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Redescription of *Liza bandialensis* (Teleostei: Mugilidae) with an identification key to mullet species of Eastern Central Atlantic

Redescription de Liza bandialensis *(Teleostei : Mugilidae) avec une clé d'identification des espèces de mulets de l'Atlantique Centre-Est*

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ABSTRACT

Liza bandialensis Diouf 1991 is redescribed because previous descriptions have not been in well-distributed publications and have lacked sufficient detail or reference to voucher specimens. The description provided here is based on specimens from the Sine Saloum estuary, Senegal (West Africa), from where the species was originally described. The distinctness of the species is confirmed both by meristic and molecular criteria. *L. bandialensis* presents a unique combination of characters with a low number of scales in the longitudinal series (32–33), 10.5–12 transverse scale rows, and distinctly yellowish dorsal, anal, and caudal fins. The currently known distribution of *L. bandialensis* includes coastal waters of Senegal, Gambia and Guinea Bissau. Finally, we provide a morphological identification key for the sixteen species of Mugilidae species occurring along the eastern central Atlantic coast of Africa.

RÉSUMÉ

Liza bandialensis Diouf 1991 est redécrite car les précédentes descriptions ne figuraient pas dans des publications bien distribuées, étaient insuffisamment détaillées et ne faisaient pas référence à des spécimens déposés dans des collections. La présente description est basée sur des spécimens de l'estuaire du Sine Saloum, au Sénégal (Afrique de l'Ouest), d'où l'espèce a été initialement décrite. La spécificité de l'espèce est confirmée à la fois par des critères méristiques et moléculaires. *L. bandialensis* présente une combinaison unique de caractères avec un faible nombre d'écailles en séries longitudinales (32–33), 10,5–12 rangées d'écailles transversales et des nageoires dorsales, anales et caudales distinctement jaunes. La distribution actuellement connue de *L. bandialensis* comprend les eaux côtières du Sénégal, de la Gambie et de la Guinée Bissau. Pour finir, nous fournissons une clé d'identification morphologique des seize espèces de Mugilidae présentes le long des côtes de l'Atlantique centre-est de l'Afrique.

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1. Introduction

According to the last global revision of the family Mugilidae there are some 62 species belonging to 14 genera [1], although more recent regional studies have suggested some taxonomic revisions. The family is distributed in shallow coastal waters, lagoons and estuaries of all continents [1,2]. Along the West African coast, between Senegal and Angola, eleven species are currently recorded [1,3–5]: *Chelon labrosus* (Risso, 1827) (Senegal is the southern edge of this species' range), *Chelon bispinosus* (Bowdich, 1825) (only known from Cape Verde Islands), *Mugil bananensis* (Pellegrin, 1927), *Mugil capurrii* (Perugia, 1892), *Mugil cephalus* Linnaeus, 1758, *Mugil curema* Valenciennes, 1836, *Liza dumerili* (Steindachner, 1870), *Liza falcipinnis* (Valenciennes, 1836), *Liza grandisquamis* (Valenciennes, 1836), *Liza richardsonii* (Smith, 1846) (Angola is the northern edge of this species' range), and *Liza tricuspidens* (Smith, 1935) (Baia de Santa Maria, Angola, is the northern edge of this species' range). In addition, studies conducted in the 1990s in the Sine Saloum estuary (Senegal) suggested the presence of a twelfth species with scalation characteristics differing from all others West African mullets [6,7]. The name *Liza bandialensis* was given to this species by Diouf [6]. Diouf's [6] original description is short but includes the new species name "*Liza sp.* 1 (= *L. bandialensis*)", a description of the species, and an illustration. The description appears in a roneotyped document of the Centre de Recherches Océanographiques de Dakar-Thiaroye (CRODT), Institut Sénégalais de Recherches Agricoles. One copy was given to one of us (I.J.H.) during a visit to the CRODT in 1993. Thus, although the document was not necessarily easily available throughout the world, it could be requested and provided, and does meet the terms of the Third Edition of the International Code of Zoological Nomenclature [8] that simply *recommends* (Recommendation 7A) to authors that the publication is widely disseminated. Diouf [6] did not name a holotype or a type series, but these were not required according to the third edition of the Code. Moreover, Diouf [6] did not explicitly refer to any specimens that were used for the description. When one of us (I.J.H.) visited Diouf at CRODT, in Senegal, in 1993, Diouf stated that all specimens that had been previously analysed had been destroyed, except for one 425 mm SL specimen that had been collected on June 30th 1992 and subsequently frozen. The 425 mm SL specimen was given to Harrison to accession into the collections of the Musée Royal de l'Afrique Centrale de Tervuren (Belgium), where it now has the collection number MRAC 93-P-27-28. This specimen could not have been part of the original series used for the description (since it was collected after 1991, the date of publication of the original description). Thus, no specimens exist that were part of the collection that Diouf used for his original description. In 1993 Harrison incorrectly considered Diouf's [6] description of *L. bandialensis* to be invalid according to terms of the Code; Harrison expected that a proper description was required, but preferred to wait until more than one specimen was available for the description. For this reason, he included a note in the jar containing the specimen MRAC 93-P-27-28 stating, incorrectly, that it would be a "possible holotype".

