Research Article

First Record of Bellybarred Pipefish, *Hippichthys spicifer* (Rüppell, 1838), (Syngnathiformes: Syngnathidae) from Balochistan Coast, Northern Arabian Sea

Asadullah Ali Muhammad[1*] and Ateeqa Baloch[2]

[1]Fisheries and Coastal Development Department, Government of Balochistan, Pakistan; [2]The Marine Reference Collection and Resource Centre, University of Karachi, Pakistan.

Abstract | This study reports the first record of the Bellybarred Pipefish, *Hippichthys spicifer* (Rüppell, 1838), from Kataow Beach, Pasni, Balochistan, on the Northern Arabian Sea. A single specimen measuring 153 mm in total length was collected from a shallow brackish water habitat. Morphological and meristic analyses revealed key diagnostic features, such as the absence of an anal fin, discontinuous trunk and tail ridges align with the original descriptions of *H. spicifer* by Rüppell, (1838) and later accounts by Dawson, (1978, 1985). The discovery extends the known geographical range of *H. spicifer*, previously reported from the Indo-Pacific, Red Sea, and various other regions, to Pakistan's coastline. The discovery underscores the importance of coastal and estuarine habitats along the Balochistan coast for ichthyofaunal diversity and highlights the need for continued research and conservation efforts for syngnathid species in Pakistan.

Received | March 23, 2025; **Accepted** | April 23, 2025; **Published** | June 02, 2025
***Correspondence** | Asadullah Ali Muhammad, Fisheries and Coastal Development Department, Government of Balochistan, Pakistan; **Email:** asadcemb@gmail.com
Citation | Muhammad, A.A. and A. Baloch. 2025. First record of bellybarred pipefish, *Hippichthys spicifer* (Rüppell, 1838), (Syngnathiformes: Syngnathidae) from Balochistan coast, Northern Arabian Sea. *Sarhad Journal of Agriculture,* 41(2): 835-841.
DOI | https://dx.doi.org/10.17582/journal.sja/2025/41.2.835.841
Keywords | Pipefish, Syngnathidae, *Hippichthys*, New record, Taxonomy, Balochistan coast

Introduction

The family Syngnathidae, encompassing seahorses, pipefishes, pipehorses, and seadragons, represents a distinctive group within the marine ecosystem, notable for its unique morphological and behavioral adaptations. Members of Syngnathidae exhibit a suite of specialized traits that set them apart from other bony fishes, including fused jaws, bony encasement of the body, and a unique gill chamber structure with pore-like openings. Furthermore, they lack both teeth and pelvic fins, contributing to their distinctiveness (Smith and Heemstra, 1987). Their slender, elongate bodies and armored rings offer camouflage and protection in these environments, while their diet primarily consists of small crustaceans such as copepods and amphipods (Ryer and Orth, 1987; Franzoi *et al.*, 1993). The members of Syngnathids are not only fascinating due to their unusual anatomy but also because of their specialized reproductive strategies. They exhibit one of the most unique forms of parental care in the animal kingdom, with the

female depositing eggs into a specialized incubation area "marsupium" on the male, either on the abdomen or tail (Herald, 1959; Kuiter, 2009). This reproductive adaptation enhances their survival and success in various aquatic environments.

Ecologically, Syngnathids are widely distributed in temperate and tropical waters of Atlantic, Pacific and Indian Ocean and occupy a wide range of habitats, from shallow tidal pools to deeper marine environments, with some species extending into brackish and freshwater systems (Nelson *et al.*, 2016; Fricke *et al.*, 2024). They are typically found in association with seagrass beds, coral reefs, and mangrove areas, which provide crucial microhabitats for their survival (Curtis and Vincent, 2006; Caldwell and Vincent, 2013; Qin *et al.*, 2018).

