THE MYSTERY OF MITCHILL'S MONSTER: AN OTODUS MEGALODON SKELETON, OR AN ASSOCIATED O. MEGALODON AND WHALE?

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Abstract - In 1818, Samuel L. Mitchill briefly detailed a fossil vertebral column with teeth found in North Carolina. It was believed to have been a sea serpent or giant shark and it was lost in a museum fire in 1866. Its true identity is difficult to ascertain with the sparse information and absence of illustrations. This specimen, dubbed 'Mitchill's monster', is reevaluated here with modern geological and paleontological knowledge. It probably came from the marine, Mio-Pliocene Eastover or Yorktown Formations. It was most likely baleen whale vertebrae with associated teeth of the megatooth shark Otodus megalodon, yet it is also not impossible that both the vertebrae and teeth were O. megalodon. Regardless of which hypothesis is correct, the monster would have been a major discovery.

INTRODUCTION

In 1818, naturalist Samuel Latham Mitchill reported the discovery of a fossilized skeleton of an unknown animal. It was found around a year prior in a hill on the bank of the Meherrin River near Murfreesboro, North Carolina. It originated from a layer of sand with polished pebbles and abundant bivalve shells. Slaves digging on a plantation had unearthed and discarded the fossils, which were later examined by a Captain Neville and Doctor Fowler/Forster.1 When they laid the recovered vertebrae out end-to-end, the column measured 34–36 feet (10.4–11 meters) long. Neville gave two teeth and one vertebra from the skeleton to Mitchill; what happened to the rest is unknown. Mitchill described the teeth as being triangular with sides 6 inches (15.2 centimeters) long and bases 4.5 inches (11.4 centimeters) wide. They were mostly covered in greyish 'enamel', except for their roots, and weighed 1 pound (0.5 kilogram) each. He did not mention the dimensions of the vertebra, only that it was 'bony' and weighed 12.5 pounds (5.7 kilograms). He identified the skeleton as a sea serpent or giant shark and guessed that it was at least 40 and possibly over 50 feet (12.2–15.2+ meters) long when complete (Mitchill, 1818; 1826). In 1826, Mitchill donated his paleontological collection to the Lyceum of Natural History in New York City.2 The teeth and vertebra were included in the donation catalogue (Mitchill, 1826). Unfortunately, the Lyceum burned down on the night of May 21, 1866 and all its specimens were destroyed (Fairchild, 1887).

SEA SERPENTS

To a modern observer, it may seem strange that a scientist like Mitchill would propose a sea serpent identity. However, in the early 19th century their existence was more widely accepted by the scientific community. For example, the Linnaean Society of New England published their compilation of sightings of the Gloucester, Massachusetts serpent in 1817. They even described a specimen reputed to be a juvenile, which they named Scoliophis atlanticus (Linnaean Society of New England, 1817). It was soon after shown to be a black racer snake with spinal deformities (Lesueur, 1818). The same year, naturalist Constantine Rafinesque published his treatise naming several genera and species of sea serpents (Rafinesque, 1817). Interest in serpents was at a peak, so it is understandable why Mitchill associated the fossil skeleton with them. At the time he was a believer who gathered accounts of marine monsters (Mitchill, 1814; 1815), although he eventually turned skeptic after a series of hoaxes and misidentifications (Mitchill, 1829). The elongated vertebral column apparently lacking limbs fit the contemporary conception of the serpent perfectly. It would not be the last instance of fossils mistaken for a sea serpent. There was Albert Koch's infamous Hydrarchos found in Alabama in 1845 (Koch, 1845), which was actually a composite of multiple basilosaurid whales (Carus, 1847).4

STRATIGRAPHIC PROVENANCE

Since it was never illustrated and was lost, establishing the stratigraphic provenance of Mitchill's monster is key for narrowing down candidates. Ray (1983) suggested that it came from Neogene sediments, while Dooley (2009) more specifically proposed the late Miocene Eastover Formation or Pliocene Yorktown Formation. The Cobham Bay Member of the Eastover Formation and the Sunken Meadow, Rushmere, and Morgarts Beach Members of the Yorktown Formation are exposed along the Meherrin River at Murfreesboro. All contain shallow marine sands or sandy clays with common bivalves and occasional pebbles (Ward & Blackwelder, 1980). Mitchill's brief description of the lithology is consistent with these four units but is too vague to determine which one is the origin. He did say that the sediment was being dug for a 'plantation-improvement', which could mean for use as fertilizer. It would line up with the Yorktown, which can have aragonitic shell preservation conducive for pre-industrial, unprocessed fertilizers (anon. reviewer, pers. comm.), but this interpretation is unconfirmed. Despite the uncertainty, this is a relatively constrained time interval. The base of the Cobham Bay Member has been dated to 7.1 Ma (Beatty & Dooley, 2013) and the top of the Morgarts Beach Member has been dated to 3.15 Ma (Dowsett et al., 2021). Additionally, vertebrate fossils are known from these units in this area (e.g., whales; Geisler et al., 2012; Godfrey et al., 2021).

