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Original Article

An annotated checklist of family Mugilidae Jarocki, 1822 (Actinopterygii: Mugiliformes) from India

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ABSTRACT

An annotated checklist of the members of Family Mugilidae Jarocki, 1822 (Actinopterygii: Mugiliformes) found in India is compiled from the published relevant literature and conducted in field surveys between 2017 to the present. A total of 24 species belonging to 10 genera are foregoing listed in Indian marine, fresh, and brackish waters. A total of six species belonging to five genera were identified between 2017 to present. Out of all the genera reported, *Planiliza* Whitley, 1945 consists of the highest number of species (10 species) followed by *Osteomugil* Luther, 1982 (four species), and *Crenimugil* Schultz, 1946 (three species), while the remaining genera consist of single species. The highest number of species of Mugilidae was reported from Tamil Nadu (22 species).

Introduction

Among 12 mega-diverse countries of the world, India comprises diverse terrestrial and aquatic habitats including four biodiversity hot spots (Myers et al. 2000). The mainland India and Island groups like Andaman and Nicobar Islands (east) and Lakshadweep Islands (west) occupy approximately 8000 km long coastline (Venkataraman and Raghunathan 2015). Coastline area forms unique habitats such as estuaries, lagoons, mangroves, backwaters, salt marshes, rocky coasts, sandy stretches, and coral reef ecosystems. Among which estuarine zone forms a unique ecosystem and makes a transition zone between the marine and freshwater ecosystem (Sarkar et al. 2012). In India, 14 major and 228 minor estuaries are present beside coastal lagoons and backwaters draining approximately 2000 km^2 of the hinterland (Sarkar et al. 2012; Venkataraman and Raghunathan 2015). Indian marine habitat is home to more than 13,000 species of various forms of marine flora and fauna (Venkataraman and Wafar 2005). Whereas, the record of approximately 9456 species from freshwater ecosystems represents approximately 9.7% of the total number of animal species (i.e., 97,708 species) recognized in India (Chandra et al. 2017). In India, ichthyofauna from the fresh and marine waters account for 9.7% of the global population, among which the marine fishes alone account for 7.4% (Eschmeyer and Fong 2014). Day (1888a, 1888b) reported 1418 species of fish belonging to 342 genera from British India. Talwar and Jhingran (1991) described 2546 species of ichthyofauna from 969 genera, 254 families and 40 orders. Recent findings have increased the number of valid fish species in India with an estimation of 3231 species of freshwater, brackish water, and marine species (Gopi and Mishra 2015). Out of the total fish diversity, marine water consists of 2443 species, freshwater consists of 675 species (Gopi and Mishra 2015), and brackish water comprises approximately 113 species (Sarkar et al. 2012).

The first known reference to the grey mullet in the world is from the Mediterranean, where it was used as a valuable nutritional resource by the Ancient Greeks and Romans (Thomson 1947). In his treatise 'The History of Animals', Aristotle documented the life history of various kinds of grey mullets (second half of the 4th century BC). He used the names 'kefalos' for Mugil cephalus, 'kestrefs' for Liza ramada, 'myxinos' for Liza aurata, and 'chelon' for Chelon labrosus, focussing on the huge lips. *M. cephalus* was later described by Linnaeus (1758) in his 'Systema Naturae'. Previously, mullets were included in order Perciformes, but now they are the only representatives of Mugiliformes (Nelson 1984).

The Mugilidae Jarocki, 1822 is one of the teleostean families of grey mullets that belongs to the class Actinopterygii, order Mugiliformes (Fricke et al. 2020). The first attempt at Mugilidae systematics was by Cuvier & Valenciennes (1836), since then the number of

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species and genera, and their phylogenetic relationships, has been constantly studied. The Atherinidae, Mugilidae, and Sphyraenidae families were placed in the order Mugiliformes by Berg (1940) but at the Sub Perciformes level. Subsequently, Greenwood et al. (1966) and Nelson (1984) reviewed the suborder status of these three families and placed them in the order Perciformes. At last, Nelson (1994) placed mullets in the separate order Mugiliformes. Schultz (1946) performed a comprehensive revision of the genera of Mugilidae, where he focussed on the taxonomic characteristics of mouth parts, position (inferior or terminal) of the mouth, the relative thickness of the lips, the degree of lips coverage by papillae and crenulations, the nature of the upper attachment of the maxilla, the curvature and degree of exposure of the posterior angle of the maxilla, the morphology and distribution of teeth, and the presence or absence of the symphysial knob. Based on the variations in the above morphology, he described a total of 13 genera. Smith (1948) performed a revision of the genera of Mugilidae with the application of characters used by Schultz. He confirmed the taxonomic value of the mouthparts but reported that Schultz did not examine worldwide representatives of the respective genera. He added five more genera to those described by Schultz (1946). Schultz (1953) reviewed his work again, and Smith's work, and after making corrections and additions, accepted 14 genera as valid. Thomson (1954) conducted a revision of the mullets of Australian waters and adjacent seas, based on characteristics of mouth parts, dentition, digestive system, morphometrics, and meristic. He described 38 nominal genera (excluding fossils) worldwide, of which 13 genera were recognized as valid and described 17 species belonging to nine genera in Australia and the South Pacific region. Thomson (1981) considered 64 species in 14 genera (of 282 nominal species) as valid and presented a detailed description of distinctive characters and diagnostic features useful for the recognition of mullet species. Thomson (1997) undertook a worldwide revision of the family Mugilidae and recognized as valid 14 of 40 described genera, and 62 of 280 nominal species. He observed that the nostrils may be variously placed in different species of mullets. In some species, the nostrils are nearer to each other than the posterior is to the eye or the anterior to the lip; in other species, their position may be different. The head as a whole is an informative organ from the taxonomic point of view and is normally employed in any identification key of mullets (Crosetti and Blaber 2016). The last revision of Mugilidae was performed by Fricke et al. (2020) who recognized 26 genera and 80 species as valid.

The diversity of Mugilidae has been studied since the 19th century in India. Hamilton (1822) studied the ichthyofaunal diversity of the river Ganga and its branches. He described a new species of the only representative of the genus *Rhinomugil* Gill, 1863 from the lower reaches of the Ganga River in West Bengal. Later, Cuvier and Valenciennes (1836) described new species *Mugil subviridis* Valenciennes, 1836 from the Malabar coast, Ganga River and *Mugil labiosus* Valenciennes, 1836 from Mumbai in their "Histoire naturelle des poisons". Between 1865 and 1888, Francis Day recorded common species of Southern Indian mullets, and a more comprehensive report was made by Whitehouse (1922). Apart from them, Bleeker 1853; Chaudhuri 1917; Herre 1939, 1941; Jacob and Krishnamurthy 1948; Pillay 1954; John 1955; Sarojini 1957, 1958; Misra 1959; Pillay 1962a, 1962b; Luther, 1967, 1973, 1974, 1977; Blanc and Hureau 1971; Jayram 1981, etc., have contributed in the field of the systematics of Mugilidae from India. The annotated checklist aims to provide updated details regarding the systematics and distribution of the mullets in India. The study also emphasizes further research on the systematics and other biological aspects of the mullets. The current inventory compiled here lists a total of 24 species belonging to 10 genera. This will further help in the conservation and management of the mullet fisheries in India.

Material and methods

The field visits were carried out by the first author to the different coastal and estuarine zones of Gujarat state between 2017 and to present, and specimens were collected, identified, and deposited in the Marine and Freshwater Biology Laboratory, Department of Zoology, The Maharaja Sayajirao University of Baroda, Vadodara (Bhatt and Mankodi 2020; Bhatt et al. 2021, Singh et al. 2021; Bhatt et al. 2022). The data collected in the present study are a compilation of all the accessible published data (1822 to present) relevant to understanding the diversity of the family Mugilidae Jarocki, 1822 found in Indian waters. The data collection on taxonomic position and geographical distribution of the species are based on the published scientific literature relevant to understanding the mullet diversity found in India. The checklist does exclude the grey literature, popular articles, and newspaper articles because it is hard to confirm the identity of the species in the absence of specimen deposition details. The occurrence of the species in different geographical zones of the country was divided into a coast/state/river-wise list to show the total diversity of each coastal zone/state/river. The presence of some species was not classified in a particular state as they were reported from the geographical areas that do not define the state boundary such as India, Western Ghats, Pulicat Lake, Ganga River, Yamuna River, Indus River, Brahmaputra River, Malabar Coast, etc. The present checklist only records those species which are distributed in India.

Abbreviation: GJ = Gujarat, MH = Maharashtra, GA = Goa, KA = Karnataka, KL = Kerala, MB = Malabar Coast [Karnataka coast + Kerala coast], TN = Tamil Nadu, PL = Pulicat Lake, PY = Pondicherry, AP = Andhra Pradesh, OR = Odisha, WB = West Bengal, AN = Andaman and Nicobar Islands, LD = Lakshadweep Islands, UK = Uttarakhand, DL = Delhi, PB = Punjab, RJ = Rajasthan, MP = Madhya Pradesh, UP = Uttar Pradesh, BR = Bihar, JH = Jharkhand, CG = Chhattisgarh, TS = Telangana, As = Assam, MN = Manipur, TR = Tripura, ML = Meghalaya, WG = Western Ghats [Gujarat, Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu], GR = Ganga River, YR = Yamuna River, IR = Indus River, BPR = Brahmaputra River, WC = West Coast of India, EC = East Coast of India, IND = India.

Ethical statement

The specimens are not under the listed category of experimental animals which need ethical approval. This checklist is mainly composed of the geographical distribution data that were collected from relevant works of literature.

Result and discussion

In India, a total of 24 species of mullets belonging to 10 genera were reported under the Mugilidae family from Indian waters. Out of all the genera reported, *Planiliza* Whitley, 1945 consists of the highest number of species (10 species) followed by *Osteomugil* Luther, 1982 (four species), and *Crenimugil* Schultz, 1946 (three species). While the remaining genera *Ellochelon* Whitley, 1930, *Minimugil* Durand, Chen, Shen, Fu & Borsa, 2012, *Mugil* Linnaeus, 1758, *Parachelon* Durand, Chen, Shen, Fu & Borsa, 2012, *Paramugil* Ghasemzadeh, Ivantsoff & Aarn, 2004, *Plicomugil* Schultz in Schultz, Herald, Lachner, Welander & Woods, 1953 and *Rhinomugil* Gill, 1863 are represented by single species. The present investigation reveals that *Rhinomugil corsula* (Hamilton 1822) species is distributed in most of the states and union territories of India, while *Parachelon grandisquamis* (Valenciennes, 1836) is restricted to the West Coast of India (Figure 1). The highest number of species of Mugilidae was reported from Tamil Nadu (22 species) followed by Gujarat (18

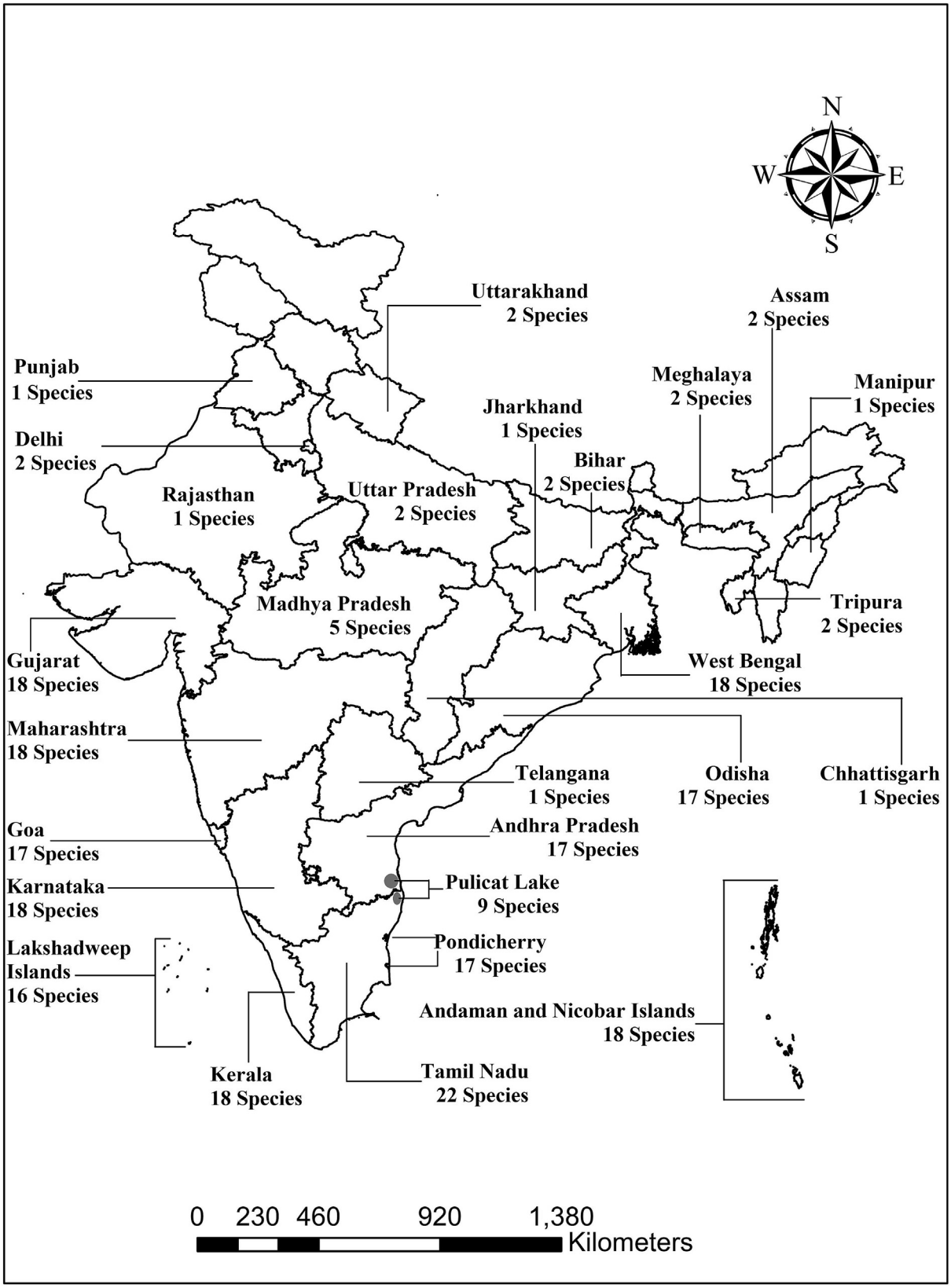

Figure 1. State-wise species diversity of Family Mugilidae (Jarocki, 1822) recorded from India.

species), Maharashtra (18 species), Karnataka (18 species), Kerala (18 species), West Bengal (18 species), Andaman and Nicobar (18 species), Goa (17 species), Pondicherry (17 species), Andhra Pradesh (17 species), Odisha (17 species), Lakshadweep (16 species), Pulicat lake (9 species), Madhya Pradesh (5 species), respectively. While from Uttarakhand, Delhi, Uttar Pradesh, Bihar, Assam, Tripura, and Meghalaya, a total of two species were reported. The remaining states, Rajasthan, Punjab, Jharkhand, Chhattisgarh, Telangana, and Manipur, were reported with single species.

