

A peer-reviewed version of this preprint was published in PeerJ on 14 October 2014.

[View the peer-reviewed version](https://peerj.com/articles/625) (peerj.com/articles/625), which is the preferred citable publication unless you specifically need to cite this preprint.

Ehret DJ, Ebersole J. 2014. Occurrence of the megatoothed sharks (Lamniformes: Otodontidae) in Alabama, USA. PeerJ 2:e625
<https://doi.org/10.7717/peerj.625>

Occurrence of the Megatoothed sharks (Lamniformes:Otodontidae) in Alabama, USA

The Otodontidae include some of the largest sharks to ever live in the world's oceans (i.e. *Carcharocles megalodon*). Here we report on Paleocene and Eocene occurrences of *Otodus obliquus* and *Carcharocles auriculatus* from Alabama, USA. Teeth of *Otodus* are rarely encountered in the Gulf Coastal Plain and this report is one of the first records for Alabama. *Carcharocles auriculatus* is more common in the Eocene deposits of Alabama, but its occurrence has been largely overlooked in the literature. We also refute the occurrence of the Oligocene *Carcharocles angustidens* in the state. Raised awareness and increased collecting of under-sampled geologic formations in Alabama will likely increase sample sizes of *O. obliquus* and *C. auriculatus* and also might unearth other otodontids, such as *C. megalodon* and *C. chubutensis*.

1 Occurrence of the Megatoothed sharks (Lamniformes:Otodontidae) in Alabama, USA

2 Authors: Ehret, Dana J.¹ and Ebersole, Jun²

3 ¹Alabama Museum of Natural History, PO Box 870340, Tuscaloosa, Alabama 35487-0340

4 Email: djehret@ua.edu

5 ²McWane Science Center, 200 19th Street North, Birmingham, Alabama 35203

6 Email: jebersole@mcwane.org

7 Corresponding Author: Ehret, Dana J.

8 Alabama Museum of Natural History, PO Box 870340, Tuscaloosa, Alabama 35487-0340

9 Email: djehret@ua.edu

10 INTRODUCTION

11 The megatoothed sharks (Family Otodontidae) are well known in the marine fossil record
12 of the Paleocene through Pliocene. These large, macro-predatory sharks are cosmopolitan in their
13 distributions, and they are present in the fossil records of Asia, Africa, Europe, and North and
14 South America (Cappetta, 2012). Beginning with *Otodus obliquus* (Agassiz, 1838) in the
15 Paleocene and including the largest shark that ever lived, *Carcharocles megalodon* (Agassiz,
16 1835), otodontids are arguably the most well known of all fossil chondrichthyans. While *C.*
17 *megalodon* is probably the most abundant and widely recognized species, other species of
18 *Otodus* and *Carcharocles* are less often reported in the literature, which may have had a negative
19 affect on the distribution and abundance of these species (Cappetta, 2012). This discrepancy
20 might be related to a sampling bias, the familiarity of *C. megalodon* compared with other
21 megatoothed species, or it might actually reflect the dispersal patterns of these other otodontid
22 species.

23 Previous reports of otodontids from Alabama have varied in accurate identifications,
24 including references to *C. auriculatus*, *C. angustidens* (Agassiz, 1835), *Otodus crassa* (Agassiz,
25 1843), and *O. crassus* (Gibbes, 1848) (Thurmond and Jones, 1981). Although middle Eocene
26 outcrops are fairly prevalent in Alabama, studies of the otodontids have largely been overlooked
27 in the state. Here we present and discuss records of *O. obliquus* and *C. auriculatus* (Blainville,
28 1818) in the Paleocene and Eocene of Alabama, respectively.

29 MATERIAL AND METHODS

30 The collections of the Alabama Museum of Natural History (ALMNH) in Tuscaloosa, the
31 Geological Survey of Alabama (GSA) in Tuscaloosa, and McWane Science Center (MSC/RMM)
32 in Birmingham were examined for specimens of otodontid sharks from Alabama. All three
33 collections contained specimens that are previously unreported in the literature. In these
34 collections, most specimens of *C. auriculatus* were correctly identified, however many of the
35 *Otodus* specimens were incorrectly assigned to either *Carcharias* or *Lamna*. These
36 misidentifications are likely the reason that *Otodus* has not been accurately reported from the
37 state previously.

38 Five *O. obliquus* specimens were identified in the collections of the Geological Survey of
39 Alabama (GSA) (Table 1). These specimens were collected in the late 1800's and early 1900's,
40 with all being unidentified or misidentified. Specimens of *Carcharocles auriculatus* located in
41 the ALMNH and MSC collections were collected over the last century from Choctaw, Clarke,
42 Covington, Washington, and Wilcox counties (Fig. 1, Table 1). All *C. auriculatus* specimens
43 were collected in Early to Middle Eocene deposits (mainly Lutetian and Bartonian) of
44 southwestern Alabama and all specimens examined in this study were found by surface collection
45 methods over the past 100+ years.

46 Geologic Setting

47 In Alabama, *Otodus obliquus* and *Carcharocles auriculatus* specimens have been
48 collected from lithostratigraphic units ranging from the early Paleocene to Middle Eocene
49 including the Midway, Sabine, Claiborne, Jackson groups (Figs. 1 and 2, Table 1). The Paleocene
50 and Eocene formations in the state make up a nearly time-continuous series that ranges from the
51 K/Pg contact to the Eocene/Oligocene contact (Raymond, 1988). A small unconformity exists
52 between the upper-most Cretaceous units in the state, the Prairie Bluff Chalk and Providence
53 Sand, and the lower-most Paleocene Clayton Formation. The Clayton Formation (which includes

54 the Pine Barren and McBryde Limestone members) is the basal unit in the Midway Group, a
55 group that also includes, in ascending order, the Porters Creek (with the Matthews Landing Marl
56 Member) and Naheola (with the Oak Hill and Coal Bluff Marl members) formations. The
57 Midway Group is conformably overlain by the Paleocene/Eocene Wilcox Group. The Paleocene
58 units within the Wilcox Group include, in ascending order, the Nanafalia Formation (with the
59 Gravel Creek Sand Member, an informal unit referred locally as the "*Ostrea thirsae* beds," and
60 the Grampian Hills Member), and the Tuscahoma Sand (which includes the Greggs Landing Marl
61 and the Bells Landing Marl members).

62 The uppermost unit of the Wilcox Group is the Early Eocene (Ypresian) Hatchetigbee
63 Formation, which contains the Bashi Marl Member at its base. The Wilcox Group is
64 disconformably overlain by the lithostratigraphic units within the Claiborne and Jackson groups.
65 The Claiborne Group consists of, in ascending order, the Tallahatta and Lisbon (with informal
66 "lower," "middle," and "upper" members) formations, and the Gosport Sand. The Jackson Group
67 includes the Moodys Branch and Crystal River formations and the Yazoo Clay. The Yazoo Clay
68 in Alabama is further subdivided into the following chronologic members: the North Twistwood
69 Creek, Cocoa Sand, Pachuta Marl, and Shubuta (Fig. 2).

