SUPPLEMENT

Whale Ears

By Dr. Carl Werner

First Edition Version 7

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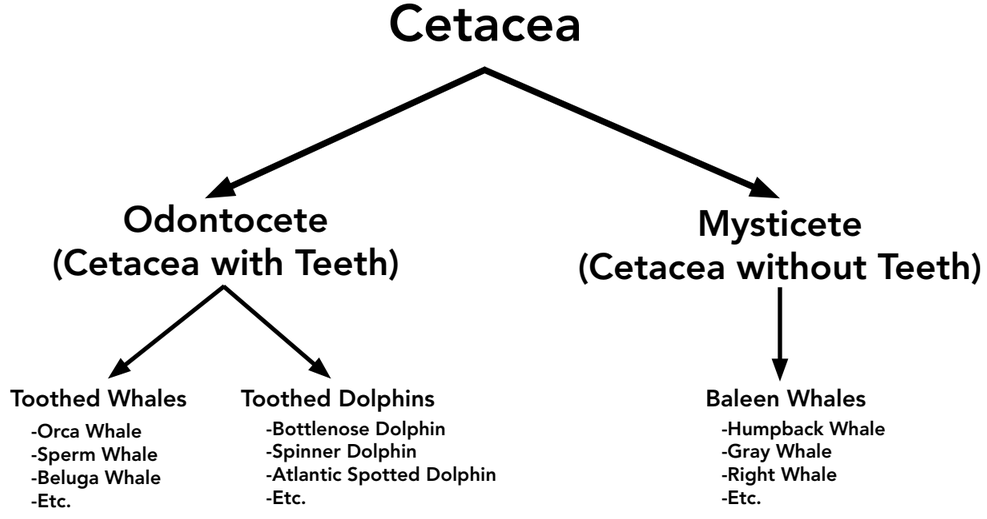
Introduction

Author's Note: This supplement to Appendix F of *Evolution: The Grand Experiment* (3rd edition) provides important information about the function and gross anatomy of the external and middle ear of land animals, whales and purported "walking whales." This material was not included in the book, the e-book or the video series because of space considerations.

Before proceeding, it would be best to first read Chapter 13 and Appendix F of the 3rd edition of *Evolution: The Grand Experiment*. Next, it is very important to read the press release at TheGrandExperiment.com under the "Whale Evolution" tab. Finally, take a brief look at the chart below detailing the classification of whales and dolphins in the mammal order called Cetacea. You will then be prepared to better understand this important information.



External Ears of Cetaceans versus Land Mammals

There are marked differences between the external ears (pinnae or auricles) of land mammals and cetaceans. Land mammals (as seen on the next page) have large, visible, external ears. These external ears collect sound waves and funnel them into the ear canal. By contrast, cetaceans (whales and dolphins) do not have visible external ears (as seen on the bottom of the next page).[1, 2]

There are also marked differences between the ear canals of land animals and odontocetes (whales and dolphins with teeth). In land mammals, the ear canal channels sound from the external ear to the ear drum. In toothed whales, the ear canal ends in a blind pouch.[3]

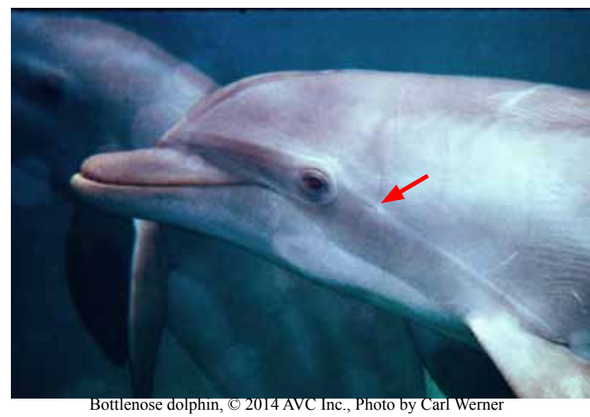
Toothed whales and dolphins do not use their external ears or ear canals to hear when they are underwater. In toothed whales and dolphins, the jaw bone absorbs underwater sounds and acts as the external ear. Inside the jaw bone there is a large fat pad that transmits sound directly to the middle ear bypassing the ear canal completely. This system is extremely efficient and allows toothed whales and dolphins to determine the direction of sound, something that a land animal cannot differentiate underwater. Detecting the direction of sound under water is difficult for land mammals because sound travels four times faster in water as compared to air.