An Annotated Checklist of Family Mugilidae Jarocki, 1822

The present paper follows the classification provided by the WoRMS (see, https://www.marinespecies.org/aphia.php?p=taxdetails&id=125546)

Order Mugiliformes
Suborder Mugiloidei
Family Mugilidae Jarocki, 1822

Genus *Crenimugil* Schultz, 1946

Crenimugil buchanani (Bleeker, 1853)

Mugil buchanani Bleeker, 1853: 99 [Verhandelingen van het Bataviaasch Genootschap van Kunsten en Wetenschappen. v. 25 (art. 8)] Hooghly River, Calcutta, India. Holotype (unique): RMNH 6383. Bleeker 1853 [WB], Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN], Jacob and Krishnamurthy 1948 [TN].

Valamugil buchanani Luther, 1974: 290 [Journal of Marine Biological Association of India, 16 (I)]. Luther 1967 [TN], Luther 1974 [TN]; Luther 1977 [KL]; [TN], Talwar and Kacker 1984 [KL]; [TN], Ramaiyan et al. 1987 [TN], Talwar and Jhingran 1991 [Ganga], Talwar et al. 1992 [WB], Venkateswarlu et al. 1998 [OR], Venkataraman et al. 2002 [TN], Barman et al. 2007 [OR], Krishnan et al. 2007 [TN], Raghunathan 2007 [KL], Ramesh et al. 2008 [TN], Santhosh and Radhakrishnan 2009 [KL], Barman et al. 2011 [TN], Sanyal et al. 2012 [WB], Rao and Rath 2013 [OR], Rajesh et al. 2014 [KA], Rao and Rath 2014 [OR], Joshi et al. 2016 [TN], Kar et al. 2017 [WB], Sen and Mandal 2019 [WB].

Moolgarda buchanani Fourmanoir & Laboute, 1976: 304 [Poissons de Nouvelle Calédonie et des Nouvelles Hébrides]. Karuppasamy 2016 [TN], Mogalekar et al. 2017 [TN], Mogalekar et al. 2018 [TN].

Remarks. The high falcate fins are characteristic, though also found in *Planiliza alata*. The absence of adipose tissue over the iris distinguishes *C. buchanani* from all other members of the genus except *C. seheli*. The pectoral fin of *C. seheli* reaches well behind the vertical from the origin of the first dorsal fin and the species has a higher lateral fin count than *C. buchanani*.

Crenimugil crenilabis Forsskål, 1775

Mugil macrocheilos Bleeker 1854:43 [Natuurkundig Tijdschrift voor Nederlandsch Indië v. 7 (no. 1)] Nova Selma, Cocos-Keeling Islands, Indian Ocean. Holotype (unique): where abouts unknown. Day 1870 [AN — as *Mugil macrochilus*].

Mugil crenilabris Forsskål 1775: Day 1878 [AN], Herre 1939 [AN], Herre 1941 [AN] — Spelling mistake.

Crenimugil crenilabis Forsskål 1775:73, xiv [Descriptiones animalium (Forsskål)] Red Sea. Rao 1991 [LD], Ramesh et al. 2008 [TN], Bharadwaj and Prasad 2021 [KA].

Crenimugil seheli (Forsskål, 1775)

Mugil axillaris Valenciennes [A.] in Cuvier and Valenciennes 1836:131 [Histoire naturelle des poissons v. 11] Mauritius, Mascarenes, southwestern Indian Ocean; New Guinea. Day 1869 [OR].

Mugil coeruleomaculatus Lacepède, 1803: 385 [Histoire naturelle des poissons. v. 5: i-lxviii + 1-803 + index, pls. 1-21]. Day 1870 [AN], Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN], Chaudhuri 1917 [OR], Herre 1941 [AN], Hora 1923 [OR].

Mugil seheli var. Fabricius [J. C.] in Niebuhr (ex Forsskål) 1775:73, xiv [Descriptiones animalium (Forsskål)] [Lohajae] Al-Luhayya, Yemen, Red Sea; [no specific locality stated] Red Sea. Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN].

Liza seheli (Forsskål, 1775): Herre 1939 [AN], Herre 1941 [AN].

Valamugil seheli (Forsskål, 1775): 73 [Descriptiones animalium avium, amphibiorum, piscium, insectorum, vermium; quae in itinere orientali observavit Petrus Forskål. Post mortem auctoris edidit Carsten Niebuhr. Hauniae. 1-20 + i-xxxiv + 1-164, map. Luther 1967 [TN], Luther 1973 [TN]; [OR], Jayram 1981 [GJ]; [MH]; [TN]; [OR]; [AN], Luther 1977 [KL]; [TN], Talwar and Kacker 1984 [TN]; [OR]; [WB], Ramaiyan et al. 1987 [TN], Talwar and Jhingran 1991 [WB], Rao et al. 1992 [OR], Talwar et al. 1992 [WB], Indra 1994 [TN], Khora and Rao 1994 [OR], Agrawal and Ghosh 1995 [WB], Rama Rao 1995 [OR], Venkateswarlu et al. 1998 [OR], Barman et al. 2000 [GJ], Krishnan and Mishra 2001 [AP], Venkataraman et al. 2002 [TN], Rajan 2003 [AN], Barman et al. 2004 [AP], Rema devi et al. 2004 [PL], Subba Rao and Sastry 2005 [GJ], Barman et al. 2007 [OR], Raghunathan 2007 [KL], Ramesh et al. 2008 [TN], Santhosh and Radhakrishnan 2009 [KL], Barman et al. 2011 [TN], Varghese et al. 2011 [TN], Barman et al. 2012 [MH], Sanyal et al. 2012 [WB], Barman et al. 2013 [KA], Rahman et al. 2013 [TN], Mohapatra et al. 2015 [OR], Govindan and Ravichandran 2016 [TN], Joshi et al. 2016 [TN], Sen and Mandal 2019 [WB].

Valamugil caeruleomaculatus (Lacepède, 1803): Ramaiyan et al. 1987 [TN].

Moolgarda seheli Randall, 1995: 237 [Coastal fishes of Oman]. Ramanujam and Anbarasan 2009 [TN], Pavinkumar 2014 [TN], Bharadhirajan et al. 2015 [TN], Mohanty et al. 2015 [OR], Pavinkumar et al. 2015 [TN], Kar et al. 2017 [WB], Mogalekar et al. 2017 [TN], Mogalekar et al. 2018 [TN].

Mugil cephalus Linnaeus, 1758: Parmar et al. 2015 [GJ] — Misidentification.

Crenimugil seheli (Forsskål 1775): Present Study [GJ].

Genus *Ellochelon* Whitley, 1930

Ellochelon vaigiensis (Quoy & Gaimard, 1825)

Mugil waigiensis Quoy [J. R. C.] & Gaimard [J. P.] 1825: 337, Pl. 59 (fig. 2) [Voyage autour du monde] Waigiou [Pulau Waigeo, Papua Barat Province, Indonesia, western Pacific]. Day 1865a [Malabar], Day 1865b [KL], Day 1870 [AN], Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN].

Liza vaigiensis Herre, 1939: 335 [On A Collection of Littoral and Freshwater Fishes from The Andaman Islands] Red Sea through the tropical Indian and Pacific oceans. Herre 1939 [AN], Herre 1941 [AN], Rama Rao 1972 [TN], Talwar and Kacker 1984 [KL]; [TN], Talwar et al. 1992 [WB], Agrawal and Ghosh 1995 [WB], Rama Rao 1995 [OR], Barman et al. 2000 [GJ], Rajan 2003 [AN], Barman et al. 2004 [AP], Rema devi et al. 2004 [PL], Gopi 2006 [KL], Barman et al. 2007 [OR], Krishnan et al. 2007 [TN], Ramesh et al. 2008 [TN], Radhakrishnan et al. 2009 [KL], Barman et al. 2011 [TN], Barman et al. 2012 [MH], Sanyal et al. 2012 [WB], Barman et al. 2013 [KA], Rahman et al. 2013 [TN], Rao and Rath 2013 [OR], Mohapatra et al. 2015 [OR].

Chelon vaigiensis Misra 1959: 213 [An Aid to The Identification of The Common Commercial Fishes of India and Pakistan] India, Pakistan, Burma, Ceylon, Red Sea, South Africa, Malaya, Malay Archipelago, Siam, China, Philippines, Melanesia, Micronesia,

Polynesia, Queensland. Misra 1959 [MH]; [Malabar]; [KL]; [TN]; [PY]; [AP], Menon 1961 [TN]; [AP]; [PY].

Mugil vaigiensis Quoy [J. R. C.] & Gaimard [J. P.] 1825:337, Pl. 59 (fig. 2) [Voyage autour du monde] Waigiou [Pulau Waigeo, Papua Barat Province, Indonesia, western Pacific]. Talwar and Sen 1967 [TN], Menon and Talwar 1972 [AN].

Ellochelon vaigiensis (Quoy & Gaimard 1825): Luther 1967 [TN], Luther 1973 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [AP]; [OR]; [WB], Luther 1977 [KL]; [TN], Mohanty et al. 2015 [OR], Joshi et al. 2016 [TN], Kar et al. 2017 [WB], Mogalekar et al. 2017 [TN], Mogalekar et al. 2018 [TN], Sen & Mandal 2019 [WB].

Liza waigiensis (Quoy & Gaimard, 1824): Venkataraman et al. 2002 [TN] – Spelling mistake.

Genus *Minimugil* Durand, Chen, Shen, Fu & Borsa, 2012

Minimugil cascasia (Hamilton 1822)

Mugil cascasia Hamilton [F.] 1822: 217, 380 [An account of the fishes found in the river Ganges] Rivers of northern Bengal. No types known. Hamilton 1822 [WB], Valenciennes 1836 [WB], Day 1873 [Upper Parts Ganga River]; [Yamuna River]; [Indus River], Day 1878 [Upper parts of Ganga River]; [Yamuna River]; [BH]; [Brahmaputra River], Majumdar 1958 [DL].

Sicamugil cascasia Misra 1959: 214 [An Aid to The Identification of The Common Commercial Fishes of India and Pakistan] India and Ceylon. Misra 1959 [DL]; [Upper Ganga]; [Yamuna]; [UP]; [BR]; [Brahmaputra], Jayram 1981 [Ganga]; [Yamuna]; [Brahmaputra], Pillay 1962 [DL]; [UP]; [AS], Sen 1985 [AS], Barman 1988 [TR], Sen 1992 [WB]; [Ganga]; [Yamuna]; [Brahmaputra], Sen 1995 [ML], Hussain 1997 [DL], Menon 1999 [Ganga]; [Yamuna]; [Brahmaputra], Karmakar 2000 [Ganga]; [Yamuna]; [Brahmaputra]; [Indus], Sen and Banerjee 2000 [GJ], Barman 2002 [TR], Sen 2003 [ML]; [AS]; [TR], Barman 2004 [TR], Karmakar and Das 2005 [MN], Barman 2007 [WB], Nandi et al. 2008 [GA], Yadav 2008 [GA], Ghosh 2009 [WB], Rema devi et al. 2009 [TN], Uniyal 2010 [UK], Sanyal et al. 2012 [WB], Jitendra et al. 2013 [UP], Barman and Das 2014 [WB], Verma et al. 2015 [UP], Sarma and Mankodi 2017 [GJ], Mogalekar and Canciyal 2018 [TN], Verma et al. 2018 [UP].

Minimugil cascasia (Hamilton 1822): Present Study [GJ].

Genus *Mugil* Linnaeus, 1758

Mugil cephalus Linnaeus, 1758

Mugil albula Linnaeus [C.] 1766:520 [Systema naturae sive regna tria naturae v. 1 (pt 1)] Carolina [South Carolina, U.S.A.], Jamaica and Bahamas. Hamilton 1822 [Ganga River].

Mugil cephalotus Valenciennes [A.] in Cuvier & Valenciennes 1836:110 [Histoire naturelle des poissons v. 11] Malabar and Puducherry, India. Valenciennes 1836 [KA]; [KL]; [PY], Gunther 1861 [PY], Blanc and Hureau 1971 [KA]; [KL]; [PY].

Mugil oeur Fabricius [J. C.] in Niebuhr (ex Forsskål) 1775: 74, xiv [Descriptiones animalium (Forsskål)] [No locality stated] Red Sea. Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN], *Myxus superficialis* Klunzinger [C. B.] 1870: 831 [Verhandlungen der K.-K. zoologisch-botanischen Gesellschaft in Wien v. 20] Al-Qusair, Red Sea Governorate, Egypt, Red Sea. Day 1888b [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN].

Mugil our Fabricius [J. C.] in Niebuhr (ex Forsskål) 1775: 74, xiv [Descriptiones animalium (Forsskål)] [No locality stated] Red Sea. Jacob and Krishnamurthy 1948 [TN].

