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First record of *Hippocampus trimaculatus* Leach, 1814 (Teleostei: Syngnathidae) from Sri Lanka —with a note on natural history and trade

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ABSTRACT

Here, we report a new distributional record of the Three-Spot Seahorse, *Hippocampus trimaculatus*, in the Indian Ocean, which represents the first record from Sri Lankan waters, specifically from Madiha on the southern coast of the island (caught ~150–200 km offshore). Examination of four dried specimens (one male and three females), including morphometric and meristic counts, confirms the diagnosis: the presence of a sharp, 'hook-like' prominent cheek spine and eye spine; absence of a nose spine; a very low coronet with five short, pointed spines; 11 trunk rings; 39 tail rings (in all undamaged specimens); head length to snout length (HL/SnL) ratio of 2.20 (± 0.02) distinguishes this species from all other congeners recorded in the region. Additionally, an unusual natural history is documented —seahorses dwelling in clumps of drifting marine debris in the open ocean. Additionally, we provide insights into the local illegal trade, along with a discussion of related issues.

Keywords: Seahorses, Sri Lanka, *Hippocampus*, Indian Ocean, Southern coast, Illegal trade

1. INTRODUCTION

Seahorses belonging to the genus *Hippocampus* Rafinesque, 1810, are a major group of the family Syngnathidae and represent a unique group of marine teleosts, which have odd characteristics that differ from other bony fishes, i.e., atypical morphology of upright swimming, monogamous pair bonding, a brood pouch, and unique parental care in males (Bell & Vincent, 2000; Lourie, 2016). About eight valid species are known to inhabit South East Asia, including the Indian Ocean (Project Seahorse, 2015, 2016). In Sri Lanka, however, only two seahorse species have been confirmed to date. These include *Hippocampus kuda* (Bleeker, 1852) and *Hippocampus spinosissimus* Weber, (1913), as reported by Lourie et al. (2004), Kumara (2012), Long et al. (2010), and more recently by Perera et al. (2017), both species from the Puttalam Lagoon in the northwestern region of the island with abundant seagrass. (What authors referred to as *Hippocampus fuscus* Rüppell, 1838, is now recognized as a junior synonym of *H. kuda*). However, considering the broad distribution and verified records from geographically proximate areas, Lourie et al. (2004) suggested that three additional

species are likely to occur in Sri Lankan waters. These include *Hippocampus histrix* Kaup, 1856, *Hippocampus kelloggi* Jordan & Snyder, 1901, and *Hippocampus trimaculatus* Leach, 1814—all of which have been recorded from regions spanning from Australia and Peninsular Malaysia to the shallow seas of the Indian Ocean and southern India (Gulf of Mannar, Kerala, Tamil Nadu) (Thangaraj et al., 2012; Behera et al., 2023; Lipton & Thangaraj, 2013; Bijukumar et al., 2008).

Due to their striking appearance, there is high demand for seahorses in the aquarium trade, and culturally, mainly dried specimens are supplied for use in traditional Chinese medicine. Thus, both live and dried seahorses are collected and smuggled (Lourie et al., 2004). The high threat intensity posed by collectors, combined with other threats such as rapid habitat loss and their sporadic distribution patterns, makes conservation a priority. Most seahorse species are considered Vulnerable (VU) or Endangered (EN) by the International Union for Conservation of Nature (IUCN) Red List (Baillie et al., 2004) and are protected under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (CITES, 2003). Even so, the trade still manages to bypass gaps in legislative enforcement. Therefore, verified records of occurrence and trade are important for diplomatic policymaking efforts in conservation initiatives (see Foster et al., 2025). Sri Lanka, especially as a continental island situated in the Indian Ocean, is strategically important for monitoring and tracking the species trade in the region.

