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Reassignment of a junior synonym of *Lepisosteus oculatus* Winchell 1864 to *L. platostomus* Rafinesque 1820

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The foundation for the current taxonomy of Lepisosteidae (gars) was laid by Suttkus (1963) and Wiley (1976); these authors recognized only two extant genera as valid, *Lepisosteus* and *Atractosteus*. These authors also only recognized seven living species of gars and assigned several previously recognized species as junior synonyms. One of these, *Lepisosteus oculatus* Winchell 1864 possesses five junior synonyms: *Cylindrosteus latirostris* Girard 1858, *Cylindrosteus productus* Cope 1865, *Cylindrosteus agassizii* Duméril 1870, *Cylindrosteus zadockii* Duméril 1870 and *Cylindrosteus bartonii* Duméril 1870. *Cylindrosteus zadockii* was described from two syntypes collected from the "Upper Mississippi River" (MHNH 5799, 5800; Figure 1), and was designated a junior synonym of *L. platostomus* by Jordan *et al.* (1930), and later placed in synonymy with *L. oculatus* by Wiley (1976). However, Wiley denoted the synonymy as questionable by placing "?" in front of the *C. zadockii* name. Although never stated, it is possible that Wiley's (1976) designation of *Cylindrosteus zadockii* as a junior synonym of *Lepisosteus oculatus* was based on the vague description of the original type locality in relation to present-day distributions of *L. oculatus* (see below). Wiley's synonymy of *C. zadockii* was accepted by Grande (2010) in his comprehensive monograph on gars but we provide reason here to challenge it. The dried syntypes of *C. zadockii* were deposited in the Muséum National d'Histoire Naturelle in Paris and we were able to access photographs of the specimens from the museum database and museum staff. Upon examination of the photographs of the syntypes, we found evidence showing *C. zadockii* to be a junior synonym of *L. platostomus* (Shortnose Gar) rather than of *L. oculatus* (Spotted Gar), supporting the original designation by Jordan *et al.* (1930).

The type locality of *C. zadockii* was described by Duméril (1870) simply as: "du Haut-Mississipi [sic]" translating to the 'high Mississippi' or the 'upper Mississippi,' a vague geographic designation that could have multiple meanings. Examining the storied biography of the collector, Christophe-Augustin Lamare-Picquot, his expedition to the 'high Mississippi' took him specifically through Indiana, Illinois, Michigan, Wisconsin, Missouri, and Minnesota (Chaigneau 1982).

If Lamare-Picquot collected the syntypes for *C. zadockii* in the Mississippi River headwaters (Minnesota), then the syntypes collected are very likely to be *L. platostomus* as that is the only gar species in the region that fits the description he provided. *Lepisosteus osseus* is also present in this region but is easily distinguished by its extremely elongated snout. It is unlikely that Duméril meant the upper/northern region of the state of Mississippi when he wrote "du Haut-Mississipi [sic]" in this description of *C. zadockii* because he specifically mentions the state of Mississippi using different language later in the same monograph ["de l'état du Mississippi" - pg. 327]; in addition, Lamare-Picquot never ventured to the state of Mississippi.

If Lamare-Picquot collected the syntypes for *C. zadockii* in the upper Mississippi River basin (Indiana, Illinois, Missouri, Wisconsin) and not specifically the river proper, then *C. zadockii* could still be either *L. oculatus* or *L. platostomus* because both occur in this area (Smith 2002; Page & Burr 2011). However, the physical characters of the syntypes of *C. zadockii* make it clear that they are *L. platostomus* and not *L. oculatus*.

There are three diagnostic characters that Grande (2010) uses to differentiate *L. platostomus* and *L. oculatus*. First, *L. platostomus* possesses a higher lateral line scale count than *L. oculatus* (59-65 in *L. platostomus* vs. 53-59 in *L. oculatus*; Suttkus (1963) as cited in Grande 2010). The syntypes possess 61 and 63 lateral line scales which falls within the range