Mugil cephalus Linnaeus [C.] 1758: 316 [Systema Naturae, Ed. X v. 1] European sea, Europe. Hamilton 1822 [Ganga River], Chaudhuri 1917 [OR], John 1955 [KL], Hora 1923 [OR], Misra 1959 [MH]; [Malabar]; [KL]; [TN]; [AP]; [OR]; [WB], Menon 1961 [TN]; [AP]; [PY], Menon 1961 [OR], Luther 1963 [TN], Shetty et al. 1965 [OR], Jhingran and Natarajan 1969 [OR], Luther 1967 [PL]; [OR], Rama Rao 1972 [TN]; [PY]; [AP], Luther 1973 [KL]; [TN]; [AP]; [OR]; [WB], Rangaswamy 1975 [PL], Das 1978 [GA], Jeyaseelen and Krishnamurthy 1980 [TN], Luther 1977 [KL]; [TN], Sulochanamma et al. 1981 [TN], Talwar and Kacker 1984 [KL]; [TN]; [PL]; [OR]; [WB], Tikader and Das 1985 [AN], Ramaiyan et al. 1987 [TN], Mandal and Nandi 1989 [WB], Nammalwar and Mohanraj 1990 [GA], Talwar and Jhingran 1991 [WB], Goswami 1992 [WB], Rao et al. 1992 [OR], Talwar et al. 1992 [WB], Barman 1993 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [AP]; [OR]; [WB], Indra 1994 [TN], Khora and Rao 1994 [OR], Gajbhiye et al. 1995 [MH], Jayaram 1995 [AP], Rama Rao 1995 [OR], Venkateswarlu et al. 1998 [OR], Indra and Mary 1999 [TN], Mishra et al. 1999 [OR], Barman et al. 2000 [GJ], Chatterjee et al. 2000 [WB], Sen and Banerjee 2000 [GJ], Cherian et al. 2001 [KL], Krishnan and Mishra 2001 [AP], Khan 2002 [WB], Venkataraman et al. 2002 [TN], Mishra and Krishnan 2003 [PY], Mishra et al. 2003 [WB], Rajan 2003 [AN], Barman et al. 2004 [AP], Rema devi et al. 2004 [PL], Hiware 2005 [MH], Narayanan et al. 2005 [KL], Ramanujam 2005 [PY], Gopi 2006 [KL], Barman et al. 2007 [MH], Barman et al. 2007 [OR], Krishnan et al. 2007 [TN], Raghunathan 2007 [KL], Mishra 2008 [AP], Nandi et al. 2008 [GA], Pal and Kar 2008 [WB], Ramesh et al. 2008 [TN], Radhakrishnan et al. 2009 [KL], Ramanujam and Anbarasan 2009 [TN], Santhosh and Radhakrishnan 2009 [KL], Saravanakumar et al. 2009 [GJ], Shinde et al. 2009 [MH], Fernandes and Achuthankutty 2010 [GA], Mishra 2010 [AP], Barman et al. 2011 [TN], Indra et al. 2011 [AP], Pawar 2011 [MH], Prabhakar 2011 [MH], Tasneem 2011 [MH], Barman et al. 2012 [MH], Karmakar et al. 2012 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [AP]; [OR]; [WB]; [AN], Sanyal et al. 2012 [WB], Barman et al. 2013 [KA], Kannappan and Karthikeyan 2013 [TN], Rahman et al. 2013 [TN], Rao and Rath 2013 [OR], Rao et al. 2013 [AP], Suresh et al. 2013 [GJ]; [MH]; [TN]; [AP], Khedkar et al. 2014 [GJ], Murugan et al. 2014 [TN], Pawar 2014 [MH], Pavinkumar 2014 [TN], Ramanujam et al. 2014 [TN], Rao and Rath 2014 [OR], Bharadhirajan et al. 2015 [TN], Khan 2015 [TN], Mahesh and Saravanakumar 2015 [TN], Mohanty et al. 2015 [OR], Mohapatra et al. 2015 [OR], Parmar et al. 2015 [GJ], Pavinkumar et al. 2015 [TN], Karuppasamy 2016 [TN], Baiju et al. 2016 [KL], Govindan and Ravichandran 2016 [TN], Joshi et al. 2016 [TN], Sahadevan 2016 [KL], Dayal et al. 2014 [WG], Kar et al. 2017 [WB], Mogalekar et al. 2017 [TN], Raju et al. 2015 [TN], Raval et al. 2017 [GJ], Yennawar et al. 2017 [WB], Mogalekar and Canciyal 2018 [TN], Mogalekar et al. 2018 [TN], Panda et al. 2018 [OR], Rakshit and Chanda 2018 [WB], Bhatt and Mankodi 2020 [GJ], Garima et al. 2020 [MH], Bharadwaj and Prasad 2021 [KA], Pathak and Lavudya 2021 [MP], Singh et al. 2021 [GJ], Sidat et al. 2021 [GJ], Present Study [GJ].

Genus *Osteomugil* Luther, 1982

Osteomugil cunnesius (Valenciennes, 1836)

Mugil cunnesius Valenciennes [A.] in Cuvier & Valenciennes 1836: 114 [Histoire naturelle des poissons v. 11] Coromandel coast, India; Molucca Islands, Indonesia; Mumbai, India. Valenciennes 1836 [MH]; [Malabar], Day 1865a [Malabar], Day 1865b [KL], Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD], Chaudhuri 1917 [OR], Hora 1923 [OR], John 1955 [KL], Sarojini 1958 [WB], Luther 1967 [TN], Blanc and Hureau 1971 [MH]; [KA]; [KL], Menon and Talwar 1972 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN], Talwar 1972 [GA], Luther 1973 [KL]; [TN]; [OR]; [WB], Raghunathan 2007 [KL], Kar et al. 2017 [WB].

Mugil amarulus Valenciennes [A.] in Cuvier & Valenciennes 1836: 133 [Histoire naturelle des poissons v. 11] Java, Indonesia; Coromandel, India; Puducherry, India. Gunther 1861 [TN]; [AP]; [PY]; [OR]; [WB], Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN], Blanc and Hureau 1971 [MH]; [PY].

Mugil kelaartii Günther [A.] 1861: 429 [Catalogue of the fishes in the British Museum v. 3] Sri Lanka and Philippines. Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN], Talwar and Sen 1967 [TN].
Liza amarula Cuvier & Valenciennes 1836: Herre 1939 [AN], Herre 1941 [AN].
Mugil ophuysenii Bleeker [P.] 1858: 279 [Natuurkundig Tijdschrift voor Nederlandsch Indië v. 16 (no. 2)] Sumatra, Indonesia. John 1955 [KL]
Liza cunnesius (Valenciennes 1836): Sarojini 1958 [WB], Mohanraj et al. 1987 [TN].
Mugil strongylocephalus Richardson [J.] 1846: 249 [Report of the British Association for the Advancement of Science 15th meeting, 1845] Hong Kong. Misra 1959 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN].
Moolgarda cunnesius Randall, 1995: 237 [Coastal Fishes of Oman]. Jeyaseelen and Krishnamurthy 1980 [TN], Murugan et al. 2014 [TN], Mohanty et al. 2015 [OR], Joshi et al. 2016 [TN], Kar et al. 2017 [WB], Mogalekar et al. 2017 [TN], Mogalekar et al. 2018 [TN].
Valamugil cunnesius Smith, 1975: 64 [Common and scientific names of the fishes from southern Africa]. Mandal and Nandi 1989 [WB], Talwar and Jhingran 1991 [WB], Goswami 1992 [WB], Talwar et al. 1992 [WB], Rama Rao 1995 [OR], Venkateswarlu et al. 1998 [OR], Barman et al. 2000 [GJ], Chatterjee et al. 2000 [WB], Sen and Banerjee 2000 [GJ], Krishnan and Mishra 2001 [AP], Venkataraman et al. 2002 [TN], Mishra and Krishnan 2003 [PY], Rajan 2003 [AN], Barman et al. 2004 [AP], Rema devi et al. 2004 [PL], Gopi 2006 [KL], Barman et al. 2007 [OR], Krishnan et al. 2007 [TN], Mishra 2008 [AP], Ramesh et al. 2008 [TN], Radhakrishnan et al. 2009 [KL], Santhosh and Radhakrishnan 2009 [KL], Ramanujam & Anbarasan 2009 [TN], Mishra 2010 [AP], Barman et al. 2011 [TN], Barman et al. 2012 [MH], Sanyal et al. 2012 [WB], Barman et al. 2013 [KA], Rahman et al. 2013 [TN], Rao and Rath 2013 [OR], Khan 2015 [TN], Mohapatra et al. 2015 [OR], Govindan and Ravichandran 2016 [TN], Yennawar et al. 2017 [WB].
Velamugil cunnesius (Valenciennes 1836): Das and Dev Roy 1989 [AN]. – Spelling mistake
Osteomugil cunnesius (Valenciennes 1836): Luther 1977 [KL]; [TN], Ramaiyan et al. 1987 [TN]

Remarks. The paired, short, stout, hook-like structures one each arising from either side of the neural arch of the trunk vertebra at the region of the neural post-zygapophysis are the posterior zygapophysial hooks. They are present on the second and third vertebra in *Mugil* and only on the second vertebra in *Valamugil* and *Ellochelon*. These are directed laterally, anteriorly, and ventrally, respectively, in the above three genera. As these hooks could be homologous to the second vertebral processes, the new genus, *Osteomugil*, alone could be considered to have no extra process of any kind on the second or third trunk vertebra (Luther 1977). On account of this distinctive character of *Mugil cunnesius* Valenciennes, Luther (1977) proposed to remove *M. cunnesius* from the *Mugil* and place it under a new *Osteomugil* gen. nov. based on osteological difference.

Osteomugil speigleri (Bleeker, 1858)
Mugil suppositus Günther [A.] 1861: 437 [Catalogue of the fishes in the British Museum v. 3] Penang River, Penang, Malaysia. Day 1865a [Malabar].
Mugil speigleri Bleeker [P.], 1858: 279 [Natuurkundig Tijdschrift voor Nederlandsch Indië v. 16 (no. 2)] Jakarta, Java, Indonesia. Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN], John 1955 [KL], Chaudhuri 1917 [OR], Hora 1923 [OR], Menon 1961 [TN]; [AP]; [PY], Menon 1961 [OR], Vanmali et al. 2015 [MH].
Moolgarda speigleri Manilo and Bogorodsky 2003: S113, Jeyaseelen and Krishnamurthy 1980 [TN], Mohanty et al. 2015 [OR], Mogalekar et al. 2017 [TN], Mogalekar et al. 2018 [TN].
Osteomugil speigleri Sathyashree, Sitarami Reddy & Natarajan, 1981: 1-6. Sathyashree et al. 1981 [TN], Ramaiyan et al. 1987 [TN].
Valamugil speigleri Talwar & Kacker 1984: 733; fig. 297 [Commercial Sea fishes of India]. Mandal & Nandi 1989 [WB], Talwar and Jhingran 1991 [WB], Rao et al. 1992 [OR], Talwar et al. 1992 [WB], Yazdani et al. 1992 [MH], Khora and Rao 1994 [OR], Rama Rao 1995 [OR], Venkateswarlu et al. 1998 [OR], Barman et al. 2000 [GJ], Venkataraman et al. 2002 [TN], Barman et al. 2004 [AP], Barman et al. 2007 [OR], Krishnan et al. 2007 [TN], Mishra 2008 [AP], Ramesh et al. 2008 [TN], Radhakrishnan et al. 2009 [KL], Santhosh and Radhakrishnan 2009 [KL], Mishra 2010 [AP], Barman et al. 2011 [TN], Barman et al. 2012 [MH], Sanyal et al. 2012 [WB], Barman et al. 2013 [KA], Rahman et al. 2013 [TN], Rao and Rath 2013 [OR], Mohapatra et al. 2015 [OR], Joshi et al. 2016 [TN], Kar et al. 2017 [WB], Sen and Mandal 2019 [WB].

Osteomugil perusii (Valenciennes, 1836)
Osteomugil perusii (Valenciennes, 1836): Rahman et al. 2014 [KL]; [TN].

Osteomugil engeli (Bleeker, 1858)
Mugil engeli Bleeker [P.] 1858: 277 [Natuurkundig Tijdschrift voor Nederlandsch Indië v. 16 (no. 2)] Jakarta, Java, Indonesia. Day 1865a [Malabar], Day 1865b [KL], John 1955 [KL]

Genus *Parachelon* Durand, Chen, Shen, Fu & Borsa, 2012

Parachelon grandisquamis (Valenciennes, 1836)
Parachelon grandisquamis (Valenciennes, 1836): Garima et al. 2020 [MH].

Remarks. The longitudinal scale counts of only five other species of *Planiliza* overlap with that of *Parachelon grandisquamis*. Of these, *Planiliza alata* and *Planiliza subviridis* differ in having 11 transverse rows of scales, in having the origin of the first dorsal fin nearer the snout tip than the caudal base, and having fewer than six pyloric caeca. *Planiliza vaigensis* has eight anal rays and has only eight transverse rows of scales. *Planiliza melinopterus* is very similar to *Parachelon grandisquamis* but like the other species contrasted above it is an Indo-Pacific species, not overlapping the range of *P. grandisquamis* in West Africa. It has relatively short pectoral fins with only 15 pectoral rays, compared with the normal 16 in *P. grandisquamis*, and its gill rackers are more numerous and of type 4 rather than type 3 (Thomson 1997).

Genus *Paramugil* Ghasemzadeh, Ivantsoff & Aarn, 2004

Paramugil parmatus (Cantor, 1849)
Mugil oligolepis Bleeker [P.] 1859: 437, 275? [Natuurkundig Tijdschrift voor Nederlandsch Indië v. 19] Sumbawa Island, Lesser Sunda Islands, Indonesia. Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN], Jacob and Krishnamurthy 1948 [TN], Jayram 1981 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [AP]; [OR]; [WB]
Chelon oligolepis Misra, 1959: 213 [An aid to commercial fishes]. Misra 1959 [MH]; [WB], Menon 1961 [OR]
Liza oligolepis Roberts 1978: 61 [An ichthyological survey of the Fly River in Papua New Guinea with descriptions of new species]. Mohanraj et al. 1987 [TN]

Genus *Planiliza* Whitley, 1945

Planiliza alata (Steindachner, 1892)
Planiliza alata (Steindachner, 1892): Joshi et al. 2016 [TN]

Remarks. Joshi et al. (2016) have reported this species in the Checklist of fishes of the Gulf of Mannar ecosystem, Tamil Nadu, India. They did not mention the identification characters and photographs of the collected specimen. Therefore, it creates ambivalence about their presence in Indian waters. According to Fish base, WoRMS, and Eschmeyer's Catalogue of Fishes, it is distributed from East and South Africa to Madagascar and Mauritius (Mascarenes); eastern Indonesia, and New Guinea east to Tonga and Marquesas Islands, south to northern Western Australia and Gulf of Carpentaria (Queensland, Australia). The distribution range has Indian waters in between. Therefore, it requires a detailed taxonomic study.

Planiliza carinata (Valenciennes, 1836)

Mugil carinatus Valenciennes [A.] (ex Ehrenberg) in Cuvier and Valenciennes 1836: 148 [Histoire naturelle des poissons v. 11] Red Sea. Day 1865a [Malabar], Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN], John 1955 [KL], Pillay 1962b [MH]; [Malabar], Blanc and Hureau 1971 [MH]; [PY], Menon and Talwar 1972 [GJ]; [MH]; [GA]; [KA]; [KL]; [AN], Talwar 1972 [GA].

Liza carinata Trewavas & Ingham, 1972: 24, Red Sea, Suez, L. Timsah, Kabrit, Port Said, Great Bitter Lake, Hammam Faroum, Bardwail. Barman et al. 2000 [GJ], Mishra and Krishnan 2003 [PY], Krishnan and Mishra 2004 [GJ]; [MH]; [PY], Ramesh et al. 2008 [TN], Barman et al. 2012 [MH], Kumar 2013 [GJ], Joshi et al. 2016 [TN], Mogalekar et al. 2018 [TN].

Planiliza klunzingeri (Day, 1888)

Mugil klunzingeri Day [F.] 1888: 264 [Proceedings of the Zoological Society of London 1888 (pt 3) (art. 4) (for 1 May 1888)] Mumbai, India. Day 1888a [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN].

Liza klunzingeri Senou, Yoshino and Okiyama, 1987: 309; fig. 3 & 5. Khedkar et al. 2014 [GJ], Joshi et al. 2016 [TN]

Chelon klunzingeri Randall, 1995: 235 [Coastal Fishes of Oman]. Mogalekar et al. 2018 [TN].

Planiliza klunzingeri (Day, 1888): Sidat et al. 2021 [GJ]

Remarks. Mugil klunzingeri Day 1888 was previously described as *Mugil carinatus* Valenciennes, 1836 (Fishes of India, p. 349, not C. & V.) by Day 1865a, 1878. Later, it was described as new species as *Mugil klunzingeri* Day, 1888 with a distribution range from red sea to seas of India.