With this background, during a study on marine teleosts along the southern coast of Sri Lanka, and as a result of inquiries with the local fishing community, we were able to examine four dried, unidentified seahorse specimens in their possession on two separate occasions (in March 2024 and June 2025), which had been caught off the southern coast of the island during multi-day fishing trips. It was immediately apparent that the species did not match the descriptions of either of the two previously confirmed seahorse species found in Sri Lanka. Following detailed examination, we present confirmation and evidence of the first recorded occurrence of the Vulnerable (VU) endangered species (Wiswedel, 2015) Three-Spot Seahorse, *Hippocampus trimaculatus*, in Sri Lankan waters (what we phrase as 'Sri Lankan waters' refers to the maritime zone administered by Sri Lanka). This is also the first authentic record of a seahorse species along the southern coast of the island, where prior occurrence reports are almost exclusively from the northern regions, including the Gulf of Mannar. Moreover, this paper also discusses noteworthy reports on the species' natural history and the local illegal trade, —information we believe may be invaluable for future conservation efforts.

2. MATERIAL AND METHODS

All dead, dried specimens were collected from the Madiha coast in the Southern Province of Sri Lanka (GPS coordinates: 5.9365° N, 80.51586° E), provided by informants from the local fishing community, and were acquired through the local trade. They were reportedly caught ~150–200 km offshore from Mirissa Harbor (Figure 1). Specimen MD0624M was collected on 26 March 2024, while the three other specimens, MD0621F, MD0622F, and MD0623F, were collected on 1 June 2025.

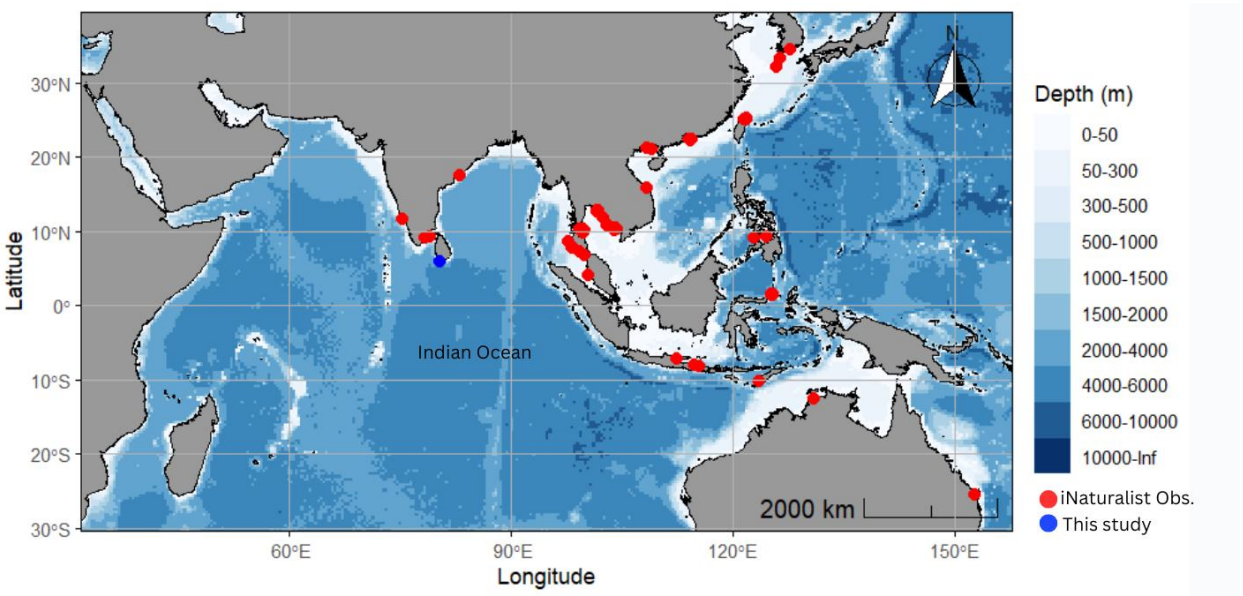

Figure 1. Known distribution of *Hippocampus trimaculatus* with the current study site indicated. Red dots: confirmed research-grade observations (n = 76) of the species from iNaturalist. Blue dot: study site location (Madiha coast, Southern Sri Lanka).