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of *L. platostomus*. Second, *L. platostomus* possesses a higher premaxillary tooth count (5-6 in *L. platostomus* vs. 1-3 in *L. oculatus*; Grande 2010). At least one of the syntypes of *C. zadockii* (MHNH 5799) possesses at least five premaxillary teeth, diagnostic of *L. platostomus.* The other syntype specimen (MHNH 5800) appears to have fewer premaxillary teeth but the view from images are obscured in the dried specimen. Despite this issue, MHNH 5800 possesses the high number of lateral line scales diagnostic of *L. platostomus.* Third, Grande (2010) details differences in the relative number of tiny ossifications (deemed "dermal denticles" or "isthmus ossifications" by Grande (2010)) present on the isthmus of the gular region in the two species, with *L. oculatus* possessing an "Isthmus region densely covered with dermal denticles." (pg. 187), and "The isthmus ossifications in *L. platostomus* are not nearly as well developed as the isthmus plates in *L. oculatus*." (pg. 177). Of these three characters, the amount of isthmus denticles is the least reliable character with isthmus denticles being variable within both *L. oculatus* and *L. platostomus* (pers. obs. of authors using comparative modern material), possibly due to ontogenetic variation or geographic variability, and thus not helpful as evidence to distinguish species.

The character that Duméril (1870) uses to primarily split the species in his synoptic table is the placement of the pelvic fins being either closer to the pectoral fins, equidistant, or closer to the anal fin (pg. 347; Figure 3). More specifically, both *C. zadockii* and *L. platostomus* share the condition of have pelvic fins positioned slightly closer to the pectoral fins.

FIGURE 1. Syntypes of *Cylindrosteus zadockii* (Top: MNHN 5799, 62 cm TL; Bottom: MNHN 5800, 66 cm TL). The Muséum National d'Histoire Naturelle appears never to have updated the labels for these specimens to show the recommended synonymy of Wiley (1976) and therefore currently shows our recommendation (and that of Jordan *et al.* 1930) to consider these syntypes as members of *Lepisosteus platostomus*. These antique tags are an example of how the slow progress of updating museum tags can sometimes work to the advantage of taxonomists.

Duméril (1870) only presented one meristic character that separated *C. zadockii* from *L. platostomus* in a dichotomous key (p. 347; Figure 3): "8 rangées d'écailles au-dessus de la ligne latérale" or "8 scale rows above the lateral line" in *C. zadockii* whereas *L. platostomus* had "7 rows above the lateral line." While modern ichthyologists would interpret this meristic count as eight scale rows above the lateral line to the dorsal-fin insertion (Grande 2010), Duméril specifically states in the *C. zadockii* description that "De la ligne latérale au rang médian du dos, 8 rangées," or "From the lateral line to the middle row of the back, 8 rows." While Duméril doesn't specifically state where along the body he counted the number of scale rows above the lateral line, we assume it is the second scale row ahead of the pelvic-fin origin which Duméril uses to tally total number of scale rows in an oblique series around the entire body (p. 323, in Duméril's descriptions of other species). Using specimens of *L. platostomus* (n=6) and *L. oculatus* (n=6) from the LSUMNS Fish Collections we repeated Duméril's method of counting scale rows above the lateral line along the second scale row ahead of the pelvic-fin origin. We repeated these counts on the syntypes of *C. zadockii* to verify Duméril's counts using the reference photos provided by the Muséum National d'Histoire Naturelle (Figures 1 & 2). We also used the modern method of counting scale rows above the lateral line (from LL to dorsal-fin origin; Hubbs *et al.* 2004) to compare the two methods. Number of scale rows

of each specimen, as well as modal values within species, were tabulated for comparison (Table 1). Pelvic fin position on LSUMNS specimens and the *C. zadockii* syntypes were determined using a digital caliper. The *C. zadockii* syntypes were measured by MNHN staff. Our results found range overlap between the three species (viz. *C. zadockii, L. platostomus*, *L. oculatus*) using Duméril's counting method as well as the modern (Hubbs *et al.* 2004) method. Despite there being a modal difference of eight scale rows above the lateral line in *C. zadockii* versus seven scale rows in *L. platostomus,* there was one *L. platostomus* specimen with eight scale rows counted above the lateral line, indicating that perhaps Duméril did not account for intraspecific variation when using this character to distinguish *C. zadockii* and *L. platostomus.* Additionally, there were no significant differences in pelvic fin position between modern specimens of *L. oculatus, L. platostomus,* or the *C. zadockii* syntypes. Upon remeasuring of the syntypes, one (MHNH 5799) has pelvic fins positioned closer to the anal fin, conflicting with Duméril's own description and his use of the character as diagnostic. Duméril does not provide his own measurements in the description of *C. zadockii.* This error fits with Duméril's reputation as a somewhat sloppy taxonomist as noted in his own time by Jordan (1930): "In a recent work on these fishes, Prof. August Duméril very laboriously distinguishes the following 'species' among the specimens of *Lepidosteus* in the Museum at Paris…Most of these nominal species are based upon the most trifling individual differences, and often the right side of a specimen indicates one 'species,' and the left another. As the matter stands, we have no alternative but to reject them all, and wait for the time when systematic writers shall be wiser or more honest" (pg. 341).