Planiliza macrolepis (Smith, 1846)

Mugil cunnumboo Day [F.] 1865: 141, Fig. [The fishes of Malabar] Malabar, India. Day 1865a [Malabar].

Mugil borneensis Bleeker [P.] 1851: 201 [Natuurkundig Tijdschrift voor Nederlandsch Indië v. 2 (no. 2)] Bandjarmasin, Borneo, Indonesia. Day 1869 [OR], Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN].

Mugil troschellii Bleeker [P.] 1858:277 [Natuurkundig Tijdschrift voor Nederlandsch Indië v. 16 (no. 2)]. Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN].

Liza borneensis Chaudhuri, 1917: 498, Fauna of the Chilika Lake: fish part III. Chaudhuri 1917 [OR], Herre 1940 [AN], Herre 1941 [AN], Hora 1923 [OR].

Liza troschelii Jordan and Richardson, 1909: 176 [Memoirs of the Carnegie Museum, IV]. Chaudhuri 1917 [OR], Whitehouse 1922 [TN], Hora 1923 [OR], Herre 1939 [AN].

Liza macrolepis Smith, 1948: 840, fig. 11, East London to Beira. Herre 1941 [AN], John 1955 [KL], Luther 1963 [TN], Luther 1967 [TN], Luther 1973 [KL]; [TN]; [AP]; [OR], Rama Rao 1972 [TN]; [PY]; [AP], Rangaswamy 1980 [PL], Jayram 1981 [KL]; [OR]; [WB], Luther 1977 [KL]; [TN], Talwar and Kacker 1984 [KL]; [TN]; [OR], Mohanraj et al. 1987 [TN], Ramaiyan et al. 1987 [TN], Das and Dev Roy 1989 [AN], Talwar et al. 1992 [WB], Jayaram 1995 [AP], Rama Rao 1995 [OR], Venkateswarlu et al. 1998 [OR], Mishra and Srinivasan 1999 [KA]; [KL], Mishra et al., 1999 [OR], Barman et al. 2000 [GJ], Krishnan & Mishra 2001 [AP], Venkataraman et al. 2002 [TN], Rajan 2003 [AN], Barman et al. 2004 [AP], Ramanujam 2005 [PY], Subba Rao and Sastry 2005 [GJ], Gopi 2006 [KL], Barman et al. 2007 [OR], Krishnan et al. 2007 [TN], Raghunathan 2007 [KL], Mishra 2008 [AP], Ramesh et al. 2008 [TN], Radhakrishnan et al. 2009 [KL], Santhosh and Radhakrishnan 2009 [KL], Mishra 2010 [AP], Barman et al. 2011 [TN], Lakra et al. 2011 [KL], Barman et al. 2012 [MH], Sanyal et al. 2012 [WB], Barman et al. 2013 [KA], Rahman et al. 2013 [TN], Rao and Rath 2013 [OR], Rao and Rath 2014 [OR], Bharadhirajan et al. 2015 [TN], Murugan et al. 2014 [TN], Ramanujam et al. 2014 [TN], Mahesh and Saravanakumar 2015 [TN], Mohanty et al. 2015 [OR], Mohapatra et al. 2015 [OR], Joshi et al. 2016 [TN], Sahadevan 2016 [KL], Dayal et al. 2014 [WG], Kar et al. 2017 [WB], Yennawar et al. 2017 [WB], Sen and Mandal 2019 [WB].

Mugil troscheli Bleeker [P.] 1858: 277 [Natuurkundig Tijdschrift voor Nederlandsch Indië v. 16 (no. 2)]. John 1955 [KL], Luther 1967 [TN].

Chelon macrolepis Misra, 1959: 213 [An Aid to Commercial Fishes] Misra 1959 [KL]; [OR]; [WB], Menon 1961 [OR], Pawar 2011 [MH], Prabhakar 2011 [MH], Khan 2015 [TN], Baiju et al. 2016 [KL].

Mugil macrolepis Smith [A.] 1846: no pagination, Pl. 28 (fig. 2) [Illustrations of the zoology of South Africa v. 4] Rivers and fresh water lakes, South Africa. Pillay 1962b [GJ]; [MH]; [Malabar]; [KL]; [TN]; [OR]; [AN], Menon and Talwar 1972 [AN], Talwar 1972 [GA].

Planiliza macrolepis (Smith 1846): Jeyaseelen & Krishnamurthy 1980 [TN], Karuppasamy 2016 [TN], Mogalekar et al. 2017 [TN], Mogalekar et al. 2018 [TN], Bharadwaj and Prasad 2021 [KA], Pathak & Lavudya 2021 [MP].

Liza microlepis (Smith, 1846): Mandal and Nandi 1989 [WB] – spelling mistake.

Remarks. Pillay (1962b) merged three species namely *M. borneensis*, *M. troschelii*, and *M. poecilus* from Day's (1878, 1889) descriptions of the Indian species of *Mugil* and considered synonyms of *M. macrolepis*. Pillay (1953) has shown that *M. poecilus* is not in any way different from *M. troschelii*. The presence of round black spot on the scales of *M. poecilus* was the only significant distinguish character examined by the Day (1865b, 1878). These spots turned to be only the groups of algae when examined by Pillay (1953). Therefore, he merged *M. poecilus* with *M. troschelii*. Jordan and Seale (1905) examined the specimens of *M. borneensis* and *M. troschelii* and found marked similarities between them. They considered the two synonymous and described the specimen under the name *Liza troscheli*. Whitehouse (1922) collected the specimens from Tuticorin, India and he also could not conclude that the specimens are of either *M. borneensis* or *M. troschelii*. However, he also described them under the name *Liza troschelli*. Roxas (1934) has found *M. troscheli* and *M. borneensis* to be synonymous with *M. macrolepis*. After taking into the consideration, the species described from Indian waters as *M. troscheli* and *M. borneensis* are to be considered synonymous with *M. macrolepis*, the latter name getting the priority.

Planiliza mandapamensis (Thomson 1997)

Liza mandapamensis Thomson [J. M.] 1997: 526 [Memoirs of the Queensland Museum v. 41 (pt 3)] Kilakarei, south of Mandapam, southern India. Thomson 1997 [TN], Mishra et al. 2013 [TN], Joshi et al. 2016 [TN].

Planiliza mandapamensis (Thomson 1997): Mogalekar at al. 2018 [TN].

Remarks. Thomson (1997) examined a holotype specimen in which he observed seven dorsal rays. This is very rare occurrence in other mugilids. *P. mandapamensis* differs from other species of *Planiliza* with only eight anal rays in having a greater longitudinal scale count. Other species that normally exhibit nine anal rays but have had individuals recorded with only eight rays are *Liza aurata*, *L. dussumerii*, and *L. subviridis*. *P. mandapamensis* differs from *L. subviridis* in an apparently greater number of pectoral rays, a lower transverse scale count, in not having the adipose tissue covering part if the iris and in various proportional measurements as well as the geographic separation. *P. mandapamensis* has a higher scale count than either *L. aurata* or *L. dussumerii*.

Planiliza melinopterus (Valenciennes, 1836)

Liza melinoptera Smith & Smith, 1986: 717, fig. 222.6 [In: Smiths' Sea Fishes] Natal; IndoWest Pacific. Herre 1939 [AN], Herre 1940 [AN], Herre 1941 [AN], Das & Dev Roy 1989 [AN], Talwar and Jhingran 1991 [WB], Rama Rao 1995 [OR], Barman et al. 2000 [GJ], Krishnan & Mishra 2001 [AP], Venkataraman et al. 2002 [TN], Barman et al. 2007 [OR], Krishnan et al. 2007 [TN], Mishra 2008 [AP], Ramesh et al. 2008 [TN], Mishra 2010 [AP], Barman et al. 2011 [TN], Barman et al. 2012 [MH], Barman et al. 2013 [KA], Kumar 2013 [GJ].

Mugil melinopterus Valenciennes [A.] (ex Quoy & Gaimard) in Cuvier and Valenciennes 1836: 146, Pl. 314 [Histoire naturelle des poissons v. 11] Vanikoro Island, Santa Cruz Islands, southwestern Pacific. Menon and Talwar 1972 [AN] as *Mugil melinoptera*.

Liza melinoptera Jordan & Seale, 1905: 21, 7 Apia, Pago Pago. Goswami 1992 [WB], Mohanty et al. 2015 [OR], Mohapatra et al. 2015 [OR], Joshi et al. 2016 [TN] — as *Liza melinopterus*.

Chelon melinoptrus Senou, 1997: 51-55; fig. 1; tables 1-2. Mogalekar et al. 2018 [TN].

Planiliza melinopterus (Valenciennes, 1836): Canciyal et al. 2020 [TN].

Remarks. Planiliza melinopterus is extremely similar to *P. subviridis* but lacks the latter's extensive adipose eyelid, has fewer transverse rows of scales and has 6 pyloric caeca (Thomson, 1997).

Planiliza parsia (Hamilton 1822)

Mugil parsia Hamilton [F.] 1822:215, 380, Pl. 17 (fig. 71) [An account of the fishes found in the river Ganges] Fresh water rivers of Bengal. No types known. Hamilton 1822 [WB], Gunther 1861 [WB], Day 1865a [Malabar], Day 1865b [KL], Day 1869 [OR], Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN], Sarojini 1957 [AP]; [WB]; [OR], Misra 1959 [MH]; [Malabar]; [KL]; [WB], Menon 1961 [TN]; [AP]; [PY], Pillay 1962b [MH]; [TN]; [PY]; [AP]; [OR]; [WB]; [AN], Talwar 1972 [GA], Tasneem 2011 [MH].

Mugil olivaceus Day [F.] 1878: 357 [The fishes of India Part 2] Seas of India, ascending rivers. Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN].

Liza parsia Munro 1955: 93; Pl. 16; fig. 258; Sri Lanka. Luther 1967 [TN]; [WB], Tilak 1972 [GA], Luther 1973 [KL]; [TN]; [AP]; [OR]; [WB], Rangaswamy 1980 [PL], Jayram 1981 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [AP]; [OR]; [WB]; [AN], Jayaram et al. 1982 [MH]; [KA]; [KL]; [TN]; [WB], Luther 1977 [KL]; [TN], Talwar and Kacker 1984 [KL]; [TN]; [PL]; [OR]; [WB], Mohanraj et al. 1987 [TN], Ramaiyan et al. 1987 [TN], Mandal and Nandi 1989 [WB], Talwar and Jhingran 1991 [WB], Indra 1992 [TN], Goswami 1992 [WB], Rao et al. 1992 [OR], Sen 1992 [WB], Talwar et al. 1992 [WB], Barman 1993 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [AP]; [OR]; [WB], Dutta et al. 1993 [MH]; [KL]; [OR] [WB], Indra 1994 [TN], Khora and Rao 1994 [OR], Agrawal and Ghosh 1995 [WB], Jayaram 1995 [AP], Rama Rao 1995 [OR], Mishra and Krishnan 1996 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [AN], Venkateswarlu et al. 1998 [OR], Mishra et al., 1999 [OR], Barman et al. 2000 [GJ], Chatterjee et al. 2000 [WB], Sen and Banerjee 2000 [GJ], Krishnan and Mishra 2001 [AP], Khan 2002 [WB], Venkataraman et al. 2002 [TN], Mishra and Krishnan 2003 [PY], Mishra et al. 2003 [WB], Rajan 2003 [AN], Barman et al. 2004 [AP], Barman et al. 2004 [WB], Rema devi et al. 2004 [PL], Ramanujam 2005 [PY], Subba Rao and Sastry 2005 [GJ], Gopi 2006 [KL], Barman 2007 [WB], Barman et al. 2007 [OR], Krishnan et al. 2007 [TN], Raghunathan 2007 [KL], Sharma 2007 [MP]; [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB], Mishra 2008 [AP], Nandi et al. 2008 [GA], Pal and Kar 2008 [WB], Ramesh et al. 2008 [TN], Radhakrishnan et al. 2009 [KL], Ramanujam and Anbarasan 2009 [TN], Santhosh and Radhakrishnan 2009 [KL], Mishra 2010 [AP], Barman et al. 2011 [TN], Barman et al. 2012 [MH], Karmakar et al. 2012 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [AP]; [OR]; [WB]; [AN], Sanyal et al. 2012 [WB], Barman et al. 2013 [KA], Kannappan and Karthikeyan 2013 [TN], Rahman et al. 2013 [TN], Rao and Rath 2013 [OR], Murugan et al. 2014 [TN], Pavinkumar 2014 [TN], Ramanujam et al. 2014 [TN], Rao and Rath 2014 [OR], Bharadhirajan et al. 2015 [TN], Mahesh and Saravanakumar 2015 [TN], Mohanty et al. 2015 [OR], Mohapatra et al. 2015 [OR], Pavinkumar et al. 2015 [TN], Joshi et al. 2016 [TN], Sahadevan 2016 [KL], Dayal et al. 2014 [WG], Raju et al. 2015 [TN], Yennawar et al. 2017 [WB], Rakshit and Chanda 2018 [WB], Sen and Mandal 2019 [WB]

Chelon parsia Shibukawa 2009: 42 [In: Fishes of Andaman Sea: west coast of southern Thailand] Jeyaseelen & Krishnamurthy 1980 [TN], Ramaiyan et al. 1987 [TN], Khan 2015 [TN], Karuppasamy 2016 [TN], Mogalekar et al. 2017 [TN], Mogalekar and Canciyal 2018 [TN], Mogalekar et al. 2018 [TN], Panda et al. 2018 [OR], Pathak and Lavudya 2021 [MP].

Liza persia (Hamilton, 1822): Khan 1995 [WB] — Spelling mistake

Planiliza parsia (Hamilton 1822): Saravanakumar et al. 2009 [GJ], Present Study [GJ]

Remarks. Planiliza *parsia* is differ from the *P. tade* and *P. subviridis* by lacking the depressed pointed head of the former which also has teeth on its vomer and palatines. It is the only member in *Planiliza* whose mid-gap is at a level above mid-pupil. *P. subviridis* has a relatively short snout and its mouth corner does not reach as far back as in *P. parsia*.

Planiliza planiceps (Valenciennes, 1836)

Mugil planiceps Valenciennes [A.] in Cuvier and Valenciennes 1836:122 [Histoire naturelle des poissons v. 11] Bengal, eastern Indian Ocean. Bleeker 1853 [WB], Gunther 1861 [WB], Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN], Blanc and Hureau 1971 [WB], Gajbhiye et al. 1995 [MH].

Mugil belanak Bleeker [P.] 1857:337 [Natuurkundig Tijdschrift voor Nederlandsch Indië v. 13 (no. 2)] Jakarta, Java, Indonesia. Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB].

Mugil gymnocephalus Swainson [W.] 1839: 234; Pl. 180 [The natural history and classification v. 2]. Chaudhuri 1917 [OR], Hora 1923 [OR].

