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Original research article

Abandance and biomass of assorted small indigenous fish species: Observations from rural fish markets of West Bengal, India

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ABSTRACT

The small indigenous fish species (SIS) are harvested as ensemble of different fish species of varying size and shape. An appraisal of the abundance and biomass of fish species constituting such ensemble was carried out with samples collected from fish markets of West Bengal, India. The data revealed that at least 22 different fish species were present varying in numbers and species combinations. The abundance and biomass of the individual fish species was negatively correlated, indicating numerical dominance of small sized species. Logarithmic regression showed a good fit of the relative abundance (y) with the species richness (x) in the samples of SIS ($y = 55.72\ln(x) - 77.27$; $r^2 = 0.940$), while power regression was best fit for the relative biomass of individual fish (y) with the species richness (x) in the samples of SIS ($y = 24.58x^{-1.54}$; $R^2 = 0.831$). In overall both species specific and individual based biomass and abundance relationships were negatively correlated. In order to ascertain the harvest and marketability of the SIS in a judicious manner, monitoring of the fish assemblages in natural habitats is recommended.
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1. Introduction

The small indigenous fish species (SIS) are characterized by small size (<25 cm standard length) with indigenous in origin, commonly found in freshwater wetlands (Nandi, Majumder, & Saikia, 2013). In West Bengal and Assam, India, the SIS are found in the rice fields and associated trap ponds, irrigation canals and rivers (Aditya, Pal, & Saha, 2010; Baishya et al., 2016). These fish are generally excluded from commercial culture fisheries and the exploitation is dependent mostly on the capture using traditional knowledge and tools (Nandi et al., 2013; Samajdar & Saikia, 2014). In India and many other Asian countries several SIS are considered as cheap sources of proteins, minerals and vitamins (Roos, Islam, & Thilsted, 2003b, 2007a, 2007b, 2003a; Fiedler, Lividini, Drummond, & Thilsted, 2016; Nandi et al., 2013; Thilsted et al., 2016) and they contribute to enrich the quality of the ecosystems of the wetlands and rice fields(Aditya, Pal, Saha, & Saha, 2012; Chandra et al., 2008; Halwart, 2006; Halwart & Gupta, 2004). The contribution to the for food security (Roos et al., 2003b, 2007a, 2007b, 2003a; Fiedler et al., 2016; Thilsted et al., 2016)and the livelihood (Gupta & Banerjee, 2008) are valued ecosystem services attributable to the SIS. Inland water fisheries involving intensive culture systems uses limited number of fish species (Naylor et al., 2000; de Silva, 2016) but they have the potential to yield greater biomass per fish unit. In contrast, with the exception of few species such as the *Amblypharyngodon mola, Chela cachiux* and *Puntius sophore* (Kohinoor, Wahab, Islam, & Thilsted, 2001; Wahab, Kunda, Azim, Dewan, & Thilsted, 2008) little importance are given to SIS in commercial fisheries. Nonetheless, SIS form a common component of the culture fisheries involving harvest from wetlands and rice field associated trap ponds and irrigational canals (Aditya et al., 2012; Chandra et al., 2008; Fiedler et al., 2016; Halwart, 2006; Halwart & Gupta, 2004).

Although SIS are commonly found in both rural and urban market places, their exploitation is not extensively documented particularly in India(Keskar, Raghavan, Kumkar, Padhye, & Dahanukar, 2017; Nandi et al., 2013; Saha et al., 2017). The

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importance of gathering information about SIS can be associated to sustainability, such that these fish resources are exploited in a manageable way for the future generations. In India, empirical studies document that SIS are commonly found in rice fields and associated canals (Aditya et al., 2010),rivers (Baishya et al., 2016), with possible utility in rice-fish culture (Baruah, Bhagowatp, & Talikdar, 2000). Similar information on the fish species associated with the rice fields are known from other Asian countries such as China (Li, 1988; Lu & Li, 2006), Thailand (Little, Surintaraseree, & Innes-Taylor, 1996), Vietnam (Berg, 2002; Berg, Berg, & Nguyen, 2012) Cambodia (Gregory, 1997; Hortle, Troeung, & Lieng, 2008) and Bangladesh (Dey et al., 2005; Wahab et al., 2008). Rice fields and associated habitats including trap ponds and irrigation canals are enriched with valuable animal food resources including fish, prawns, crabs and snails (Halwart, 2006; Nurhasan et al., 2010). Natural colonization and establishment of taxonomically diverse fish species is the basis for promoting rice fish cultures which may be considered a sustainable source of secure food production andprotein supplement (Dey et al., 2008; Halwart & Gupta, 2004). The link between river, canals and trap ponds of the rice agro-ecosystem facilitate fish colonization and the production of diverse SIS. Consequently, the harvested fish species are diverse in taxonomic composition and sizes, and are sold as an assortment of multiple species (Saha et al., 2017).