Diouf [7] provided further description of *L. bandialensis*, once again referring to it as a new species (although his description in 1991 qualified it as a previously described species). Diouf [7] did not name any type specimens, but did note "Une confirmation de la validité de cette nouvelle espèce a été réalisée par Ian Harrisson [sic] systématicien spécialiste des mullets travaillant alors au Musée Royal de l'Afrique Centrale de Tervuren (Belgique) où un spécimen a été déposé". That specimen is MRAC 93-P-27-28, the specimen discussed above. Eschmeyer and Fricke [9] overlooked the description by Diouf [6] and, on the basis of erroneous information, considered the description by Diouf [7] to represent the first valid description and listed MRAC 93-P-27-28 as the holotype. Discussion above has shown that Diouf's [6] description precedes his [7] description as the valid one, and that the MRAC specimen is not the holotype.

There has been very little further discussion of *L. bandialensis* [10,11]; the species is otherwise not mentioned in recent, published, regional and worldwide taxonomical revisions of the Mugilidae family [1,3,12]. Therefore, there is a need to provide a full description in a widely distributed publication, and recommendation of a neotype.

In this article, we redescribe *L. bandialensis* from seven specimens collected in the Sine Saloum estuary (Senegal) and provide a morphological identification key for the sixteen species of mugilids found along African coastal waters of the eastern central Atlantic.

2. Material and methods

One specimen of *L. bandialensis* was collected in June 1992 and six between October and December 2008. All specimens were collected by traditional fishermen, in the Sine Saloum estuary, Senegal (see Material Examined). Morphometrics and molecular data were obtained as described below.

2.1. Morphometrics

2.1.1. Measurements

All length measurements (Table 1) were taken between parallels or using dividers and follow Harrison et al. [13] except for the following (not mentioned by those authors): FL, the fork length, measured from the tip of the snout to the center of the fork of the tail; the interorbital distance, the shortest distance between eyes; and AV1, the length of axillary scale of the pelvic fin.

2.1.2. Scales

The number of scales in longitudinal series on the midline (LL) and the number of scales in transverse series (TR) was counted following Harrison et al. [13]. The peduncle scale count (PED) is the number of scales between the mid-dorsal and mid-ventral lines down one side of the caudal peduncle, excluding any median scales. Other scale counts are the number of scales between the operculum and the vertical from the origin of the first

Table 1
Morphometric measurements for specimens of *Liza bandialensis*.

Morphometric measurement	Specimen number							
	Range; all specimens	MNHN 0970 Neotype	MNHN 0791	MNHN 0792	MNHN 0793	MNHN 0794	IRD 2885	MRAC 93-P-27-28
Standard length (SL)/mm	285–439	439	356	302	285	299	287	425
Fork length (FL)/mm	336–503	503	414	349	336	347	340	
Morphometrics								
As % SL								
Head length (H)	22.4–26.5	24.8	26.4	25.5	25.6	25.8	26.5	22.4
Snout to anal fin (SN/A)	73.1–77.3	73.1	73.9	74.5	74.7	77.3	76.7	76.7
Snout to first dorsal fin (SN/D1)	50.6–54.7	50.6	52.5	53.0	51.9	51.5	54.7	50.8
Snout to second dorsal fin (SN/D2)	75.6–78.8	76.5	77.0	78.8	77.5	75.6	78.7	76.7
Snout to pelvic fin (SN/V)	36.7–39.3	37.6	39.3	38.1	38.9	38.1	38.7	36.7
First dorsal to caudal peduncle (D1/CP)	45.3–49.4	49.4	47.5	47.0	48.1	48.5	45.3	48.0
First dorsal fin to caudal peduncle (D1/CP)	45.3–49.4	49.4	47.5	47.0	48.1	48.5	45.3	48
Pectoral fin length (Pl)	18.9–22.6	18.9	20.2	20.9	21.1	21.8	22.6	20.7
Body width at pectoral fin (Pw)	12.9–15.8	15.0	13.8	13.6	13.7	14.0	12.9	15.8
Body depth at first dorsal fin (D1d)	24.2–28.5	27.6	24.2	28.5	25.6	27.1	26.5	24.7
Body width at first dorsal fin (D1w)	10.1–15.3	12.8	10.1	11.9	10.9	11.7	10.5	15.3
Length of base of second dorsal fin (D2b)	8.1–9.6	9.6	8.1	8.3	8.4	9.0	8.0	8.7
Length of base of anal fin (Ab)	9.6–11.2	11.2	10.7	9.6	10.2	10.0	9.8	10.8
Body depth at anal fin (Ad)	23.0–26.5	23.9	23.0	26.5	25.3	25.8	25.4	24.5
Body width at anal fin (Aw)	7.0–11.3	8.2	7.6	7.9	8.1	8.0	7.0	11.3
Caudal peduncle length (CP)	13.9–16.9	15.5	16.9	14.6	14.7	15.7	13.9	14.1
Length of axillary scale of pelvic fin	7.4–9.0	7.5	8.4	7.9	7.4	9.0	8.0	–
As % H								
Snout length (SN)	19.7–24.5	22.9	24.5	22.1	20.5	23.4	19.7	22.1
Eye diameter	17.0–21.1	17.4	17.0	18.2	19.2	18.2	19.7	21.1
Interorbital distance	36.2–46.3	39.4	36.2	37.7	37.0	39.0	38.2	46.3
Upper lip thickness (ULth)	5.2–7.4	6.4	5.3	5.2	5.5	5.2	5.3	7.4
Pectoral fin length (Pl)	76.1–92.6	76.1	76.6	81.8	82.2	84.4	85.5	92.6
Pelvic fin length (Vl)	64.2–76.8	64.2	66.0	66.2	71.2	70.1	68.4	76.8
As % CP								
Caudal peduncle depth (CPd)	75.0–92.9	79.4	75.0	90.9	92.9	85.1	92.5	91.7