Liza tade Munro 1955: 93; Pl. 16; fig. 257; Sri Lanka. Luther 1967 [TN], Kannappan and Karthikeyan 2013 [TN].

Mugil tade Fabricius [J. C.] in Niebuhr (ex Forsskål) 1775:74, xiv [Descriptiones animalium (Forsskål)] [No locality stated] Red Sea. No types known. Talwar 1972 [GA].

Liza planiceps Carpenter, Krupp, Jones and Zajonz 1997: 203. Barman et al. 2013 [KA], Rahman et al. 2013 [TN], Mohapatra et al. 2015 [OR], Kar et al. 2017 [WB].

Chelon planiceps Fricke & Kulbicki, 2006: 321, from New Caledonia. Rao and Rath 2013 [OR], Pavinkumar 2014 [TN], Khan 2015 [TN], Pavinkumar et al. 2015 [TN], Karuppasamy 2016 [TN], Ansar et al. 2017 [KL], Mogalekar and Canciyal 2018 [TN], Panda et al. 2018 [OR], Bhatt and Mankodi 2020 [GJ], Pathak & Lavudya 2021 [MP].
Planiliza planiceps (Valenciennes, 1836): Sidat et al. 2021 [GJ], Bhatt et al. 2022 [GJ].

Planiliza tade (Fabricius 1775)
Mugil bontah Bleeker [P.] 1853: 48 [Verhandelingen van het Bataviaasch Genootschap van Kunsten en Wetenschappen. v. 25 (art. 8)] Puducherry and Bengal, India. Day 1870 [AN].
Mugil tade Fabricius [J. C.] in Niebuhr (ex Forsskål) 1775: 74, xiv [Descriptiones animalium (Forsskål)] [No locality stated] Red Sea. No types known. Day 1888b [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN], Kulkarni 1947 [MH], Herre 1941 [AN], John 1955 [KL], Misra 1959 [OR]; [WB]; [AN], Menon 1961 [TN]; [AP]; [PY], Rama Rao 1972 [TN]; [PY]; [AP], Nandi et al. 2001 [WB].
Mugil poicilus Day [F.] 1865: 33 [Proceedings of the Zoological Society of London 1865 (pt 1) (art. 1)] Cochin, Malabar coast, India. Day 1865a [Malabar], Day 1865b [KL], Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL].
Liza tade Munro, 1995: 93; Pl. 16; fig. 257; Ceylon. Pillay 1954 [WB], Luther 1973 [KL]; [OR]; [WB], Jayram 1981 [MH]; [KL]; [TN]; [AP]; [OR]; [WB]; [AN], Jayram et al. 1982 [KA]; [TN]; [OR]; [WB]; [AN], Luther 1977 [KL]; [TN], Talwar and Kacker 1984 [KL]; [OR]; [WB], Mohanraj et al. 1987 [TN], Ramaiyan et al. 1987 [TN], Mandal and Nandi 1989 [WB], Talwar and Jhingran 1991 [WB], Goswami 1992 [WB], Talwar et al. 1992 [WB], Agrawal and Ghosh 1995 [WB], Jayaram 1995 [AP], Khan 1995 [WB], Rama Rao 1995 [OR], Venkateswarlu et al. 1998 [OR], Mishra et al., 1999 [OR], Barman et al. 2000 [GJ], Chatterjee et al. 2000 [WB], Krishnan and Mishra 2001 [AP], Khan 2002 [WB], Venkataraman et al. 2002 [TN], Mishra et al. 2003 [WB], Barman et al. 2004 [AP], Barman et al. 2004 [WB], Remadevi et al. 2004 [PL], Barman et al. 2007 [MH], Barman 2007 [WB], Barman et al. 2007 [OR], Krishnan et al. 2007 [TN], Raghunathan 2007 [KL], Mishra 2008 [AP], Pal and Kar 2008 [WB], Ramesh et al. 2008 [TN], Mishra 2010 [AP], Barman et al. 2011 [TN], Barman et al. 2012 [MH], Karmakar et al. 2012 [MH]; [KL]; [TN]; [AP]; [OR]; [WB]; [AN], Sanyal et al. 2012 [WB], Rahman et al. 2013 [TN], Rao and Rath 2014 [OR], Bharadhirajan et al. 2015 [TN], Murugan et al. 2014 [TN], Ramanujam et al. 2014 [TN], Mohanty et al. 2015 [OR], Yennawar et al. 2017 [WB], Rakshit and Chanda 2018 [WB], Sen and Mandal 2019 [WB].
Chelon tade Fricke, 2008: 20. Joshi et al. 2016 [TN], Mogalekar et al. 2017 [TN], Mogalekar et al. 2018 [TN].
Planiliza tade (Fabricius 1775): Canciyal et al. 2020 [TN].

Planiliza subviridis (Valenciennes 1836)
Mugil subviridis Valenciennes [A.] in Cuvier and Valenciennes 1836: 115 [Histoire naturelle des poissons v. 11] Ganges River, Malabar, India. Valenciennes 1836 [Malabar], Gunther 1861 [Malabar]; [TN], Day 1865a [Malabar], Chaudhuri 1917 [OR], Hora 1923 [OR], Menon 1961 [OR], Blanc & Hureau 1971 [MH]; [PY]; [WB].
Mugil cantoris Bleeker [P.] 1853: 100, Pl. 1 (fig. 4) [Verhandelingen van het Bataviaasch Genootschap van Kunsten en Wetenschappen. v. 25 (art. 8)] Hooghly River, Calcutta, India. Bleeker 1853 [WB], Gunther 1861 [WB].
Mugil sundanensis Bleeker [P.] 1853: 265 [Natuurkundig Tijdschrift voor Nederlandsch Indië v. 4 (no. 2)] Benculen [Bengkulu], Sumatra; Jakarta, Java, Indonesia. Day 1865a [Malabar], Day 1865b [KL], Day 1870 [AN].
Mugil dussumieri Valenciennes [A.] in Cuvier and Valenciennes 1836: 147 [Histoire naturelle des poissons v. 11] Mumbai and Coromandel coast, India. Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN], Herre 1940 [AN], Herre 1941 [AN], Blanc and Hureau 1971 [TN]; [PY]; [AP], Ramesh et al. 2008 [TN].
Mugil jerdoni Day [F.] 1878: 352 [The fishes of India Part 2] Seas of India. Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN], Chaudhuri 1917 [OR], Hora 1923 [OR].
Liza dussumieri Thomson, 1954: 97, fig 6 [The Mugilidae of Australia and Adjacent Seas]. Jacob & Krishnamurthy 1948 [TN], Ramaiyan et al. 1987 [TN], Ramanujam 2005 [PY], Joshi et al. 2016 [TN], Sahadevan 2016 [KL].
Liza subviridis McCulloch 1929: 116-117 [A checklist of the fishes recorded from Australia. Part I] Queensland. Jeyaseelen and Krishnamurthy 1980 [TN], Mandal and Nandi 1989 [WB], Talwar and Jhingran 1991 [WB], Goswami 1992 [WB], Talwar et al. 1992 [WB], Rama Rao 1995 [OR], Venkateswarlu et al. 1998 [OR], Barman et al. 2000 [GJ], Cherian et al. 2001 [KL], Krishnan & Mishra 2001 [AP], Mishra and Krishnan 2003 [PY], Barman et al. 2004 [AP], Krishnan and Mishra 2004 [MH]; [PY], Rema devi et al. 2004 [PL], Gopi 2006 [KL], Barman et al. 2007 [OR], Ramesh et al. 2008 [TN], Radhakrishnan et al. 2009 [KL], Santhosh and Radhakrishnan 2009 [KL], Barman et al. 2011 [TN], Barman et al. 2012 [MH], Sanyal et al. 2012 [WB], Barman et al. 2013 [KA], Rahman et al. 2013 [TN], Rao and Rath 2013 [OR], Murugan et al. 2014 [TN], Pavinkumar 2014 [TN], Bharadhirajan et al. 2015 [TN], Mohanty et al. 2015 [OR], Mohapatra et al. 2015 [OR], Pavinkumar et al. 2015 [TN], Joshi et al. 2016 [TN], Mogalekar et al. 2017 [TN], Yennawar et al. 2017 [WB], Sen & Mandal 2019 [WB].
Liza sp.: Narasimhaiah et al. 2013 [KA].
Chelon subviridis Randall, 1995: 236 [Coastal fishes of Oman]. Khan 2015 [TN], Kar et al. 2017 [WB], Mogalekar et al. 2017 [TN], Mogalekar and Canciyal 2018 [TN].
Planiliza subviridis (Valenciennes 1836): Mogalekar et al. 2018 [TN].

Remarks. Durand et al. (2012)Durand et al. (2012) restructured the seven genera of Mugilidae. In which, they transferred Indo-Pacific *Chelon spp*., Indo-Pacific *Liza spp*., and *Paramugil parmatus* under the genus *Planiliza* Whitley, 1945; *Sicamugil cascasia* under *Minimugil*; *Osteomugil* for several species currently under *Moolgarda* and *Valamugil*, including *M. cunnesius*, *M. engeli*, *M. perusii* and *V. robustus* and *Plicomugil* for *Oedalechilus labiosus*.

Genus *Plicomugil* Schultz in Schultz, Herald, Lachner, Welander & Woods, 1953

Plicomugil labiosus (Valenciennes 1836)
Mugil labiosus Valenciennes [A.] in Cuvier and Valenciennes 1836: 125 [Histoire naturelle des poissons v. 11] Red Sea; Mumbai, India. Valenciennes 1836 [MH], Day 1878 [AN], Day 1878 [GJ]; [MH]; [GA]; [KA]; [KL]; [TN]; [PY]; [AP]; [OR]; [WB]; [LD]; [AN].
Liza labiosus Cuvier & Valenciennes, 1836: Herre 1941 [AN].
Plicomugil labiosus Schultz, 1953: 202, Text-fig. 4, pp. 320-322 [U.S. Nat. Mus. Bull.] Bikini, Rongelap, Kwajalein Atolls, Romuk and Reer islands, the Philippines, the Red Sea. Pillay 1962 [AN], Rao 1991 [LD].

Remarks. Valenciennes (Cuvier & Valenciennes, 1836) described it first time and pointed out its closeness to *Mugil crenilabis* Forskal, 1775. Day (1870) described *M. macrochilus* Bleeker, 1854 from Andaman Islands but later, he considered it a synonym of *M. crenilabis* Forskal, 1775 and recorded an allied form, *M. labiosus* Valenciennes,

1836 also from the Andamans in his fishes of India (1878-1888). 2 specimens of *M. labiosus* and one labelled *M. macrochillis*, of Day's collections, were examined by Pillay (1962) and it was found that these three specimens were identical in all essential details. Therefore, if, as Day (1878) considered, his *M. macrochilus* is synonymous with *M. crenilabis*, Day's *M. labiosus* will also have to be considered a synonym of *M. crenilabis*. Schultz (1953), however, has given a clearly defined description of the differences between the two where; he separated them under two different genera, *Crenimugil* and *Plicomugil*. The specimens examined by Pillay (1962) come under Schultz's (1953) *Plicomugil* and not under his *Crenimugil*.

Genus *Rhinomugil* Gill, 1863

Rhinomugil corsula (Hamilton 1822)

Mugil squamipinnis Swainson, 1839: 234 & 413, Ganges River.

Mugil corsula Hamilton [F.] 1822: 221, 381, Pl. 9 (fig. 97) [An account of the fishes found in the river Ganges] Hamilton 1822 [WB], Valenciennes 1836 [WB], Bleeker 1853 [WB], Gunther 1861 [WB], Day 1969 [OR], Day 1873 [AP], Day 1878 [WB], Sinha & Shiromany 1954 [UP], Majumdar 1958 [DL], Jayaram & Singh 1977 [WB].

Siza corsula Chaudhuri 1917: 498 [Fauna of Chilka Lake: Fish]. 3. Chaudhuri 1917 [OR]; [WB]; [BR], Hora 1923 [OR].

Mugil (Liza) corsula Chauhan 1954: 415, Pl. 14 (fig. 16) [Fauna of The Balangir District (Formerly Patna State), Orissa] Chauhan 1954 [OR].

Rhinomugil corsula (Hamilton 1822): Misra 1959: 51, 215 (fig 129) [PB]; [UP]; [BR]; [OR]; [WB], Pillay 1962 [WB], Srivastava 1968 [UP]; [BR]; [WB], Ranganathan and Natrajan 1969 [TN], Luther 1973 [OR]; [WB]; [UP]; [BH], Jayaram and Majumdar 1976 [OR], Menon and Jayaram 1977 [KA]; [TN], Jayram 1981 [Ganga], Jayram et al. 1982 [TN]; [OR]; [WB], Pradhan and Singh 1984 [MH], Talwar and Kacker 1984 [OR]; [WB], Tikader and Das 1985 [AN], Ramaiyan et al. 1987 [TN], Barman 1988 [TR], Karmakar and Datta 1988 [CG], Mandal and Nandi 1989 [WB], Indra 1991 [TN], Talwar and Jhingran 1991 [Ganga], Goswami 1992 [WB], Sen 1992 [WB], Talwar et al. 1992 [WB], Barman 1993 [GJ]; [TN]; [AP]; [OR]; [WB]; [PB]; [UP]; [BR], Dutta et al. 1993 [PB]; [UP]; [BR]; [OR]; [WB], Indra 1994 [TN], Agrawal and Ghosh 1995 [WB], Ghate and Wagh 1995 [MH], Jayaram 1995 [KA]; [TS]; [AP], Khan 1995 [WB], Rama Rao 1995 [OR], Sen 1995 [ML], Hussain 1997 [DL]; [GJ]; [TN]; [AP]; [OR]; [WB]; [PB]; [UP]; [BR], Menon 1999 [UP]; [BR]; [WB]; [OR]; [TN], Rema Devi and Raghunathan 1999 [TN], Sarkar 1999 [JH], Chatterjee et al. 2000 [WB], Sen and Banerjee 2000 [GJ], Krishnan and Mishra 2001 [AP], Barman 2002 [TR]; [GJ]; [TN]; [AP]; [OR]; [WB]; [PB]; [UP], Khan 2002 [WB], Yazdani and Singh 2002 [MH], Barman 2003 [AP], Mishra et al. 2003 [WB], Sen 2003 [ML]; [TR], Yadav 2003 [WG], Barman 2004 [TR], Krishnan et al. 2004 [KA], Yadav 2004 [MH]; [UP]; [WB]; [OR]; [TN], Yadav 2005 [MH]; [KL]; [TN]; [OR]; [WB]; [UP]; [BH], Yadav 2006 [MH]; [TN]; [OR]; [WB]; [UP]; [BH], Barman 2007 [WB], Barman et al. 2007 [OR], Sharma 2007 [MP]; [GJ]; [TN]; [AP]; [OR]; [WB]; [BR]; [PB]; [UP], Karmakar et al. 2008 [JH]; [OR]; [WB], Mishra 2008 [AP], Pal and Kar 2008 [WB], Ramesh et al. 2008 [TN], Devi et al. 2008 [AP], Sharma 2008 [MP]; [GJ]; [BH]; [AP]; [OR]; [PB]; [TN]; [UP]; [WB]; [CG], Barman 2009 [AP], Rema Devi et al. 2009 [TN], Sen 2010 [ML]; [TR]; [AS]; [UP]; [BR]; [WB]; [OR]; [TN], Uniyal 2010 [UK], Karmakar et al. 2012 [MH]; [KA]; [TN]; [AP]; [OR]; [WB], Sanyal et al. 2012 [WB], Rao et al. 2013 [GJ]; [TN]; [AP]; [OR]; [WB]; [PB]; [UP], Jitendra et al. 2013 [UP], Rema Devi et al. 2013 [KA], Roy et al. 2013 [WB], Barman and Das 2014 [WB], Khedkar et al. 2014 [GJ], Rama Rao 2014 [TS], Rao and Rath 2014 [OR], Banyal and Kumar 2015 [RJ], Jagatheeswari et al., 2016 [AP], Mohanty et al. 2015 [OR], Mohapatra et al. 2015 [OR], Verma et al, 2015 [UP], Joshi et al. 2016 [TN], Laxmappa and Bakshi 2016 [TS], Dayal et al. 2014 [WG], Kar et al. 2017 [WB], Mogalekar et al. 2017 [TN], Rama Rao et al. 2017 [TS], Yennawar et al. 2017 [WB], Mogalekar and Canciyal 2018 [TN], Rakshit and Chanda 2018 [WB], Bose et al. 2019 [MP], Rama Rao et al. 2019 [TS], Sen and Mandal 2019 [WB], Bhatt and Mankodi 2020 [GJ], Canciyal et al. 2020 [TN], Bhatt et al. 2021 [GJ], Mukherjee and Chanda 2020 [WB], Pathak and Lavudya 2021 [MP], Present Study [GJ].