The *external* ears (pinnae or auricles) of land mammals are made of soft tissues (skin and cartilage, not bone). Because the pinnae are soft, when an animal dies, the, external ears rot and generally are not fossilized. (Occasionally, a bat fossil is found in Mesel, Germany with the ears and wing membranes preserved, but this is rare. This can be seen on page 103 of *Evolution The Grand Experiment.*). Since external ears are not preserved as fossils, this lack of fossilization has allowed scientists to create images of missing links by adding external ears to land animals.

Imagine if a scientist found a found a skull of a *land mammal* that he or she incorrectly believed was a whale. If the scientist commissioned an artist to create a painting, the scientist might ask the artist to place tiny external ears or no external ears on the land mammal to represent a partially-evolved whale-like animal. By doing this, one could create a walking whale from a land mammal skull. This, of course, would be pure conjecture based on no fossil evidence. This has been done repeatedly in the walking whale drawings currently in museums and textbooks, which will be revealed shortly.

Cetacean Versus Land Mammal Ears

Land animals, such as this dog, have large ears for collecting slow-moving sound waves. Toothed cetaceans, such as this orca (below left) and this dolphin (below right), do not have external ears but have small openings on each side of their head. This is because toothed whales do not use their ears to hear under water.



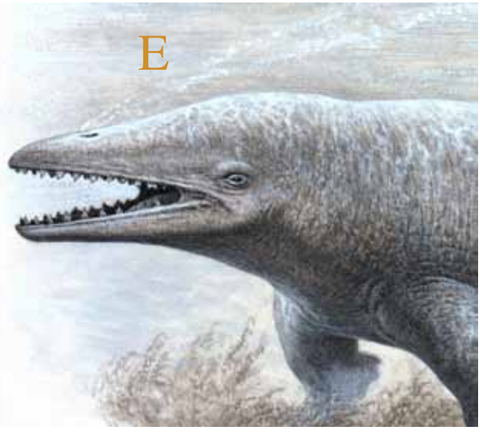
Bottlenose dolphin, © 2014 AVC Inc., Photo by Carl Werner

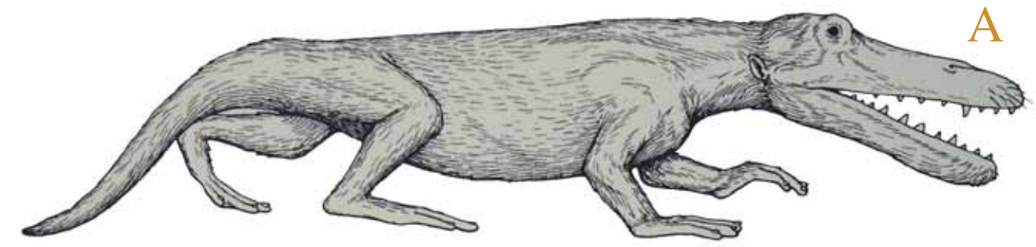
Adding Whale Ears to Land Mammal Skulls

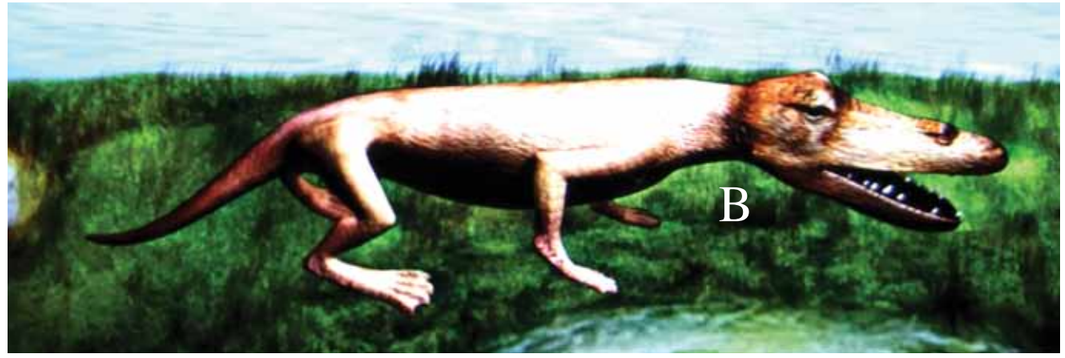
Look now at these drawings of the three most prominent "walking whales" promoted by scientists who support evolution. In each case, the artist drew or painted an animal with small or absent (whale-like) external ears. In reality, the internal ear bones, and their function, of *Ambulocetus* and *Pakicetus* were similar to land mammal internal ear bones.[4, 5, 6] Imagine if these same drawings had been made with large external ears. These animals then would then look more like land mammals.

