vachellii*, each individual about 5 cm TL (Photograph by: Ong JunXiang Lumin). Fig. 10. Dorsal view of an undetermined genus & species of mullet, juvenile of about 2.5 cm TL, on 1 June 2024 (Photograph by: Ong JunXiang Lumin). Fig. 11. Two adult *Petrosirtes variabilis*, each about 10 cm TL, interacting with each other on 2 June 2024 (Photograph by: Tan Heok Hui). Fig. 12. Lateral view of an adult *Diploprion bifasciatum*, about 15 cm TL, inspecting a juvenile *Lobotes surinamensis* (Photograph by: Ong JunXiang Lumin). Fig. 13. Dorso-lateral view of a shoal of *Terapon theraps*, the larger individuals around 6 cm TL (Photograph by: Ong JunXiang Lumin).

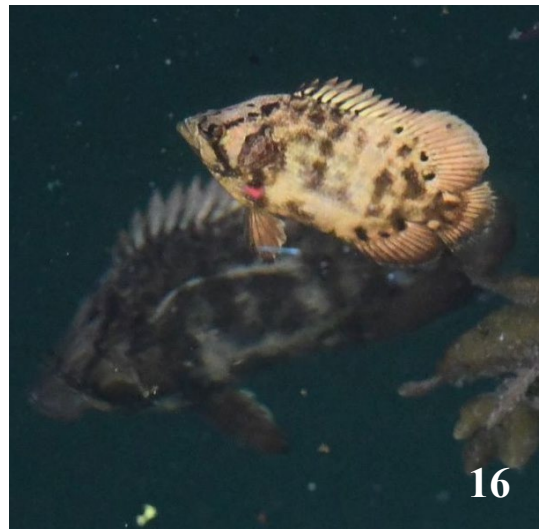


Fig. 14. Dorso-lateral view of a *Platax teira* of about 8 cm TL (Photograph by: Ong JunXiang Lumin). Fig. 15. Dorsal view of a juvenile *Monodactylus argenteus* of about 3 cm TL on 1 June 2024. Note its bright orange dorsal fin (Photograph by: Ong JunXiang Lumin). Fig. 16. Dorso-lateral view of two *Lobotes surinamensis* on 2 June 2024. Note the large individual (possibly over 20 cm TL) deeper in the water column (Photograph by: Tan Heok Hui). Fig. 17. Dorsolateral view of a *Chaetodermis pencilligerus* of about 6 cm TL (Photograph by: Ong JunXiang Lumin). Fig. 18. Dorsal view of a *Pseudomonacanthus macrurus* of about 6 cm TL (Photograph by: Tay Jing Xuan). Fig. 19. Rear ventral view of the dead *Arothron stellatus* of about 30 cm TL floating on the water on 1 June 2024. Note the black blotch on the anus and black spots on the side that are diagnostic for the species (Photograph by: Ong JunXiang Lumin). Fig. 20. Lateral view of one of several mastigiid sea-jellies of about 15 cm in bell diameter (Photograph by: Ong JunXiang Lumin).



Fig. 21. Dorsal view of a *Varuna yui* of about 7 cm carapace width swimming at the water surface (Photograph by: Ong JunXiang Lumin). Fig. 22. Dorsal view of one of two *Chloeia* sp. of about 10 cm total length swimming at the water surface on 1 June 2024 (Photograph by: Ong JunXiang Lumin). Fig. 23. Dorso-lateral view of an *Aplysia extraordinaria* of about 12 cm total length among the flotsam on 1 June 2024 (Photograph by: Ong JunXiang Lumin).

Fishes: 1) *Hippocampus comes* – One photographed on 2 June 2024 suspended motionless at the water surface (Fig. 3) among *Terapon theraps*, and only noticed when the photographs were being reviewed. 2) *Sphyræna barracuda* – A dead example of about one metre total length observed floating among the debris (Fig. 4), decomposing over 30 May 2024 to 1 June 2024, before disappearing by 2 June 2024. 3) *Alectis ciliaris* – Four juveniles observed on 1 June 2024 (Fig. 5). 4) *Tylosurus* sp. – Two juveniles observed on 1 June 2024 (Fig. 6), one among a small shoal of *Zenarchopterus* (Fig. 7). 5) *Zenarchopterus* sp. – Dozens present during all three observations. From the body markings, there could be more than one species (Fig. 7). 6) *Parexocoetus* sp. – Eight to ten juveniles observed on 1 June 2024 (Fig. 8). 7) *Ambassis vachellii* – Dozens present on all three observations (Fig. 9). 8) Undetermined genus & species of Mugilidae – Four or five juveniles observed only on 1 June 2024 (Fig. 10). 9) *Petroscirtes variabilis* – One to three seen on all three occasions (Fig. 11). 10) *Diploprion bifasciatum* – Ten to 15 seen on all three occasions. Large individuals observed stalking prey concealed among the garbage, such as juvenile *Lobotes surinamensis* (Fig. 12). They also pursued active swimmers such as *Terapon theraps* and *Ambassis vachellii*. 11) *Terapon theraps* – Dozens present on all three observations (Fig. 13). 12) *Platax teira* – Two to three juveniles (Fig. 14) observed on both 30 May 2024 and 1 June 2024. 13) *Monodactylus argenteus* – Two to three observed only on 1 June 2024 (Fig. 15). 14) *Lobotes surinamensis* – Dozens of juveniles encountered on all three observations (Fig. 16). 15) *Chaetodermis penicilligerus* – Four to six individuals sighted on all three occasions (Fig. 17). 16) *Pseudomonacanthus macrurus* – Four to six seen on all three occasions (Fig. 18). 17) *Arothron stellatus* – A carcass of about 30 cm total length noted on 1 June 2024 (Fig. 19) floating among debris.