Remarks. Rhinomugil is distinguished from all other mugilids by showing the overhanging snout and elevated eyes. Chaudhuri (1917) collected and examined a young specimen with 40 mm length from the north-east portion of the lake about eight miles south-east of Kalupara Ghat, Odisha. The juvenile specimen does not develop morphological characters as adults. Therefore, it was placed under *Liza* Jordan and Swain, 1884.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Length–Weight Relationship, Condition Factor, Gonadosomatic Index and Gut-Content Analysis of *Planiliza planiceps* (Valenciennes 1836) (Actinopterygii, Mugiliformes, Mugilidae) from the Four Major Estuaries of Gujarat, India

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Abstract
Planiliza planiceps (Valenciennes 1836) commonly known as tade-grey mullet is having non-carnivorous feeding habit, high-quality flesh, wide environmental resilience power and high fecundity make it a good candidate for poly-culture. A study was conducted on *P. planiceps* in the four major estuaries of Gujarat between June 2017 to March 2018. The significant results of the length–weight relationship were measured. The male populations were showing negative allometric ($b < 3$) growth in all the study sites *i.e.*, Sabarmati, Mahi, Narmada and Tapi estuaries. The female populations from Sabarmati and Mahi were showing isometric growth while from Narmada and Tapi were showing positive ($b > 3$) and negative ($b < 3$) allometric growth respectively. The Fulton's condition factor of males and females was measured and the average condition factor in males were reported as 0.81 ± 0.08, 0.71 ± 0.11, 0.91 ± 0.18, 0.86 ± 0.15 and in females were reported as 0.90 ± 0.10, 0.82 ± 0.08, 0.87 ± 0.12, 0.97 ± 0.21 from the Sabarmati, Mahi, Narmada and Tapi estuaries respectively. The mean gonadosomatic index (I_G) was observed 16.92 ± 2.46 from Sabarmati, 8.73 ± 1.39 from Mahi, 7.87 ± 1.56 from Narmada and 7.60 ± 1.34 from Tapi. Gut content analysis confirmed that *P. planiceps* consumes rotifers, copepods, phytoplankton such as Bacillariophyceae, Cyanophyceae, Ulvophyceae, Zygnematophyceae and Chlorophyceae; zooplanktons and fish eggs. The present study findings will be useful in the context of scientific management of tade-grey mullet fishery as well as to find out its aquaculture potential.

Keywords *Planiliza planiceps* · Length–Weight Relationship · Fulton's Condition Factor · Gonadosomatic Index · Gut-content Analysis · Aquaculture Potential

Introduction

Among teleost fishes, Mugilidae Jarocki, 1822 is the family of grey mullets belongs to class Actinopterygii, order Mugiliformes which includes 20 genera and 79 species (Fricke et al. 2021). Majority of the species are euryhaline, found in coastal marine waters, hypersaline to brackish water lagoons, estuaries and freshwater (Crosetti and Blaber 2016), where the sediment is enriched with organic matter (Odum 1970; Blaber and Whitfield 1977; Mallo et al. 1993; Cardona et al. 2001). In food web, mullets come at secondary trophic level with having particulate organic matter, detritus and benthic microalgae as food which makes them comparatively efficient secondary producers of protein. In Ichthyofauna, no other family members depend so much on microphytobenthos, which are significant food component of mullet diet. Thus, mullets have ability to make high quality fish protein available to top predators (Whitefield et al. 2012). *Planiliza planiceps* (Valenciennes 1836) is commonly known as tade grey mullet. It is geographically found throughout the Indo-Pacific region *i.e.,* from the Red Sea in the West to China and

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Marianas Island in the north and Vanuatu in the south (Shen and Durand 2016). It is one of the most important mullet fishes widely cultured in both freshwater and brackish water (Mon et al. 2020). Tade mullet is having good consumer preference and market price. Its non-carnivorous feeding habit and high number of seed production make it a good candidate for poly-culture (Biswas et al. 2012). Tade mullet has a high-quality flesh, predominant development and wide salinity and temperature resilience power (Mon et al. 2020).

Considering the significance of the mullet fishery length–weight relationship (LWR), Fulton's condition factor (*K*) (Froese 2006), Gonadosomatic Index (I_G) and Gut-Content Analysis (GCA) of fishes has been considered as one of the essential biological tools for fishery management and conservation. The empirical equation between weight and length of fish species is an effective index for estimating growth, reproduction, and overall condition of the species (Le Cren 1951). The scope of LWR in fisheries research is very wide and used for the estimation of biomass for fish populations, morphological comparisons among species or among populations of the same species from different geographical regions/habitats (Moutopoulos and Stergiou 2002), development of single species stock assessment models, construction of multi-species multi-fleet ecosystem models, and evaluation of condition of fish in aquaculture systems (Srihari et al. 2018). LWR and *K* are frequently used to follow seasonal variations in fish growth and to estimate condition indexes (Anderson and Gutreuter 1983; Safran 1992; Richter et al. 2000). Gonadosomatic Index (I_G) – a term proposed by Meien (1927) provides the information of gonadal development changes of a species in every month which can be useful for the management of fishery and aquaculture sector. Scientific study of food and feeding habit of fish is an important aspect for fish production. Food preferences of the fish vary with season, size of an individual and with habitat (Isa et al. 2012). GCA provides the information on different food materials and feeding preferences (Mondal and Chakravarty 2017).

Growth indexes can be affected by several factors like stress, sex, season, availability of feeds, and other water quality parameters (Khallaf et al. 2003). The production of mullets in India is exhibiting decreasing pattern year after year because of various anthropogenic pressure such as habitat degradation and over exploitation. Thus, many of such species are becoming threatened (Pramanick et al. 2017). Hence, there is a need of detailed biological investigation on these species to find out possible management measures in capture fisheries as well as to explore aquaculture potential (Pramanick et al. 2017). The present study was aimed to evaluate the LWR, *K*, I_G and GCA of the *P. planiceps*, which are fundamental tools in establishing ecological status of the species in the respective niche. Thus, the data from this study will provide information for sustainable management for fisheries of *P. planiceps* in all four major estuaries of Gujarat.

Materials and Methodology

Study Area and Sample Collection

The study was carried out in four significant estuaries (Sabarmati, Mahi, Narmada and Tapi) of Central and South Gujarat on the west coast of India between June 2017 to March 2018. During the study, a total of 770 specimens (390 males and 380 females) were examined. The specimens were collected monthly from landing sites of the estuaries (Fig. 1). The identification of specimen was carried out using authentic identification literatures and identified as *Planiliza planiceps* (Valenciennes 1836) (Fig. 2) (Day 1888; Thompson 1997; Bhatt and Mankodi 2020; Froese and Pauly 2021).

Length–Weight Relationship (LWR)

The length–weight relationship (LWR) was calculated using equation $W = aL^b$, where 'W' and 'L' represent weight and length respectively. For LWR, total length (TL) nearest to 0.1 mm (Fig. 3) and total body weight (BW) nearest to 0.1 g were measured. The TL was measured from anterior most tip of the snout to the tip of the upper lobe of the caudal fin. The natural logarithmic transformation of the equation $\text{Log(BW)} = \text{Log(a)} + b\text{Log(TL)}$ (Froese et al. 2011; Bhatt et al. 2021) is used to find out the values of 'a' (an exponent indicates the rate of change with regards to length) and 'b' (weight at unit length). If $b = 3$, indicates isometric growth which means body length and weight increasing in same proportions and if $b \neq 3$, that indicates allometric growth ($b < 3$ = negative allometric growth and $b > 3$ = positive allometric growth) (Morey et al. 2003). Further, 95% confidence limits of a, b and the coefficient of determination were estimated. Student's *t-test* was performed for the null hypothesis of the isometric growth (H_0: $b = 3$) using equation $t_b = (b - 3)/s_b$, where S_b is the standard error of the slope ($p = 0.05$) (Morey et al. 2003).

The Fulton's Condition Factor (K)

The *K* was measured to evaluate the condition of each individual sampled in each month using the equation $K = 100 \times (BW/TL^3)$, where BW = total body weight in g and TL = total length in mm (Fulton 1904). It is assumed when *K* value is equal or close to 1, considered as the overall robustness or well-being for fish species (Jisr et al. 2018; De Vries et al. 2020; Bhatt et al. 2021). In present study, the *K* was compared among estuaries, both as separate male and female populations and as a pooled sample.

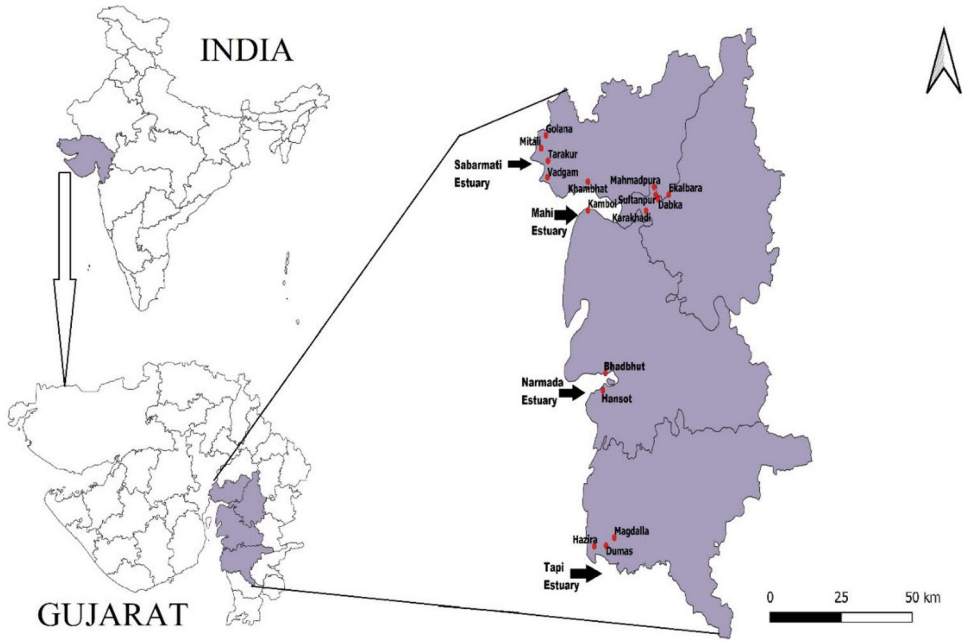

Fig. 1 Sampling Sites: Four Major Estuaries of Gujarat viz. **Sabarmati Estuary:** Golana (22°27′33.50"N 72°25′6.29"E), Mitali (22°25′1.99"N 72°23′45.51"E), Tarakpur (22°22′34.19"N 72°25′41.05"E), Vadgam (22°19′22.13"N 72°25′33.68"E), Khambhat (22°18′26.92"N 72°37′11.89"E); **Mahi Estuary:** Ekalbara (22°15′57.25"N 73° 0′37.51"E), Dabka (22°14′58.81"N 72°57′31.65"E), Mahmadpura (22°17′27.03"N 72°56′24.44"E), Sultanpur (22°15′56.31"N 72°56′50.43"E), Karakhadi (22°12′45.37"N 72°54′2.44"E), Kamboi (22°12′49.38"N 72°37′14.04"E); **Narmada Estuary:** Bhadbhut (21°41′03"N 72 50′39"E), Hansot (21°34′55"N 72°48′42"E); **Tapi Estuary:** Magdalla (21° 8′ 41.27"N 72°44′52.70"E), Dumas (21° 7′7.06"N 72°42′30.47"E), Hazira (21° 6′59.93"N 72°39′5.80"E)

Gonadosomatic Index (IG)

In the absence of sexual dimorphism, identification of sex was performed by slightly squeezing from belly towards anal pore. If golden yellow substance is found then it is considered as female whereas leaking milt considered as male sperms (McDonough et al. 2003). After on field preliminary observations, required specimens were brought to the laboratory where dissection was performed to confirm the sex and gonad weight. The mean gonadosomatic index (I_G) of females was calculated for each month using standard equation: $I_G = (\text{Gonad Weight / Total Body Weight}) \times 100$ (Render et al. 1995).

Gut-Content Analysis (GCA)

For GCA, collections of fresh specimens were carried out and immediately dissected open on the field to collect the gut. Gut was preserved in 4% formalin to stop the digestive activity of the gut. Samples were transported to the laboratory where the gut content was removed and stored in formalin. Gut-contents were examined under the light microscope (10 × and 40x) to identify the food materials at their Genus/Class level (Sultana et al. 2013).