70 SYSTEMATIC PALEONTOLOGY

71 Class Chondrichthyes Huxley, 1880

72 Subclass Elasmobranchii Bonaparte, 1838

73 Order Lamniformes Berg, 1958

74 Family Otodontidae Glikman, 1964

75 Genus *Otodus* Agassiz, 1838

76 *Otodus obliquus* Agassiz, 1838

77 Figure 3A-D, Table 1

78 Referred Specimens

79 GSA CZ 5050, GSA CZ 5051, GSA CZ 5052, GSA CZ 5053, GSA CZ 5054

80 Occurrence

81 Wilcox County, Alabama

82 Description

83 *Otodus obliquus* teeth were identified using the following characteristics: triangular cusp,
84 lacking serrations on cutting edges; labial face is moderately convex and does not overhang the
85 root; lingual face is smooth and convex; a well developed v-shaped chevron on the lingual face; a
86 pair of triangular cusplets that lack serrations; and a highly developed lingual protuberance of the
87 root (Cappetta, 2012). Five *O. obliquus* specimens were identified in the historical collections
88 housed at the Geological Survey of Alabama (GSA). GSA CZ 5051 (Fig. 3A) is part of the
89 Schowalter Collection and was collected prior to 1889. Unfortunately the precise locality and
90 formation of origin for GSA CZ 5051 is unknown as the specimen is only accompanied by a label
91 marked "Tertiary, Wilcox," presumably referring to the Cenozoic strata in Wilcox County,
92 Alabama. Of the Cenozoic units within this county, exposures can be found of all five Paleocene
93 formations, which make up the Midway Group (Clayton, Porters Creek, and Naheola formations)
94 and Wilcox Group (Nanafalia Formation and Tuscahoma Sand) in Alabama. Wilcox County also

95 has exposures of the Ypresian Hatchetigbee Formation, also part of the Wilcox Group (Fig. 1).
96 Based on the surface exposures of these formations, we argue this specimen is either Selandian
97 (Naheola Formation) or Thanetian (Tuscahoma Sand) in age. The tooth is a nearly complete
98 posterolateral that exhibits large triangular cusplets, with a secondary pair also present. GSA CZ
99 5051 also exhibits a v-shaped chevron on its lingual surface, and smooth cutting edges on the
100 main cusp. Although the tip is broken, the measured main crown height is 25.5 mm, while its
101 width is 17.9 mm.

102 GSA CZ 5050 (Fig. 3B) represents a right posterolateral tooth that is accompanied with a
103 label inscribed “Sucarnoochee, Clarence Jones’ Place.” The term “Sucarnoochee” refers to the
104 Sucarnoochee beds, a historical and informal unit that was described as being between the
105 Paleocene Clayton and the Naheola formations. “Clarence Jones’ Place” refers to a historic
106 locality located near Camden in Wilcox County that is known for its fine exposures of the
107 Matthews Landing Marl, which is the upper member of the Porters Creek Formation (Smith and
108 Johnson, 1887). This member falls within the *Morozovella angulata* planktonic foraminiferal
109 zone, placing it within the early Thanetian (Mancini and Tew, 1988). The tooth is fairly worn,
110 and it is missing the distal cusplet as well as portions of the root. The main crown is 22.6 mm
111 high and 16.0 mm wide and it does display a prominent v-shaped chevron, making the
112 identification possible.

113 GSA CZ 5052 (Fig. 3C) was found in the GSA collections with a label inscribed
114 “Naheola, Matthews Landing, Alabama River”, referring to the Naheola Formation and the
115 historic locality Matthews Landing which is located along the Alabama River in Wilcox County.
116 The listed formation, however, is likely an error as this locality represents the type section for the
117 Matthews Landing Marl Member, which is the uppermost unit of the Porters Creek Formation.
118 This member underlies the Naheola Formation, but in historical usage, the Matthews Landing
119 Marl was incorrectly thought to be a member of the Naheola Formation (see Keroher et al.,
120 1966). Therefore, the specimen can be referred to the very latest Danian or earliest Selandian.
121 GSA CZ 5052 represents an anterior tooth, based on the symmetry of the main cusp. The tooth
122 displays well-developed cusplets, a v-shaped chevron, smooth cutting edges, and a pronounced
123 lingual protuberance of the root. The apex of the crown is chipped, but the remaining portion
124 measures 29.8 mm in height and is 14.3 mm wide.

125 GSA CZ 5053 (Fig. 3D) is listed as coming from “Grave Yard Hill No. 4” in Wilcox
126 County. Graveyard Hill is another important historic locality in eastern Wilcox County that
127 contains a fossil zone located at the top of the Porters Creek Formation, making the specimen
128 latest Danian or earliest Selandian (Toulmin, 1977). The specimen represents an anterior or first
129 posterolateral tooth, with a crown height of 31.0 mm and a crown width of 18.8 mm. GSA CZ
130 5053 is worn, likely from being exposed for a long period of time, but exhibits a pronounced
131 lingual protuberance, v-shaped chevron, and has well developed cusplets.

132 The final *O. obliquus* specimen found in collections is GSA CZ 5054 (Fig. 3E). The label
133 associated with this specimen states: “State Collection Midway Group”. Although the exact
134 locality for this specimen is unknown, the label indicates that it was discovered within the strata
135 of the Midway Group. This lower to middle Paleocene group includes the Clayton, Porters Creek,
136 and Naheola formations, meaning the tooth is either latest Danian or Selandian. This specimen is
137 highly worn, missing the apex of the crown, cusplets, and most of the root. However, it does
138 preserve the v-shaped chevron, which is diagnostic for the Otodontidae. The remaining portion of
139 the crown is 18.4 mm in height and 19.1 mm wide.

140 **Remarks**

141 The taxonomic assignment of the Otodontidae is a contentious subject that has been
142 debated for over a century (Agassiz, 1843; Jordan and Hannibal, 1923; Glikman, 1964; Cappetta,
143 1987, 2012; Applegate and Espinosa-Arrubarrena, 1996; Zhelezko and Kozlov, 1999; Purdy et
144 al., 2001; Nyberg et al., 2006; Pimiento et al., 2010, 2013; Ehret et al., 2009, 2012). Original
145 descriptions by Agassiz (1843) placed the megatoothed sharks within the Lamnidae, however
146 they have since been reclassified as the Otodontidae by Glikman (1964) to recognize their
147 distinct evolutionary history. Since being formally described in the 1840s, the taxonomy of the
148 otodontids has undergone a multitude of changes reflecting reinterpretations of their relationships
149 by a host of researchers (see references above). It is beyond the scope of this study to address the
150 taxonomic stability of the otodontid sharks, however we recognize the genera *Otodus* and
151 *Carcharocles* for the lineage ending with *Carcharocles megalodon*. This arrangement stands in
152 contrast with Glikman (1964) and Cappetta (2012), who both referred species with large lateral
153 cusplets to *Otodus*, and those with small or no cusplets to the genus *Megaselachus*. Cappetta
154 (2012) revised the taxonomy further, by separating the genus *Otodus* into three subgenera based
155 on the presence, absence, or size of serrations and cusplets as well as differences in root
156 morphology. Furthermore, Zhelezko and Kozlov (1999) separated many of the *Otodus* and
157 *Carcharocles* species into subspecies (e.g., *Otodus obliquus mugodzharicus* and *Otodus*
158 *poseidoni poseidoni*) based on specimens from Kazakhstan. These constructions only further
159 complicate the taxonomy of the Otodontids and do little to elucidate the relationships of the
160 megatoothed sharks. We also argue that, under a biological species concept, it is not possible to
161 recognize subgenera and subspecies in the fossil record. Therefore, we reject these confusing and
162 somewhat subjective designations. Otodontids do likely represent a chronospecific sequence,
163 with individual species derived from a pattern of development that replaces one species with
164 another sequentially through geologic time by incremental morphological and genetic changes
165 (Applegate and Espinosa-Arrubarrena, 1996; Cappetta, 2012). This mechanism results in a
166 descendant that is much different from its original ancestor, however when looking at smaller
167 time intervals, species distinctions are much more difficult to discern. In the absence of a
168 phylogenetic or a more thorough morphometric analysis, and until further work is conducted and
169 published, we refer the unserrated form to *Otodus obliquus* and serrated forms to the genus
170 *Carcharocles*.