The syngnathids have economic and cultural significance as these fishes are extensively traded in dried form for use in Traditional Chinese Medicine, where they are believed to treat various ailments ranging from asthma to impotence, popular in the marine aquarium trade and are often embedded in plastics for use as curios (Vincent *et al.*, 2011). This high demand has led to overfishing and significant conservation concerns, as highlighted by their status on the IUCN Red List of Threatened Species and under international trade regulations such as CITES (2002). Among involved countries in traditional medicine Malaysia, in particular, plays a key role in the international trade of syngnathids, facing ongoing challenges to manage and conserve these unique fishes amidst growing pressure from commercial exploitation (Martin-Smith *et al.*, 2003; Martin-Smith and Vincent, 2006; Perry *et al.*, 2010).

This family is comprised of approximately 331 valid species distributed across 59 genera (Fricke *et al.*, 2024). The genus *Hippichthys*, reviewed extensively by Dawson (1978, 1985), provides an illustrative example of the diversity within Syngnathidae with distinctive morphological features such as the number of trunk rings and dorsal fin rays. This genus, endemic to the Indo-Pacific region, including five valid species as follows: *H. spicifer* (Ruppell, 1838); *H. heptagonus* (Bleeker 1849); *H. cyanospilus* (Bleeker, 1854); *H. penicillus* (Cantor 1849); *H. parvicarinatus* (Dawson, 1978).

Currently four genera and six species of pipefishes are reported from Pakistan including: *Trachyrhamphus serratus* (Temminck and Schlegel, 1850); *Trachyrhamphus longirostris* (Kaup, 1856); *Ichthyocampus carce* (Hamilton, 1822); *Microphis cuncalus* (Hamilton, 1822); *Bryx analicarens* (Duncker, 1915) and *Syngnathoides biaculeatus* (Bloch 1785) (Qureshi, 1969; Jalil and Khaliluddin, 1981; Kazmi *et al.*, 2022). The genus *Hippichthys* has not been previously documented in Pakistan. This study presents the first confirmed record of *Hippichthys spicifer* from Kataow Beach, Pasni. The discovery expands the known geographical distribution of the species, highlighting the biodiversity of the region and contributing valuable data to the ichthyofauna of Pakistan.

Materials and Methods

A single live specimen of the Bellybarred Pipefish, *Hippichthys spicifer* was collected from Kataow Beach (25°16'34"N, 63°28'32"E), Pasni, Balochistan coast (Figure 1) on 08 November 2024. This is an estuarine environment characterized by a mixed substrate of sandy and muddy areas with patches of mangroves. Morphometric characters and meristic details were recorded following the standard protocol by Lourie *et al.* (1999) and photographed using a stereo-zoom microscope (Wild 181300, Switzerland) at (10x50 magnification). The specimen was then preserved in 70% alcohol for further study and was identified using available literature (Rüppell, 1838; Dawson, 1978, 1985; Smith and Heemstra, 1987; Parvathy *et al.*, 2023). After carrying out the taxonomic examination, the specimen was deposited (MRCandRC-UOK-PICS-127) at the Repository of Marine Reference Collection and Resource Centre, University of Karachi.

Results

Systematics accounts

Family Syngnathidae Bonaparte 1831

Genus *Hippichthys* Bleeker 1849

Hippichthys spicifer (Rüppell 1838) (Figure 2)

Material examined

A single specimen, Catalogue no. (MRC and RC-UOK-PICS-127); 153 mm TL and 3 gm TW, collected on 08 November, 2024 from Kataow Beach (25°16'34"N, 63°28'32"E), Pasni, Northern Arabian Sea.