TABLE 1: Individual scale row counts at two fixed points for six *Lepisosteus platostomus* specimens, six *L. oculatus* specimens, and the photos of two syntypes for *Cylindrosteus zadockii*. Range and modal number of scale rows above the lateral line using the two methods for each species were calculated. Note the negligible difference in modal number of scale rows between the *L. platostomus* and *L. oculatus* and the range overlap between *C. zadockii* and *L. platostomus* on both counts.

Catalog #	# Scale Rows Abv LL two rows ant. to Pelvic Fin Origin (Duméril 1870)	Species Mode	# Scale Rows Abv LL to Dorsal Fin Insertion (Hubbs *et al.* 2004)	Species Mode
L. platostomus	Range: 7–8	7	Range: 10–12	12
LSUMZ 1677	8		12	
LSUMZ 1773.1	7		10	
LSUMZ 1773.2	6		10	
LSUMZ 2176	7		12	
LSUMZ 2937.1	7		12	
LSUMZ 2937.2	7		12	
L. oculatus	Range: 6–7	7	Range: 9–11	11
LSUMZ 21875	7		11	
LSUMZ 22066.1	7		11	
LSUMZ 22066.2	6		9	
LSUMZ 22066.3	7		11	
LSUMZZ 22069	7		10	
LSUMZ 22050	7		11	
C. zadockii	Range: 8	8	Range: 10–13	NA
MNHN 5799	8		13	
MNHN 5800	8		10	

The shared morphological characteristics of these type specimens to *L. platostomus* (number of lateral line scales, number of premaxillary teeth), lack of those same shared features in *L. oculatus,* and the use of modern specimens to refute Duméril's ambiguous single scale difference between *C. zadockii* and *L. platostomus* as well as similarity in pelvic-fin position, warrants a challenge to the current taxonomy. We formally recommend that *Cylindrosteus zadockii* Duméril 1870 be recognized as a junior synonym of *Lepisosteus platostomus* Rafinesque 1820, and not of *L. oculatus*.

FIGURE 2. Diagram showing number of scale rows above the lateral line, using the same method as Duméril (1870) on the two syntypes of *Cylindrosteus zadockii*. Yellow stars: Pelvic-fin origin; Green circles: Lateral line scales; Blue circles: Recognizable scales used as reference across both views; Orange circles: Scales on the row that was counted that can be traced back to blue reference scales; Red circles: Other scales along the scale row that were counted. Notes that there are eight scale rows (red + orange) above the lateral line on both syntype specimens using the same counting method as Duméril (1870).