The specimens were photographed on-site, and species identification was carried out using simplified field guides and keys for Southeast Asian seahorses provided by Project Seahorse (https://projectseahorse.org) (Project Seahorse, 2015, 2016) and Lourie et al. (2004). Morphological characteristics and meristic data were recorded following the methods outlined in Lourie (2003) and Lourie et al. (2004, 2016), using a digital vernier caliper to the nearest 0.01 mm, except for height (Ht), which was measured using a piece of string and a ruler to the nearest 1 mm, as recommended by Lourie et al. (2004), due to the wrinkled condition of the specimens' tails. Abbreviations used for morphometric and meristic counts are as follows: Standard Length (SL), Height (Ht), Head Length (HL), Snout Length (SnL), Trade Height (TH), Trunk Length (TrL), Tail Length (TaL), Head Depth (HD), Snout Depth (SnD), Coronet Height (CH), Width between Trunk Rings 4–5 (TD4), Width between Trunk Rings 9–10 (TD9), Trunk Rings (TrR), Tail Rings (TaR), and Total Rings (TR).

Specimens were closely examined under a stereo-microscope at 10×, 16×, and 40× magnifications. Additionally, the distributional records and occurrence data for *Hippocampus trimaculatus* in the Indian Ocean were obtained from the iSeahorse/iNaturalist (iNaturalist, 2025) web-explorer and Oceanic Biodiversity Information System (OBIS) databases (following Charles et al 2024).

This study is based on four deceased specimens collected from a fishing community in the southern coastal region of Sri Lanka. Therefore, no ethical guidelines have been violated, and ethical approval is not applicable in this case.

3. RESULTS

3.1. Diagnosis

All examined specimens were identified as *Hippocampus trimaculatus* Leach, 1814, based on external morphological characters following the identification guide by Lourie et al. (2004), and confirmed by field expert Miguel Correia (IUCN SSC SPS SG, Project Seahorse) (Pers.Com). General body shapes and sizes as shown in Fig. 2. Morphometric, meristic, and morphological characters are detailed in Table 1 and relative measurements are presented in Table 2. Sex was determined by the presence or absence of brood pouch remains, which were clearly visible in all specimens. Females: MD0621F, MD0622F, and MD0623F; male: MD0624M.

Distinct backward-pointing, 'hook-like' cheek spine pair; 'hook-like' eye spine pair (see white arrowheads, Fig. 2e); nose spine absent; coronet very low, in line with arch of neck, with five short, pointed spines; head narrow; two trunk rings and one tail ring supporting the dorsal fin; 11 trunk rings; 39 tail rings in all specimens except MD0624M, which had a damaged tail with only 29 visible tail rings; 50 total body rings in all undamaged specimens; dorsal, (slightly raised) low spines; Head length to Snout length (HL/SnL) ratio (excluding MD0624M due to damages): mean 2.20 (SD = 0.02). Dorsal and pectoral fin ray counts could not be determined due to the dried condition of the material.

3.2. Color

Dried specimens were pale-yellow (See Figure 2) color. The characteristic pigmentation pattern of three distinct dark spots, iconic to the species, was not observed in these specimens.

3.3. Material

MD0621F, female, 99.77 mm SL; MD0622F, female, 99.80 mm SL; MD0623F, female, 113.18 mm SL; MD0624M, male, 106.56 mm SL. All specimens collected from Madiha coast, southern Sri Lanka (5.9365° N, 80.51586° E), Janamina Bandara. Specimens are deposited in the marine fish collection of the Faculty of Fisheries and Marine Sciences & Technology, University of Ruhuna, Matara, Sri Lanka.

