

1 **A new maximum size for the family Nomeidae and the third record of a longfin**
2 **cigarfish, *Cubiceps paradoxus* (Stromateoidei: Nomeidae) from California, USA**

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18 **Abstract:** We report the largest specimen from the stromateoid family Nomeidae. The specimen,
19 measuring 1283 mm total length unpreserved, was caught on hook and line from shore in Port
20 Hueneme, California, USA in June 2019. Despite scavenging damage, the specimen was
21 identified as a longfin cigarfish, *Cubiceps paradoxus*, using morphological characters and
22 molecular techniques. This is the third record of *C. paradoxus* from California. We also provide
23 an account of a previously unreported *C. paradoxus* collected off the US-Mexico Border in 1999
24 that was examined but not preserved.

25 **INTRODUCTION**

26 An exceptionally large stromateoid fish was caught by angler G. Mayer while surf-fishing on
27 Family Beach in Naval Base Ventura County Point Mugu, c. 8 km SE of Port Hueneme,
28 California, USA on 28 June 2019. G. Mayer took images of the specimen (Figure 1a) and
29 released it alive. The specimen subsequently died and G. Mayer recovered it off the beach 6 h
30 later. In the intervening time, scavengers damaged the specimen (Figure 1b), but it was
31 identifiable as a representative of the rarely encountered driftfish (Family Nomeidae) genus
32 *Cubiceps*, known as cigarfishes or fatheads. G. Mayer gifted the specimen to the second author
33 for study.

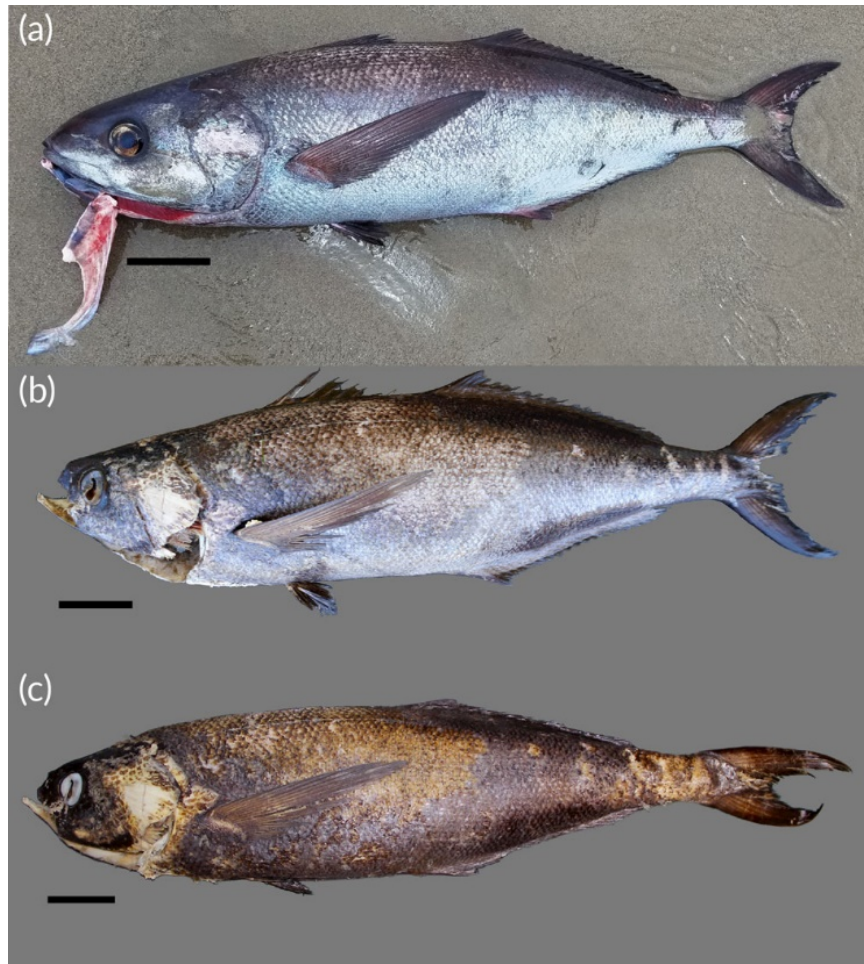
34 The family Nomeidae comprises three genera and 16 species of open-ocean epi- and
35 mesopelagic fishes. The 10 species of *Cubiceps* are found throughout tropical and subtropical
36 oceans (Agafonova, 1994). They are caught as bycatch in longline fisheries or sometimes taken
37 in small-scale fisheries and have been collected from stomach contents (Butler, 1979).