171 Genus *Carcharocles* Jordan and Hannibal, 1923

172 *Carcharocles auriculatus* Blainville, 1818

173 Figures 3F-H, 4A-G, Table 1

174 **Referred Specimens:** ALMNH 1985.30.2, ALMNH 1985.35.2, ALMNH 1985.72.28.5,
175 ALMNH 1985.72.33, ALMNH 1985.72.43.3, ALMNH 1985.72.55.2, ALMNH 1985.72.62.3,
176 ALMNH 1985.72.83, ALMNH 1985.72.84, ALMNH 1985.72.88, ALMNH 1988.1.9, ALMNH
177 1988.29.1, ALMNH 1989.4.50.1, ALMNH 1992.28.44.1, ALMNH 1992.28.44.2, ALMNH
178 2000.1.4.1, ALMNH 2000.1.16.1, ALMNH 2000.1.27.1, ALMNH 2000.1.29.1, ALMNH
179 2000.1.33.1, ALMNH 2000.1.53, ALMNH 2000.1.57, ALMNH 2000.1.59, ALMNH 2005.6.259,
180 ALMNH 2005.6.279, ALMNH 2005.6.294, ALMNH 2005.6.334.6, ALMNH 2005.6.407,
181 ALMNH 2005.6.408.1, ALMNH 2010.5.3, MSC 20968, MSC 20969, MSC 20970, MSC 20971,
182 MSC 20972, MSC 20973, MSC 20974, MSC 20975, MSC 20976, MSC 20977, MSC 20978,

183 MSC 20979, MSC 20980, MSC 20981, MSC 20982, MSC 20983, MSC 20984, MSC 20985,
184 MSC 34422, MSC 34423, RMM 2370, RMM 2371

185 **Occurrence**

186 Choctaw, Clarke, Covington, Washington, and Wilcox counties, Alabama

187 **Description**

188 Characters used to identify *C. auriculatus* in this study include: a large, triangular crown
189 with the presence of lateral, serrated cusplets; serrated cutting edges that are fairly coarse and
190 irregular; presence of a v-shaped chevron on the lingual surface of the crown; and developed
191 lingual protuberance on the root. Remains of *Carcharocles auriculatus* are much more prevalent
192 in Alabama than those of *Otodus obliquus*. This difference is likely related to the fact that
193 Middle-Late Eocene deposits are much more expansive in Alabama than are sediments of the
194 Paleocene and Early Eocene.

195 In the ALMNH collections, 30 specimens of *C. auriculatus* were identified (Fig. 4A, E-G,
196 Table 1). These teeth were collected from Choctaw, Clarke, Covington, Washington, and Wilcox
197 counties in Alabama. Most of the teeth in the ALMNH collections were found in the Yazoo Clay
198 of the Jackson Group and are Priabonian in age. Outcrops of the Yazoo Clay are prevalent
199 throughout the western portion of Alabama and are well known for their marine fossils including
200 early cetaceans such as *Basilosaurus*, *Zygorhiza*, and *Cynthiacetus* (Uhen, 2013). One specimen
201 each of *C. auriculatus* was collected in the Lisbon Formation and the Gosport Sand, which are
202 Lutetian and Bartonian in age, respectively.

203 Twenty-two *C. auriculatus* specimens were identified in the MSC collections. (Fig. 4B-D,
204 H, Table 1). A majority (17) of these teeth were collected from a single locality called Point A
205 Dam in Covington County. Outcrops at this locality represent the boundary of the Tallahatta and
206 Lisbon formations (middle Lutetian; Clayton et al., 2013). The remaining specimens were
207 recovered from the Bartonian Gosport Sand in Choctaw County and the Priabonian Pachuta Marl
208 Member of the Yazoo Clay of Washington County.

209 One specimen in the collections at MSC (MSC 34423; Fig. 3F) bears resemblance to the
210 Late Paleocene – Early Eocene *Otodus aksuaticus* (Menner, 1928). Here, we define *O.*
211 *aksuaticus* as specimens that exhibit triangular lateral cusplets; a triangular cusp; coarse
212 serrations that fine towards the apex of the cusp; a v-shaped chevron; and a strong lingual
213 protuberance of the root. This species is considered to be part of the chronospecies sequence
214 between *O. obliquus* and *C. auriculatus* (Zhelezko and Kozlov, 1999) as it exhibits a transition
215 from the unserrated *O. obliquus* to the serrated *C. auriculatus*, by means of coarse, irregular
216 serrations that do not continue to the apex of the crown. This pattern of serration acquisition is
217 very similar to that seen in the transition from *Carcharodon hastalis* to *Carcharodon carcharias*
218 via *Carcharodon hubbelli*, with coarser serrations at the base of the crown, fining towards the apex
219 (Ehret et al., 2012).

220 MSC 34423 is here referred to *C. auriculatus* as it was discovered in sediments located at
221 the Middle Eocene (Lutetian) boundary between the Lisbon and Tallahatta formations in
222 Choctaw County. This specimen does exhibit coarse serrations that fine towards the apex of the
223 cusp and might be close to *O. aksuaticus*, but we refer it here to *C. auriculatus* based on its
224 Lutetian age. MSC 34423 represents a lateral tooth with a crown height of 18.8 mm and a crown
225 width of 14.5 mm. The tooth has an average of 1.2 serrations per mm on both anterior and distal
226 cutting edges.

227 Two other specimens in the ALMNH collections, ALMNH 1992.28.44.1 and ALMNH
228 1992.28.44.2 (Fig. 3G-H), we also refer to *C. auriculatus*, however they demonstrate more coarse
229 serrations that fine towards the apex as seen in the earlier *O. aksuaticus*. The specimens are also
230 Lutetian in age, having been collected at the boundary between the Lisbon and Tallahatta
231 formations in Covington County, Alabama. Both teeth have broken apices and average 1.2
232 serrations per mm on their cutting edges. Although we assign all three of the aforementioned
233 teeth to *C. auriculatus*, based on their similar morphology, we think there is a good potential for
234 also finding *O. aksuaticus* in Alabama.