Results and Discussion

Length–Weight Relationship

The significant results of the LWR including sample size (n), ranges of total length (mm) and weight (g), the parameters of LWR, "a" and "b" with their respective 95% confidence intervals, coefficient of determination (r^2) and parabolic equation $W = aL^b$ are shown in Table 1. The linear regressions on log transformed data were significant ($p < 0.05$) except for female populations of Sabarmati and Mahi estuaries and pooled population of Narmada estuary. The highly significant ($p < 0.001$) values were observed in the populations of Mahi and Narmada estuaries. The 'b' value of female populations of Sabarmati ($t_b = 0.24$, df = 79, p = 0.59), Mahi ($t_b = 0.27$, df = 99, p = 0.6) and pooled population of Narmada ($t_b = 0.22$, df = 199, p = 0.59) were not that much significantly different from the cubic value as accepted by isometry ($H_0 = 3$) (Fig. 4b, e, i). However, the 'b' value of female population of Narmada ($t_b = 2.88$, df = 99, p = 0.004) was significantly different from expected cubic value representing positive allometric ($H_0 \neq 3$) growth which means body weight of an individual was increasing with higher rate compare to body length (Fig. 4h). While the

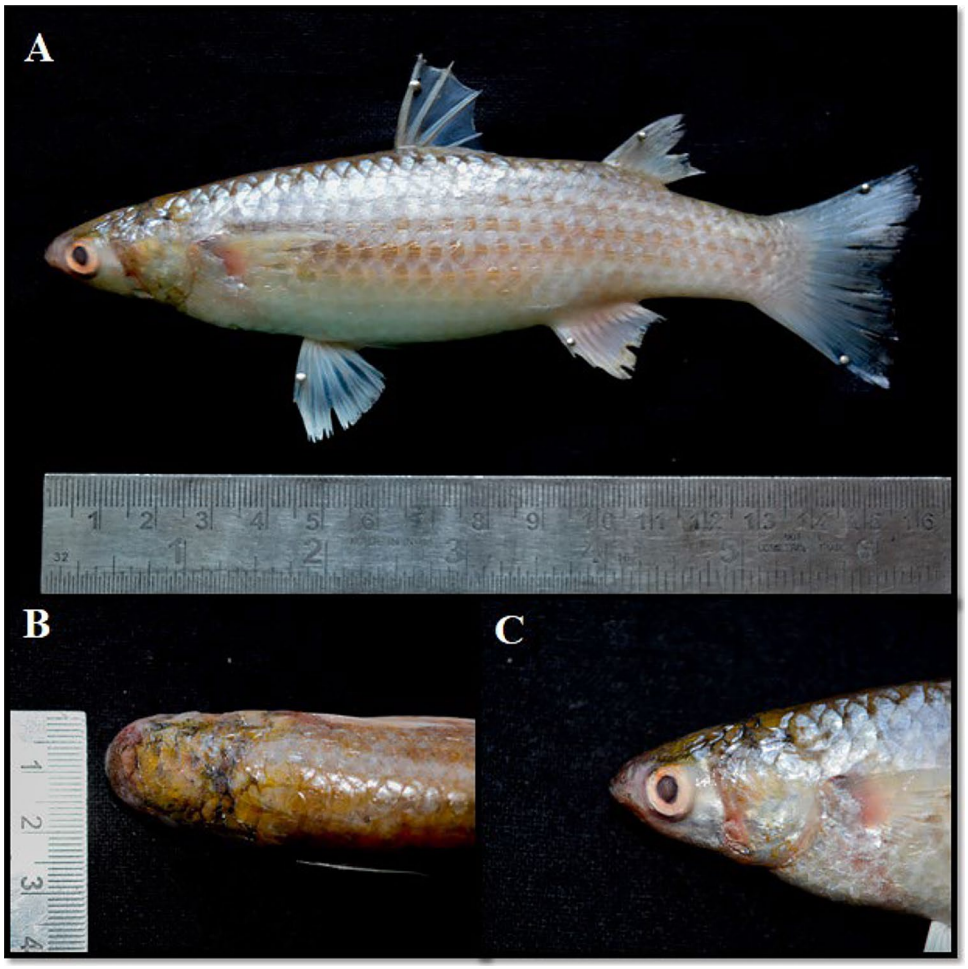

Fig. 2 *Planiliza planiceps* (Valenciennes 1836) (**A**) Specimen examined in the laboratory; (**B**) Head dorsal view; (**C**) Head lateral view (Bhatt and Mankodi 2020)

female population of Tapi (t_b = -2.71, df = 99, p = 0.003) was showing significant results and indicating negative allometric growth (Fig. 4k).

The pooled populations of Sabarmati (t_b = -2.27, df = 169, p = 0.01), Mahi (t_b = -3.14, df = 199, p = 0.001) and Tapi (t_b = -4.56, df = 199, p = 0.001) were also showing highly significant difference from expected cubic value indicating negative allometric growth ($H_0 \neq 3$) (Fig. 4c, f, l). Similarly, the male populations from Sabarmati (t_b = -2.09, df = 89, p = 0.01), Mahi (t_b = -2.17, df = 99, p = 0.01), Narmada (t_b = -1.93, df = 99, p = 0.02) and Tapi (t_b = -2.76, df = 99, p = 0.003) were showing negative allometric growth which represents the decrease in weight at a particular length (Fig. 4a, d, g, j). The growth conditions were varied due to several factors such as gonad maturity, sex, stomach fullness, health, season, habitat, temperature, salinity, feeding etc. (Ricker 1975; Bagenal and Tesch 1978). The obtained results indicate that the slope (b) of the LWR of *P. planiceps* from the study area fell within the expected range of 2.5–3.5 proposed by Froese (2006). The values of intercept (a) were observed within the normal range 0.001–0.05 (Froese 2006). The value of coefficient of determination (r^2) confirmed that the relationship between length and weight was significant or not which can take values ranging between 0 and 1. The value of (r^2) higher than 0.5 stated that length weight relationship was positively correlated (Mon et al. 2020). In the present study, the r^2 values ranged from 0.7–0.9 for combined sexes, males and females of *P. planiceps*. So, the

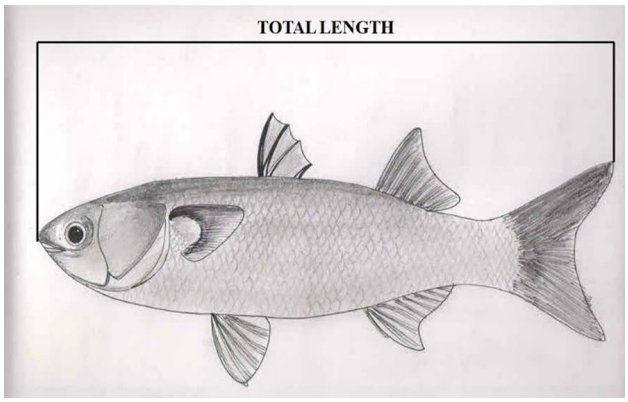

Fig. 3 Diagrammatic representation of the measurement taken of *Planiliza planiceps* (Valenciennes 1836) for Length–Weight Relationship and Condition Factor

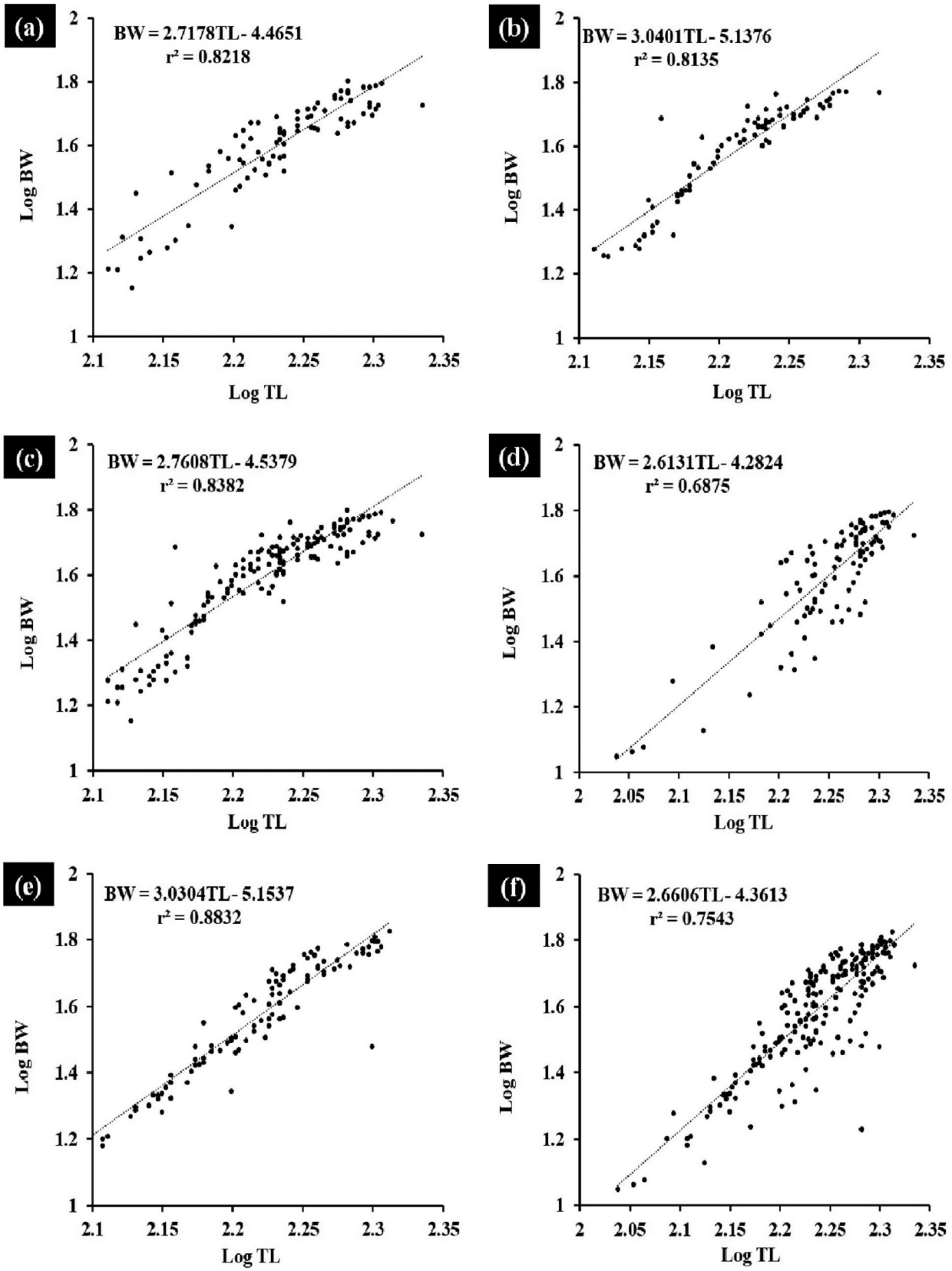

Fig. 4 Logarithm form of L-W Relationship of *Planiliza planiceps* (Valenciennes 1836) (**a**) Male – Sabarmati Estuary (**b**) Female – Sabarmati Estuary (**c**) Pooled—Sabarmati Estuary (**d**) Male – Mahi Estuary (**e**) Female—Mahi Estuary (**f**) Pooled—Mahi Estuary (**g**) Male—Narmada Estuary (**h**) Female – Narmada Estuary (**i**) Pooled—Narmada Estuary (**j**) Male – Tapi Estuary (**k**) Female—Tapi Estuary (**l**) Pooled—Tapi Estuary

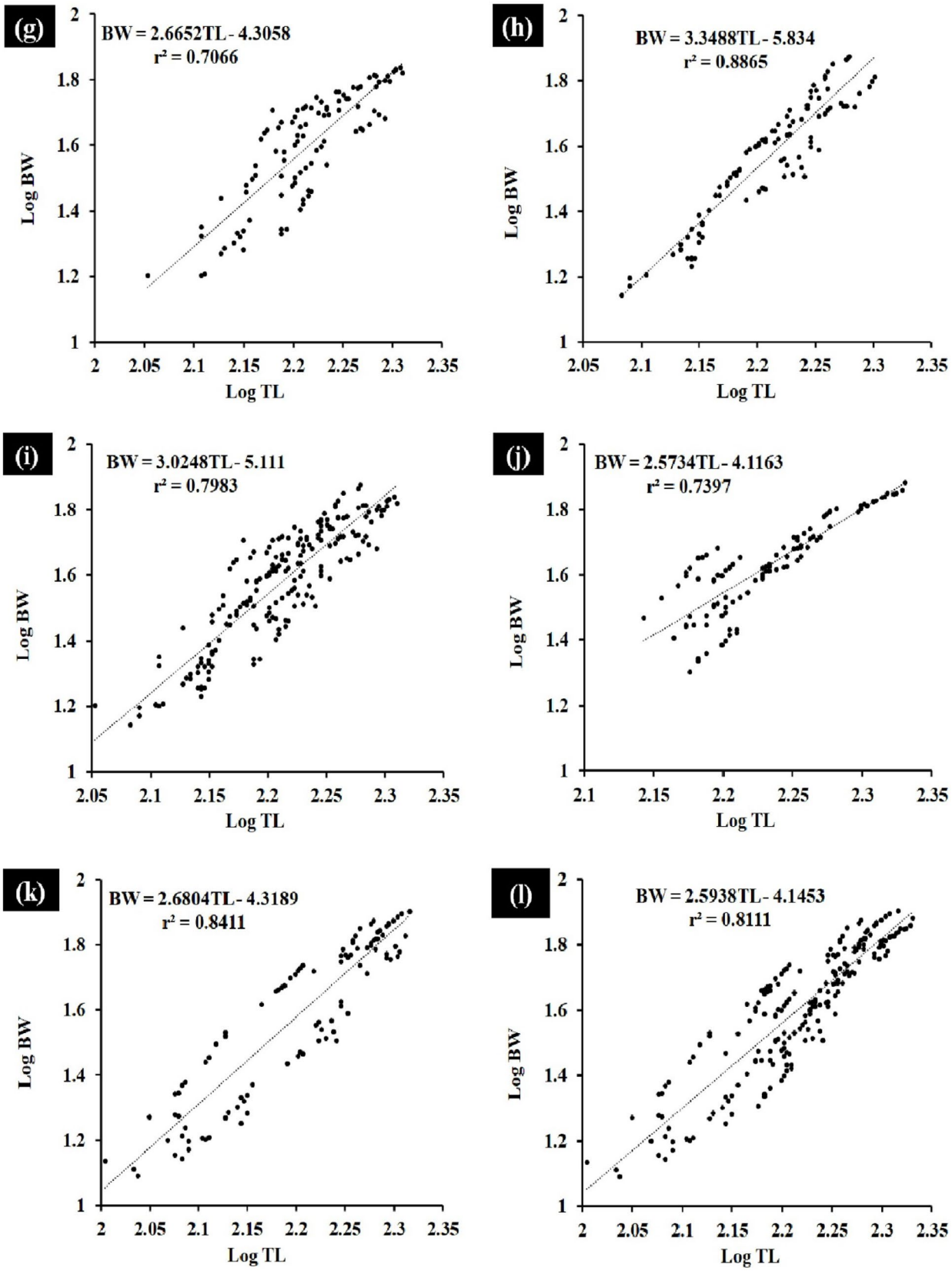

Fig. 4 (continued)

Table 1 Statistical analysis of Length-Weight Relationship (LWR) of *Planiliza planiceps* (Valenciennes 1836) found in estuaries of Sabarmati, Mahi, Narmada and Tapi