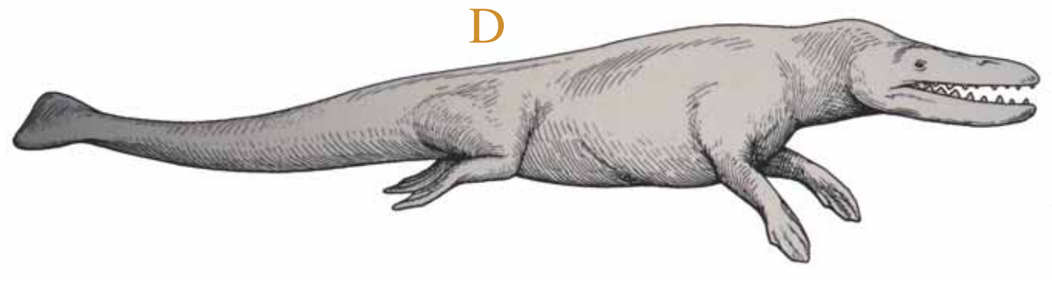
Based on interviews in *Appendix F of Evolution: The Grand Experiment* (3rd edition), each of these "walking whales" turned out to be a land animal. (*Ambulocetus,* A and B, had a land animal ear bulla, a land animal eye socket location, and a land animal cheekbone. It did not have a blowhole as shown here. *Rodhocetus,* C and D, did not have a whale's tail (fluke) and did not have front flippers as shown in these images. Rather, *Rodhocetus* walked on the tips of its front hooved toes, similar to a pronghorn or deer. *Pakicetus,* E and F, did not have flippers or low set eyes as shown below. Also it did not have a blowhole as originally proposed. Rather, it had a nose and eye socket location similar to a land mammal. In each case the artists made the ears whale-like (absent of ears) or partially evolved (with small partial external ears) based purely on conjecture.

Clockwise from top:
A: *Ambulocetus* at the University of Michigan Ann Arbor Natural History Museum, 2001.
B: *Ambulocetus* on display at the Smithsonian National Museum of Natural History, 2011.
C: *Rodhocetus* as pictured on the cover of *Science.* Drawn by John Klausmeyer of the University of Michigan Exhibit Museum, 2001.
D: *Rodhocetus*, University of Michigan Ann Arbor Natural History Museum, 2001
E: *Pakicetus* from the Natural History Museum London website, 2014.
F: *Pakicetus* from the cover of *Science*, drawn by Karen Klitz, of the University of Michigan Exhibit Museum, 1983.