38 *Cubiceps* are rare off California, with only three adults from two species known in
39 collections. These are two longfin cigarfish (or giant fathead *sensu* Kukuev & Gulyugin, 2015),
40 *C. paradoxus* Butler, 1979: the holotype, LACM 37048-1 caught on hook and line off
41 Portuguese Bend, Los Angeles County in 1954 (Butler, 1979) and LACM 45680-1 collected in
42 Los Angeles Harbour in 1986 (Ellis *et al.*, 1988) and a single record of the Cape cigarfish, *C.*
43 *capensis* (Smith, 1845), CAS 218171 caught in a gill net 145 km WSW of Morro Bay, San Luis
44 Obispo County, outside state waters in 2003 (McCosker *et al.*, 2004). In addition, the California
45 Cooperative Oceanic Fisheries Investigations collected larvae identified as black fathead, *C.*
46 *baxteri* McCulloch 1923 far offshore (Watson, 1996).

47 Despite damage to the head and upper jaw, we identified the newly collected specimen as *C.*
48 *paradoxus* based on key morphological features. This species is known from the eastern Pacific
49 and eastern Atlantic oceans to depths of 400 m (Agafonova, 1994; Kukuev & Gulyugin, 2015).
50 To further verify the identification, a sequence of the mitochondrial cytochrome-oxidase I gene
51 from this specimen was compared against voucher records.

52 **MATERIALS AND METHODS**

53 Counts and measurements follow Butler (1979). Measurements were taken with digital callipers
54 or meterstick and are reported to the nearest 1 mm. Standard (SL), fork (FL) and head length
55 (HL) were all taken from the tip of the lower jaw as the upper jaw was completely missing [as
56 the jaws were subequal (Figure 1a), the lower jaw provides an accurate measure of length]. Gill
57 raker counts are presented as upper + lower rakers on the anterior face of the first arch; the angle
58 raker is included in the lower count. Morphometric values are presented in Table 1. The
59 specimen was deposited at Scripps Institution of Oceanography (SIO) and institutional
60 abbreviations follow Sabaj (2019).



61
62 **FIGURE 1** *Cubiceps paradoxus*, SIO 19-76, 1262 mm total length preserved, 1058 mm standard
63 length preserved, Ventura County, California, USA. (a) Live specimen when first landed, before
64 scavenger damage. Image reversed, right side shown; scale bar estimated. Photograph: G. Mayer.
65 (b) Specimen on recovery by authors. Photograph: M. McCrea. (c) Specimen in preservation.
66 Photograph: B. Frable. Scale bars represent 100 mm

67 **TABLE 1** Proportional measurements of specimens of *Cubiceps paradoxus*

	SIO 19-76	Specimen measured by R.N. Lea
Total length	1262 (1283)	1090
Fork length	1136 (1158)	1000
Standard length	1058 (1080)	–
Head length	310	300
As % head length Snout length	Damaged	30.7
Upper jaw length	Damaged	31.7
Orbit diameter	16.8	20.0
Interorbital width	29.0	–
As % standard length Head length	29.3	–
Body depth	25.0	–
Dorsal–fin length	54.8	–
Anal–fin length	30.2	–
Pectoral–fin length	29.8	–
Pelvic–fin length	8.0	–
Predorsal length	31.2	–
Preanal length	57.7	–
Caudal peduncle length	11.8	–
Caudal peduncle depth	6.7	–

68 Note: Lengths reported in mm. Unpreserved lengths in parentheses for SIO 19-76.

69 **ETHICS**

70 The specimen was caught by a licensed recreational angler (G. Mayer), who released it alive.
 71 The fish was found washed ashore dead hours later and salvaged by G. Mayer, who gifted it to
 72 the second author. As salvage, or a legally caught and legally gifted recreational catch, the fish
 73 was taken in accordance with applicable law.

74 **MOLECULAR METHODS**

75 PCR reactions were prepared to amplify a ~700 bp fragment of the cytochrome oxidase I (COI)
 76 mtDNA gene using M13-tailed primer cocktail COI-3 from Ivanova *et al.* (2007) (Table 1).
 77 Reactions had a final concentration of 2 mM each deoxynucleoside triphosphates (dNTP), 0.25
 78 μ M of each primer, 0.5 mg ml⁻¹ bovine serum albumin (BSA) and 0.5 U of standard DNA
 79 polymerase. Following denaturation at 94°C for 2 min, 35 cycles of the following were
 80 performed: 94°C for 30 s, 55°C for 30 s and 72°C for 1 min. A final extension at 72°C for 3 min
 81 terminated the cycling. Sanger sequencing was performed in both directions with universal M13
 82 primers using BigDye Terminator v3.1 chemistry following the manufacturer's protocol.
 83 Sequences were generated on an ABI3730 at the Southwest Fisheries Science Center. Sequences
 84 were aligned and edited in Sequencher v4.8, and the resulting contig was compared to sequences
 85 in GenBank using the BLAST function.

