Bulletin of the Mizunami Fossil Museum, no. 28 (2001), p. 211-215, 1 pl., 1 table.

Fossil sharks from Jamaica

Stephen K. Donovan* and Gavin C. Gunter+

*Department of Palaeontology, Nationaal Natuurhistorisch Museum, Postbus 9517, 2300 RA Leiden, The Netherlands <donovan@naturalis.nnm.nl>
+Department of Geography and Geology, University of the West Indies, Mona, Kingston 7, Jamaica

Abstract

Jamaican fossil fishes are rare and few nominal taxa have been recognised. To these can now be added *Carcharias* sp. (Eocene), *Carcharodon megalodon*? L. Agassiz (late Cenozoic) and *Carcharodon* sp. (possibly Eocene), all identified from specimens in the Geology Museum, University of the West Indies, Jamaica.

Key words: Sharks, teeth, Cenozoic, Jamaica

Introduction

Fossil fishes are a poorly known component of the Jamaican rock record (Table 1). It is only with the recent documentation of the diverse otoliths of the Upper Pliocene Bowden shell bed (Stringer, 1998) that it can be claimed that, at last, a diverse fish fauna, based upon abundant otoliths, is known from at least one horizon on the island. Otherwise, fish specimens are rare even from intervals that are otherwise highly fossiliferous (see discussion in Purdy *et al*., 1996, and below).

Hitherto, only two nominal species of fossil shark have been reported from Jamaica (Table 1); *Carcharhinus limbatus* (Valenciennes) from the late Pleistocene (Purdy *et al*., 1996) and *Serratolamna serrata* (L. Agassiz) from the Maastrichtian (Underwood & Mitchell, 2000). The present communication documents further Jamaican shark teeth, found in the collections of the Geology Museum, University of the West Indies (UWIGM), by the junior author. Although this collection is small, including three out of four specimens without roots, and is unfortunately associated with poor supporting data (an apparently common feature of Greater Antillean fossil sharks; Iturralde-Vinent *et al*., 1996, p. 8), these few specimens take on some not inconsiderable significance if their rarity in the Jamaican rock record is taken into account. The terminology of sharks' teeth used herein follows Purdy (1990). The higher classification is that of Cappetta (1987).

Systematic Palaeontology

Class Chondrichthyes Huxley
Subclass Elasmobranchii Bonaparte
Order Lamniformes Berg
Family Odontaspididae Müller & Henle

Remarks: It is relevant to note that even an authority such as Cappetta (1987, p. 86) considered that "The systematics of this family is far from clear, mainly at the generic level ... attribution [of species] to a genus may be very difficult, especially when Cretaceous or Paleogene forms are studied."

Genus *Carcharias* Rafinesque
Carcharias sp.
(Pl. 1, fig. 4)

Material and horizon: A single anterior tooth, UWIGM 9089. Locality and horizon unknown (unfortunately, a not uncommon problem of UWIGM specimens; for discussion,

see Wood & Donovan, 1996), but almost certainly from the mid Lower to mid Middle Eocene Chapelton Formation, Yellow Limestone Group (see below).

Discussion: This specimen is preserved on the surface of a grey biosparite cobble, weathering orange, that is rich in disarticulated (and fragmented?) ostreid oysters, with less common nummulitid foraminifers, gastropods and lithic fragments. This lithology and faunal assemblage is typical of certain horizons of the Eocene Chapelton Formation, particularly in the central and western parts of the island.

The morphology of this tooth (Pl. 1, fig. 4) is typical of an odontaspid and is reminiscent of the lower anterior teeth of, for example, *Odontaspis winkleri* (Leriche) (Kemp *et al*., 1990, pl. 4, fig. 2). However, further specimens would be desirable for a more precise determination to be made. This is the first odontaspid to be recorded from the Jamaican succession and, indeed, the first Eocene shark known from the island. This paucity of early Cenozoic sharks seems to be reflected in Cuba, where, despite having a diverse Neogene elasmobranch fauna, only four taxa are recorded from the Eocene; indeed, only five are known from the Paleogene (Iturralde-Vinent *et al*., 1996). Of these, only *Striatolamia* spp. approaches the morphology of the Jamaican specimen (compare Pl. 1, fig. 4 herein with Iturralde-Vinent *et al*., 1996, fig. 1 I, J), but the Cuban teeth are more gracile and somewhat larger. At the present day, the only common odontaspid in the tropical western Atlantic is the sand tiger shark *Carcharias taurus* Rafinesque (Robins & Ray, 1986, pp. 17-18). For a discussion of the closely related genera *Carcharias* and *Odontaspis* L. Agassiz, see Compagno & Follett (1986).