4. DISCUSSION

4.1. Comparative remarks

The presence of a single pair of 'hook-like', sharp cheek spines and a single pair of flat 'hook-like' eye spines—key diagnostic features characteristic of *Hippocampus trimaculatus*—clearly distinguishes these specimens from all other congeners recorded in the region (Lourie et al., 2004; Correia, Pers. Com.). For comparison: *H. kuda* typically exhibits a blunt, rounded bump as a cheek spine; *H. kelloggi* has blunt-tipped, rounded eye spines; *H. fuscus* shows only rudimentary, low spines; and *H. spinosissimus* may have well-developed but blunt single or double cheek spines. None of these species possess the distinct "hook-like" sharp cheek or eye spines seen in our specimens (see Lourie et al., 2004). Therefore, even if some meristic features do not perfectly align with published descriptions (though in our case they do), it remains evident that the species is indeed *H. trimaculatus*.

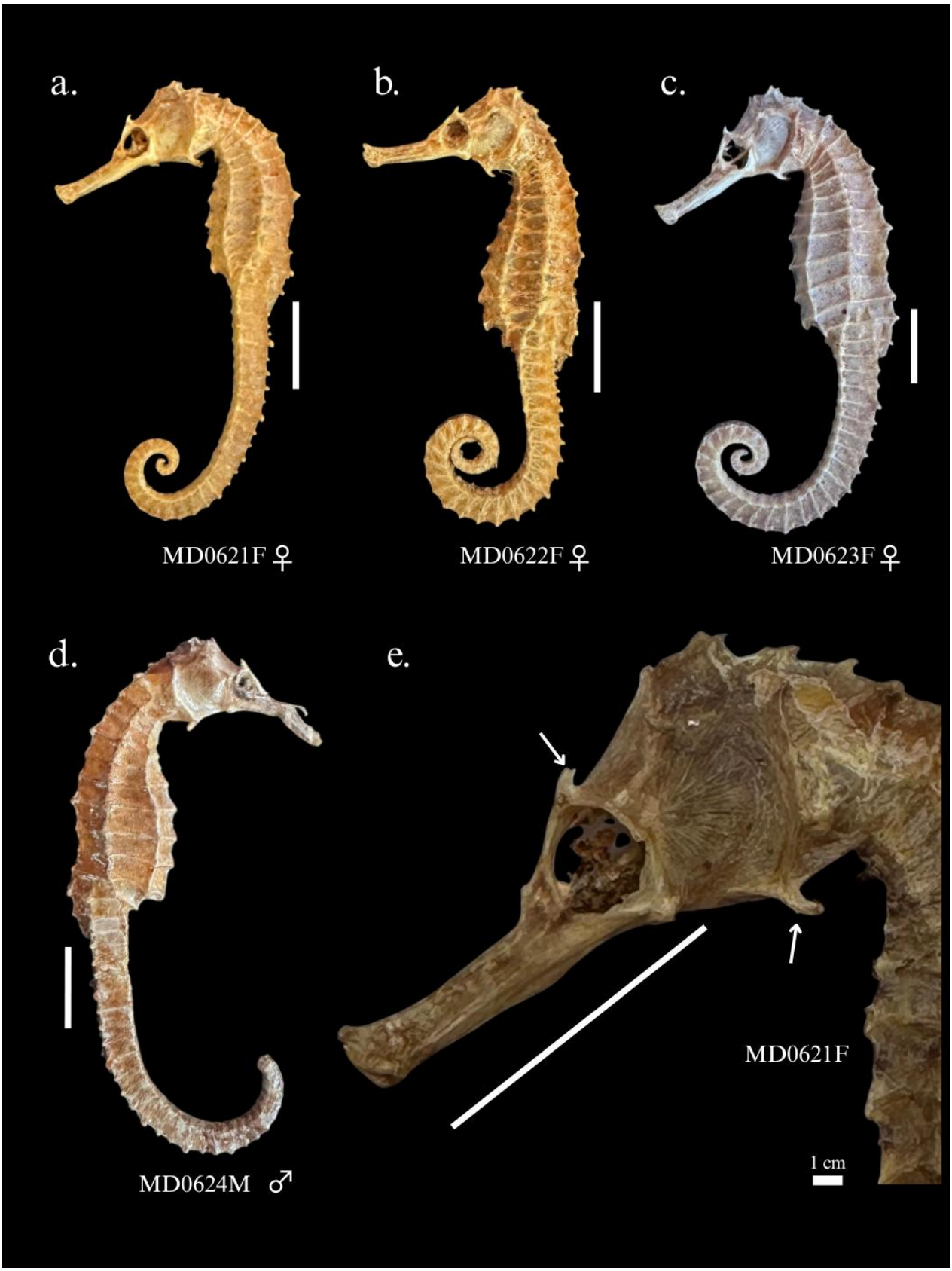

Figure 2. *Hippocampus trimaculatus* specimens examined (Scale bar = 1 cm). **(a)** MD0621F, female, 99.77 mm SL; **(b)** MD0622F, female, 99.80 mm SL; **(c)** MD0623F, female, 113.18 mm SL; **(d)** MD0624M, male, 106.56 mm SL; **(e)** Enlarged view of head of MD0621F, with white arrowheads indicating distinct "hook-like" sharp cheek spine and eye spine.

Table 1. Morphometric measurements and meristic counts of the examined *Hippocampus trimaculatus* specimens with mean values (mean ± standard deviation (S.D)). Note: Due to damage to the MD0624M, it was not included in the calculation of the mean and S.D. values.

	Male (n=1)	Female (n=3)	Mean (± S.D)
Morphometric measurements:			
Standard Length (mm)	106.56	99.77-113.28	104.28 (± 7.79)
Height (cm)	8.9	8.2-9.5	8.7 (± 0.7)