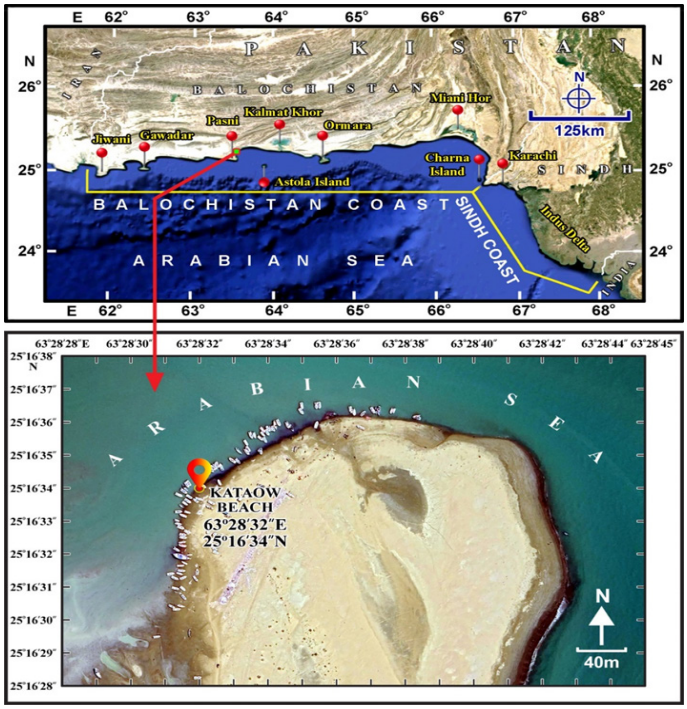

Figure 1: *Study area map, Kataow Beach (25°16'34"N, 63°28'32"E), Pasni.*

Description

Body thin, elongated with tapering snout with total body length from snout to tail reaching 153 mm (Figure 2A). Fresh specimen with greenish-brown color and brownish when preserved. Body with 14 prominent dark bars and encased with total of 54 series of bony rings made of 14 trunk rings and 40 tail rings (Figure 2G). Trunk with a length of 43 mm, trunk depth with 4 mm and tail length 83mm. Head dark brownish with long tubular snout with a length of 17 mm; plain in the upper half and pale to brownish spots on lower half (Figure 2B). Pore-like gill opening above operculum (Figure 2C). Eyes rounded with orbital diameter of 2 mm. Dorsal fin length 17 mm, white with 30 rays (Figure 2E). Pectoral fin length 4mm, white with 14 rays (Figure 2D) and caudal fin fan shaped with a length of 4mm, dark brown with white margin and 10 rays (Figure 2H). Anal fin absent. Anus present at the area below the beginning of dorsal fin (Figure 2E). Superior trunk and tail ridges discontinuous near rear of dorsal-fin base; lateral trunk and tail ridges also discontinued (Figure 2F). Continuous inferior trunk and tail ridge. No brood pouch observed beneath anus. Morphometric and meristic data are presented in Table 1.

Habitat: Found in shallow brackish water.

Distribution: Indo-Pacific region, from Red Sea and East Africa to Sri Lanka, Samoa, India and now from Pakistan.

Table 1: *The morphometric measurements and meristic counts for Hippichthys spicifer (Rüppell 1838) collected from Kataow Beach, Pasni, Balochistan.*

Morphometrics	Measurements (Present study)	Parvathy et al. (2023)	Kitahara and Moriguchi 2022	Dawson 1978
Total length	153 mm	-	101.9-103.7	-
Standard length	149 mm	106 mm	128.6–144.2	80.5-170.5 mm
Trunk depth	4	2.39	36.4–38.3	2.3–4.1
Head length	17	9.84	12.4–12.9	6.9–10.3
Dorsal fin base	1.7	1.2	69.7–71.8	1.1–1.8
Trunk rings	14	14	15–16	14–16
Tail rings	40	42	39–40	36–41
Total rings	54	56	55	51–56
Meristic counts				
Dorsal fin rays	30	25	26–28	25-30
Pectoral fin rays	15	15	16–17	15-18
Caudal fin rays	10	10	10	10