Family Carcharodontidae Applegate

Genus *Carcharodon* Müller & Henle

Remarks. For recent assessments of the two morphologically similar genera *Carcharodon* and *Carcharocles* Jordan & Hannibal, see Applegate & Espinosa-Arrubarrena (1996), Gottfried *et al*. (1996) and Purdy (1996), amongst others. Mikuž (1999, figs. 2, 3) provided a convenient visual guide for differentiating *Carcharodon* from *Carcharocles*.

Carcharodon megalodon ? (L. Agassiz)

(Pl. 1, figs. 6, 7)

Material and horizon: A single tooth, UWIGM 8789. Locality and horizon unknown. An associated label states "Modern Tooth of Shark", but, assuming the identification made herein to be correct, it is Mio-Pliocene in age (Flemming & McFarlane, 1998).

Discussion: It is uncertain if this tooth is Recent or fossil. If the former, as is suggested by the label, it is undoubtedly derived from the Great White Shark, *Carcharodon carcharias* (Linné), whose teeth are "... unmistakable - large and triangular, with serrated edges" (Robins & Ray, 1986, p. 20). Flemming & McFarlane (1998, p. 317) considered that "Diagnostic features of the [extinct Great White Shark *Carcharodon megalodon*] include the great size, triangular shape, and the fine serrations along the margins of the tooth ... Other species .... exhibit large size or serrations, but this combination is apparently unique to *C. megalodon*." However, tooth size and serrations are poor taxonomic indicators, and can show greater variations within species than is recognised between *Carcharodon* spp.; these criteria are thus not justifiable grounds for classification (R. W. Purdy, written comm.). The imperfect preservation of the Jamaican specimen (Pl. 1, figs. 6, 7), lacking the root and more basal parts of the crown, prevents a confident assessment of its true size, but it is undoubtedly a large tooth. Despite the comments on the label, the residence of this specimen in a geological museum and the largely oceanic habit of *C. carcharias* (Robins & Ray, 1986) both suggest that this specimen is more likely to represent the extinct Neogene species.

Carcharodon sp.

(Pl. 1, figs. 1-3, 5)

Material and horizon: Two teeth, UWIGM 9079[1] and [2]. Locality and horizon unknown. An associated label, much chewed by insects, states "Fossil ... of Shar ..." Possibly from the mid Lower to mid Middle Eocene Yellow Limestone Group (see below).

Discussion: Unlike *Carcharias* sp. (see above), these specimens are not preserved in the matrix and are clean externally. However, the core of these specimens is very orange-brown and is reminiscent of the staining commonly associated with the Yellow Limestone Group. These specimens compare well with those illustrated as *Carcharodon auriculatus* (Blainville) by Iturralde-Vinent *et al*. (1996, figs. 1 K, L), who based their report on collections of many hundreds of specimens, however.

Discussion

Purdy *et al*. (1996, p. 15) asked one of the key questions

regarding the vertebrate fossil record of Jamaica - "where are all the Cenozoic fish?" For example, in the tropical western Atlantic at the present day, there are about 480 extant, common, shallow water fish taxa (Stokes, 1988), in contrast to only three (including two in open nomenclature) from the Pleistocene of Jamaica. While part of the problem may be inadequate collecting, there is nevertheless a considerable paucity of marine vertebrate remains, both fishes and tetrapods, in the Jamaican Cenozoic.