235 One partial vertebral centrum, MSC 20968 (Fig. 4H), recovered from the Point A Dam
236 locality in Covington County, is also referred to *C. auriculatus*. The partial specimen
237 (representing approximately one half of the centrum) is approximately 11.2 cm in diameter and
238 3.9 cm in thickness. The centrum is typically lamniform in appearance, laterally compressed with
239 concave articular surfaces and radiating calcified lamellae within the intermedialia. Only one pit
240 is preserved for the insertion of either the neural or haemal arch, however the centrum is
241 fragmentary and it cannot be deduced as whether or not it is dorsal or ventral. We are confident in
242 referring this specimen to *C. auriculatus* because of its lamniform appearance, age, and large
243 size. Other lamniform taxa recovered from the Point A Dam locality are primarily odontaspids
244 (Clayton et al., 2013), which would not have centra this large. For example, Hansen et al. (2013)
245 reported a 6th vertebral centrum diameter of 30 mm for a recent *Odontaspis ferox* specimen with a
246 total body length of 297 cm, which is significantly smaller than our fossil specimen.

247 DISCUSSION

248 Surprisingly, the presence of otodontid sharks in Alabama has not been extensively
249 reported in the literature. Agassiz (1843) noted the presence of *Otodus crassa* in Alabama,
250 although he provided no additional details. Leriche (1926) synonymized *O. crassa* with
251 *Carcharodon hastalis*, which is probably correct for some of the specimens figured in Agassiz
252 (1843). However, the Miocene *C. hastalis* has not been reported from Alabama and at least one
253 of the specimens figured in Agassiz (1843) appears to be *O. obliquus*. As a result, it stands to
254 reason that Agassiz (1843) might have been the first researcher to identify *O. obliquus* from
255 Alabama. A few years later, Gibbes (1848) described the presence of *Otodus crassus* within the
256 Cretaceous of Alabama. Describing what appears to be *Carcharocles auriculatus*, Gibbes, like
257 many researchers at the time, mistakenly referred the Eocene deposits in the state to the Upper
258 Cretaceous (Ebersole and Dean, 2013). Since that time, however, no other *Otodus* teeth are
259 known to have been reported in Alabama. As discussed above, many of the *Otodus* teeth in the
260 GSA collections were misidentified as *Odontaspis*, *Lamna*, or *Carcharias*, which could have
261 confounded the situation. Furthermore, outcrops of the Midway and Wilcox groups are not
262 widely exposed in Alabama, making it difficult to find Paleocene and Early Eocene fossils.
263 Another large *O. obliquus* specimen was observed by one of the authors in the collection of a
264 private collector; unfortunately this specimen could not be secured for the ALMNH collections at
265 the present time (D. Ehret, pers. observ.). *Otodus* specimens have also been found in nearby
266 states including the Williamsburg Formation of South Carolina (Purdy, 1998) and the Tusahoma
267 Formation of Mississippi (Case, 1994). These discoveries leads us to propose that *Otodus* teeth
268 might be more prevalent in Alabama than previously thought if the proper aged outcrops are
269 targeted for collecting.

270 *Carcharocles auriculatus* is the megatoothed species that is more commonly found in
271 Alabama. Its predominance is likely a result of the comparably numerous outcrops of the Eocene

272 Tallahatta and Lisbon formations and the Yazoo Clay. The large size of the teeth is also likely a
273 factor in their discovery and collection. The closely related *Carcharocles angustidens* was
274 reported from Alabama by White (1956) and Thurmond and Jones (1981). The specimens
275 discussed in White (1956) that are housed in the British Museum (NHM London) are referred to
276 the Jackson Group and, based on specimens discussed and figured here, are most likely *C.*
277 *auriculatus*. Thurmond and Jones (1981) figured a specimen (Fig. 22, pg. 56) referred to *C.*
278 *angustidens* as a line drawing, which was reported as being part of the former Birmingham
279 Southern College collections and collected from an unknown locality. Unfortunately the
280 whereabouts of this specimen are unknown, and the poor quality of the figure does not allow for
281 an accurate identification. *C. angustidens* is a species of otodontid recorded from the Oligocene
282 that exhibits a larger overall tooth size, smaller cusplets, and finer serrations than *C. auriculatus*.
283 Because there are relatively few Oligocene outcrops in Alabama and the relatively high
284 prevalence of Eocene outcrops, we are confident that all records of *Carcharocles* in Alabama
285 thus far represent *C. auriculatus*. Furthermore, prospecting Oligocene sediments in Alabama by
286 both authors has only yielded small to microscopic chondrichthyan teeth of Carcharhiniformes,
287 Ginglymostomatidae, and Myliobatidae. No occurrences of *Carcharocles chubutensis* or
288 *Carcharocles megalodon* have been accurately reported from Alabama, likely a result of the
289 historic lack of systematic collecting in the Mio-Pliocene formations in the state. However more
290 concentrated collecting efforts in southern Alabama where Oligocene-Pleistocene deposits are
291 more concentrated may yield new specimens. Additionally, the use of historic collections (e.g.,
292 the Geological Survey of Alabama collections) can be a valuable resource in identifying
293 overlooked or misidentified specimens.

294 CONCLUSIONS

295 The fossil record of otodontid sharks in Alabama has gone largely unreported in the
296 literature. Reviews of the collections at the Alabama Museum of Natural History, McWane
297 Science Center, and the Geological Survey of Alabama have yielded late Paleocene through
298 Eocene otodontids including *O. obliquus* and *C. auriculatus* from the state. This study represents
299 the first reliable report of *Otodus* from Alabama, with specimens identified from multiple
300 localities. *Otodus obliquus* was identified in the collections at the Geological Survey of Alabama,
301 most of which were collected prior to 1910. Based on observations of amateur collections, we
302 think that the presence of *O. obliquus* is likely more common than what the few specimens in
303 museum collections suggest. *C. auriculatus* is the most common otodontid shark recovered in
304 Alabama, typically recovered from Lutetian-Ypresian outcrops in southwestern Alabama. While
305 large specimens are not as common as they were 50-100 years ago, teeth assigned to this taxon
306 are still recovered with some regularity. We also refute Thurmond and Jones' (1981) report of *C.*
307 *angustidens* from the state. This specimen was most likely *C. auriculatus*, however, its status is
308 unknown until the tooth can be rediscovered. *C. chubutensis* and *C. megalodon* are currently not
309 known from Alabama, but with increased collection in the southern Cenozoic deposits in the
310 state, specimens might be recovered.

311 Acknowledgements

312 Many thanks to Sandy Ebersole, Geological Survey of Alabama, for access to the fossil
313 collections and help compiling the geologic data for Figure 1. The authors would also like to
314 thank Dave Cicimurri, South Carolina Museum of Natural History, and Chuck Ciampaglio,

315 Wright State University, for useful discussions on otodontid records. We would also like to thank
316 the reviewers of this manuscript.

