

A Checklist of Estuarine Ichthyofaunal Diversity in mangrove-sheltered Soft-Substrate Intertidal Pools of the Indian Sundarbans

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ABSTRACT

The following work is a brief documentation of ichthyofauna of soft substrate intertidal pools (SSITPs) from the estuarine mangroves of Indian Sundarbans. SSITPs are shallow benthic and brackish water tidepools that potentially act as a microhabitat and refugia for estuarine fishes. The multi season study pointed out 31 fish taxa as inhabitant of these pools, although many of them are transient, residing brief period in pool as a juvenile. A majority of these fish taxa are from family Gobiidae, which is a species rich group in the estuarine mangrove zones of tropical and subtropical indo-pacific region. The standard length (SL) based comparison have shown no representative fish taxa irrespective of the source SSITPs in any season has grown far from 75mm. This contemplates the potential role of SSITPs as juvenile nursery and small fish refugia. The presence absence data along with 6 different criteria based matrix show that majority of the fish taxa found inside the SSITPs are resident in terms of pool utilization, while few are transient in terms of the traits. Current understanding regarding research and ecology of SSITPs are very limited, hence a holistic approach for conservation of these ephemeral shallow water bodies are very important.

Keywords: Soft-substrate Intertidal pools, Indian Sundarbans, estuarine fish, mangrove, taxa checklist, pool utility.

INTRODUCTION

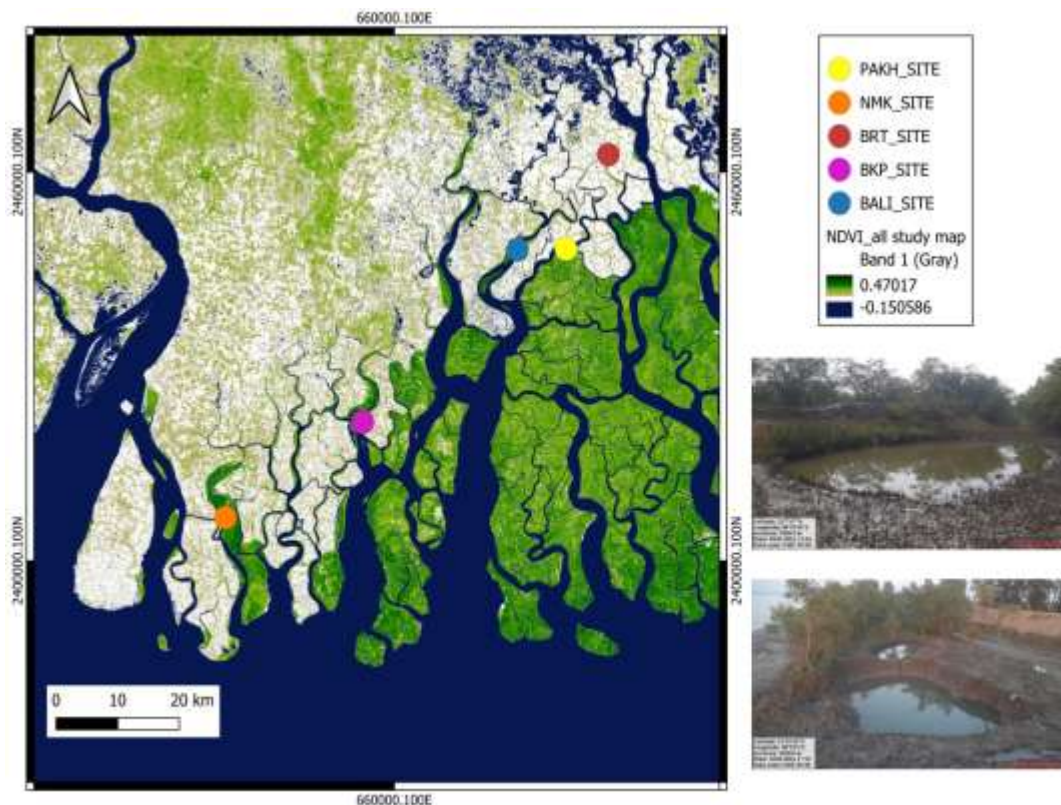
Estuarine zones are the main confluence of both coastal marine regime and riverine freshwater regime. Mangroves are on the other hand are predominantly a modified group of coastal vegetation type which has a relative tolerance to regular and intermittent water submergence, water and soil salinity, high TDS tolerances. Other than this, tolerance to high wave action, adaptation for upright position on silty soil matrix and survival on metabolically dry soil, are some basic adaptation for mangrove vegetation. In mature and fringe mangrove patches, there are not only true mangroves present, but also, mangrove-associated plants and other salt and tide tolerant shrubs are present. In a broader term, the idea of mangroves also projects towards the, area generally in the estuarine –coastal landscapes, which has a forest or natural vegetation cover that are largely comprised of true mangroves and mangrove associated flora. In the term of estuarine-mangrove regime, several micro and macro structures were formed many are natural in origin, while some have degrees of anthropogenic interventions. The dynamic nature of the estuarine zone shows most of these structures or their geomorphological variations are of two types, first one is deposition based, with examples like Mudflats, sandbars, tidal marsh, shoal and tidal deltas, whereas, the second type is based on the erosion