Head length (mm)	17.56	15.8-18.28	17.28 (± 1.31)
Snout length (mm)	9.01	7.25-8.22	7.86 (± 0.53)
Trade Height	38.03	27.85-33.6	30.39 (± 2.93)
Trunk length (mm)	34.33	24.82-30.23	26.78 (± 3.00)
Tail length (mm)	54.67	57.18-64.77	60.22 (± 4.01)
Coronet height (mm)	1.60	1.27-1.78	1.55 (± 0.26)
Head depth (mm)	7.39	6.19-7.82	6.86 (± 0.85)
Snout depth (mm)	2.54	1.61-1.89	1.76 (± 0.14)
Trunk width 4 (mm)	9.73	7.12-8.36	7.54 (± 0.71)
Trunk width 9 (mm)	11.65	8.79-11.23	10.02 (± 1.22)
Meristic counts:			
Trunk rings (TrR)	11	11	
Tail rings (TaR)	29	39	
Total rings (TR)	40	50	
Trunk rings supporting dorsal fin	2	2	
Tail rings supporting dorsal fin	1	1	
Cheek spine pairs	1	1	
Eye Spine pairs	1	1	
Nose spine	0	0	
Coronet spines	5	5	

Table 2. Relative measurements (ranges & mean values) of *Hippocampus trimaculatus* specimens examined (n = 4; male: MD0624M; females: MD0621F, MD0622F, MD0623F). The MD0624M specimen was excluded from the calculation of mean and standard deviation (S.D.) values due to damages. Refer to Table S1 for individual morphometric measurements and meristic counts. Abbreviations are defined in the Methodology section.

	Male (n=1)	Female (n=3)	Mean (± S.D)
Standard length (mm)	106.56	99.77-113.28	104.28 (± 7.79)
HL/SnL	1.95	2.18-2.22	2.20 (± 0.02)
% of SL			
Height	83.41	82.19-84.14	83.41 (± 1.07)
Head length	16.59	15.83-17.81	16.59 (± 1.07)
Snout length	7.55	7.26-8.13	7.55 (± 0.50)
Trade Height	29.11	27.91-29.77	29.11 (± 1.04)
Trunk length	25.63	24.88-26.69	25.63 (± 0.94)
Tail length	57.78	57.18-57.18	57.78 (± 0.92)
% of HL			
Snout length	45.50	44.97-45.89	45.50 (± 0.48)
Head Depth	39.62	36.92-42.78	39.62 (± 2.96)
Snout depth	10.18	10.02-10.34	10.18 (± 0.16)
Coronet height	8.91	8.04-9.74	8.91 (± 0.85)