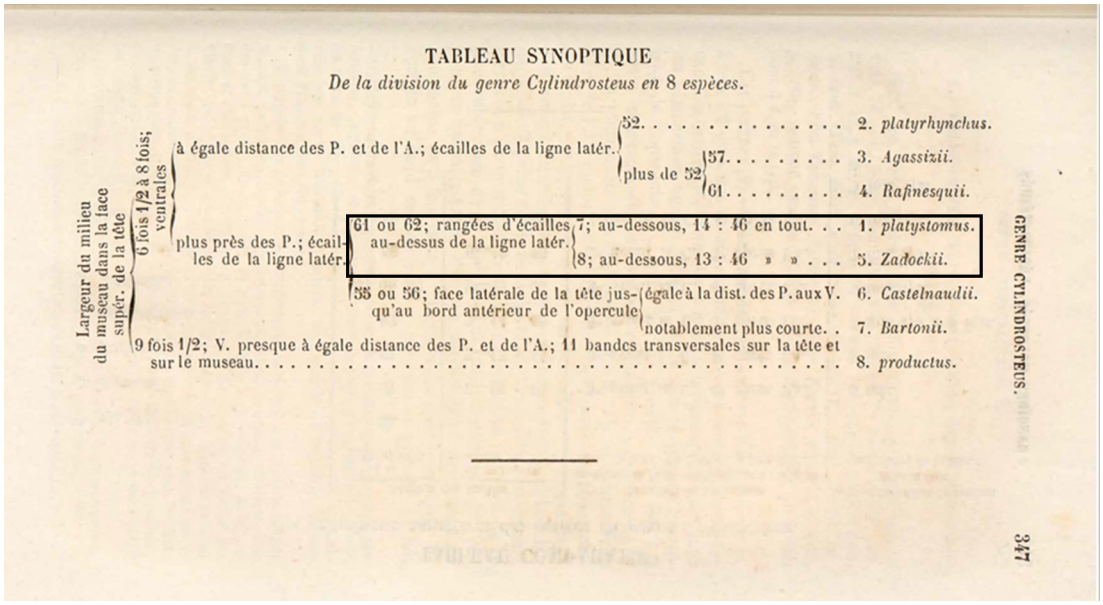

TABLEAU SYNOPTIQUE

De la division du genre Cylindrosteus en 8 espèces.

Largeur du milieu du museau dans la face supér. de la tête 6 fois 1/2 à 8 fois; ventrales

- à égale distance des P. et de l'A.; écailles de la ligne latér. 52. . . . . 2. *platyrhynchus.*
- plus près des P.; écailles de la ligne latér.
  - plus de 52: 57. . . . . 3. *Agassizii.*; 61. . . . . 4. *Rafinesquii.*
  - 61 ou 62; rangées d'écailles au-dessus de la ligne latér.: 7; au-dessous, 14 : 46 en tout. . . 1. *platystomus.*; 8; au-dessous, 13 : 46 » » . . . 5. *Zadockii.*
  - 55 ou 56; face latérale de la tête jusqu'au bord antérieur de l'opercule: égale à la dist. des P. aux V. 6. *Castelnaudii.*; notablement plus courte. . 7. *Bartonii.*

9 fois 1/2; V. presque à égale distance des P. et de l'A.; 11 bandes transversales sur la tête et sur le museau. . . . . 8. *productus.*

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FIGURE 3. Duméril (1870: 347) showing the full table for syntypes for the now subsumed subgenus *Cylindrosteus* (of which *Lepisosteus platostomus* was once a part). The suspect meristic character "Number of scales above lateral line", and the one scale difference between *L. platostomus* and *C. zadockii* are highlighted with a black box.

TABLE 2: Measurements relating to pelvic fin position on six *Lepisosteus platostomus* specimens, six *L. oculatus* specimens, and the two *Cylindrosteus zadockii* syntypes (measured by MHNH staff). Note that pelvic fin placement is not diagnostic between *L. platostomus* and *L. oculatus,* as multiple character states are seen within the same species with no indication of ontogenetic variation. Also note, one of the *C. zadockii* syntypes and some *L. platostomus* specimens possess pelvic fins slightly closer to the anal fin, contrary to Duméril's description of the character state in the two species. Pelvic fin position was considered roughly equidistant if measurements were within a half centimeter of each other.

	Total Length (cm)	Pectoral Fin to Pelvic Fin Distance (cm)	Pelvic Fin to Anal Fin Distance (cm)	Pelvic Fin Position
L. platostomus				
LSUMZ 1677	49.5	11.9	10.5	Anal Fin
LSUMZ 1773.1	48.1	11.1	10.7	Anal Fin
LSUMZ 1773.2	44	9.8	10.1	~Equidistant
LSUMZ 2176	47.7	10.3	10.4	~Equidistant
LSUMZ 2937.1	52.9	12.4	11.7	Anal Fin
LSUMZ 2937.2	51.7	11	11.8	Pectoral Fins
L. oculatus				
LSUMZ 21875.2	52.2	11.9	13.5	Pectoral Fins
LSUMZ 22066.1	62.1	14.9	14.7	~Equidistant
LSUMZ 22066.2	54.9	12.9	12.3	Anal Fin
LSUMZ 22066.3	59.6	13.7	13.1	Anal Fin
LSUMZ 22069.1	57.3	13.4	14.0	Pectoral Fins
LSUMZ 22050	66.9	15.1	17.0	Pectoral Fins
C. zadockii				
MNHN 5799	62.0	15.1	14.1	Anal Fin
MNHN 5800	66.0	13.7	14.4	~Equidistant

Material Examined

Lepisosteus platostomus: Six specimens total, all preserved in alcohol: LSUMZ 1677, 1773.1, 1173.1, 2167, 2937.1, 2937.1.

Lepisosteus oculatus: Six specimens total, all preserved in alcohol: LSUMZ 21875.2, 22050, 22066.1, 22066.2, 22066.3, 22069.1.

Cylindrosteus zadockii: Photos of two dried specimens (both dried and stuffed): MNHN 5799 and 5800.

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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