based micro and macro structures, which includes, tidepools, tidal creeks, mangrove swamps and meandering edges of tidal delta. Of these erosion dominated hydro-geomorphological forms, tidepools are a special type of variant, where erosion of soil, sand or rocky layer create a shallow pool with limited water contacts. Intertidal tidepools, are semi-isolated aquatic habitats formed by depressions in intertidal substrates that retain coastal seawater or estuarine riverine water during low tide periods. Although generally small and shallow in spatial extent, tidepools exhibit considerable biological complexity and can be utilized as important natural laboratories for investigating ecological processes, community organization, species interactions, and physiological adaptation (Vinagre et al., 2025). Early ventures of intertidal researches largely concentrated on emergent rocky surfaces and sessile organisms, inhabiting rocky tidepools (Metaxas et al., 1994), whereas subsequent studies (Coppo et al., 2025) demonstrated that tidepools support distinctive assemblages of fishes, macroalgae, invertebrates and microorganisms. The classic ecological review by Metaxas and Scheibling (1993) emphasized that the physical isolation of tidepools during low tide modifies the environmental conditions and allows organisms to persist in locations where they would otherwise be exposed to heat and desiccation. The essential ecological feature of a tidepool is therefore not simply that it is a “small pool of flowing water,” but that it represents a temporarily isolated aquatic habitat embedded within the intertidal land-aquascapes. During high tide, a tidepool connected to the surrounding larger flowing water regime (sea or river, often active creeks also) experience flushing, recruitment, competitive feeding by transient organisms, siltation and rapid exchange of dissolved substances (Green, 1971).

A major portion of studies on tidepools, mainly focused on the rocky tidepools of the tropical and temperate coasts. In which diverse macrobenthos, macro-micro algae, non-algal macrophytes and ichthyofaunal diversity were discussed extensively (Andrades et al., 2023; Ostalé-Valriberas et al., 2023). On the other hand, very few studies have discussed extensively about tidepools of non-rocky origin (Arakaki and Tokeshi, 2005), which are mostly common in indo-pacific shallow estuarine zones, often at the tidal intersection of Mega Rivers and large tropical bays. The soft-substrate intertidal pools are one of the lesser studied tidepool subtypes currently. Soft-substrate intertidal pools are prominent variants of shallow benthic pools in estuarine waters, which intermittently get recharged with tidal riverine brackish water during high tide and in monsoon. In low tide conditions, these ephemeral pools remain isolated and serve as potential microhabitats for estuarine fish, crustacean, mollusk, polychaetes etc. The term soft-substrate indicates towards the benthic or stratum region of these pools that are constantly filled with newly accumulated soft silts (Kunishima and Tachihara, 2020) and rotting flora vegetation, most of which are sourced from nearby mangrove forest vegetation patches that encircles the pools and also from the tidal waters of nearby river and/or creeks. Due to the seemingly stagnant nature of the pools along with partially canopy shaded condition, the basic water chemistry of the pools are somewhat different from the nearby source of flowing water regime, i.e. river and/or creeks. The stagnant nature of these pools at least in pre and post monsoon months, create a highly specific water chemistry with elevated critical parameters which are not suitable for many a species, whereas in peak monsoon these pools literally vanishes under surging riverine waters, which dilutes the hostility of pool water chemistry and become nearly equalized with riverine waters. The similar pattern is also evident in the regular tidal cycle, where, during low tide condition, water of the SSITPs, remain enclosed as a separate geomorphological entity with clear boundaries, but in high tide condition, it get submerged under inflow of tidal waters, making it invisible in plain sight. The bevelled slopes of these pools are generally studded with pneumatophores, stilt roots, saplings of mangrove and/or mangrove associated plants along with mature mangrove trunks and stumps (Fig 1). The presence of these living vertical bio-structures create a studded open sieve like trap for the pools, which pools up dead litters and litter falls into the tidepool during high tide but to some extent restrict its exit, hence layers after layer organic flora litter get deposited in SSITPs, which decomposes (mostly anaerobic), while submerged in water and create dark black benthic layer along with newly accumulated silts (Bhattacharjee et al., 2023). Hence, it is a unique pool type to study further.