Auditory Bulla: Attached or Unattached

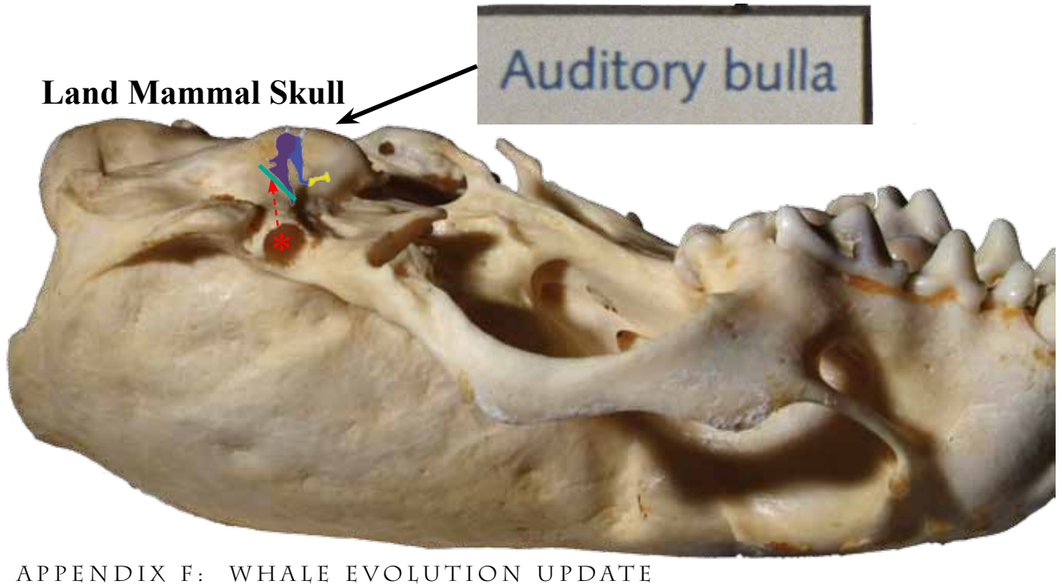
Middle Ear Bones of Land Animals: The bone encasing the three small bones of the middle ear of toothed whales is called the auditory bulla or the tympanic and is *very* different from the auditory bulla of land mammals.

As you recall, in *land* mammals sound waves are funneled by the large cartilaginous external ears into the ear canal (red asterisk below). Sound travels down the ear canal (dotted red line below) to the eardrum. When the sound waves reach the end of the ear canal, they cause the ear drum (solid green line below) to vibrate. Note that the land animal skull below has been turned upside down so that you can see the opening of the ear canal and the auditory bulla (where the three tiny bones of the middle ear are contained).

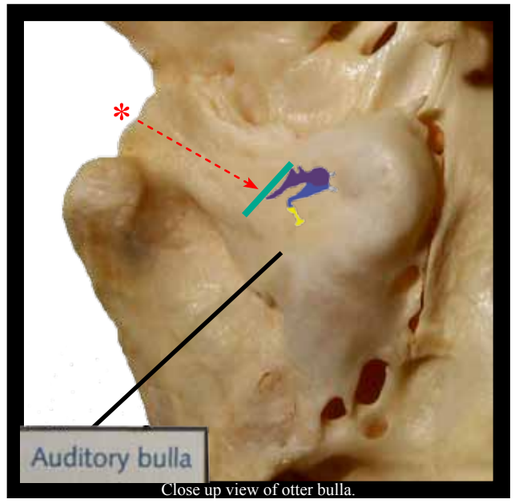
The vibration of the eardrum (solid green line below) causes the bones of the middle ear to move. The three bones of the middle ear are the malleus (seen below in purple), the incus (seen below in blue), and the stapes (seen below in yellow). The mechanical movement of the bones of the middle ear is then converted into electrical energy in the inner ear and sent to the brain. The brain interprets the electrical signals coming from the ear as sound.

The round walnut-shaped bone that encases the three bones of the middle ear (auditory bulla or tympanic) is indicated by the black arrow below. In land animals, the auditory bulla is *attached* to the bottom of the skull. In contrast, the auditory bulla in toothed whales is *not* attached to the skull but floats in fat underneath the bottom of the skull. When a whale dies and the fat surrounding the auditory bulla rots away, the auditory bulla simply *falls off* the skull! This is one easy way to distinguish a land animal skull from a toothed whale skull.