MNHN: Museum national d'histoire naturelle, Paris; IRD: Institut de recherche pour le développement, Dakar; MRAC: Musée Royal de l'afrique centrale de Tervuren (Belgique).

dorsal fin (D1sc), the number of scales between the operculum and the vertical from the origin of the second dorsal fin (D2sc), and the number of scales in longitudinal series extending to the tip of the pectoral fin when laid back (Psc).

2.1.3. Fins

The number of spines of the anal fin (A) is indicated by Roman numerals and the number of branched rays by Arabic. Roman numerals indicate the number of spines of the first dorsal fin (D1). Sp. I, Sp. II, Sp. III and Sp. IV are the first to fourth spines in D1. For the second dorsal fin (D2), small Roman numerals indicate the number of unbranched rays and the Arabic numerals indicate the number of branched rays. For the pectoral fin (P), the number indicates the total number of rays in the fin.

2.1.4. Pharyngobranchial morphology

Buccal dentition and pharyngobranchial morphology are described according to the terminology of Harrison and Howes [14].

2.2. Molecular study

Total DNA of specimens was extracted from muscle tissues or fins using standard ethanol-chloroform protocols [10,15]. The mitochondrial 16S RNA gene was amplified using the universal primers 16SARL (5′-CGCCTGTTTATCAAAAACAT-3′) and 16SBRH (5′-CCGGTCTGAACTCAGATCACGT-3′) described by Palumbi et al. [16]. A polymerase chain reaction was carried out in a 50 μl reaction volume containing 5 μl of 10× reaction buffer (Promega, Charbonnieres, France), 1.5 μl of $MgCl_2$ (25 mM), 2 μl of dNTP (5 mM), 0.5 μl of each primer (10 μM), 1 unit of GoTaq DNA polymerase (Promega) and 1 μl of template DNA. PCR amplification conditions were as follows: preliminary denaturation at 92 °C (5 min), strand denaturation at 92 °C (1 min), primer annealing at 50 °C (1 min), and primer extension at 72 °C (1.5 min) repeated for 35 cycles and final extension at 72 °C (5 min). Sequencing was carried out by Macrogen (Seoul, S. Korea-http://dna.macrogen.com) using the 16SARL primer, and sequences were deposited in GenBank (JQ060708). When available, sequences of Atlantic species of the same or close related genera (*Chelon, Liza* and *Oedalechilus*, see [10,17]) were retrieved from GenBank and compared using the Kimura 2-parameter distance with the software MEGA 4.0 [18].

3. Results

Liza bandialensis Diouf, 1991 (Fig. 1, Table 1).

Fig. 1. View of *Liza bandialensis* (Neotype MNHN 2009.0790).

3.1. Material examined

Neotype. MNHN 2009.0790, collected in 2008 by local fishermen in the region of Foundiougne village, Saloum channel, Sine Saloum estuary, Senegal, (14°7.000′N; 16°28.000′W). See Discussion for justification of designation of the neotype.

Other material. MRAC 93-P-27-28, collected on June 30, 1992 by local fishermen in the region of Missirah village, Bandiala channel, Sine Saloum estuary, Senegal, (13°41.000′N; 16°30.000′W). MNHN 2009.0791, MNHN 2009.0792, MNHN 2009.0793, MNHN 2009.0794 and IRD TR.2885, collected in 2008 by local fishermen in the region of Foundiougne village, Saloum channel, Sine Saloum estuary, Senegal, (14°7.000′N; 16°28.000′W).