This pattern is well illustrated by the record of shark teeth, a fossil morphology that is both distinctive and popular with collectors. If all elasmobranchs are included, ray teeth and dental plates are known from multiple specimens from the Eocene, but one specimen only from each of the Paleocene and Miocene (Table 1). This is in considerable contrast to fossil elasmobranchs from the nearby island of Cuba, which consists of 19 taxa from the Paleocene (two species), Eocene (four species), Miocene (14 species) and Mio-Pliocene (one species) (Iturralde-Vinent *et al*., 1996). Thus, the available Jamaican data is inadequate to support the sort of biogeographic analysis of Iturralde-Vinent *et al*. (1996). However, it is anticipated that this situation will be improved following publication of the results of research by Drs. S. F. Mitchell and C. J. Underwood on the vertebrates of the mid-Tertiary White Limestone Group.

Acknowledgements

Professor Edward Robinson (University of the West Indies, Mona) first alerted S. K. D. to the existence of this then-lost collection in the late 1980s. Mr. Ian Brown (UWIGM) arranged the loan of specimens. Mrs Alison Longbottom (Natural History Museum) is thanked for allowing us to benefit from her considerable knowledge of fossil shark teeth. Mr. Robert W. Purdy (National Museum of Natural History, Smithsonian Institution) is thanked for his constructive review comments. This is a contribution to The Natural History Museum, London, project number 286 "Evolution of cartilaginous fishes."

References

Applegate, S. P. and Espinosa-Arrubarrena, L. (1996), The fossil history of *Carcharodon* and its possible ancestor, *Cretolamna*: a study in tooth identification. *In* Klimley, A. P. and Ainley, D. G. (eds.), *Great White Sharks*: *The Biology of Carcharodon carcharias*, pp. 19-36. Academic Press, San Diego.

Caldwell, D. K. (1966), A Miocene needlefish from Bowden, Jamaica. *Q. Jl Fl. Acad. Sci*., **28** (for 1965), 339-344.

Cappetta, H. (1987), *Handbook of Paleoichthyology. Volume 3B. Chondrichthyes II. Mesozoic and Cenozoic Elasmobranchii*. Gustav Fischer Verlag, Stuttgart, 193 pp.

Chubb, L. J. (1958), The Cretaceous rocks of central St. James. *Geonotes*, **1**, 3-11.

Clarke, M. R. and Fitch, J. E. (1979), Statoliths of Cenozoic teuthoid cephalopods from North America. *Palaeontology*,

Table 1. Stratigraphic distribution of fossil fishes known from Jamaica.

	TAXA	REFERENCE
*Pleistocene	*Carcharhinus limbatus* (Valenciennes) [shark tooth] *Chilomycterus* sp. or *Diodon* sp. [tooth plates] Perciform indet. [fragment of dentary]	Purdy *et al*. (1996)
Pliocene	Otoliths representing at least 38 teleost families and 68 species	Stringer (1998)
Miocene	Undescribed ray tooth (Newport Formation) Undescribed shark teeth (Montpelier Formation)	S.F. Mitchell (research in progress) S.F. Mitchell & C.J. Underwood (research in progress)
Oligocene	Undescribed shark tooth	D.J. Ward (research in progress)
Eocene	Undescribed fish fragments *Carcharias* sp.	Donovan *et al*. (1990), Domning *et al*. (1995) This paper
Paleocene	Undescribed ray tooth (specimen lost)	Joseph (1998)
Upper Cretaceous	Fish teeth *Serratolamna serrata* (L. Agassiz) Undescribed fossil fish	Chubb (1958) Underwood & Mitchell (2000) S.F. Mitchell (research in progress)
Stratigraphic position uncertain	*Carcharodon megalodon*? (L. Agassiz) *Carcharodon* sp.	This paper

* = Caldwell (1966) described a supposed needlefish jawbone from Bowden, southeast Jamaica. Blow (*in* Clarke & Fitch, 1979, p. 495) reclassified this as a claw from the callianassid shrimp *Ctenocheles* sp. Caldwell's locality data indicates that this specimen came from the Pleistocene at Old Pera, south of Bowden (Donovan, 1998, p. 6).

22, 479-511.

Compagno, L. J. V. and Follett, W. I. (1996), *Carcharias* Rafinesque, 1810 (Chondrichthyes, Lamniforms): proposed conservation by the use of the relative precedence procedure. Z. N. (S) 2414. *Bull. zool. Nom*, **43**, 89-92.

Domning, D. P., Donovan, S. K., Dixon, H. L., Portell, R. W. and Schindler, K. (1995), The world's most primitive sea cow: a new sirenian site in western Jamaica. *Geol. Soc. Amer. Abstr. w. Progr*., **27**(6), A386.