The current objective of this study centred on the annotated checklist of fish genera and species found in the SSITPs from a multi season survey with annual replicates. Other than this the load and the possible status of the fish as a pool utilizer are discussed here, along with a brief analysis of length (standard length/SL) based study to evaluate up to which length a fish would remain in an SSITP during low tide condition, irrespective of site and season

Figure 1: Representative map of the study sites from Indian Sundarbans with pictures of SSITP in inset.



METHODOLOGY

The soft-substrate intertidal pools (SSITPs) are the semi-isolated pockets of estuarine water, which often act as refugia for some estuarine fishes. 5 different study sites are selected based upon their proximity to mangrove vegetation and flowing water regime (river/creek), long-term viable ephemeral condition and relative logistic ease.

All of the study sites, except one, are situated in South 24 Parganas. The study sites (along with codes) and their brief description are as follows, 1. Bali island (BALI, an island beside river Dutta and are adjacent to Gosaba, this small island is mainly depend upon agricultural and fishery practices); 2. Baikunthapur (BKP, a riverside village in Maipith beside river Thakuran); 3. Namkhana (NMK, more specifically, Ishwaripur village, which is adjacent to river Saptamukhi and are largely dedicated to agriculture and semi-natural Bheri fishery practices); 4. Pakhiralaya (PAKH, A prominent village in island Gosaba, where boat or motor vessel based tourism is prominent seasonally, adjacent to river Bidya); 5. Baro tushkhali (BRT, More specifically, Joygopalpur village, which is in North 24 Parganas of West Bengal, the village, which is mostly depends upon agricultural practices and fishery are situated beside the meandering creek of Korakati khal which ultimately converges with river Raimangal. A study site map showing 5 sampling SSITPs are depicted with help of QGIS (version 3.40) with a layout of 2025 NDVI (Normalized Difference Vegetation Index) map to justify the presence of these SSITPs in fringe mangrove patches in NPA (non-protected areas) zones of Sundarban Biosphere Reserve (SBR), India (Fig 1). NPA is generally considered a common area within a large protected area, where anthropogenic development and settlement are permitted along with limited farming, fishing (including fish farming), pastoralism (including livestock and poultry), logging, tourism and other essential activities. (Thapa et al., 2021)

Fishes were sampled from different SSITPs, i.e. soft-substrate intertidal tidepools (5 sites) in 3 different seasons (Premonsoon (PRM), Monsoon (MON) and Postmonsoon (POM)) for consecutive 5 years (2022-2026). All of the fish samples were caught using retractable rod with D shaped fine net (mesh size 2mm-3mm). Most of the sampling events were executed only in the low tide conditions, when the outlines of the

SSITPs were clearly elucidated. The samplings were essentially done on the early morning hours in every seasons just after the ample visible sunlight (0700-10-00 hrs), to avoid mid-afternoon hostile environments. The fishes were not only captured by skimming the upper surface of the pool water or mid water columns, but also by manual sieving the benthic muddy and rotten flora layers, where often benthic gobies take refuge. After sampling events the fishes were washed using potable clean water, then euthanized using eugenol spiked distilled water, after sacrifice, the fish samples were loaded into sample collection jars containing 2% buffered formaldehyde solution for fixation. The fishes were identified using several key characters and meristic counts along with consultation with databases and taxonomic literatures (Key, monographs, article and books). Fishes were identified up to the designated species level, often the postflexion or the juvenile stages are not identified properly, in that case, the identification were done up to genus level. Fish taxa were distributed upon presence-absence matrix, to show which taxa were present most of the season and pools (SSITPs). The taxonomic roots of the present taxa up to family and order level are traced. Fishes were also divided into 3 major ecological groups (resident, transient and accidental inhabitant) based upon 3 major criteria, whether they are found in every season, whether they are abundant and whether both adult (including gravid females) as well as juveniles of the conspecific fish taxa are found in the same pool. The standard length (SL in mm) is taken from a section of representative specimens to find the upper limit of the size of fish which reside in the pool during low tide scenario.