317 REFERENCES

- 318 Agassiz LJR. 1833-1844. *Recherches sur les poisons fossils*. Text (5 vols; I. xlix + 188 pp., II xii
319 + 310 + 366 pp., III viii + 390 pp., IV XVI + 296 pp., V xii + 122 +160 pp.) and Atlas.
320 Neuchâtel, Imprimerie de Petitpierre.
- 321 Applegate SP, Espinosa-Arrubarrena L. 1996. The fossil history of *Carcharodon* and its possible
322 ancestor, *Cretolamna*: a study in tooth identification. In: Klimley A, Ainley D, eds. *Great*
323 *White Sharks: the Biology of Carcharodon carcharias*. San Diego: Academic Press, 19-36.
- 324 Berg S. 1958. *System der rezenten und fossilen Fischgartigen und Fische*. Berlin: Deutsche
325 Verlag Wissenschaften.
- 326 Bieler R, Dockery III DT. 2007. Recognition of the Paleocene gastropods “*Solariella*”
327 *alabamensis* (Aldrich, 1886) as a member of lower heterobranchs (Mathildidae), with
328 description of *Toulminella* n. gen. *Paläontologische Zeitschrift* 81(3):283-290.
- 329 Blainville HMD de. 1818. Prodrôme d’une distribution systématique du regne animal. *Bulletin*
330 *des Sciences par la Société Philomathique de Paris* 8:105-124.
- 331 Bonaparte CL. 1838. Selachorum tabula analytica. *Nuovi Annali della Science Naturali, Bologna*
332 2:195-214.
- 333 Cappetta H. 1987. Chondrichthyes II. Mesozoic and Cenozoic Elasmobranchii. In: Schultze HP,
334 ed. *Handbook of Paleichthyology Volume 3B*. New York: Verlag Dr. Gustav Fischer, 1-193.
- 335 Cappetta H. 2012. Chondrichthyes. Mesozoic and Cenozoic Elasmobranchii: Teeth. In: Schultze
336 HP, ed. *Handbook of Paleichthyology Volume 3E*. Munich: Verlag Dr. Gustav Fischer, 1-
337 512.
- 338 Clayton AA, Ciampaglio CN, Cicimurri, DJ. 2013. An inquiry into the stratigraphic occurrence
339 of a Claibornian (Eocene) vertebrate fauna from Covington County, Alabama. *Bulletin of the*
340 *Alabama Museum of Natural History* 31(2):60-73.
- 341 Ebersole JA, Dean LS. 2013. The history of Late Cretaceous vertebrate research in Alabama.
342 *Bulletin of the Alabama Museum of Natural History* 31(1):3-45.
- 343 Ehret DJ, Hubbell G, MacFadden BJ. 2009. Exceptional preservation of the white shark
344 *Carcharodon* (Lamniformes, Lamnidae) from the early Pliocene of Peru. *Journal of*
345 *Vertebrate Paleontology* 29(1):1-13.
- 346 Ehret DJ, MacFadden BJ, Jones DS, DeVries TJ, Foster DA, Salas-Gismondi R. 2012. Origin of
347 the white shark *Carcharodon* (Lamniformes: Lamnidae) based on recalibration of the upper
348 Neogene Pisco Formation of Peru. *Palaeontology* 55(6):1139-1153.
- 349 Garner J, Bowles E. 1939. The *Venericardia planicosta* Group in the Gulf Province. Geological
350 Survey Professional Paper 189–F:143-215.
- 351 Geological Survey of Alabama. 2006. Geologic map of Alabama Digital Version 1.0. Alabama
352 Geological Survey Special Map 220A. Geological Survey of Alabama, Tuscaloosa, Alabama
353 [adapted from Szabo, et al., 1988].
- 354 Gibbes RW. 1848. Monograph of the fossil Squalidae of the United States. *Journal of the*
355 *Academy of Natural Sciences of Philadelphia* 7:191-206.
- 356 Glikman LS. 1964. *Sharks of the Paleogene and their stratigraphic significance*. Moscow: Nauka
357 Press, Moscow. [In Russian]
- 358 Hansen BB, Cuny G, Rasmussen BW, Shimada K, Jacobs P, Heilman-Clausen C. 2013.
359 Associated skeletal and dental remains of a fossil odontaspid shark (Elasmobranchii:

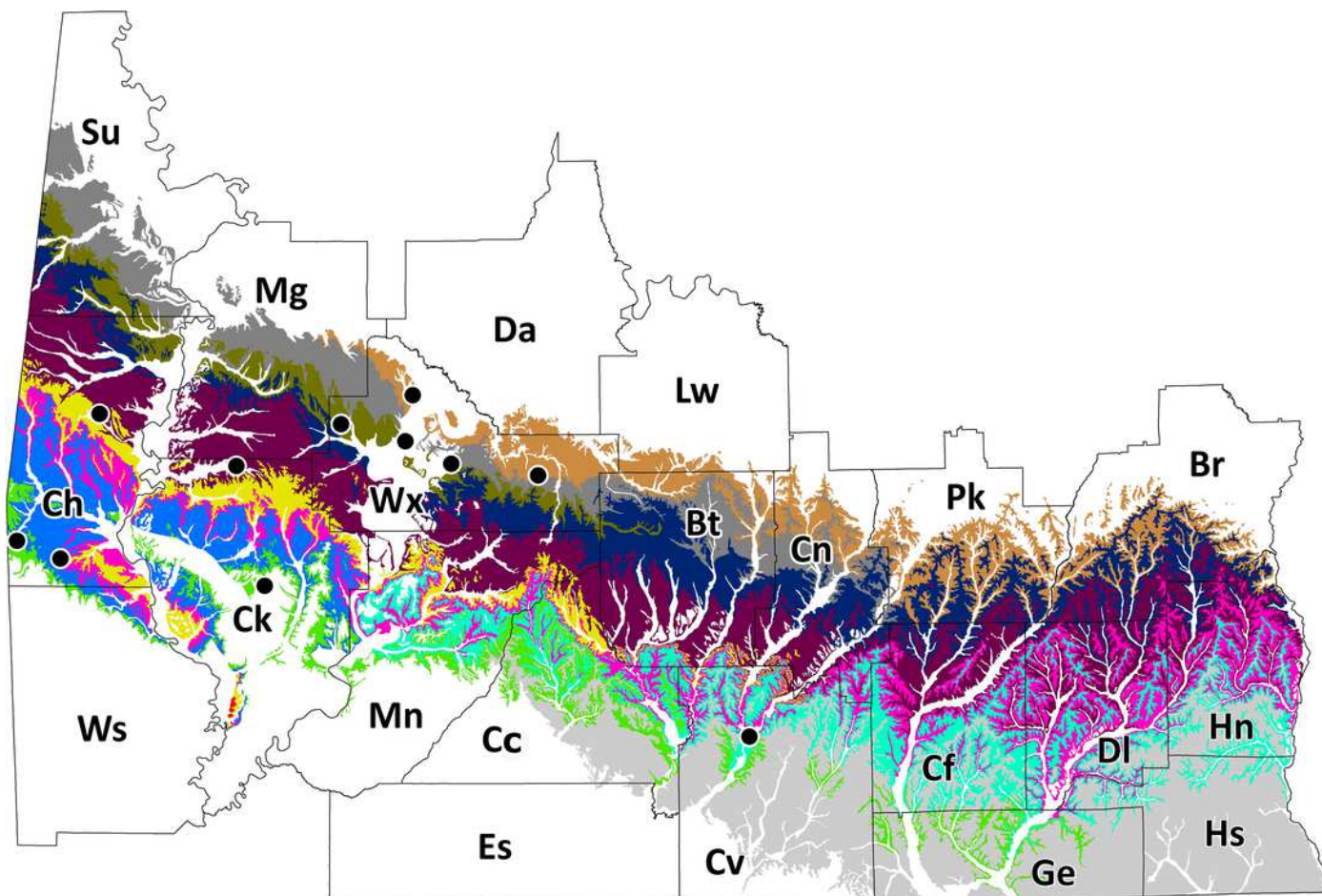
- 360 Lamniformes) from the Middle Eocene Lillebælt Clay Formation in Denmark. *Bulletin of the*
361 *Geological Society of Denmark* 61:37-46.
- 362 Huxley TH. 1880. *A manual of the anatomy of vertebrated animals*, D. New York: Appleton.
- 363 Johnson CW. 1932. Truman Hemingway Aldrich. *The Nautilus* 46(1):34-35.
- 364 Jordan DS, Hannibal H. 1923. Fossil sharks and rays of the Pacific Slope of North America.
365 *Bulletin of the Southern California Academy of Sciences* 22:27-63.
- 366 Keroher GC et al., 1966. Lexicon of geologic names of the United States for 1936-1960. *U.S.*
367 *Geological Survey Bulletin* 1200, 3 parts, 4,341 p.
- 368 Leriche M. 1926. Les poisons Néogènes de la Belgique. *Mémoires de Musée Royal du d'Histoire*
369 *Naturelle de Belgique* 32:367-472.
- 370 Mancini EA, Tew BH. 1988. Paleocene sequence Stratigraphy of southwestern Alabama. *Gulf*
371 *Coast Association of Geological Societies Transactions* 38:453-460.
- 372 Mancini EA, Tew BH. 1991. Relationships of Paleogene state and planktonic foraminiferal zone
373 boundaries to lithostratigraphic and allostratigraphic contacts in the eastern Gulf Coastal
374 Plain. *Journal of Foraminiferal Research* 21(1):48-66.
- 375 Menner VV. 1928. The Palaeogene sharks of Mangyschlak, Emba and from the east of Oural.
376 *Bulletin de la Société des Naturalistes de Moscou Section, Géologique* 6(3-4): 291-338. [In
377 Russian]
- 378 Nolf D, Dockery III DT. 1993. Fish otoliths from the Matthews Landing Marl Member (Porters
379 Creek Formation), Paleocene of Alabama. *Mississippi Geology* 14(2):24-39.
- 380 Nyberg KG, Ciampaglio CN, Wray GA. 2006. Tracing the ancestry of the great white shark,
381 *Carcharodon carcharias*, using morphometric analyses of fossil teeth. *Journal of Vertebrate*
382 *Paleontology* 26:806-814.
- 383 Pimiento C, Ehret DJ, MacFadden BJ, Hubbell G. 2010. Ancient nursery area for the extinct
384 giant shark Megalodon from the Miocene of Panama. *PLoS One* 5(5): e10552.
- 385 Pimiento C, Gonzalez-Barba G, Hendy AJW, Jaramillo C, MacFadden BJ, Montes C, Suarez SC,
386 Shippritt M. 2013. Early Miocene chondrichthyans from the Culebra Formation, Panama: A
387 window into marine vertebrate faunas before closure of the Central American Seaway.
388 *Journal of South American Earth Sciences* 42: 159-170.
- 389 Purdy R. 1998. Chondrichthyan fishes from the Paleocene of South Carolina. In: Sanders AE, ed.
390 *Paleobiology of the Williamsburg Formation (Black Mingo Group; Paleocene) of South*
391 *Carolina, U.S.A.* Transactions of the American Philosophical Society Vol. 88, Pt. 4:122-146.
- 392 Purdy R, Schneider VP, Applegate SP, McLellan JH, Meyer RL, Slaughter BH. 2001. The
393 Neogene sharks, rays, and bony fishes from Lee Creek Mine, Aurora, North Carolina. In: Ray
394 CE, Bohaska DJ, eds. *Geology and Paleontology of the Lee Creek Mine, North Carolina, III.*
395 *Smithsonian Contributions to Paleobiology* no. 90: 71-202.
- 396 Raymond DE, Osborne WE, Copeland CW, Neathery TL. 1988. Alabama Stratigraphy.
397 *Geological Survey of Alabama Circular* 140. 97 pp.
- 398 Smith EA, Johnson LC. 1887. Tertiary and Cretaceous strata of the Tuscaloosa, Tombigbee, and
399 Alabama Rivers. *Bulletin of the United States Geological Survey* 43:1-189.
- 400 Szabo MW, Osborne WE, Copeland CW, Jr., Neathery TL. 1988. Geologic map of Alabama
401 (1:250,000): Alabama Geological Survey Special Map 220, Tuscaloosa.

- 402 Thurmond JT, Jones DE. 1981. *Fossil vertebrates of Alabama*. Tuscaloosa: University of
403 Alabama Press.
- 404 Toulmin LD. 1977. Stratigraphic Distribution of Paleocene and Eocene Fossils in the Eastern
405 Gulf Coast Region, Volume I. *Geological Survey of Alabama Monograph* 13, 602 pp.
- 406 Uhen MD. 2013. A review of North American Basilosauridae. *Alabama Museum of Natural
407 History Bulletin* 31 (2): 1–45.
- 408 White EI. 1956. The Eocene fishes of Alabama. *Bulletins of American Paleontology*, 36 (156):
409 123-150.
- 410 Zhelezko V, Kozlov V. 1999. Elasmobranchii and Paleogene biostratigraphy of Transurals and
411 Central Asia. *Materials on stratigraphy palaeontology of the Urals*, Vol. 3. Russian Academy
412 of Sciences, Urals Branch, Uralian Regional Interdepartment Stratigraphical Commission,
413 Yekaterinburg, 324 pp.

Figure 1

Geologic map of Paleocene and Eocene strata in Alabama

Map showing Paleocene and Eocene strata in Alabama and known collecting localities for Otodontid specimens. County abbreviations: Br, Barbour; Bt, Butler; Cc, Conecuh; Cf, Coffee; Ch, Choctaw; Ck, Clarke; Cn, Crenshaw; Cv, Covington; Da, Dallas; Dl, Dale; Es, Escambia; Ge, Greene; Hn, Henry; Hs, Houston; Lw, Lowndes; Mg, Marengo; Mn, Monroe; Pk, Pike; Su, Sumter; Ws, Washington, and Wx, Wilcox. Compiled using Geological Survey of Alabama digital geology data (GSA, 2006).



50 miles

Legend

Paleocene

- Tuscahoma Sand
- Nanafalia Formation
- Salt Mountain Limestone
- Naheola Formation
- Porters Creek Formation
- Clayton Formation

Eocene-Oligocene

- Residuum

Eocene

- Jackson Group undifferentiated
- Gosport Sand and Lisbon undiff.
- Lisbon Formation
- Tallahatta Formation
- Hatchetigbee Formation



50 miles

Figure 2

Paleocene and Eocene Stratigraphy of Alabama

Stratigraphic chart showing the age of Paleocene and Eocene formations of Alabama.

Modified from Mancini and Tew (1991).