UNMASKING THE MONSTER

The Mio-Pliocene age and marine paleoenvironment, combined with the sizes of the teeth and vertebral column, limit the possible candidates to large sharks or whales. Indeed, both Ray (1983) and Dooley (2009) advocated that the teeth belonged to the megatooth shark Otodus megalodon.5 Out of the sharks known from the Yorktown Formation (Purdy et al., 2001; Maisch et al., 2018), teeth that are isosceles triangles with slant heights of 6 inches and root widths of 4.5 inches only match O. megalodon. Some toothed whales from the Yorktown (physeteroids; Whitmore & Kaltenbach, 2008; Gilbert et al., 2018) can have teeth this tall, but their smaller widths, curved, conical crowns, and tapering, cylindrical roots do not fit. Therefore, the teeth of the monster were most likely O. megalodon. What Mitchill called 'enamel' actually would have been the enameloid that covers all shark teeth (Enault et al., 2015). Using the provided measurements results in an estimated total height of 5.56 inches (14.12 centimeters) for each tooth.

Assuming they were second upper anteriors (one of the tallest in the dentition) and using the equation of Gottfried et al. (1996) leads to an estimated total length of 43.77 feet (13.34 meters) for this individual. It is tentative because more recent methods for length estimation requiring crown height (Shimada, 2021) or summed crown width (Perez et al., 2021) could not be applied.

The classification of the vertebrae is more contentious. Ray (1983) supposed that they were a baleen whale, while Dooley (2009) posited that they were also O. megalodon. The 34–36 foot length of the column is within the range of larger baleen whales from the Yorktown (Balaena, Megaptera; Whitmore & Kaltenbach, 2008) and the hypothetical O. megalodon that produced the teeth. Mitchill's characterization of the vertebrae as 'bony' at first appears to rule out O. megalodon, since those of sharks are cartilaginous. On the contrary, their centra are well-calcified (Dean & Summers, 2006) and could be mistaken for bone. The morphological features of the vertebrae were not revealed and thus cannot distinguish between whales and sharks either. Ultimately, only the weight of the single vertebra indicates its affinities. A fossilized baleen whale vertebra can easily reach and exceed a weight of 12.5 pounds (Boessenecker, pers. comm.). In contrast, the heaviest O. megalodon vertebra from the most complete column weighs ~1.76 pounds (~0.8 kilograms; see Appendix). That individual has an estimated total length of 52.2 feet (15.9 meters; Cooper et al., 2022), so it is probably larger than the one that furnished the monster's teeth. Although taphonomic factors like completeness and mineralization cause vertebral weights to vary, it is unlikely that a smaller individual would have vertebrae seven times heavier. The vertebrae of the monster being O. megalodon cannot be conclusively dismissed, but the available evidence supports them being a whale instead.

CONCLUSIONS

Had it not perished in flames, Mitchill's monster would have been an important specimen. If it was the less likely O. megalodon teeth and vertebrae, it was the first megatooth shark skeletal material ever documented.6 The earliest confirmed otodontid skeletons were published almost 70 years later (Dollo, 1887). If it was the more likely O. megalodon teeth and whale vertebrae, it was also the first of its kind. Whales with associated O. megalodon teeth were not published until recently. These include a vertebra with an embedded tooth (Aguilera et al., 2008) and two fractured vertebrae with an adjacent tooth (Godfrey & Beatty, 2022). The vertebra in Mitchill's possession lacked embedded teeth or other pathologies, but it is possible that the vertebrae not collected had them. Bite marks occur on isolated whale vertebrae in the Yorktown Formation (Purdy, 1996; Godfrey et al., 2018), so they may have been present on the monster's as well. If it was the remains of a predation and/or feeding event, as opposed to a coincidental association, it represented an uncommon occasion. Large baleen whales were infrequently encountered by O. megalodon compared to smaller prey (Cooper et al., 2022). In any case, the monster demonstrates the many pitfalls of early paleontology — precise locality and stratigraphic data were not recorded, the majority of the specimen was not retrieved, it was erroneously interpreted as a fantastical creature, it was never thoroughly described or figured, and it was destroyed alongside an entire museum. It likewise demonstrates that there is merit to reexamining historical losses, as they may have been more significant than previously thought.