3.2. Diagnosis

L. bandialensis has several features that are typical of species of the genus *Liza* (see Discussion for comments on use of the genus names *Liza* and *Chelon*). These are described below (with comparisons to contrasting features seen in other genera present in the eastern central Atlantic; [5]). Upper lip without any vertical ridges of horny epidermis (present in *Oedalechilus)* or longitudinal rows of cornified papillae (present in *Chelon*). Translucent adipose eyefold tissue restricted to a ring around border of eye in adults (extensive over eye in *Mugil*). Posterior end of maxilla sigmoid in adults, curving down over the premaxilla and extending below the corner of the mouth when the mouth is closed (maxilla straight in *Mugil*, not extending below corner of mouth). Serrate, anteroventral edge of lachrymal is concave adjacent to the mouth; ventral end of lachrymal broad and squarish (serrate, anteroventral edge of lachrymal straight in *Mugil*, and ventral tip slender and pointed). Mouth wide in ventral view, with angle at dentary symphysis 90° or more (mouth ogive with acute angle at dentary symphysis in *Mugil*). Pectoral axillary scale short or absent (long in *Mugil*). Pharyngobranchial organ usually with two vales (single valve in *Mugil*). Alimentary tract with more than two pyloric caeca (only two caeca in *Mugil*).

When compared with other central eastern Atlantic species of *Liza*, *L. bandialensis* can be distinguished from *L. tricuspidens* by the absence of tricuspid teeth; and it is distinguished from *L. falcipinnis* by having ctenoid scales on the flanks (cycloid in *L. falcipinnis*) and fewer than ten filamentous rays in the anal fin [5,19]. *Liza aurata*, *L. ramada*, *L. saliens* and *L. richardsonii* all have more than 40 scales in longitudinal series and 13 or more scales in transverse series (as do *C. bispinosus* and *C. labrosus*, which may aid identification of juvenile specimens of *Chelon* when the upper lip papillae are not well developed), whereas *L. bandialensis* has 33 or fewer scales in longitudinal series and 12 or fewer scales in transverse series [5]. *Liza saliens* also has two to five, and perhaps as many as eight mucuous canal grooves on the predorsal scales whereas *L. bandialensis* has one or occasionally two grooves on the predorsal scales [5]. Similarly, *L. dumerili* (in specimens of 30 mm SL or larger) has one to 14 grooves on the predorsal scales, and has 33–41 (usually 35–37) scales in longitudinal series and 11–14 transverse scales [5,19]. *L. bandialensis* is most similar to *L. grandisquamis*, but differs from it in having 32–33 scales in longitudinal series and 10.5-12 scales in transverse series (vs. 25–30 scales in longitudinal series and 8–10.5 scales in transverse series in *L. grandisquamis*; [5,19]). The buccal teeth are slightly larger in *L. bandialensis* than in *L. grandisquamis*, and the dorsal, anal, and caudal fins are distinctly yellowish in *L. bandialensis* whereas they are less distinctly yellowish in *L. grandisquamis*.

Analysis of the 547 base pairs of the 16S rRNA gene fragments indicates that *L. bandialensis* is molecularly distinct from all Atlantic species of genera *Liza*, *Chelon* and *Oedalechilus* for which sequences are available: *C. labrosus* (GQ258711, EF437089), *L. dumerili* (FJ874771), *L. falcipinnis* (FJ874770), *L. grandisquamis* (FJ874768, FJ874769), *L. aurata* (EF437090, EF437091, AY169699), *L. ramada* (EF437094, AY169700, AY169701), *L. saliens* (EF437095), and *O. labeo* (GQ258713, GQ258714). Mean genetic distances between *L. bandialensis* and other species ranged between 0.008 ± 0.001 and 0.079 ± 0.002 (Table 2). Lowest and highest mean genetic distance values were observed for *L. saliens* and *L. falcipinnis*, respectively.

3.3. Etymology

The name *L. bandialensis* indicates the species is from the Bandiala channel, the main arm of the Sine Saloum estuary in Senegal where the species was first collected [6]. The local, sérère name for this species is "diassanga". Diouf [6] therefore proposed the French common name of "mulet diassanga" and the English common name of "diassanga mullet".

3.4. Description

In the following description, morphometric and meristic features that are typical of the neotype are marked with an asterisk.

3.4.1. Size

Maximum observed standard length 439 mm*, fork length 503 mm*; Diouf [7] cites the maximum body length as 572 mm. Proportional morphometric measurements are given in Table 1.

3.4.2. General body morphology

Body moderately deep; body depth at first dorsal fin origin 24.2–28.5% of SL; and at origin of anal fin is 23–26.5%. Posterior end of maxilla sigmoid in adults, curving

Table 2
Genetic distances (Kimura 2-parameter) within and between species of *Liza, Chelon* and *Oedalechilus* for the 16S rRNA gene.