Donovan, S. K. (1998), An introduction to the Bowden shell bed, southeast Jamaica. *In* Donovan, S. K. (ed.), *The Pliocene Bowden Shell Bed, Southeast Jamaica. Contr. Tertiary Quaternary Geol*., **35**, 3-8.

Donovan, S. K., Domning, D. P., Garcia, F. A. and Dixon, H. L. (1990), A bone bed from the Eocene of Jamaica. *J. Paleont*., **64**, 660-662.

Flemming, C. and McFarlane, D. A. (1998), New Caribbean locality for the extinct Great White Shark *Carcharodon megalodon*. *Carib. J. Sci*., **34**, 317-318.

Gottfried, M. D., Compagno, L. J. V. and Bowman, S. C. (1996), Size and skeletal anatomy of the giant "megatooth" shark *Carcharodon megalodon*. *In* Klimley, A. P. and Ainley, D. G. (eds.), *Great White Sharks*: *The Biology of Carcharodon carcharias*, pp. 55-66. Academic Press, San Diego.

Iturralde-Vinent, M., Hubbell, G. and Rojas, R. (1996), Catalogue of Cuban fossil Elasmobranchii (Paleocene to Pliocene) and paleogeographic implications of their Lower to Middle Miocene occurrence. *J. Geol. Soc. Jamaica*, **31**, 7-21.

Joseph, J. -E. (1998), *Berridale - Fellowship - Stanton Harcourt area in the Parish of Portland, Jamaica*. Unpublished B. Sc. thesis, University of the West Indies, Mona, iii+55 pp.

Kemp, D., Kemp, L. and Ward, D. (1990), *An Illustrated Guide to the British Middle Eocene Vertebrates*. David Ward, London, iv+59 pp.

Mikuž, V. (1999), Velikozobi morski pes *Carcharocles megalodon* (Agassiz) tudi v srednjemiocenskih-badenijskih plasteh nad Trbovljami. *Geologija*, **42**, 141-150.

Purdy, R. W. (1990), *A Key to the Common Genera of Neogene Shark Teeth*. **<http://www.nmnh.si.edu/paleo/sharkteeth/index.html>**. 28 pp. [Active June 2001.]

Purdy, R. W. (1996), Paleoecology of fossil white sharks. *In* Klimley, A. P. and Ainley, D. G. (eds.), *Great White Sharks*: *The Biology of Carcharodon carcharias*, pp. 67-78. Academic Press, San Diego.

Purdy, R. W., Donovan, S. K., Pickerill, R. K. and Dixon, H. L. (1996), Fish teeth from the Pleistocene of Jamaica. *J. Vert. Paleont*., **16**, 165-167.

Robins, C. R. and Ray, G. C. (1986), *A Field Guide to Atlantic Coast Fishes*. Houghton Mifflin, Boston, xi+354 pp.

Stokes, F. J. (1988), *Divers and Snorklers Guide to the Fishes and Sea Life of the Caribbean, Florida, Bahamas and Bermuda* (revised edition). Academy of Natural Sciences of Philadelphia, Philadelphia, 160 pp.

Stringer, G. L. (1998), Otolith-based fishes from the Bowden shell bed (Pliocene) of Jamaica: systematics and palaeoecology. *Contr. Tertiary Quaternary Geol*., **35**, 153-171.

Underwood, C. J. and Mitchell, S. F. (2000), *Serratolamna serrata* (Agassiz) (Pisces, Neoselachii) from the Maastrichtian (Late Cretaceous) of Jamaica. *Carib. J. Earth Sci*., **34**, 25-30.