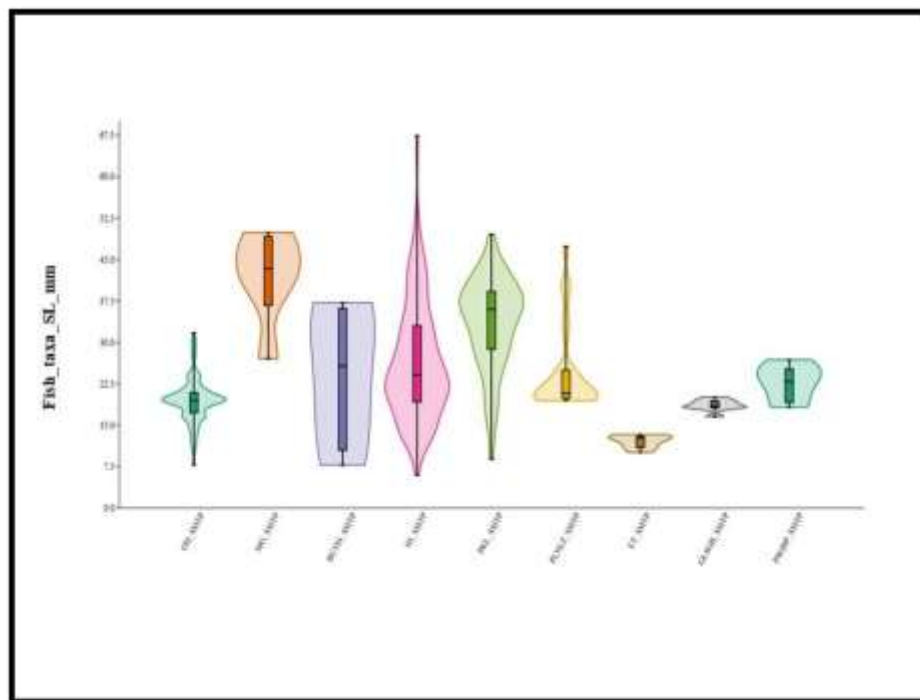


Figure 2: Standard lengths (SL) of representative fish taxa from SSITPs, showing maximum size range of fishes in SSITPs during low tide events.

Table 1: Presence-absence data matrix of fish taxa from different SSITPs in different seasons.

	BAL I_M ON	BAL I_P OM	BAL I_P RM	BK P_M ON	BK P_P OM	BK P_P RM	BR T_M ON	BR T_P OM	BR T_P RM	NM K_M ON	NM K_P OM	NM K_P RM	PAK H_M ON	PAK H_P OM	PAK H_P RM
<i>Oryzias dancena</i>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Stigmatogobius</i>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

<i>sadanundio</i>															
<i>Stigmatogobius pleurostigma</i>	0	1	0	0	1	0	0	0	0	0	1	1	0	1	1
<i>Aplocheilichthys panchax</i>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Puntius vittatus</i>	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0
<i>Butis butis</i>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Glossogobius aureus</i>	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0
<i>Eleutheronema tetradactylum</i>	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
<i>Acentrogobius viridipunctatus</i>	0	1	1	0	1	1	1	0	1	0	0	1	1	1	0
<i>Brachygobius natus</i>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Periophthalmus kalolo</i>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Mystus gulio</i>	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Glossogobius olivaceus</i>	0	0	0	1	1	1	1	1	1	1	1	1	0	1	0
<i>Planiliza melinoptera</i>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Terapon jarbua</i>	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Moringua sp.</i>	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1
<i>Redigobius sp.</i>	0	0	0	1	1	1	1	1	0	1	0	1	0	0	0
<i>Pseudogobius sp. 1</i>	1	0	1	1	0	0	1	1	0	0	0	1	0	1	1
<i>Pseudogobius sp. 2</i>	0	0	1	1	0	0	1	0	1	1	0	1	1	0	1
<i>Eleotris fusca</i>	1	0	1	1	1	1	1	1	0	1	1	1	1	0	1

<i>Microphis cuncalus</i>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Ichthyocampus carce</i>	0	1	0	1	1	1	1	1	0	1	1	1	1	0	1
<i>Gobiopertus chuno</i>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Scatophagus argus</i>	1	0	1	1	0	0	0	0	1	1	1	1	1	0	1
<i>Pomadasys maculatus</i>	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1
<i>Pseudogobius poicilosoma</i>	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1
<i>Aulopareia sp.</i>	0	1	0	0	1	1	0	0	0	1	0	0	0	1	0
<i>Polynemus sp.</i>	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1
<i>Omobranchus punctatus</i>	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Priolepis sp.</i>	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0
<i>Hemigobius hoevenni</i>	0	1	0	1	1	0	1	1	1	1	0	1	0	0	0