	L. bandialensis	*L. dumerili*	*L. falcipinnis*	*L. grandisquamis*
L. bandialensis	0.002			
L. dumerili	0.061 (0.001)	0.000		
L. falcipinnis	0.079 (0.002)	0.105	0.000	
L. grandisquamis	0.043 (0.007)	0.089 (0.009)	0.096 (0.009)	0.011
L. aurata	0.021 (0.002)	0.072 (0.001)	0.073 (0.002)	0.053 (0.007)
L. ramada	0.018 (0.002)	0.065 (0.002)	0.080 (0.002)	0.050 (0.007)
L. saliens	0.008 (0.001)	0.058	0.075	0.040 (0.008)
C. labrosus	0.021 (0.002)	0.067 (0.001)	0.079 (0.001)	0.055 (0.007)
O. labeo	0.052 (0.002)	0.081 (0.003)	0.092 (0.003)	0.068 (0.007)

	L. aurata	*L. ramada*	*L. saliens*	*C. labrosus*	*O. labeo*
L. bandialensis					
L. dumerili					
L. falcipinnis					
L. grandisquamis					
L. aurata	0.004 (0.001)				
L. ramada	0.013 (0.003)	0.004 (0.002)			
L. saliens	0.016 (0.001)	0.013 (0.002)	0.000		
C. labrosus	0.017 (0.001)	0.017 (0.003)	0.016 (0.001)	0.002	
O. labeo	0.050 (0.002)	0.050 (0.003)	0.048 (0.003)	0.055 (0.003)	0.004

When more than two haplotypes of species were available, a mean genetic distance (± standard deviation) has been calculated.

down over the premaxilla and extending below the corner of the mouth when the mouth is closed. Anteroventral edge of lachrymal serrate and distinctly concave adjacent to mouth; ventral end of lachrymal broad and squarish, extending posterior to and ventrally below the level of the corner of the mouth. Translucent adipose tissue around eye weakly developed in adults, forming only a narrow rim around the eye and extending anteriorly a short way onto the lateral part of the snout. Head broad; head depth slightly less than head width at level of posterior of operculum. Anterior and posterior nostril close-set; anterior nostril nearer posterior nostril than lip, and posterior nostril nearer anterior nostril than eye. Fleshy covering to basihyal (“tongue”) with low median ridge.

3.4.3. Scalation

LL: 32*–33. TR: 10.5–12*. PED: 7* or 8. Psc: 8 or 9*. D1sc: 11*. D2sc: 21*–23. Predorsal scales extending at least to posterior nostrils, and to anterior nostrils in some specimens; predorsal scales with one* or two, long mucuous canals. Scales on body ctenoid. Pectoral axillary scale short. Moderate length pelvic axilla scale lateral to each pelvic fin, reaching three-fifths to three-quarters along pelvic spine. Moderate length obbasal scale on each side of base of first dorsal fin, extending posteriorly beyond the base of Sp. IV. Second dorsal and anal fins with small scales on anterior and basal parts, otherwise naked.

Fins. D1: IV*. D2: i, 8*. A: III, 9*. P: one ray appearing as a small spine, closely apposed to the next ray, and 15 or 16 segmented rays. Origin of first dorsal fin nearer to caudal base than tip of snout. First dorsal spines quite elongate; Sp. I shorter than Sp. II; Sp. IV weak, not reaching behind vertical from tip of Sp. III when fin raised. Origin of second dorsal fin at vertical approximately one-third along anal fin base; tips of anterior rays reaching behind tips of posterior rays. Anal fin higher than second dorsal fin, both higher than first dorsal fin. Second dorsal and anal fins falcate, but not strongly so. The pectoral fin does not extend to the origin of the first dorsal fin, and is 18.9–22.6% SL and 76.2–92.6% of head length. Pectoral fin reaching the anterior rim of eye when laid forward, or extending anterior to rim of eye; and reaching one-third to two-thirds along pelvic fin when laid back. Origin of pelvic fin equidistant between pectoral fin origin and first dorsal fin origin, its tip reaching to vertical between bases of Sp. III and Sp. IV of first dorsal fin. Pelvic fins not longer than length of head minus snout. Caudal fin lunate.

3.4.4. Lips and jaws

Lips thin; maximum depth of upper lip 21.7–33.3% of snout length; mouth wide in ventral view (approx 120° at dentary symphysis). Upper and lower lips of juvenile and adult fish each with a single row of small, relatively well-spaced ciliiform teeth, just visible to the naked eye. Upper lip without enlarged papillae or crenulations. Mouth corner at vertical just anterior to anterior nostril in neotype, but extending to level of posterior nostrils in some other specimens.

3.4.5. Pharyngobranchial morphology

Pharyngobranchial organ with two valves; a large, flap-like anteroventral valve and a smaller, finger-like posterior valve.

3.4.6. Alimentary tract

Seven or eight pyloric caeca, which may be arranged in a group of short caeca and a group of longer caeca. There are one or two loops in the alimentary tract, which may be less than in other species.