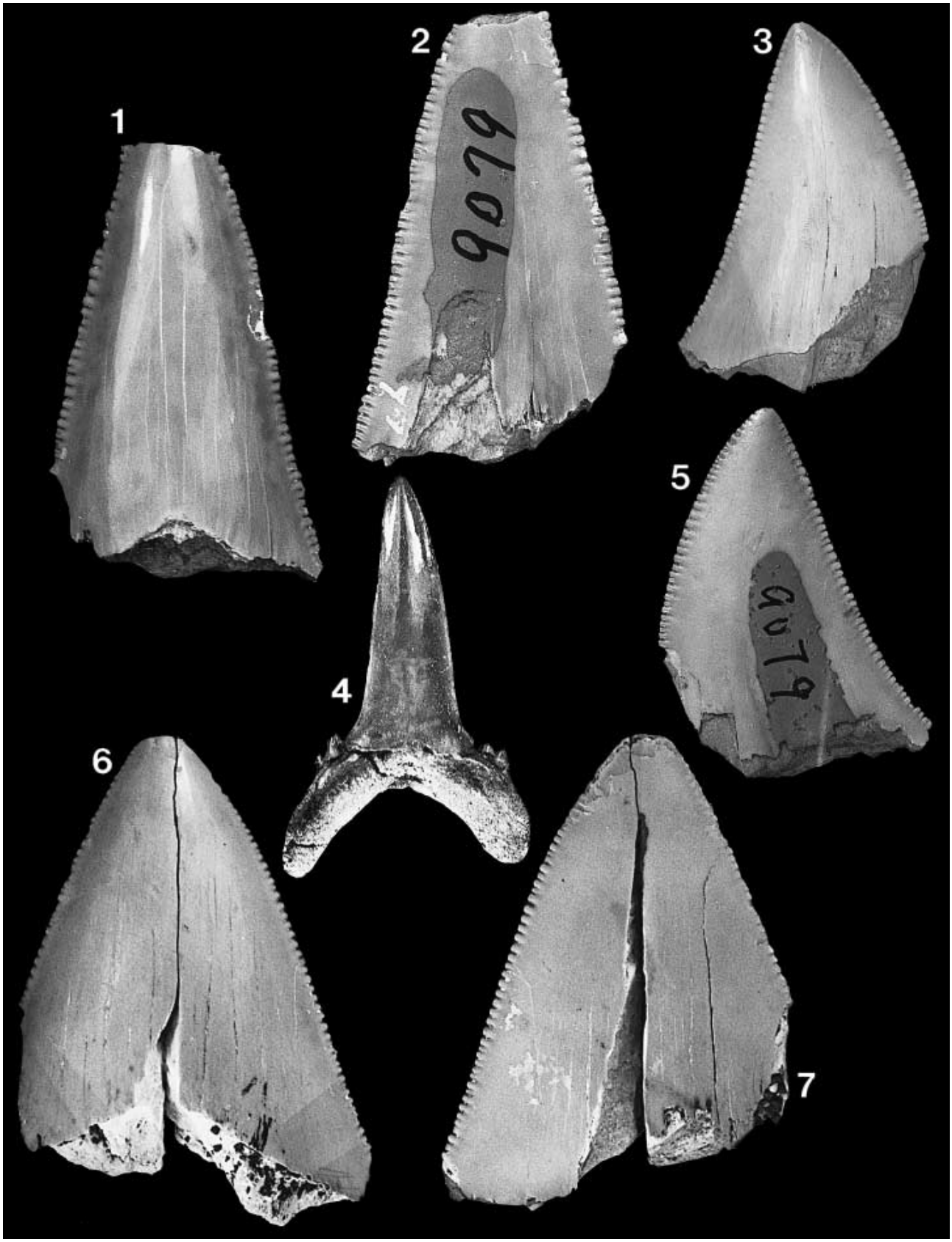
Wood, S. J. and Donovan, S. K. (1996), A septarian nodule from the sedimentary record of Jamaica: lessons from a museum specimen. *J. Geol. Soc. Jamaica*, **31**, 33-36.

Manuscript accepted on 2nd July, 2001

Explanation of Plate 1

Figs. 1-3, 5.	*Carcharodon* sp., possibly Eocene.
	Figs. 1, 2. UWIGM 9079[1], × 2.1.
	Figs. 3, 5 UWIGM 9079[2], × 1.8.
Fig. 4.	*Carcharias* sp., UWIGM 9089, anterior tooth, Eocene, outer surface, × 2.8.
Figs. 6, 7.	*Carcharodon megalodon* ? (L. Agassiz), UWIGM 8789, late Cenozoic, × 1.5.

Specimens not coated for photography.


1
2
3
4
5
6
7