86 **MATERIAL**

87 *Cubiceps paradoxus*, SIO 19-76, 1, 1283 mm TL (unpreserved), 1262 mm TL (preserved), 1058
88 mm SL (preserved), 19.02 kg (unpreserved), male, USA, California, Ventura County, Naval
89 Base Ventura County Point Mugu Family Beach, 34°05.97'N, 119°05.55'W, 28 June 2019, hook
90 and line, G. Mayer. GenBank Accession: MN938391.

91 **DESCRIPTION**

92 D XI, I 21; A III 20; P 21; gill rakers 10 + 19, total 29; lateral line scales 95; no apparent teeth on
93 remaining segment of vomer; tongue missing; body fusiform, dorsal profile slightly convex,
94 abdomen straight; body slightly compressed, depth relatively uniform throughout; snout rounded,
95 longer than orbit diameter; eye small 6.0 times in HL; head tapering towards snout. Pectoral fin
96 just longer than head; origin of dorsal fin over pectoral fin base; caudal peduncle narrow, depth
97 3.7 times in body depth, length 2.5 times in HL; caudal fin forked with posterior tips pointed.
98 Colour in life (Figure 1a): dorsal surface of body dark, sooty grey to black; reflective grey-blue
99 below lateral line and on ventral half of head; all fins except anal fin black; anal fin hyaline with
100 silvery scales extending onto base. Colour in preservation (Figure 1c): body dark grey, darker on
101 dorsal and ventral surfaces; head black; dorsal and pelvic fins black; anal fin dark grey; pectoral
102 fins brown, darker on margins; caudal fin dark brown to black at margins.

103 Species of *Cubiceps* are differentiated by the presence and arrangement of teeth on the vomer
104 and tongue (Agafonova, 1994; Butler, 1979; Kukuev & Gulyugin, 2015). In this specimen, a
105 portion of the vomer is present and no teeth are apparent, which excludes all *Cubiceps* species
106 except *C. paradoxus*. Additionally, the orbit diameter of the specimen is small, 6.0 times in head
107 length and c. 2.0 times in snout length (estimated from Figure 1a), matching descriptions of *C.*
108 *paradoxus* (in *C. capensis* and *C. baxteri* the orbit diameter is equal to snout length (Butler,
109 1979; Kukuev & Gulyugin, 2015).

110 We resolved 651 bp of the COI gene (MN938391). BLAST results revealed that the
111 sequence is 99.5% similar to AB205442 (FAKU 83202), *Cubiceps paradoxus*. The next closest
112 sequences on GenBank are *C. gracilis* (KC015307) and *C. baxteri* (DQ107606), both ~93.0%
113 similar. This result supports that SIO 19-76 is *C. paradoxus*.

114 Kukuev and Gulyugin (2015) reported a specimen 1270 mm TL (unpreserved) from off
115 Mauritius in the Eastern Atlantic that was not retained or examined in detail by Kukuev and
116 Gulyugin. SIO 19-76 is slightly larger and represents the largest *C. paradoxus* and largest
117 nomeid recorded.

118 In discussions regarding this specimen, R.N. Lea (personal communication, January 2020)
119 provided notes of an additional *Cubiceps* specimen obtained by the California Department of
120 Fish and Game in 1999. The fishing vessel *Kema Sue* collected the specimen outside state waters
121 on longline ~370 km west of the US–Mexico border on 11 November 1999 and N. Tolchin
122 retained it. Lea examined the specimen on 18 July 2001 and recorded that the length was 1090
123 mm TL (1000 mm FL), that the pectoral fins were noticeably long (345 mm; Table 1) and that
124 there were no teeth apparent on the vomer (R.N. Lea, personal communication), matching the
125 diagnostic characters of *C. paradoxus*. It is distinguished from *C. capensis* and *C. baxteri* in that

126 the eye diameter (60 mm) is significantly shorter than the snout length (92 mm; Table 1).
127 Unfortunately, this specimen was discarded.

128 The rare encounters with *Cubiceps* spp. off California do not correspond to time of year or
129 climatic events, suggesting that these individuals are vagrants or present in low densities. The
130 collection of SIO 19-76 and previous California specimens close to shore is surprising given that
131 the genus is usually encountered far offshore at great depths and indicates that large individuals,
132 of at least *C. paradoxus*, venture into shallow coastal waters.

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136 initial counts and measurements of the specimen. Finally, we thank R.N. Lea for extensive
137 discussions on driftfishes in the Eastern Pacific and for providing notes on the specimen he
138 examined 20 years ago.

139 **AUTHORS CONTRIBUTIONS**

140 M.M. and M.S.L. recovered the specimen and took initial measurements. M.T.C. sequenced the
141 tissue and wrote the molecular sections. B.W.F. wrote the manuscript and took preserved
142 measurements. All authors edited, commented on and approved the manuscript.

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