3.4.7. Colour in fresh/recently preserved specimens

Body dusky greyish dorsally, silvery laterally and pale ventrally. First dorsal fin brownish, perhaps very slightly yellow. Second dorsal fin and anal fin brownish and distinctly yellow. Pectoral fins pale but the posterior

two-thirds of the fin are dark and slightly yellowish on the distal two-thirds of the rays, and the dorsal margin of the first segmented ray is distinctly dark. Inner face of the pectoral fins is dark-brownish with some yellow at posterior tips of rays. Pelvic fins are pale whitish, but with yellow tips to first and second filamentous rays (and slightly on third filamentous ray). Caudal fin darkish, particularly at distal margin, and distinctly yellow.

3.4.8. Conservation status

The currently known distribution of *L. bandialensis* includes coastal waters of Senegal, Gambia and Guinea Bissau. Although *L. bandialensis* is well-known to some local fishermen of the Sine Saloum estuary in Senegal, it is a rare species and only large specimens (> 250 mm) have been observed. Local fishermen in the region of the Bandiala channel reported in 1993 that the species was not common and appeared seasonally, usually in the early part of the year around February. The fishermen reported that it seemed to be more numerous in previous years. Of 8,438 juveniles of Mugilidae (9–93 mm SL) that we collected in the Sine Saloum estuary during a year-round study (2007–2008), none belonged to this species [11]. It is possible that the species has become less prevalent due to increasing salinities in the Sine Saloum associated with decreased precipitation and freshwater flows, although other species of mugilids do not seem to be significantly affected by these ecological changes [11]. If *L. bandialensis* is affected by these changes, then the threats they pose may be exacerbated by regional fishing pressure. *L. bandialensis* has also been collected by local fishermen in the Gambia estuary, as reported to one of us (IJH) and colleagues (O. Sadio, personal communication), but is probably rare in this estuary since no specimens were collected by Albaret et al. [20].

While some information indicates that *L. bandialensis* might be threatened by impacts of climate change and fisheries within its restricted geographical range, there is insufficient evidence to evaluate the possible decline in the population. For these reasons, and according to the IUCN [21] *Red List Categories and Criteria*, we propose that *L. bandialensis* be listed on the IUCN *Red List of Threatened Species* as "Data Deficient".

4. Discussion

The current analyses confirm that Diouf's [6] species *L. bandialensis* has features typical of the genus *Liza*, as well as several diagnostic characters that indicate that it is distinct from other West African species in the genus. Some authors have noted *Liza* Jordan & Swain, 1884 as congeneric with *Chelon* Artedi 1793 and used the name *Chelon* as the senior synonym (e.g. [22]). There are anatomical and molecular similarities between *Chelon labrosus* and species of *Liza*, including the type species, *Liza ramada* (see [2]). However, *Liza* appears to be a non-monophyletic assemblage, with new genera being split from it [14,23]. Therefore, we follow Harrison [19] in continuing to recognize *Liza* and *Chelon* as distinct until such time as a full taxonomic revision of the complex genus *Liza* has been completed.

Both morphological and molecular data demonstrate the distinctness of *L. bandialensis* from other species of Mugilidae occurring in the Atlantic Ocean. There are in fact no other species of *Liza* from any part of the world that share the morphological features of *L. bandialensis* [1]. However, the species does show strong overall similarity to *Liza grandisquamis* with which it might be confused [6]. For these reasons, we consider it useful to nominate a neotype to help clarify the taxonomic status and to act as a reference specimen for future analyses (according to article 75.3.1. of the fourth edition of the Code [24]). All other qualifying conditions for nominating the neotype have been met. The description above gives the diagnostic features of *L. bandialensis*, as indicated by the neotype (art. 75.3.2 and 75.3.3); the Introduction on this paper clearly explains that no type specimens were previously validly designated (art. 75.3.4). Although Diouf's [6] description does not refer to any one particular specimen, the neotype is consistent with Diouf's [6] overall description (art. 75.3.5) because it shares diagnostic features, described above, that were also described by Diouf [6]; the neotype was collected from the Sine Saloum estuary, where the specimens used for the original description were collected [6] (art. 75.3.6); the neotype is preserved in the collections of the MNHN, that has the proper facilities for preserving name-bearing types, and makes these specimens accessible for study (art. 75.3.7).

As noted above, the distribution of *L. bandialensis* includes coastal waters of Senegal, Gambia and Guinea Bissau. *L. bandialensis* seems to be more common around the Bijagos Islands of Guinea Bissau from where we obtained tissues of randomly collected mullets that belonged to this species. In addition, several specimens of *Liza* from Rio Buba (Guinea Bissau), presenting the meristic criteria of *L. bandialensis*, were reported by Kromer et al. [25]. *L. bandialensis* is usually found over sandy bottoms, compared to muddy bottoms where *L. grandisquamis* is found. Dissected specimens of *L. bandialensis* tend to have mainly sand in the alimentary tract. If *L. bandialensis* are feeding on slightly coarser grain particulate material than *L. grandisquamis,* then this might explain the larger teeth and pharyngobranchial valves, and shorter intestine seen in *L. bandialensis* compared to *L. grandisquamis*. Local fishermen of the Sine Saloum estuary in Senegal have, for many years, recognized *L. bandialensis* as a different species to other mullets present, and have noted that it has a better taste, which might be due to its tendency to forage over sandy rather than muddy substrates. *L. bandialensis* is also reported to be a very good jumper, better at jumping than any other species with which it is sympatric. It is apparently difficult to catch in nets because it may jump over them, up to 70 cm out of the water.