% of HD			
Coronet height	22.51	20.52-24.24	22.51 (± 1.87)
% of SnL			
Snout depth	22.38	21.95-22.99	22.38 (± 0.54)
% of TrL			
Trunk width 4	28.20	27.65-28.77	28.20 (± 0.56)
Trunk width 9	37.41	35.41-39.68	37.41 (± 2.14)

Two seahorse species whose external morphology is somewhat similar to *H. trimaculatus* are *H. fisheri* (from Hawaii) and *H. zebra* (from Australia), neither of which has been recorded from the Indian Ocean (Lourie et al., 2004). However, the spines differ: *H. fisheri* has double cheek and eye spines (vs. single spines in *H. trimaculatus*), possesses a prominent nose spine which *H. trimaculatus* lacks, a hook spine in front of the coronet, and differences in tail ring counts and fin rays. In *H. zebra*, cheek spines are absent (vs. one pair in *H. trimaculatus*), and it has fewer tail rings, fewer dorsal fin rays, and a higher coronet, which *H. trimaculatus* lacks (Lourie et al., 2004; 2016).

Our morphometric data and meristic counts fall squarely within the ranges reported by Lourie et al. (2004, 2016). For instance, the head length to snout length (HL/SnL) ratio reported by Lourie et al. is 2.2 (range: 1.9–2.4). Our calculated mean HL/SnL ratio was exactly 2.20 (S.D. = 0.02, n = 3), with individual values ranging from 2.18 to 2.22. Although the damaged specimen MD0624M was excluded from the calculation, it still showed a ratio of 1.95, which falls within the reported range (see Table 1). The standard lengths (SL) of our specimens averaged 104.28 mm (S.D. = 7.79, excluding MD0624M), which is nearly identical to the mean SL reported by Bijukumar et al. (2008) for female *H. trimaculatus* from the southwest coast of India (108.50 mm, S.D. = 5.80, n = 20). However, our specimens appeared slightly smaller than those reported by Shapawi et al. (2015) from Malaysia, where dried female specimens had a mean SL of 167.50 mm (S.D. = 10.51, n = 16). Meristic characters: All our undamaged specimens had 11 trunk rings (TrR), consistent with descriptions by Lourie et al. (2004), and 39 tail rings (TaR)—values that align with those reported by Bijukumar et al. (2008) and Lipton & Thangaraj (2013) for populations from southern India. Some individuals from other regions, such as those documented by Zhou et al. (2021), have been reported with 40–41 tail rings. This is not considered an anomaly, as Lourie et al. (2016) discuss variation in TaR counts across populations, which typically range between 38-43. Overall, the relative measurements presented by Bijukumar et al. (2008) and Lipton & Thangaraj (2013) for *H. trimaculatus* from the southern coast of India are comparable to the morphometrics listed in Table 2, with only slight variations. Therefore, we consider it reasonable to conclude that the specimens identified in this study as *H. trimaculatus* closely match both the species descriptions and confirmed populations from geographically proximate regions.

Regarding pigmentation, the dark spots typically observed in live specimens may sometimes be absent in certain individuals, as noted by Lourie et al. (2004, 2016). *H. trimaculatus* is known to exhibit a wide range of color patterns (e.g., the "zebra-striped" form), suggesting that pigmentation is not a consistently reliable diagnostic feature. In the dried specimens examined here, we suspect that pigmentation marks may have been lost due to the drying process.