AGE	GRP.	W	ALABAMA STRATIGRAPHY	E	PLANKTONIC FORAMINIFERAL ZONE	NP ZONE	STG.			
EOCENE	Jackson	Yazoo Clay	Shubuta Mbr.	Crystal River Fm.	<i>Gr. cerroazulensis</i> I. Z.	P 17 (in part)	NP 20	Priabonian		
			Pachuta Marl Mbr.			P 16	NP 19			
			Cocoa Sand Mbr.			P 15	NP 18			
	Claiborne		North Twistwood Creek Clay Member	Lisbon Formation	<i>T. rohri</i> I. Z.	P 14	NP 17	Bartonian		
			Moody's Branch Formation							
			Gosport Sand							
			"upper Lisbon"							
			"middle Lisbon"							
			"lower Lisbon"							
			Tallahatta Formation							
Hatchetigbee Formation	Bashi Marl Member			<i>M. subbotinae</i> I. Z.	P 10	NP 15	Lutetian			
PALEOCENE	Wilcox		Bells Lnd. Marl Mbr.	Tusahoma Sand	<i>M. velascoensis</i> I. Z.	P 6	NP 14	Ypresian		
			Greggs Lnd. Marl Mbr.						P 5	NP 9
	Nanafalia Formation			Grampian Hills Mbr.	<i>Pr. pseudomenardii</i> R. Z.	P 4	NP 8	Selandian		
				" <i>Ostrea thirsae</i> beds"						
				Gravel Creek Sand Mbr.						
	Midway			Coal Bluff Marl Mbr.	<i>Pr. pusilla pusilla</i> I. Z.	P 3	NP 5			
				Oak Hill Mbr.						
				Matthews Landing Marl Mbr.					P 2	NP 4
				Porters Creek Fm.						
Clayton Fm.			McBryde Ls. Mbr.	<i>M. uncinata</i> I. Z.	P 2	NP 4				
			Pine Barren Mbr.							
				<i>S. trinidadensis</i> I. Z.	P 1	NP 3	Danian			
				<i>S. pseudobulloides</i> I. Z.				NP 2		
						NP 1				



Range of *Otodus obliquus*
in Alabama



Range of *Carcharocles auriculatus*
in Alabama

Figure 3

Otodus obliquus and *Carcharocles auriculatus* teeth from Alabama

Otodus obliquus specimens from Alabama. Labial view on left, lingual view on right. A) GSA CZ 5051, Unknown formation; B) GSA CZ 5050, Matthews Landing Marl Mbr.; C) GSA CZ 5052, Matthews Landing Marl Mbr.; D) GSA CZ 5053, Porters Creek Fm. E) GSA CZ 5054, Midway Group; *Carcharocles auriculatus* specimens, labial view on left, lingual view on right. F) MSC 34423, Lisbon-Tallahatta fms.; F) ALMNH 1992.28.44.1, Lisbon-Tallahatta fms.; G) ALMNH 1992.28.44.2, Lisbon-Tallahatta fms. Scale Bar = 5 cm.

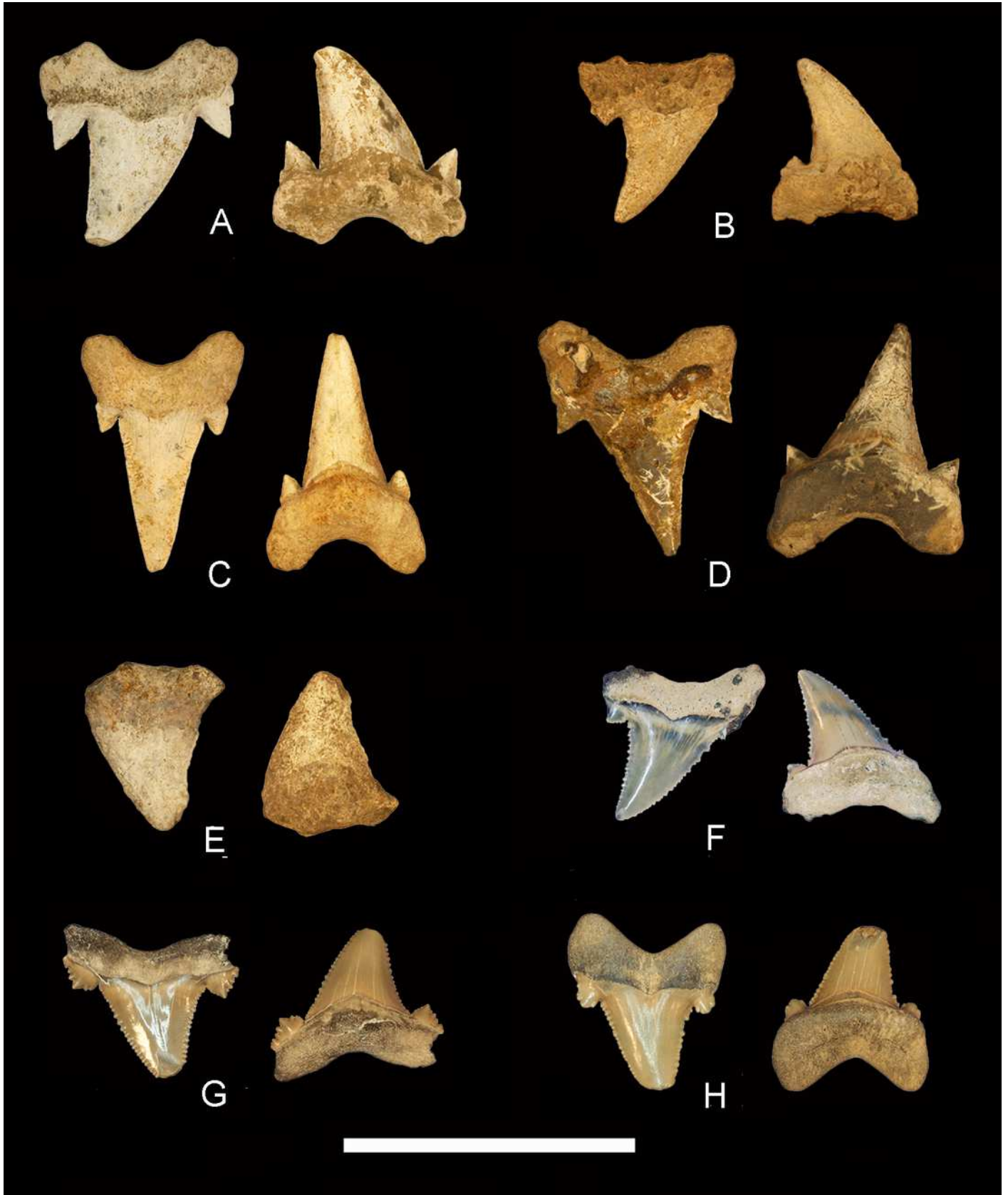


Figure 4

Carcharocles auriculatus teeth from Alabama

Carcharocles auriculatus specimens from Alabama. Labial view on left, lingual view on right. A) ALMNH 1988.29.1, Hatchetigbee Fm.; B) MSC 20970, Lisbon-Tallahatta Fms.; C) MSC 20973, Lisbon-Tallahatta Fms.; D) RMM 2371, Gosport Sand; E) ALMNH 2000.1.29.1, Yazoo Clay; F) ALMNH 2000.1.33.1, Yazoo Clay; G) ALMNH 2005.6.294, Unknown formation; H) MSC 20968, Lisbon-Tallahatta Fm. Scale Bar = 5 cm.