NOTES

1. The exact identities of these men are unknown because their first names were not stated. The captain may be the same Neville who recounted a giant cephalopod carcass in an 1817 letter to Mitchill (Lee et al., 1819). The doctor's surname was given as Fowler in Mitchill (1818), but Forster in Mitchill (1826).
2. Mitchill was a founding member of the Lyceum and its first president from 1817–1823 (Fairchild, 1887).
3. Mitchill was not involved in the Linnaean Society's report, but he did arrange for the publication of David Humphreys' competing work on the Gloucester serpent (Humphreys, 1817), albeit uncredited. The type specimen of Scoliophis was later sent to him preserved in alcohol (Mitchill, 1829).
4. Despite its relevance, the monster has gone unnoticed in the cryptozoological literature. The foundational monographs of sea serpentism (Oudemans, 1892; Heuvelmans, 1965/1968) did not discuss it and were seemingly unaware of it, even though they covered Mitchill's later skepticism and the similar Hydrarchos.
5. This species was referred to the genera Carcharodon and Carcharocles by Ray (1983) and Dooley (2009), respectively. It is here assigned to Otodus following the argument of Shimada et al. (2017). The Eastover Formation is comparatively poorly sampled, so only the extensively sampled fauna of the Yorktown Formation is used here for comparison with the monster.
6. The monster was omitted from the author's list of megatooth skeletal material (Greenfield, 2022a; b) due to its ambiguous status.

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INSTITUTIONAL ABBREVIATION

IRSNB — Institut royal des Sciences naturelles de Belgique, Brussels, Belgium

Vertebra number	Centrum diameter (centimeters)	Weight (grams)	Vertebra number	Centrum diameter (centimeters)	Weight (grams)
6	14.726	~600	87	13.279	~800
7	14.662	~600	88	13.335	402.07
14	14.823	~600	89	13.291	~500
18	14.712	438.98	96	12.81	~600
28	14.436	466.17	101	12.797	308.88
31	13.765	364.55	119	12.507	~700
54	13.821	422.31	120	12.339	~700
55	13.949	437.96	126	12.291	~600
67	13.63	~700	127	11.898	~700
76	13.458	~500	140	10.51	318.37
77	13.629	507.83	143	9.552	336.78
78	13.084	404.54	144	9.426	485.93

Table 1. Measurements of selected vertebrae from the most complete vertebral column of *Otodus megalodon*, IRSNB P 9893. Weight measurements are from Folie (pers. comm.) and centrum diameter measurements are from Cooper et al. (2022). Vertebrae over 500 grams (except number 77) were measured using a less precise scale, so their weights are approximate.

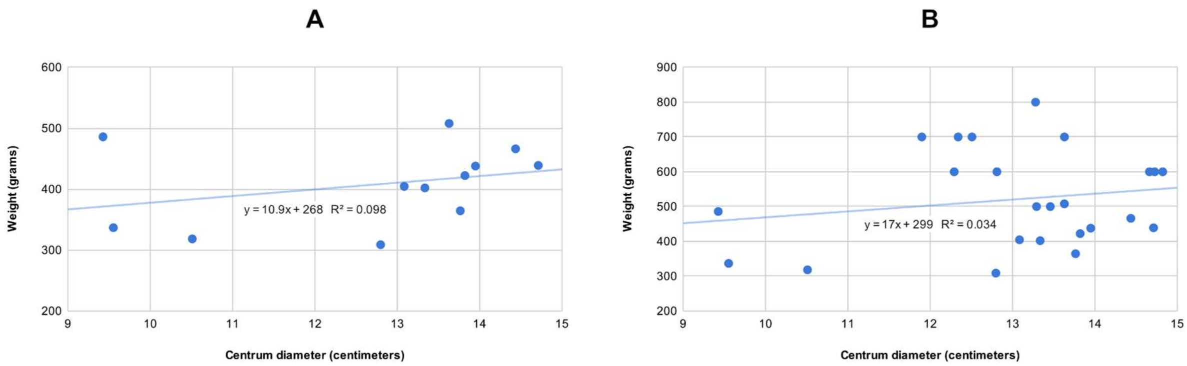

Figure 1. Scatter plots of vertebral weight and centrum diameter in IRSNB P 9893, with the approximate weights excluded (A) and included (B). The low R^2 values of the linear regression equations show little correlation between the two measurements. This is to be expected with the varying completeness of the vertebrae and the small sample size.