4.2. Natural History

Based on interviews, all specimens were collected during multi-day fishing expeditions ~150-200 km off the southern coast, either unintentionally through by-catch or using scoop-nets and hand-nets if they were spotted, and then brought to shore upon the fishermen's return. Multiple reports confirm the observations and presence of seahorses dwelling in the drifting 'marine-debris' in open ocean (southern coast), mostly consisting of abandoned fishing nets, plastic, and various types of domestic waste (see Figure 3). It's noteworthy, as they mention, that the collected individuals did not seem to be entangled in the debris (as in the case of ghost net entanglement of *H. kelloggi* reported by Mahapatro et al, 2024), but rather appeared to be 'actively' using it as a surface refuge—clinging to the floating substrate, much like certain seahorse species naturally associate with floating seaweed clumps (see Lourie et al. 2004). This observation, however, has not been previously documented for any seahorse species.

An interesting fact is that Benadon (2024) demonstrates that marine debris can act as a mobile natural habitat substitute, facilitating the long-distance dispersal of marine species, as observed in other marine fishes. In this case, we suspect there is a strong possibility that the recorded population may have originated from a nearby region through such dispersal mechanisms, potentially influenced by oceanic gyres and drift patterns, as explained by Moore (2008).

Additionally, Riera et al. (1999) show that fish actively use drift floating material—which includes anthropogenic objects—and that it may even act as a nursery. Given that the *Hippocampus trimaculatus* is known to have a specialized carnivorous diet, we speculate that

this occupation is mainly driven by the availability of resources. Juveniles feed on copepods and larval meroplankton, while adults primarily feed on small crustaceans like amphipods and caridean shrimps (Yip et al., 2014). Given that this prey organisms are probably found in the biological communities linked to drifting material, it is possible that these habitats provide the species with both refuge and food.

At present, collectors appear to specifically search among floating debris for seahorses. Given that these records occurred on multiple occasions over different time periods, it is reasonable to consider this in future habitat assessments and conservation efforts. Furthermore, this presents a unique natural experimental setup to investigate how marine species adapt to anthropogenically altered environments and occupy new spatial niches in response to a changing world, particularly as plastic waste and marine debris continue to emerge as significant ecological issues (Katsanevakis, 2008).

Figure 3. a & b. Collected debris along the southern coast, mainly consisting of domestic waste, plastics, and abandoned fishing gear, which ultimately accumulate in the open ocean to form drifting masses of marine debris. Photo courtesy: Young Biologist Association.

4.3. Illegal trade & Conservation implications

Although seahorse species are protected under CITES and listed as Vulnerable (VU) on the IUCN Red List, including all species currently recorded in Sri Lanka (now *H. kuda*, *H. spinosissimus*, and *H. trimaculatus*), it is apparent that the seahorse trade exists in Sri Lanka, including along the southern coast, even if not on a large scale. Vincent et al. (2007, 2011) reported that Sri Lanka trades in live seahorse specimens; however, there is substantial evidence to suggest that dried forms are also commonly traded. Currently, dried small to medium-sized *H. trimaculatus* specimens (< 30 mm in height) are sold for approximately LKR 1,000.00 (Sri Lankan Rupees) (about USD 3.30, based on an exchange rate of 1 USD ≈ 300 LKR in 2024–2025) per specimen, to local buyers, and can fetch up to LKR 5,000.00 (approximately USD 16.70) for foreign buyers (Pers. Obs.). Larger specimens are significantly more expensive, with values notably higher than the prices reported by Laksanawimol et al. (2013), who found almost similar-sized dried seahorses sold for USD 0.90–1.80 on the east coast of the Gulf of Thailand. Salin et al. (2005, 2006) also documented the Indian Ocean seahorse trade, specifically from India's Palk Bay and Gulf of Mannar coasts, where they reported exports of species like *H. trimaculatus*, *H. kuda*, and *H. spinosissimus*to Singapore, Hong Kong, Malaysia, and the United Arab Emirates. It's also noteworthy, that the dried seahorses purchased are used to make 'gold-plated' pendants, driven by the myth that they bring good luck—similar to traditional beliefs surrounding black and red coral. There is a modest but persistent demand for dried seahorses on the black market.