RESULT AND DISCUSSION

All total of 31 different fish morphotypes were identified, based on meristic and morphometric keys of taxonomy, of which 7 were identified only up to genus level, rest (24) are can be traced upon species level (Table 2). It is found that, there is a majority of family Gobiidae with 14 representative taxa, which is quite common in estuarine mangrove region globally, as these areas are often known as the hotspot for gobies and blennies (Polgar, 2012; Hammer et al., 2021). Several juvenile stages of commercially important fishes are also found here, which includes, *Planiliza melinoptera*, *Eleutheronema tetradactylum*, *Scatophagus argus* and *Terapon jarbua*. Several of the fish taxa were found in the SSITPs as juvenile or post-flexion larvae but not as an adult individual.

Whereas, few fish taxa were found with multiple size classes and/or gravid females. On a separate instance, very few species were also found as an accidental visitor, which means that these fish taxa were found in the pool in very few instances. Along with this factors like presence of fish taxa in all season and all pool in high abundances are also taken into account for. The abovementioned traits are evaluated for the, collected fish samples and are tabulated for the categorization of resident, transient and accidental taxa currently in the SSITPs (Table 3).

The total cumulative value against each fish taxa on the basis of 7 parameters, are given here, the parameters are given in as a presence-absence (1/0) matrix. The resultant values can be segregated into 3 groups as SSITP utilizer, values ranging from 5-4 are for the resident taxa; whereas, value 3 is for transient fish taxa, on the other hand value 2 is only for accidental species. This result shows that out of 31 taxa present in the

SSITPs, 17 taxa are presumed to be resident based on the criteria, while 9 are transient and rest (5) of the taxa are accidental pool utilizer.

In terms of 3 seasons, fishes were distributed seemingly homogenously with few exception (Table 1), showed with bipartite plots, (Fig 3a, b, c). The larger bubbles on the fish taxa side represents the presence of fish on every site and every season combination pair (Highest is 5, as sites are 5, while lowest is 0, which means no individuals of a fish taxa were present in a given site (SSITPs) in a predefined season (PRM/MON/POM).

On the basis of standard length (SL), few major fish taxa (9 taxa) found in SSITPs and are stacked together to visualize a violin-box plot. The resultant plot shows, a certain length of fish (7.5-65.5 mm) are mostly present in the SSITPs (Fig 2), which can be potentially inferred to this conclusion, that SSITPs have the possible potential as a physical size limiting filtering microhabitat for estuarine fish species in low tide condition (Macieira and Joyeux, 2011).

This also nods to the proven notion that, mangrove in general act as a nursery and viable sheltering spot for multiple estuarine-marine fishes, and soft substrate intertidal pools in broader terms also abide by the rule.

Table 2: Taxonomic highlights of fish taxa sampled from SSITPs of Indian Sundarbans.

Family	Scientific name
Adrianichthyidae	<i>Oryzias dancena</i> (Hamilton, 1822)
Aplocheilidae	<i>Aplocheilus panchax</i> (Hamilton, 1822)
Blenniidae	<i>Omobranchus punctatus</i> (Valenciennes, 1836)
Butidae	<i>Butis butis</i> (Hamilton, 1822)
Cyprinidae	<i>Puntius vittatus</i> Day, 1865
Eleotridae	<i>Eleotris fusca</i> (Forster, 1801)
Gobiidae	<i>Acentrogobius viridipunctatus</i> (Valenciennes, 1837)
	<i>Aulopareia</i> sp.
	<i>Brachygobius nusus</i> (Hamilton, 1822)
	<i>Gobiopterus chuno</i> (Hamilton, 1822)
	<i>Glossogobius giuris</i> (Hamilton, 1822)