With this new species, twelve species of Mugilidae are currently known to occur along the West African coast between Senegal and Angola (see key below, which also includes four species whose range is just north of Senegal). *L. bandialensis* is remarkable by its large size reaching at least 572 mm [7], much larger than those of other *Liza*/*Chelon* species from West Africa for which the maximum reported FL are 410 mm for *L. falcipinnis*, 297 mm for

L. grandisquamis, 282 mm for *Liza richardsonii*, 210 mm for *L. dumerili* and 183 mm for *C. bispinosus* [1,3]. Interestingly, genetic data indicate that *L. bandialensis* is very close to *L. saliens*, a species occurring in temperate waters of North East Atlantic Ocean and in the Mediterranean Sea.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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Appendix. Key to species of Mugilidae occurring on eastern central Atlantic coast of Africa

1a. Serrate, anteroventral edge of lachrymal with deep, concave notch adjacent to mouth; upper lip with numerous vertical ridges of horny epidermis. Lower lip projecting anteriorly, fringed with ridges of horny epidermis; thick upper lip thick (depth 14–17% head length); lips deeply folded into lachrymal notch at corner of mouth; at least 39 scales usually 44–49, in longitudinal series (excluding scales on caudal fin base); ventral one or two pectoral fins rays free from membrane ..... **Oedalechilus labeo**

1. Serrate, anteroventral edge of lachrymal only slightly notched or straight; lower lip always smooth; upper lip smooth or bearing papillae, but without ridges of horny epidermis; upper lip 2.8–15% head length; lips not deeply folded into corners of mouth; 25–48 scales in longitudinal series (excluding scales on caudal fin base); ventral pectoral fin rays not free from membrane..... 2

2a. Translucent adipose tissue extensive over eye in specimens over 30 mm SL; mouth ogive in ventral view, with acute angle at dentary symphysis; maxilla straight, with posterior tip not extending below corner of mouth; serrate, anteroventral edge of lachrymal straight; ventral end of lachrymal slender and pointed); pharyngobranchial organ 3

2b. Translucent adipose tissue restricted to a narrow ring around border of eye; mouth wide in ventral view, with an angle of 90° or more obtuse at dentary symphysis; posterior end of maxilla sigmoid, curved down below corner of mouth; serrate, anteroventral edge of lachrymal weakly concave or noticeably kinked; ventral end of lachrymal broad and squarish; pharyngobranchial organ usually with two valves (sometimes one)..... 6

3a. Ventral end of lachrymal not reaching level of posterior tip of maxilla; 43–47 scales in longitudinal series; pectoral fin extending to level of first dorsal fin or posteriorly beyond ..... **Mugil capurrii**

3b. Ventral end of lachrymal reaching level of posterior tip of maxilla; 32-42 scales in longitudinal series; pectoral fin not reaching, or not quite reaching level of first dorsal fin 4

4a. Anal fins with 3 spines (first spine very short) and nine (rarely 10) soft rays in adults, or two spines and 10 (rarely 11) soft rays in specimens less than *ca.* 30 mm SL; scales covering entire second dorsal and anal fins in adults (less heavily scaled in specimens under ca. 50 mm SL) ..... **Mugil curema**

4b. Anal fins with three spines (first spine very short) and eight (very rarely 9) soft rays in adults, or two spines and nine (very rarely 10) soft rays in specimens less than *ca.* 50 mm SL; second dorsal and anal fins of adults with few scales (on anterior and base of fin) 5

5a. 13–15 scales in rearward transverse series between pelvic and first dorsal fins; upper lip with one or two outer rows of small unicuspid teeth, and up to six inner rows of smaller, bicuspid teeth; lower lip with an outer row of small unicuspid teeth and sometimes one or more inner rows of smaller bicuspid teeth; 50 or more gill rakers on lower part of first gill arch; pelvic fins, anal fin, and lower lobe of the caudal fin yellowish ..... **Mugil cephalus**

5b. 11–13 scales in rearward transverse series between pelvic and first dorsal fins; upper lip with single row of longish, recurved, unicuspid teeth and no inner rows; lower lip without teeth or with a single row of minute, ciliiiform teeth; 46 or fewer gill rakers on lower part of first gill arch; pelvic fins, anal fin, and lower lobe of the caudal fin pale greyish, without yellowish color ..... **Mugil bananensis**