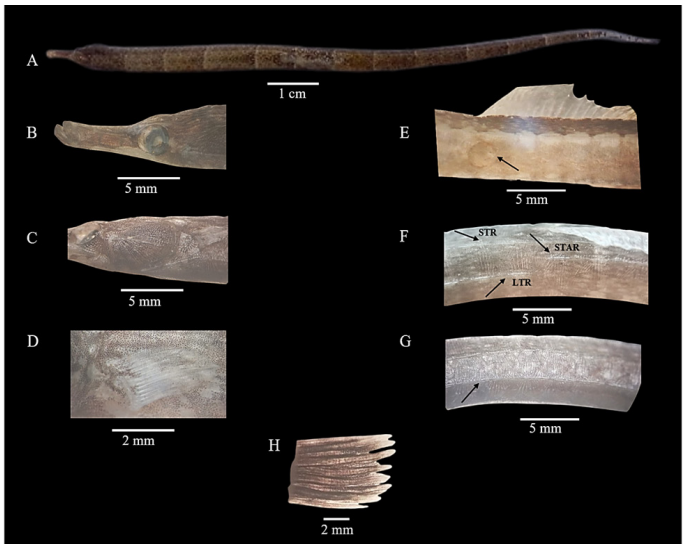

Figure 2: *Hippichthys spicifer. Fresh specimen (A) Snout (B) Pore-like gill opening (C) Pectoral fin (D) Dosal fin and position of anus (E) Lateral view, indicating lateral trunk and tail ridges and discontinued superior trunk and tail ridges; STR: superior trunk ridge; STAR: superior tail ridge; LTR: lateral trunk ridge (F) Dorsal view, arrow indicates ring of bony plates (G) Caudal fin (H).*

Discussion

This study presents a detailed investigation based on comprehensive examination of the morphological and taxonomic characteristics of *Hippichthys spicifer*. The discovery of *H. spicifer* from Kataow Beach, Pasni, marks the first record of this species from the coastal

waters of Balochistan, Pakistan, Northern Arabian Sea, significantly expanding its known geographical range.

This specimen aligns with the diagnostic traits of the genus *Hippichthys* (Bleeker 1849), supporting earlier findings by Dawson (1978, 1985). It is characterized by the lack of an anal fin; the discontinuous trunk and tail ridges; a continuous inferior trunk and tail ridge; and a laterally deflected trunk ridge, as noted in this study. Notably, this specimen does not exhibit a brood pouch, indicating it was likely a non-breeding male or possibly a female. Brood pouches are generally present in male Syngnathidae, where they serve to incubate eggs, representing a distinctive reproductive adaptation within this family (Herald, 1959; Kuiter, 2009).

Hippichthys spicifer is found in the Indo-West Pacific and inhabits brackish water environments of rivers (Dawson, 1978; Senou, 2002). This species was originally described by Rüppell (1838) from the Red Sea and subsequently was reported from Venezuela and Colombia (Jordan *et al.*, 1930), Indo-pacific (Dawson, 1978, 1985, 1986), South Africa (Cyrus and McLean, 1996; Mbande, 2003; Harrison and Whitfield, 2006; Forbes *et al.*, 2013), Western Central Pacific (Paulus, 1999), Australia (Kuiter, 2000, 2009; Allen *et al.*, 2002), Japan (Senou, 2002; Iwatsuki *et al.*, 2017; Kitahara and Moriguchi, 2022), Tonga (Randall *et al.*, 2003), New Caledonia (Fricke and Kulbicki, 2006; Fricke *et al.*, 2011), Malaysia (Lim *et al.*, 2011), Philippines (Guzman and Capaque, 2014), Kenya (Dubey, 2018), Indonesia (Miesen *et al.*, 2018; Yustian *et al.*, 2024), sub-Saharan Africa and adjacent islands (Claassens *et al.*, 2022), India (Das *et al.*, 2021; Parvathy *et al.*, 2023) and Mozambique (Whitfield and Weerts, 2024).