	<i>Glossogobius olivaceus</i> (Temminck & Schlegel, 1845)
	<i>Hemigobius hoevenii</i> (Bleeker, 1851)
	<i>Priolepis</i> sp.
	<i>Pseudogobius poicilosoma</i> (Bleeker, 1849)
	<i>Pseudogobius</i> sp. 1
	<i>Pseudogobius</i> sp. 2
	<i>Redigobius</i> sp.
	<i>Stigmatogobius pleurostigma</i> (Bleeker, 1849)
	<i>Stigmatogobius sadanundio</i> (Hamilton, 1822)
Oxudercidae	<i>Periophthalmus kalolo</i> Lesson, 1831
Haemulidae	<i>Pomadasys maculatus</i> (Bloch, 1793)
Moringuidae	<i>Moringua</i> sp.
Mugilidae	<i>Planiliza melinoptera</i> (Valenciennes, 1836)
Polynemidae	<i>Eleutheronema tetradactylum</i> (Shaw, 1804)
	<i>Polynemus</i> sp.
Scatophagidae	<i>Scatophagus argus</i> (Linnaeus, 1766)
Syngnathidae	<i>Ichthyocampus carce</i> (Hamilton, 1822)
	<i>Microphis cuncalus</i> (Hamilton, 1822)
Terapontidae	<i>Terapon jarbua</i> (Forsskal, 1775)

Figure 3: Diversity of fish in SSITPs in Premonsoon (PRM) season using bipartite plot.

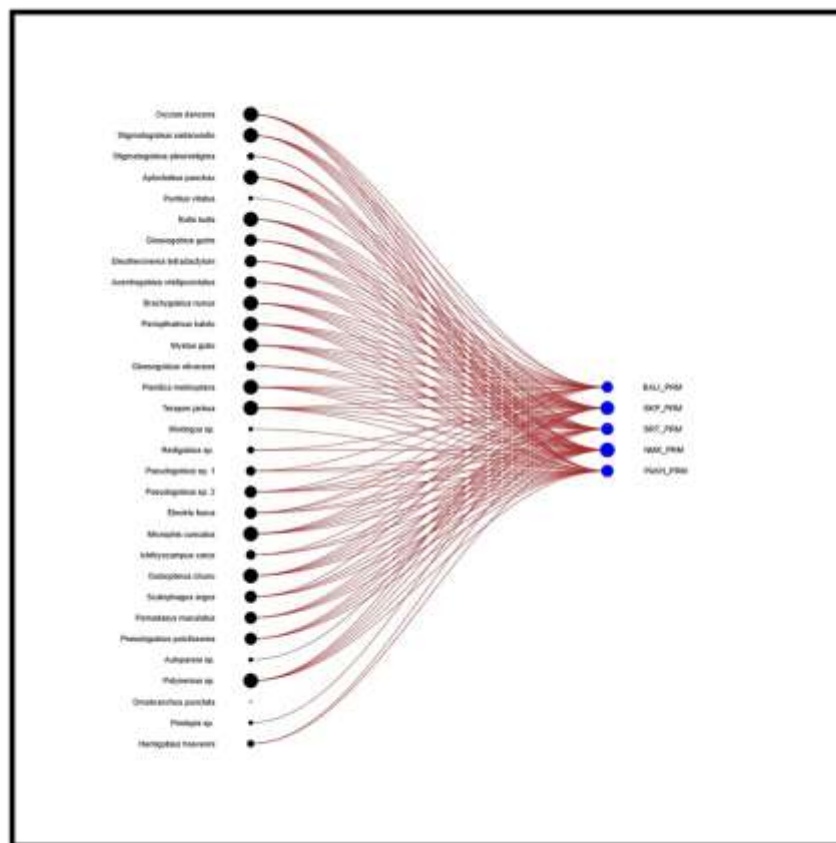
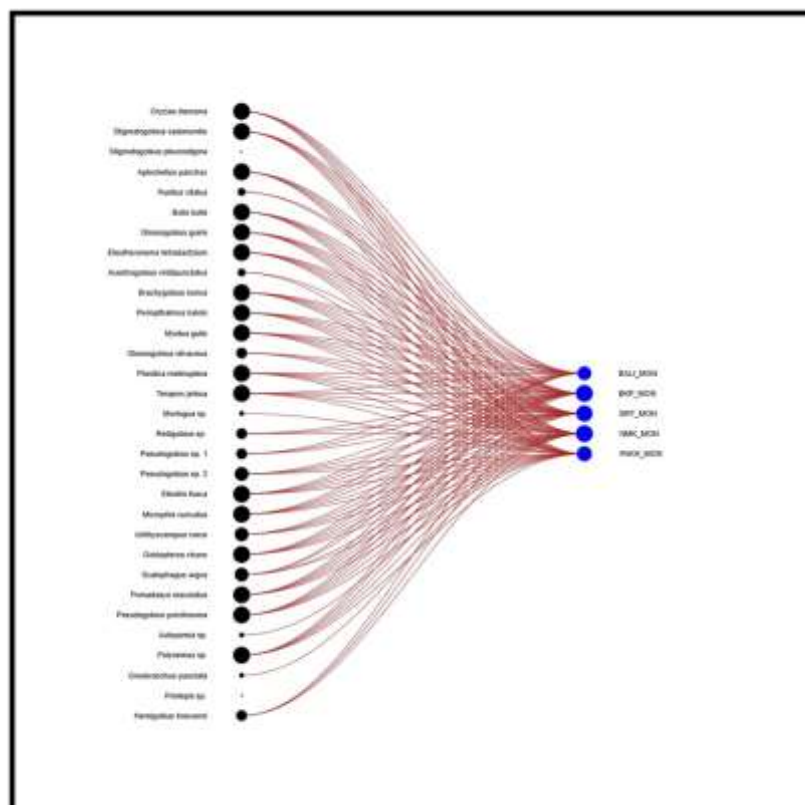