Invertebrates: 1) Undetermined genus & species of sea-jelly – Five to eight individuals observed on all three occasions (Fig. 20). 2) *Varuna yui* – Three to five individuals recorded during all three observations (Fig. 21). 3) *Chloeia* sp. – Two individuals observed only on 1 June 2024 (Fig. 22). 4) *Aplysia extraordinaria* – One example observed only on 1 June 2024 (Fig. 23).

Remarks: This may be the first documentation of macro-fauna amongst marine flotsam in Singapore. In marine water bodies, wave motions and surface currents such as the Stokes Drift (Kubota, 1994; Van Sebille et al., 2020) and Langmuir Circulation (Chen et al., 2019; Machu et al., 2023) are known to result in aggregation of floating debris such as plastics. Such factors likely caused the formation of the dense patch of floating debris at Marina South.

This record reveals a significant diversity of fauna among debris, especially ray-finned fishes, some of which (e.g., *Lobotes surinamensis*) are uncommon in Singapore (Jiayuan Lin, pers. obs.). Juvenile *Lobotes surinamensis*, *Zenarchopterus* sp., *Tylosurus* sp., *Terapon theraps*, *Petroscirtes variabilis*, *Platax teira*, *Parexocoetus* sp., *Chaetodermis penicilligerus* and *Pseudomonacanthus macrurus* are known to associate with floating objects (see Kingsford, 1993; Dempster & Kingsford, 2004; Bilecenoglu & Kaya, 2006; Casazza & Ross, 2008; Lewallen et al., 2011; Ranjan et al., 2017; Kanou et al., 2019) in order to avoid predators (Mitchell & Hunter, 1968) and for improved feeding opportunities (Gooding & Magnuson, 1967). Some fish could have taken shelter among the debris when in deeper waters, and subsequently drifted inshore with the debris. This seems likely for *Lobotes surinamensis*, which in Singapore is rarely found away from floating debris or sargassum (Jiayuan Lin, pers. obs.). The flying fish (*Parexocoetus* spp.) are epipelagic and typically reproduce in offshore waters, with certain species producing eggs with filamentous extensions that attach to floating debris (Tsukahara, 1959; Lewallen et al., 2011).

Already present in inshore waters and possibly inhabiting nearby reefs, or already living around the seawalls, fishes such as *Hippocampus comes*, *Tylosurus* sp., *Zenarchopterus* sp., *Ambassis vachellii*, mullets, *Petroscirtes variabilis*, *Diploprion bifasciatum*, *Terapon theraps*, *Monodactylus argenteus*, *Chaetodermis penicilligerus* and *Pseudomonacanthus*

macrurus likely congregated around the debris due to the availability of shelter and the abundance of smaller fish and other food items present among the flotsam. The same likely applies to the four species of invertebrates, although the appearances of the sea-jelly and sea-hare are possibly seasonal.

Alectis ciliaris is a pelagic fish with adults inhabiting deeper waters, while juveniles often enter coastal waters (Cervigón et al., 1992; Smith-Vaniz, 2003). Jiayuan Lin had previously observed juveniles at the locality without flotsam. Although these fish do appear to gain shelter from the floating debris, it is believed that these do not influence their presence.

Sphyrna barracuda and *Arothron stellatus* are largely associated with reefs (see Tan, 2011; Daly-Engel et al., 2012) and unlikely to be living among flotsam. Both species occur in Singapore waters, and the two carcasses encountered are likely to have originated locally. While the cause of death could not be determined, gas buildup in their abdominal cavities from decomposition caused them to float and get washed inshore together with the debris.

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