Ecologically, the association of *H. spicifer* with mangrove and estuarine habitats has been well-documented, particularly in Southeast Asia. Its presence in Kataow Beach, an estuarine environment, is consistent with this ecological preference, suggesting that mangrove-lined coastal areas along the Balochistan coast may serve as suitable habitats for this species. Similar findings have been reported in studies from other regions (Curtis and Vincent, 2006; Caldwell and Vincent, 2013), reinforcing the importance of these ecosystems for syngnathid conservation.

In comparison to previous studies, the present specimen from Kataow Beach shows notable similarities and some deviations in morphometric and meristic characteristics when compared to other documented specimens of *H. spicifer*. The standard length (149 mm) recorded in this study falls within the size range reported by Dawson (1978), who noted total lengths between 80.5 mm - 170.5 mm. However, when compared to Parvathy *et al.* (2023), who documented slightly smaller specimens with a standard length of 106 mm, and Kitahara and Moriguchi (2022) with length of 128.6–144.2. The present specimen appears to represent a larger individual. Such size variation is not uncommon in marine fish populations and may reflect differences in habitat conditions, food availability, or population structure across different regions.

From meristic point of view, the present specimen exhibited 14 trunk rings and 40 tail rings, aligning closely with Dawson's (1978) reported range of 14–16 trunk rings and 36–41 tail rings. However, the total number of rings (54) in the present study slightly deviates from the higher count of 55 rings by Kitahara and Moriguchi (2022) and 56 rings observed by Parvathy *et al.* (2023) suggesting minor variability within the species across its range. The dorsal fin ray count of 30 in the present specimen also falls within the upper range reported by (Dawson 1978) (25–30 rays), and similarly, the caudal fin ray count of 10 matches with all previous records, The pectoral fin ray count (15) is identical to the findings of both Parvathy *et al.* (2023) and Dawson (1978), confirming the stability of this character across different populations.

In conclusion, the present study adds valuable data to the ichthyofaunal diversity of Pakistan and highlights the significance of conserving coastal and estuarine habitats. The comparison with other regional studies shows that while there are some minor variations in morphometric and meristic characters, the present specimen confirms largely to the existing descriptions of *H. spicifer*. This study also reinforces the importance of further research on syngnathid populations in Pakistan to ensure sustainable management and conservation of these unique species, particularly in light of their vulnerability to overexploitation and habitat degradation around the world.

Acknowledgments

The authors extend their sincere gratitude to Dr. Javed Anwar Shahwani, Secretary of the Fisheries and Coastal Development Department, Government of Balochistan, for his invaluable support of our research. This study is conducted as part of the project titled "Stock Assessment of Fish Species in the Coastal Waters of Balochistan: Focus on Fish Stock Depletion". The authors also wish to extend their heartfelt gratitude to Mr. Abdul Wahid (Fisherman Pasni) to help during the fish sample collection. We would like to extend our gratitude to Dr. Ali Reza Sari and Dr Qadeer Muhammad Ali for identification of fish and reviewing the manuscript.

Novelty Statement

This study presents the first record of the Bellybarred Pipefish, *Hippichthys spicifer*, along the Balochistan coast of the Northern Arabian Sea, expanding the known geographic distribution of the species and contributing new data to regional marine biodiversity records.

Author's Contribution

Asadullah Ali Muhammad: Conceptualization, Execution, drafting the manuscript.
Ateeqa Baloch: Data analysis, editing.

Funding
No funding was received for conducting this study.

Ethics approval and consent of publication
The Research Paper has not been published previously nor is being considered for publication. Approval of all authors have been obtained. No approval of research ethics committees was required to complete the objectives of this study because the work was conducted with an unregulated fish species.

Data availability
All data supporting of the finding of this study are available within the article and its supplementary material.

Conflict of interest
The authors have declared no conflict of interest.

References

Allen, G.R., S.H. Midgley and M. Allen. 2002. Field guide to the freshwater fishes of Australia. Perth: Western Australian Museum, pp. 394.