Figure 4: Diversity of fish in SSITPs in Monsoon (MON) season using bipartite plot.



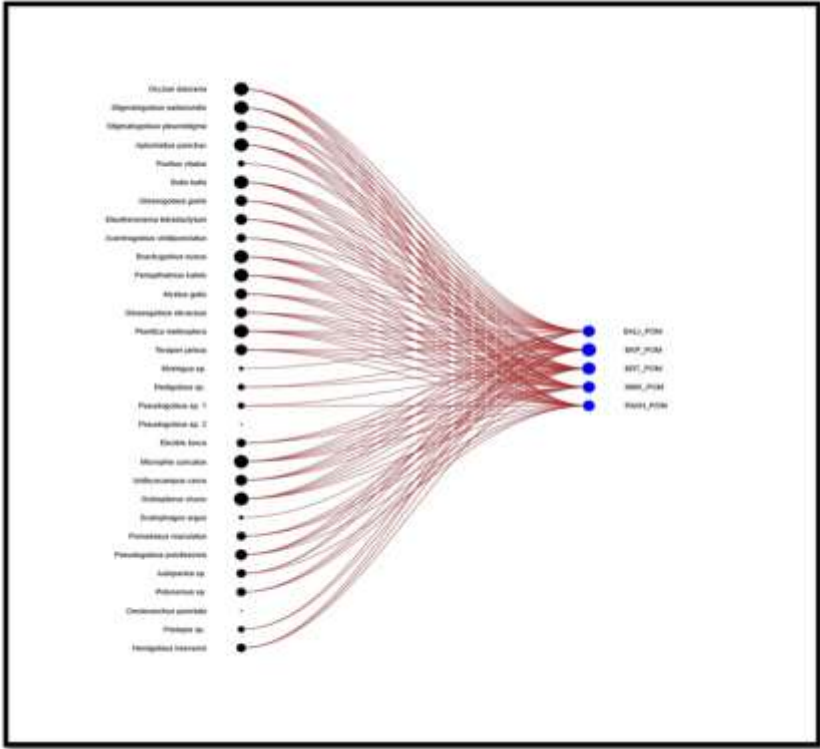


Figure 5: Diversity of fish in SSITPs in Postmonsoon (POM) season using bipartite plot.

Table 3: A representative table on the pool utilizer category of fish found in SSITPs.

Fish taxa	Presence of multiple size classes	Gravid female s/adult s	High abundanc es	Presence in all SSITPs	Presence in all Season	Infrequen t occurrence	Only juvenile and/or postflexio n larvae	Total sum value	Stat us as pool utiliz er
<i>Oryzias dancena</i>	1	1	1	1	1	0	0	5	Resi dent
<i>Stigmatogobius sadanundio</i>	1	1	1	1	1	0	0	5	Resi dent
<i>Stigmatogobius pleurostigma</i>	1	0	0	0	0	1	1	3	Tran sient
<i>Aplocheliu s panchax</i>	1	0	0	1	1	0	1	4	Resi dent
<i>Puntius vitatus</i>	0	0	0	0	0	1	1	2	Acci dent al
<i>Butis butis</i>	1	1	0	1	0	1	0	4	Resi