Table 1 (on next page)

Otodus and *Carcharocles* specimens in museum collections from Alabama

Otodus and *Carcharocles* specimens from the Alabama Museum of Natural History (ALMNH), Geological Survey of Alabama (GSA), and McWane Science Center collections (MSC/RMM).

Catalog/Accession Number	Genus	Species	Formation/Unit	Stage	County	State	Locality
ALMNH 1985.30.2	<i>Carcharocles</i>	<i>auriculatus</i>	Unknown	Unknown	Unknown	AL	Unknown
ALMNH 1985.35.2	<i>Carcharocles</i>	<i>auriculatus</i>	Unknown	Unknown	Unknown	AL	Unknown
ALMNH 1985.72.28.5	<i>Carcharocles</i>	<i>auriculatus</i>	Hatchetigbee or Lisbon Fm.	Ypresian or Lutetian/Bartonian	Choctaw	AL	Shell Creek
ALMNH 1985.72.33	<i>Carcharocles</i>	<i>auriculatus</i>	Unknown	Unknown	Unknown	AL	Unknown
ALMNH 1985.72.43.3	<i>Carcharocles</i>	<i>auriculatus</i>	Unknown	Unknown	Unknown	AL	Unknown
ALMNH 1985.72.55.2	<i>Carcharocles</i>	<i>auriculatus</i>	Unknown	Unknown	Unknown	AL	Unknown
ALMNH 1985.72.62.3	<i>Carcharocles</i>	<i>auriculatus</i>	Unknown	Unknown	Unknown	AL	Unknown
ALMNH 1985.72.83	<i>Carcharocles</i>	<i>auriculatus</i>	Unknown	Unknown	Unknown	AL	Unknown
ALMNH 1985.72.84	<i>Carcharocles</i>	<i>auriculatus</i>	Unknown	Unknown	Unknown	AL	Unknown
ALMNH 1985.72.88	<i>Carcharocles</i>	<i>auriculatus</i>	Unknown	Unknown	Unknown	AL	Unknown
ALMNH 1988.1.9	<i>Carcharocles</i>	<i>auriculatus</i>	Yazoo Clay	Bartonian/Priabonian	Unknown	AL	Unknown
ALMNH 1988.29.1	<i>Carcharocles</i>	<i>auriculatus</i>	Gospport Sand	Bartonian	Choctaw	AL	Puss Cuss Creek
ALMNH 1989.4.50.1	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon Fm.	Lutetian/Bartonian	Choctaw	AL	Butler
ALMNH 1992.28.44.1	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
ALMNH 1992.28.44.2	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
ALMNH 2000.1.4.1	<i>Carcharocles</i>	<i>auriculatus</i>	Yazoo Clay	Bartonian/Priabonian	Choctaw	AL	Unknown
ALMNH 2000.1.16.1	<i>Carcharocles</i>	<i>auriculatus</i>	Yazoo Clay	Bartonian/Priabonian	Choctaw	AL	Unknown
ALMNH 2000.1.27.1	<i>Carcharocles</i>	<i>auriculatus</i>	Yazoo Clay	Bartonian/Priabonian	Choctaw	AL	Unknown
ALMNH 2000.1.29.1	<i>Carcharocles</i>	<i>auriculatus</i>	Yazoo Clay	Bartonian/Priabonian	Choctaw	AL	Unknown
ALMNH 2000.1.33.1	<i>Carcharocles</i>	<i>auriculatus</i>	Pachuta Marl Member	Priabonian	Washington	AL	Bashi
ALMNH 2000.1.53	<i>Carcharocles</i>	<i>auriculatus</i>	Yazoo	Bartonian/Priabonian	Choctaw	AL	Unknown
ALMNH 2000.1.57	<i>Carcharocles</i>	<i>auriculatus</i>	Yazoo	Bartonian/Priabonian	Choctaw	AL	Unknown
ALMNH 2000.1.59	<i>Carcharocles</i>	<i>auriculatus</i>	Yazoo	Bartonian/Priabonian	Choctaw	AL	Unknown
ALMNH 2005.6.259	<i>Carcharocles</i>	<i>auriculatus</i>	Yazoo Clay	Bartonian/Priabonian	Choctaw	AL	Unknown
ALMNH 2005.6.279	<i>Carcharocles</i>	<i>auriculatus</i>	Yazoo Clay	Bartonian/Priabonian	Clarke	AL	Grove Hill
ALMNH 2005.6.294	<i>Carcharocles</i>	<i>auriculatus</i>	Unknown	Unknown	Unknown	AL	Unknown
ALMNH 2005.6.334.6	<i>Carcharocles</i>	<i>auriculatus</i>	Tallahatta Fm.	Ypresian/Lutetian	Wilcox	AL	Prairie Bluff
ALMNH 2005.6.407	<i>Carcharocles</i>	<i>auriculatus</i>	Unknown	Unknown	Unknown	AL	Unknown
ALMNH 2005.6.408.1	<i>Carcharocles</i>	<i>auriculatus</i>	Unknown	Unknown	Wilcox	AL	Prairie Bluff
ALMNH 2010.5.3	<i>Carcharocles</i>	<i>auriculatus</i>	Unknown	Unknown	Unknown	AL	Unknown
GSA 5050	<i>Otodus</i>	<i>obliquus</i>	Matthews Landing Marl Member	Selandian	Wilcox	AL	Camden
GSA 5051	<i>Otodus</i>	<i>obliquus</i>	Unknown	Unknown	Wilcox	AL	Unknown
GSA 5052	<i>Otodus</i>	<i>obliquus</i>	Matthews Landing Marl Member	Selandian	Wilcox	AL	Matthews Landing
GSA 5053	<i>Otodus</i>	<i>obliquus</i>	Porters Creek Formation	Danian	Wilcox	AL	Graveyard Hill No. 4
GSA 5054	<i>Otodus</i>	<i>obliquus</i>	Midway Group	Danian/Selandian	Unknown	AL	Unknown
MSC 20969	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20970	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20971	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20972	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20973	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20974	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20975	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20976	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20977	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20978	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20979	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20980	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20981	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20982	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20983	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20984	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 20985	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 29068	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Covington	AL	Point-A Dam
MSC 34422	<i>Carcharocles</i>	<i>auriculatus</i>	Yazoo Clay - Pachuta Marl Mbr.	Priabonian	Washington	AL	Unknown
MSC 34423	<i>Carcharocles</i>	<i>auriculatus</i>	Lisbon-Tallahatta Contact	Lutetian	Choctaw	AL	Silas
RMM 2370	<i>Carcharocles</i>	<i>auriculatus</i>	Gospport Sand	Bartonian	Choctaw	AL	Puss Cuss Creek
RMM 2371	<i>Carcharocles</i>	<i>auriculatus</i>	Gospport Sand	Bartonian	Choctaw	AL	Puss Cuss Creek