Caldwell, I.R. and A.C. Vincent. 2013. A sedentary fish on the move: effects of displacement on long-snouted seahorse (*Hippocampus guttulatus* Cuvier) movement and habitat use. Environ. Biol. Fish., 96: 67-75. https://doi.org/10.1007/s10641-012-0023-4

Cites (Convention on the International Trade in Endangered Species of Wild Flora and Fauna), 2002. Amendments to Appendices I and II of the convention adopted by the Conference of the Parties at its 12th meeting in Santiago, Chile, from the 3rd to 15th November 2002 Available on line http://www.cites.org/eng/cop/12/Adopted_Amendments.pdf

Claassens, L., A.N. Hodgson, G. Short and D. Harasti. 2022. Diversity, distribution, ecology and conservation status of the family Syngnathidae in sub-Saharan Africa and adjacent islands. Oceanogr. Mar. Biol., pp. 169-242. https://doi.org/10.1201/9781003288602-4

Curtis, J.M.R. and A.C.J. Vincent. 2006. Life history of an unusual marine fish: Survival, growth and movement patterns of *Hippocampus guttulatus* Cuvier, 1829. J. Fish Biol., 68(3): 707-733. https://doi.org/10.1111/j.0022-1112.2006.00952.x

Cyrus, D.P. and S. McLean. 1996. Water temperature and the 1987 fish kill at Lake St Lucia on the south-eastern coast of Africa. S. Afr. J. Aquat. Sci., 22(1–2): 105–110. https://doi.org/10.1080/10183469.1996.9631377

Das, M.K., M.R.K. Rao and S.S. Singh. 2021. Diversity of native larvivorous fish fauna during pre-and post-tsunami in Car Nicobar, Andaman and Nicobar Islands, India. J. Vector Borne Dis., 58(2): 165-174. https://doi.org/10.4103/0972-9062.318317

Dawson, C.E., 1978. Review of the Indo-Pacific Pipefish Genus *Hippichthys* (Syngnathidae). Proc. Biol. Soc. Washington, 91(1): 132–157.

Dawson, C.E., 1985. Indo-pacific pipefishes (Red Sea to the Americas). Gulf Coast Research Lab, Ocean Springs, Mississippi, pp. 230.

Dawson, C.E., 1986. Family No. 145: Syngnathidae. pp. 445-458. In: Smith MM, Heemstra PC (eds) Smith's Sea Fishes, Johannesburg, Macmillan South Africa xx + 1047 pp 144

Dubey, R., 2018. Fish diversity in the freshwater lakes, rivers, flood plains and swamps of Kenya. Biospectra, ISSN 0973-7057, 13(1): 25-30

Duncker, G. 1915. Revision der Syngnathidae. Erster Teil. Erster Teil. Mitteilungen aus dem Naturhistorischen (Zoologischen) Museum in Hamburg. 32: 9-120

Forbes, A.T., N.T. Forbes and Bundy. 2013. Baseline ecological assessment for the port of richards bay expansion programme selected aquatic and terrestrial habitats. MER Report 7/2013, Durban: Marine and Estuarine Research.

Franzoi, P., R. Maccagnani, R. Rossi and V.U. Ceccherelli. 1993. Life cycles and feeding habits of *Syngnathus taenionotus* and *S. abaster* (Pisces, Syngnathidae) in a brackish bay of the Po River delta (Adriatic Sea). Mar. Ecol. Prog. Ser., 97: 71–81. https://doi.org/10.3354/meps097071

Fricke, R., W.N. Eschmeyer and J.D. Fong. 2024. Genera/species by family/subfamily in Eschmeyer's catalog of fishes. California Academy of Sciences, San Francisco, USA. CAS - Eschmeyer's Catalog of Fishes - Genera/Species by Family/Subfamily (calacademy.org) (Assessed on 28 September 2024).

Fricke, R. and M. Kulbicki. 2006. Checklist of the shore fishes of New Caledonia. Compendium of Marine Species from New Caledonia, Nouméa. Doc. Sci. Tech. IRD II, 7: 313-358.