As an extension to the recent findings (Fiedler et al., 2016; Saha et al., 2017; Thilsted et al., 2016), the biomass-abundance relationship of the SIS available in the fish market may enable justifying the heterogeneity of the harvested fish species (Saha et al., 2017). Thus the objective of the present study was to highlight the extent of variations in the relative abundance and the biomass of the SIS in the assorted samples sold in the markets. The results of the present study will provide the necessary information for sustainable exploitation of resources and selection of the most appropriate fish species for rice-fish culture (Kohinoor et al., 2001; Kunda et al., 2008). Assessment of species specific abundance and biomass will provide an overview of the population structure that exists in the natural water bodies. The present information will also justify the dependence on the capture fisheries (Thilsted et al., 2016) and the role of SIS in food security and livelihood (Roos et al., 2003b, 2007a, 2007b, 2003a) in Asian countries including India.

2. Materials and methods

In order to characterize the abundance and biomass of the small indigenous fish species (SIS) as food resource, a survey and collections were performed in the fish markets of Burdwan, Birbhum and Howrah districts of West Bengal, India. The study on the SIS availability was carried out between 2009 and 2016 (Saha et al., 2017) and 86 samples were used to assess the abundance-biomass relationship of the representative fish species. The vendors of the fish market sold the SIS in assortments of multiple species, mostly captured in combinations of multiple species using indigenous fishing gears such as *ghuni* (Samajdar & Saikia, 2014) and *mugri* (Manna & Bhattacharjya, 2009)from the rice fields, trap ponds and irrigation canals. The SIS samples originating directly from the rivers of the concerned geographical areas (River Ajay, River Damodar) were excluded either due to the assortment being made separately from different collections, or the harvested fish were sold as individual species. No samples were considered from the vendors selling SIS as segregated units of single species. A sample of 200 g of assorted multiple fish species were purchased from the local vendors and brought to the laboratory for assessment of biomass and relative abundance. In the laboratory, each sample was segregated on the basis of the constituent species

Table 1
Relative abundance (n_i) and body weight (BW, in gm) of the small indigenous fish species (SIS) sold in assorted form in the fish markets of West Bengal, India. Data of 86 different samples of 200gm each were used for the analysis. A - acronym for the species name used.

No.	Fish name	A	n_i	BW
Family- Cyprinidae				
1	*Puntius sophore* (Hamilton, 1822)	PSO	23.51 ± 1.64	2.36 ± 0.13
2	*Puntius terio* (Hamilton, 1822)	PTE	8.27 ± 1.61	1.39 ± 0.08
3	*Pethia ticto* (Hamilton, 1822)	PTI	8.72 ± .99	1.64 ± 0.12
4	*Pethia phutunio* (Hamilton, 1822)	PPH	10.75 ± 1.88	1.51 ± 0.07
5	*Amblypharyngodon mola* (Hamilton, 1822)	AMO	69.51 ± 4.05	1.61 ± 0.08
6	*Esomus danrica* (Hamilton, 1822)	EDA	40.59 ± 7.34	1.27 ± 0.06
7	*Laubuka fasciata* (Silas, 1958)	LFA	18.00 ± 2.74	1.38 ± 0.05
8	*Laubuka laubuca* (Hamilton, 1822)	LLA	10.69 ± 2.16	1.33 ± 0.02
Family- Aplocheilidae				
9	*Aplocheilus panchax* (Hamilton, 1822)	APA	7.33 ± 2.01	1.52 ± 0.14
Family- Ambassidae				
10	*Chanda nama* Hamilton, 1822	CNAM	47.61 ± 3.63	1.32 ± 0.13
11	*Parambassis ranga* (Hamilton, 1822)	PRA	45.02 ± 6.04	1.07 ± 0.1
Family- Osphronemidae				
12	*Trichogaster fasciata* Bloch & Schneider 1801	TFA	17.47 ± 6.85	1.31 ± 0.07
13	*Trichogaster lalius* (Hamilton, 1822)	TLA	13.50 ± 4.06	1.55 ± 0.08
Family- Bagridae				
14	*Mystus vittatus* (Bloch, 1794)	MVI	61.76 ± 11.95	4.03 ± 0.32
15	*Mystus tengara* (Hamilton, 1822)	MTE	25.45 ± 5.67	3.76 ± 0.90
Family- Mastacembelidae				
16	*Macrognathus pancalus* Hamilton 1822	MPA	11.50 ± 9.50	6.85 ± 0.75
17	*Macrognathus aculeatus* (Bloch, 1786)	MAC	22.50 ± 5.50	7.28 ± 1.07
Family- Gobiidae				
18	*Glossogobius giuris* (Hamilton, 1822)	GGI	10.03 ± 1.91	2.13 ± 0.42
Family- Cobitidae				
19	*Lepidocephalichthysguntea* (Hamilton, 1822)	LGU	12.11 ± 4.65	2.14 ± 0.32
Family- Badidae				
20	*Badis badis* (Hamilton, 1822)	BBA	3.00 ± 1.00	0.81 ± 0.50
Family- Channidae				
21	*Channa punctata* (Bloch, 1793)	CPU	3.33 ± 1.09	4.08 ± 0.72
22	*Channa striata* (Bloch, 1793)	CST	13.67 ± 3.38	6.22 ± 1.92

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