Estuary	Sex	N	TL (mm)		TW (g)		Regression Parameters					Growth (t-test)	p	Parabolic Equation
			Min	Max	Min	Max	'a'	95% CI of a	'b'	95% CI of b	r^2			
Sabarmati	♂	90	129	216	14.3	63.4	0.011	0.006-0.021	2.72	2.45-2.99	0.8	b<3	S	$W = 0.013L^{2.61}$
	♀	80	129	206	18.1	93.2	0.005	0.003-0.012	3.04	2.71-3.37	0.8	b>3	NS	$W = 0.005L^{3.04}$
	Pooled	170	129	216	14.3	93.2	0.01	0.007-0.002	2.76	2.55-2.97	0.8	b<3	S	$W = 0.01L^{2.76}$
Mahi	♂	100	109	216	11.2	62.9	0.013	0.006-0.031	2.61	2.26-2.29	0.7	b<3	S	$W = 0.013L^{2.61}$
	♀	100	122	205	15.2	67.3	0.005	0.004-0.009	3.03	2.81-3.25	0.9	b>3	NS	$W = 0.005L^{3.03}$
	Pooled	200	109	216	11.2	67.3	0.012	0.008-0.021	2.66	2.45-2.87	0.8	b<3	HS	$W = 0.012L^{2.66}$
Narmada	♂	100	113	204	16	69	0.013	0.006-0.289	2.67	2.32-3.00	0.7	b<3	S	$W = 0.013L^{2.67}$
	♀	100	121	200	14	75.2	0.002	0.002-0.005	3.35	3.11-3.59	0.9	b>3	S	$W = 0.002L^{3.35}$
	Pooled	200	113	204	14	75.2	0.006	0.004-0.010	3.02	2.74-3.19	0.8	b>3	NS	$W = 0.006L^{3.02}$
Tapi	♂	100	139	214	20.2	76.3	0.016	0.008-0.032	2.57	2.26-2.88	0.7	b<3	S	$W = 0.016L^{2.57}$
	♀	100	101	207	12.3	80	0.013	0.008-0.022	2.68	2.44-2.91	0.8	b<3	S	$W = 0.013L^{2.68}$
	Pooled	200	101	214	12.3	80	0.015	0.011-0.023	2.59	2.42-2.76	0.8	b<3	HS	$W = 0.015L^{2.59}$

N number of individuals, *TL* total length, *TW* total weight, *CI* confidence interval, *S* Significant (p 0.05), *NS* non-significant (p>0.05), *HS* highly significant ($p \leq 0.01$)

relation between the length and weight of *P. planiceps* was positively correlated and highly significant. The study carried out in Chilka Lake – the largest brackish water lake in Asia reported the length and weight of *P. planiceps* ranged from 135 to 300 mm and 25 to 242 g, respectively, and the derived LWR was $W = 0.000062L^{2.65}$ (Panda et al. 2018). Similar study conducted in Mandovi-Zuari estuarine system, Goa—west coast of India by Srihari et al. (2018) reported negative allometric growth ($b = 2.73$; $a = 0.03$; $r^2 = 0.99$). A study carried out in Myanmar on 1264 samples (623 males, 641 females) of *P. planiceps* (*Liza tade* Forsskål 1775) reported the negative allometric growth. They recorded the regression slopes or growth coefficients, b values of *P. planiceps* was found to be 2.82 in males, 2.84 in females and 2.83 in total respectively (Mon et al. 2020).

Fulton's Condition Factor

The monthly Fulton's condition factor (*K*) of males and females was measured and variation in condition was observed in each estuary during respective month. The *K* values provide the information of the well-being of the particular sex in their respective habitat (Froese 2006). The better nutritional condition should yield a higher *K* (Heincke 1908). The *K* of male *P. planiceps* ranged between 0.99 (Sep) to 0.7 (Mar) from Sabarmati estuary, 0.9 (Sep) to 0.49 (Jun) from Mahi estuary, 1.2 (Aug) to 0.63 (Jun) from Narmada estuary and 1.21 (Aug) to 0.63 (Jun) from Tapi estuary (Fig. 5). In females, it was ranged between 1.13 (Oct) to 0.77 (Jul) from Sabarmati, 0.98 (Nov) to 0.68 (Mar) from Mahi, 1.09 (Dec) to 0.74 (Feb) from Narmada, and 1.35 (Aug) to 0.71 (Feb) from Tapi (Fig. 6). The average condition factor in males were reported as follows: 0.81 ± 0.08 (Sabarmati), 0.71 ± 0.11 (Mahi), 0.91 ± 0.18 (Narmada), and 0.86 ± 0.15 (Tapi). While in females, it was reported as: 0.90 ± 0.10 (Sabarmati), 0.82 ± 0.08 (Mahi), 0.87 ± 0.12 (Narmada) and 0.97 ± 0.21 (Tapi). The males of Sabarmati were showing good condition followed by Mahi, Narmada and Tapi. While in females, the well-being was observed in Mahi followed by Narmada, Sabarmati and Tapi estuaries. Month-wise condition of the male and female *P. planiceps* from all four estuaries are shown in Figs. 5 and 6, which indicates better nutritional conditions for respective sex in particular estuary. Mon et al. (2020)

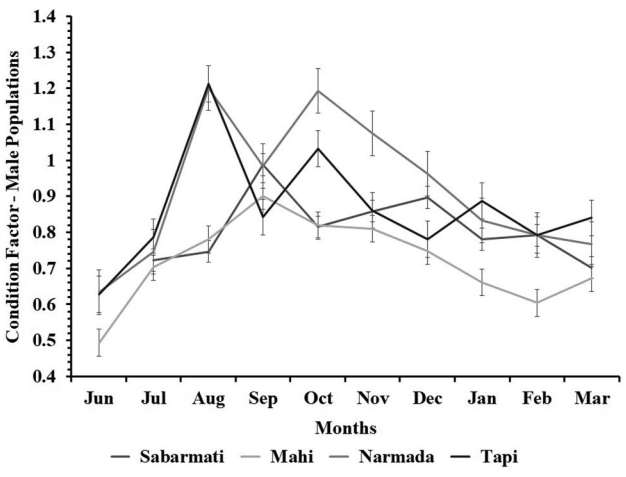

Fig. 5 Fulton's Condition Factor of *Planiliza planiceps* (Valenciennes 1836) – Male population found in Four Major Estuaries of Gujarat, India

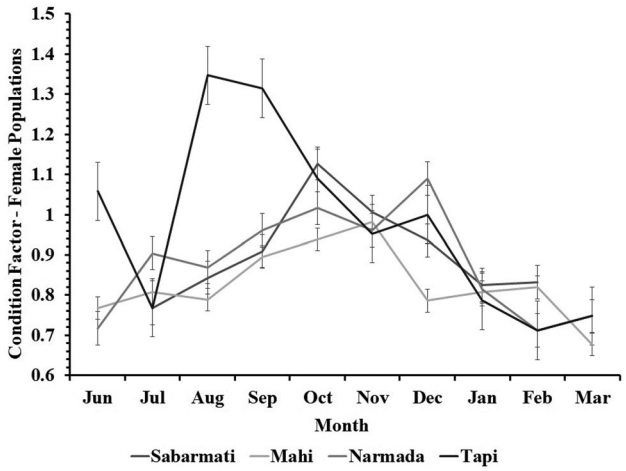

Fig. 6 Fulton's Condition Factor of *Planiliza planiceps* (Valenciennes 1836) – Female population found in Four Major Estuaries of Gujarat, India

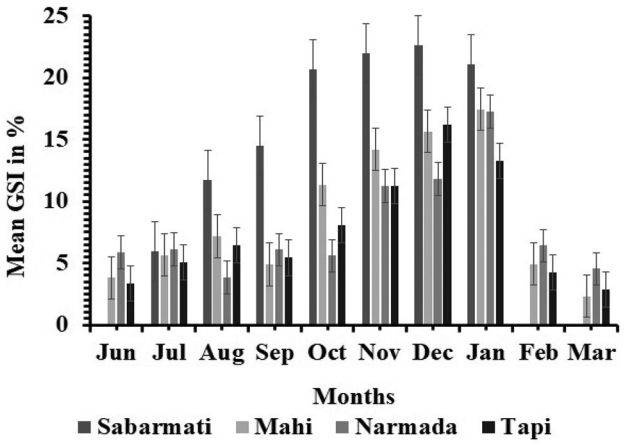

Fig. 7 Gonadosomatic Index (I_G)of *Planiliza planiceps* (Valenciennes 1836) found in Four Major Estuaries of Gujarat, India

reported average *K* of male (1.08 ± 0.03), female (1.14 ± 0.03) and pooled population (1.11 ± 0.02) from Mawlamyine, Mon State, Myanmar. Similar study was carried out in Hooghly-Matlah Estuary, West Bengal, India by Pramanick et al. (2017) reported the monthly mean *K* values ranged from 1.04–1.12 and 1.01–1.23 for the male and female respectively. In that study, the highest *K* values were found in July month which is opposite to the present findings. This contradiction could be governed by several factors like age and sex of the individual (Everhart et al. 1975), availability and types of food abundance and environmental factors (Ranganathan and Natarajan 1970), onset of maturity (Hoda 1987), spawning (De Silva and Silva 1979), breeding (Dhanze and Dhanze 1997), pollution (Sandhya and Shameem 2003; Rao et al. 2005) etc.

Gonadosomatic Index (IG)

Gonadosomatic index of female *P. planiceps* was studied from all the four estuaries to check the physiological state of the gonads (González-Castro and Minos 2016). It was observed that female *P. planiceps* shows highest gonadal maturation between September to January (Fig. 7). From February to June, a decrease in gonad's weight was observed which as well indicates the decrease in development of gonad. The mean I_G were observed, 16.92 ± 2.46 with a range of 5.96–22.64 from Sabarmati, 8.73 ± 1.39 with a range of 2.32–17.42 from Mahi, 7.87 ± 1.56 with a range of 3.83–17.25 from Narmada and 7.60 ± 1.34 with a range of 2.82–16.16 from Tapi. The monthly highest average value of I_G was found 22.64 ± 2.81 (Dec) from Sabarmati, 17.42 ± 2.04 (Jan) from Mahi, 17.25 ± 2.28 (Jan) from Narmada, and 16.16 ± 0.97 (Dec) from Tapi (Fig. 7). Wijeyaratne and Costa (1987) recorded the gonadal development female *P. planiceps* and found mature eggs in June, August, October and December whereas ripe and running (stage IV) females were found in June, December, January, February and March from the Negombo lagoon, Sri Lanka.

Gut Content Analysis

Preliminary survey on food and feeding habit of preference of *P. planiceps* was carried out. Mullets are highly dependent on mud, detritus, and deposited matters. During the study it was found that *P. planiceps* consumes high amount of mud along with sand particles. According to Odum (1970), mullets feed by scraping the stones and digging the bottom due to having well developed mouth apparatus. Here, we also observed that large amount of the different algae species was found in their stomach namely Bacillariophyceae – diatoms (*Coscinodiscus centralis*, *Navicula sp.*, *Melosira sp.*, *Synedra sp.*, *Pleurosigma sp.*, *Cocconeis sp.*); Cyanophyceae – blue green algae (*Spirulina sp.*); Ulvophyceae (*Cladophora sp., Ulothrix sp.*); Zygnematophyceae (*Spirogyra sp.*) and Chlorophyceae (*Volvox sp., Microspora sp.*). Apart from these, rotifers (*Brachions sp.*) and Copepods (*Acartia clausi*, *Oncaea venusta*, *Nauplii sp.*) were found abundantly (Fig. 8). During the post monsoon season, phytoplankton, zooplankton and fish eggs were abundant in the gut of *P. planiceps* from all the four estuaries. During the dry seasons stomach of the fish was mostly filled with mud, detritus materials and *Spirulina sp.* We also observed that, during the breeding season the consumption of food decreased. This might be due to the maturation of the gonads. Our findings are consistent with the observation by Pillay (1953) and he also found that mullets consume tough filamentous algae and silicious diatoms. He added that in marine environment diatoms and algae were consumed in larger quantities. Similar study by Mondal et al. (2016) in West Bengal also reported the most abundance of

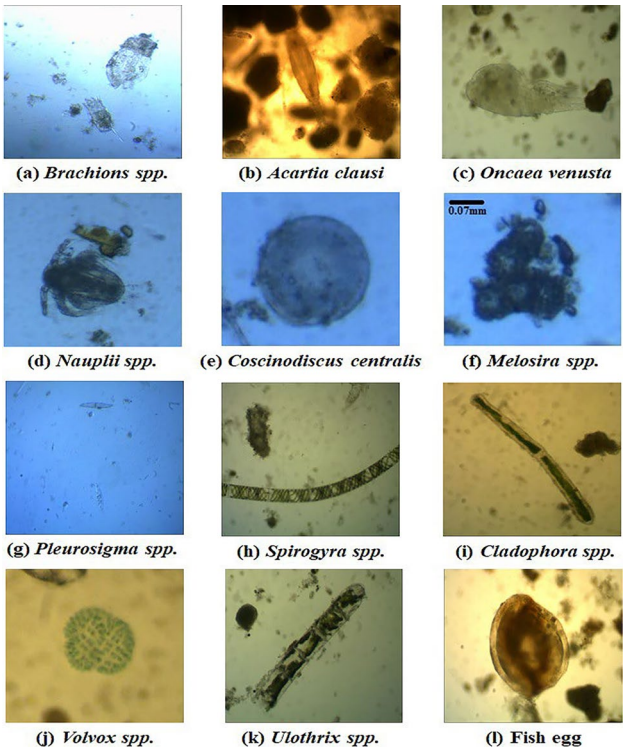

Fig. 8 Gut-contents of *Planiliza planiceps* (Valenciennes 1836) found in Four Major Estuaries of Gujarat, India

Bacillariophyceae (23.04–40.10%) followed by Chlorophyceae (9.59- 20.39%) and Myxophyceae (4.45–14.36%). The dominant zooplankton groups in the stomach were dinoflagellates (1.84–5.11) followed by copepods (0.20–2.97%).

Conclusions

The growth index of the *P. planiceps* was found to appropriate due to the nature of isometric growth which represents the suitability of habitat. Gonadosomatic index (I_G) confirmed the gonadal maturation time in the respective estuaries. The diverse feeding habit represents the omnivorous nature of the fish. Considering that *P. planiceps* provides the nutrition and income to the locals and fishermen, it is pivotal to manage their fisheries in a sustainable manner. The present study could be useful for the relevant biological and population studies and also emphasizes on the potential of the brackish water aquaculture in this region.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s41208-022-00422-8.

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Author's Contribution All authors contributed to the study conception and design. DMB is the main research scholar worked on this topic, on illustrations and pictures and prepared the draft of the manuscript. NJT, KJS and PCM conceived and designed research, critically reviewed for improving the quality of the manuscript. DMB conducted the field work and laboratory work. All authors read and approved the final manuscript.

Declarations

Ethics Approval Consent to Participate The specimens are not under the listed category of experimental animals which need ethics approval.

Competing Interests The authors declare that they have no competing interests. No potential conflict of interest was reported by the authors.

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