Fricke, R., M. Kulbicki and L. Wantiez. 2011. Checklist of the fishes of New Caledonia, and their distribution in the Southwest Pacific Ocean (Pisces). Stuttgarter Beiträge zur Naturkunde. Serie A (Biologie) Neue Ser., 4: 341-463.

Guzman, A.M.T. and T.P.V. Capaque. 2014. Inventory of ecologically-important fish species in Bugang River, Philippines. Aquacult. Aquarium Conserv. Legislat., 7(5): 396-404.

Harrison, T.D. and A.K. Whitfield. 2006. Estuarine typology and the structuring of fish communities in South Africa. Environ. Biol. Fishes, 75: 269–293. https://doi.org/10.1007/s10641-006-0028-y

Herald, E.S., 1959. From pipefish to seahorse-a study of phylogenetic relationships. Proc. Calif. Acad. Sci. Ser., 4(29): 465–473.

Iwatsuki, Y., H. Nagino, F. Tanaka, H. Wada, K. Tanahara, M. Wada, H. Tanaka, K. Hidaka and S. Kimura. 2017. Annotated checklist of marine and freshwater fishes in the Hyuga Nada area, southwestern Japan. Bull. Grad. Sch. Bioresour. Mie Univ., 43: 27-55.

Jalil, S.A. and M. Khaliluddin. 1981. A checklist of marine fishes of Pakistan. Marine Fisheries Department, Karachi. pp. 1-6.

Jordan, D.S., B.W. Everman and H.W. Clark. 1930. Checklist of the fishes and fishlike vertebrates of North and Middle America north of the Northern boundary of Venezuela and Colombia. Rep. U. S. Commiss. Fish., 1928: 670.

Kazmi, Q.B., R. Naushaba, M. Moazzam and M.A. Kazmi. 2022. Pakistani marine faunal biodiversity inventory and taxonomic resources. Zool. Soc. Pak. Lahore, pp. 735.

Kitahara, Y. and H. Moriguchi. 2022. Records of a brooding males of Bellybarred pipefish, Hippichthys (Hippichthys) spicifer (Rüppell, 1838), from Shizuoka Prefecture, Japan. Bull. Mus. Nat. Environ. Hist. Shizuoka, 15: 47–51.

Kuiter, R.H., 2000. Seahorses, pipefishes and their relatives. Chorleywood, UK: TMC Publishing, pp. 240.

Kuiter, R.H., 2009. Seahorses and their relatives. Seaford, Australia: Aquatic Photographics, pp. 331

Lim, A.C.O., V.C. Chong, C.S. Wong and C.K. Choo. 2011. Diversity, habitats and conservation threats of syngnathid (Syngnathidae) fishes in Malaysia. Trop. Zool., 24(2): 193-222.

Lourie, S.A., A.C. Vincent and H.J. Hall. 1999. Seahorses: An identification guide to the world's species and their conservation. Project Seahorse. London, pp. 214.

Martin-Smith, K.M., T.F. Lam and S.K. Lee. 2003. Trade in pipehorses *Solegnathus* spp. for traditional medicine in Hong Kong. Traffic Bull., 19(3): 139-148.

Martin-Smith, K.M. and A.C.J. Vincent. 2006. Exploitation and trade of Australian seahorses, pipehorses, sea dragons and pipefishes (Family Syngnathidae). Oryx, 40(2): 141-151. https://doi.org/10.1017/S003060530600010X

Mbande, S., 2003. Fishes of the Mngazi and Mngazana Estuaries, with particular emphasis on the community structure and primary carbon sources. MSc thesis, Rhodes University, Grahamstown.

Miesen, F.W., F. Droppelmann, S. Hullen, R.K. Hadiaty and F. Herder. 2018. An annotated checklist of the inland fishes of Sulawesi. Bonn Zool. Bull., 64(2): 77–106.

Nelson, J.S., T.C. Grande and M.V. Wilson. 2016. Fishes of the world, vol 707, 5th edn. John Wiley and Sons, Hoboken, New Jersey.