6a. In adults of *ca.* 90 mm SL or larger, lower third to half of the upper lip with one to seven rows of cornified papillae, and upper lip deep, its depth at the point of the snout 5.5-15% of head length; 41-47 scales in longitudinal series 7

6b. Upper lip always without papillae and usually thin, its depth at the point of the snout 4–8% of the head length; 25–52 scales in longitudinal series 8

7a. In adults, upper lip 5.5–11% of head length; lower third to half of upper lip with 1–5 rows of cornified papillae; pectoral fin 75–86% head length; 13.5–15 scales in rearward transverse series between pelvic and first dorsal fins ..... **Chelon labrosus**

7b. In adults, upper lip 14–15% of head length; lower third to half of upper lip with 5–7 rows of cornified papillae; pectoral fin 84–87% head length; 17 scales in rearward transverse series between pelvic and first dorsal fins ..... **Chelon bispinosus**

8a. Upper jaw with tricuspid teeth . . . **Liza tricuspidens**

8b. Upper jaw without tricuspid teeth 9

9a. Anal fin with at least 13 (usually 14) rays in total (usually three spines and eleven soft rays in adults); anterior rays of anal fin elongate, giving falciform appearance; usually ten (rarely nine) rays in second dorsal fin; scales on flanks cycloid. . . . . **Liza falcipinnis**

9b. Anal fin usually with 12 or fewer rays in total (usually three spines and nine soft rays in adults); anal fin not falciform; usually nine rays in second dorsal fin; scales on flanks usually ctenoid (may be cycloid in *L. richardsonii* with 12 anal rays in total) 10

10a. Scales 33 or less in longitudinal series (excluding scales on caudal fin base), 12 scales or less in rearward transverse series between pelvic and first dorsal fins; usually one but not more than two longitudinal mucuous canal grooves on predorsal and interdorsal scales 11

10b. Scales 33 or more in longitudinal series (LL) (excluding scales on caudal fin base), 11–16.5 in rearward transverse series (TR) between pelvic and first dorsal fins; specimens with LL 33 and TR 11 or 12 will have at least two (usually more) longitudinal mucuous canal grooves on predorsal and interdorsal scales (*Liza dumerili*) 12

11a. Scales 25–30 in longitudinal series (excluding scales on caudal fin base), 8–10.5 in rearward transverse series between pelvic and first dorsal fins; dorsal, anal and caudal fins slightly but not distinctly yellowish; Senegal to Republic of Congo . . . . . **Liza grandisquamis**

11b. Scales 32–33 in longitudinal series (excluding scales on caudal fin base), 10.5–12 in rearward transverse series between pelvic and first dorsal fins; dorsal, anal and caudal fins distinctly yellowish; Senegal, Gambia and Guinea Bissau . . . . . **Liza bandialensis**

12a. 2 or more longitudinal grooves on the predorsal and some interdorsal scales; pyloric caeca arranged in a dorsal group of short caeca and a ventral group of long caeca 13

12b. 1 (sometimes 2) longitudinal grooves on the predorsal and interdorsal scales; pyloric caeca subequal 14

13a. 43–48 scales in longitudinal series (excluding scales on caudal fin base); 31–33 scales anterior to origin of second dorsal fin; pharyngobranchial organ with two valves, both similarly developed as small folds; coast of Morocco and the Azores . . . . . **Liza saliens**

13b. 33–41 scales in longitudinal series (excluding scales on caudal fin base); 24–25 scales anterior to origin of second dorsal fin; pharyngobranchial organ with one or two valves; anteroventral valve a semi-lunate flap; posterior valve usually only a small nodule or fold, or may be absent; west African coasts from Mauritania to Namibia. . . **Liza dumerili**

14a. 40–62 lower gill rakers on first gill arch; body depth at origin of first dorsal fin 25–30% standard length; west African coasts from Angola to South Africa . . . . . **Liza richardsoni**

14b. 60–113 lower gill rakers on first gill arch; body depth at origin of first dorsal fin 19–25% standard length; west African coasts from Azores, Madeira, and Morocco, northwards to the British Isles 15

15a. Body depth at origin of first dorsal fin in adults 19–20% of SL; predorsal scales to level of anterior nostrils; upper lip with outer row of very small, teeth, close-set in a fine "comb"; posteroventral corner of lachrymal truncate; pectoral fin 59–74% of head length; pectoral fin not reaching level of eye when bent forward; dark spot at origin of pectoral fin; gold patch on operculum diffuse . . . . . **Liza ramada**

15b. Body depth at origin of first dorsal fin in adults 20-25% SL; predorsal scales to level of posterior nostrils; upper lip with outer row of small to moderate size teeth, slightly separated from each other; posteroventral corner of lachrymal more or less pointed; pectoral fin 77–95% of head length; pectoral fin reaching at least to anterior margin of eye when bent forward; no dark spot at origin of pectoral fin; gold patch on operculum usually distinct . . . . . **Liza aurata**

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