									dent
<i>Glossogobius guiris</i>	1	1	0	1	0	0	0	3	Tran sient
<i>Eleutheronema tetradactylum</i>	1	0	0	0	1	0	1	3	Tran sient
<i>Acentrogobius viridipunctatus</i>	1	1	1	1	1	0	0	5	Resi dent
<i>Brachygobius nunus</i>	1	0	1	1	1	0	1	5	Resi dent
<i>Periophthalmus kalolo</i>	1	1	1	1	1	0	0	5	Resi dent
<i>Mystus gulio</i>	1	0	0	0	0	1	1	3	Tran sient
<i>Glossogobius olivaceus</i>	1	0	0	0	0	1	1	3	Tran sient
<i>Planiliza melinoptera</i>	1	0	1	0	0	0	1	3	Tran sient
<i>Terapon jarbua</i>	1	0	0	0	0	1	1	3	Tran sient
<i>Moringua sp.</i>	0	0	0	0	0	1	1	2	Acci dent al
<i>Redigobius sp.</i>	1	0	0	0	1	0	1	3	Tran sient
<i>Pseudogobius sp. 1</i>	1	1	0	0	1	1	0	4	Resi dent
<i>Pseudogobius sp. 2</i>	1	0	0	0	1	1	1	4	Resi dent
<i>Eleotris fusca</i>	1	0	0	0	1	1	1	4	Resi dent
<i>Microphis</i>	1	0	0	1	1	0	1	4	Resi

<i>cuncalus</i>									dent
<i>Ichthyocampus carce</i>	1	1	0	0	1	0	1	4	Resi dent
<i>Gobiopertus chuno</i>	1	1	0	1	0	1	0	4	Resi dent
<i>Scatophagus argus</i>	1	0	0	0	0	1	1	3	Tran sient
<i>Pomadasys maculatus</i>	0	0	0	0	1	1	1	3	Tran sient
<i>Pseudogobius poicilosoma</i>	1	1	0	0	1	1	0	4	Resi dent
<i>Aulopareia sp.</i>	0	0	0	0	0	1	1	2	Acci dent al
<i>Polynemus sp.</i>	1	0	0	0	1	0	1	4	Tran sient
<i>Omobranchus punctatus</i>	0	0	0	0	0	1	1	2	Acci dent al
<i>Priolepis sp.</i>	0	0	0	0	0	1	1	2	Acci dent al
<i>Hemigobius hoeverni</i>	1	1	0	1	1	0	0	4	Resi dent

CONCLUSION

The present study provides a brief ecological assessment of soft-substrate intertidal pools (SSITPs) of the Indian Sundarbans as a distinct microhabitat supporting diverse estuarine ichthyofauna. The documentation of 31 fish morphotypes, including 24 species-level identifications and seven genus-level taxa, highlights the taxonomic diversity of these habitats, with Gobiidae representing the predominant family. The occurrence of juvenile stages of commercially important fishes, multiple size classes, and gravid individuals indicates that SSITPs may serve diverse ecological functions, including temporary sheltering, feeding, and potential reproductive utilization.

The classification of fish taxa based on seven ecological parameters further revealed heterogeneous patterns of habitat association, with 16 taxa categorized as presumed residents, 10 as transient utilizers, and 5 as accidental visitors. This distribution suggests that SSITPs are not merely incidental repositories of estuarine fishes but may represent regularly utilized components of the mangrove-estuarine habitat mosaic.

Furthermore, the observed standard-length range of 7.5–65.5 mm among the representative taxa suggests substantial utilization by smaller-bodied individuals and early developmental stages. This pattern supports the hypothesis that the shallow, spatially restricted configuration of SSITPs may influence fish accessibility and size-structured habitat use during low-tide conditions.

Collectively, these findings highlight the potential contribution of SSITPs to the maintenance of estuarine fish diversity and the provision of supplementary nursery-associated and refuge habitats within the Indian Sundarbans. Their ecological significance may be particularly relevant under tidal conditions when connectivity with adjacent aquatic habitats is reduced. However, the proposed role of these pools as size-selective microhabitats and their contribution to recruitment and population persistence require further validation through longitudinal sampling, comparative habitat assessments, and direct measurements of pool geomorphology and tidal connectivity.

This brief volume of work essentially doesn't hold the full essence of soft-substrate intertidal pool ecology of fishes from the Indian Sundarbans, but it points out the possible avenues of work, which are yet to be followed up. SSITPs are the example of model microhabitats, which need to be conserved with care, as it is as much as in fragile condition as estuarine mangroves are now in general, due to anthropogenic pressure. Hence it is essential to study this microhabitat and its connections with its inhabitants to study the in-situ macrocosm of tidepools.

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The authors confirm that there are no conflicts of interest related to this work.

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