Parvathy, R., V.L. Sruthy, R.R. Kumar and P. Kaladharan. 2023. First record of bellybarred pipefish, *Hippichthys spicifer* (Syngnathiformes: Syngnathidae) from the west coast of India. Thalassas: Int. J. Mar. Sci., 39(2): 867-873. https://doi.org/10.1007/s41208-023-00576-z

Paulus, T., 1999. Family syngnathidae. In: (eds. K.E. Carpenter and T.H. Niem) the living marine resources of the western central pacific. FAO species identification guide for fisheries purposes. Rome: FAO, 4: 2069-2790.

Perry, A.L., K.E. Lunn and A.C.J. Vincent. 2010. Fisheries, large-scale trade, and conservation of seahorses in Malaysia and Thailand. Aquat. Conserv. Mar. Freshw. Ecosyst., 20: 464-475. https://doi.org/10.1002/aqc.1112

Qin, G., C. Johnson, Y. Zhang, H. Zhang, J. Yin, G. Miller, R.G. Turingan, E. Guisbert and Q. Lin. 2018. Temperature-induced physiological stress and reproductive characteristics of the migratory seahorse *Hippocampus erectus* during a thermal stress simulation. Biol. Open, 7(6): bio032888. https://doi.org/10.1242/bio.032888

Qureshi, M.R., 1969. Fishes of the order Syngnathiformes. Pak. J. Sci. Ind. Res., 12: 268-271.

Randall, J.E., J.T. Williams, D.G. Smith, M. Kulbicki, G.M. Tham, P. Labrosse, M. Kronen, E. Clua and B.S. Mann. 2003. Checklist of the shore and epipelagic fishes of Tonga. Atoll. Res. Bull., https://doi.org/10.5479/si.00775630.502.1

Rüppell, W.P.E., 1838. Neue Wirbelthiere zu der Fauna von Abyssinien gehörig. Fische des Rothen Meeres. Frankfurt, 81–148, 22–33.

Ryer, C.H. and R.J. Orth. 1987. Feeding ecology of the northern pipefish, *Syngnathus fuscus*, in a seagrass community of the lower Chesapeake Bay. Estuaries, 10(4): 330–336. https://doi.org/10.2307/1351891

Senou, H., 2002. Syngnathidae. In: Nakabo T (ed) Fishes of Japan, with pictorial keys to the species, English ed. Tokai University Press, Tokyo, pp. 520–536.

Smith, M.M. and P.C. Heemstra. 1987. Smith's sea fishes. Springer science and business media, pp. 445–458. https://doi.org/10.1007/978-3-642-82858-4

Temminck C.J. and H. Schlegel. 1850. Pisces. In: Siebold, P.F. de (ed.): Fauna Japonica, sive descriptio animalium, quae in itinere per Japoniam suscepto annis 1823-1830 collegit, notis, observationibus et adumbrationibus illustravit Ph. Fr. de Siebold. Apud Arnz et socios, Lugduni Batavorum. Last part (15). pp. 270-324.

Vincent, A.C., S.J. Foster and H.J. Koldewey. 2011. Conservation and management of seahorses and other Syngnathidae. J. Fish Biol., 78(6): 1681–1724. https://doi.org/10.1111/j.1095-8649.2011.03003.x

Whitfield, A. and S. Weerts. 2024. Fish species, families and guilds recorded in selected estuaries of Mozambique. W. Indian Ocean J. Mar. Sci., 23(1): 53-67. https://doi.org/10.4314/wiojms.v23i1.6

Yustian, I., A. Setiawan, M. Iqbal, W. Indriati, P. Pormansyah and H. Zulkifli. 2024. A rapid assessment of vertebrate in Pasir Timbul-Sungsang IV, Banyuasin, South Sumatra, Indonesia. In BIO Web. Conf., EDP Sci., 92: 01032. https://doi.org/10.1051/bioconf/20249201032