Addressing illegal wildlife trade and uncovering its networks is challenging. Conservationists must rely on the support of local communities—such as the informants from the fishing community in this case—who possess a deeper understanding of their community than most non-residents. Therefore, collaboration between scientists and local stakeholders is essential. Although raids to control the trade are already underway, they appear to be largely ineffective. We strongly recommend increased enforcement efforts, especially during the major tourist season of down south, from December to April. Furthermore, we also observed that the local collectors were often unaware of relevant legislation or the ecological importance of these species. Therefore, in addition to strengthening the enforcement of current legislation, raising awareness among local fishermen, tour guides, and foreign tourists is essential for minimising both illegal trade and bycatch.

5. CONCLUSION

With the verified occurrence of *Hippocampus trimaculatus* in Sri Lankan waters, the number of confirmed valid seahorse species on the island now stands at three, alongside *H. kuda* and *H. spinosissimus*. An unusual record of habitat use—dwelling in floating marine debris—is also highlighted here, which we believe has not been previously documented. The drivers behind such habitat use remain inconclusive. Additionally, our observations provide valuable insights and evidence into the illegal trade of dried seahorses in Sri Lanka, which may prove useful for future conservation efforts.

Supporting Information

Table S1. Morphometric measurements, meristic counts, and remarks for each *Hippocampus trimaculatus* specimen examined.

Trait	Specimen ID			
	MD0621F	**MD0622F**	**MD0623F**	**MD0624M**
Morphometric measurements:				
Standard Length (mm)	99.77	99.8	113.28	106.56
Height (cm)	8.2	8.4	9.5	8.9
Head length (mm)	17.77	15.8	18.28	17.56
Snout length (mm)	8.11	7.25	8.22	9.01
Trade Height	27.85	29.71	33.6	38.03
Trunk length (mm)	24.82	25.28	30.23	34.33
Tail length (mm)	57.18	58.72	64.77	54.67
Coronet height (mm)	1.59	1.27	1.78	1.60
Head depth (mm)	6.56	6.19	7.82	7.39
Snout depth (mm)	1.78	1.61	1.89	2.54
Trunk width 4 (mm)	7.14	7.12	8.36	9.73
Trunk width 9 (mm)	8.79	10.03	11.23	11.65
Ratios:				
HL/SnL	2.19	2.18	2.22	1.95
Meristic counts:				
Trunk rings	11	11	11	11
Tail rings	39	39	39	29
Total rings	50	50	50	40
Trunk rings supporting dorsal fin	2	2	2	2
Tail rings supporting dorsal fin	1	1	1	1
Cheek spine pairs	1	1	1	1
Eye Spine pairs	1	1	1	1
Nose spine	0	0	0	0
Coronet spines	5	5	5	5
Remarks:				
Shape of the cheek & eye spines	Hook-like	Hook-like	Hook-like	Hook-like
Dorsal appearance	Low spines	Low spines	Low spines	Low spines
Coronet remarks	Low-short	Low-short	Low-short	Low-short
Sex	Female	Female	Female	Male
Specimen status	complete	complete	complete	Damaged

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Authors contributions

Conceptualization: J.B.; data collection: Statistical analysis: data interpretation: J.B., S.R.; writing the first draft: J.B.; Manuscript editing and reviewing: J.B., S.R.; All authors have accepted responsibility for the content of the manuscript, reviewed all results, and approved the final version.

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Conflict of Interest

The authors declare that they have no conflicts of interests, competing financial interests or personal relationships that could have influenced the work reported in this paper.

Informed consent

Not applicable.

Ethical approval & declaration

This study is based on four deceased specimens collected from a fishing community in the southern coastal region of Sri Lanka. Therefore, no ethical guidelines have been violated, and ethical approval is not applicable in this case.

Data and materials availability

Data supporting the findings of this study are embedded within the manuscript and provided in the Supporting Information section.

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