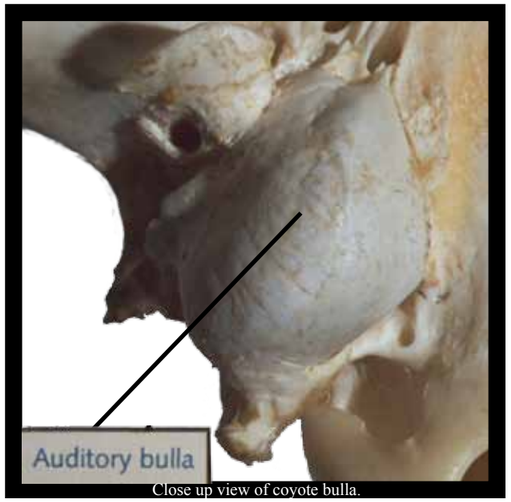
On the next four pages, the reader can view two land animal skulls and two whale skulls to view and compare the differences between the *attached* versus *unattached* auditory bulla! Then you will be afforded an opportunity to use this information to judge if the "walking whales" named *Ambulocetus* and *Pakicetus* are, in fact, whales.



Land Animal—Auditory Bulla Attached



Close up view of otter bulla.

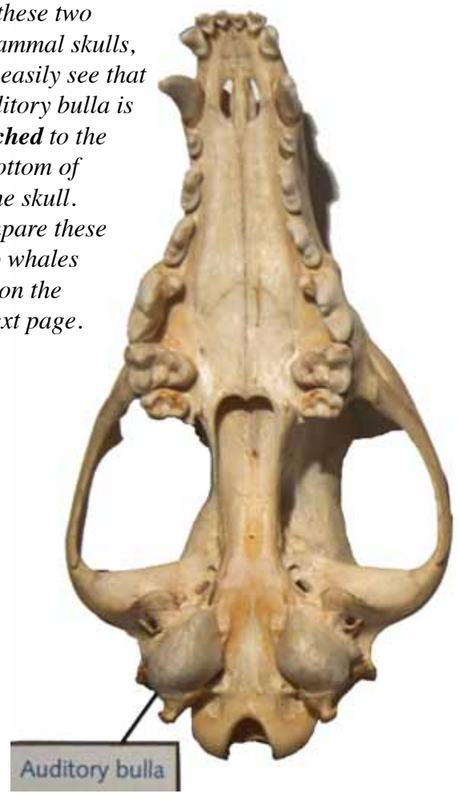


Close up view of coyote bulla.

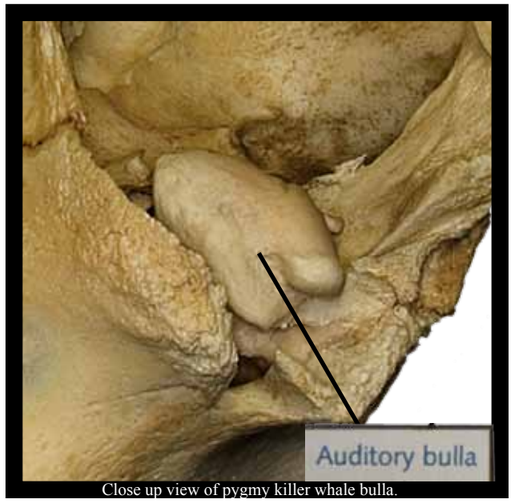
Otter (Land Mammal)

Coyote (Land Mammal)

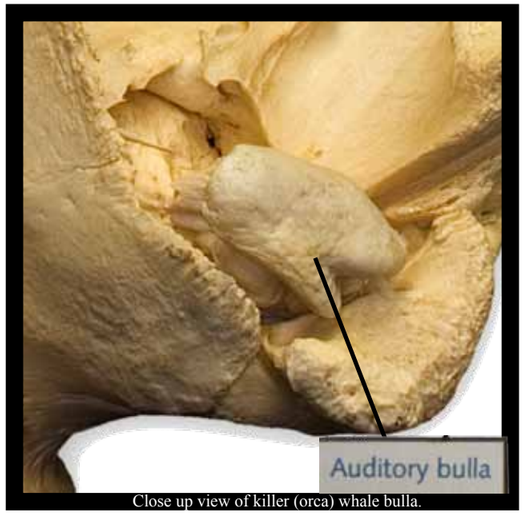
In these two land mammal skulls, you can easily see that the auditory bulla is ***attached*** *to the bottom of the skull. Compare these to whales on the next page.*



Whale—Auditory Bulla *Not* Attached



Close up view of pygmy killer whale bulla.

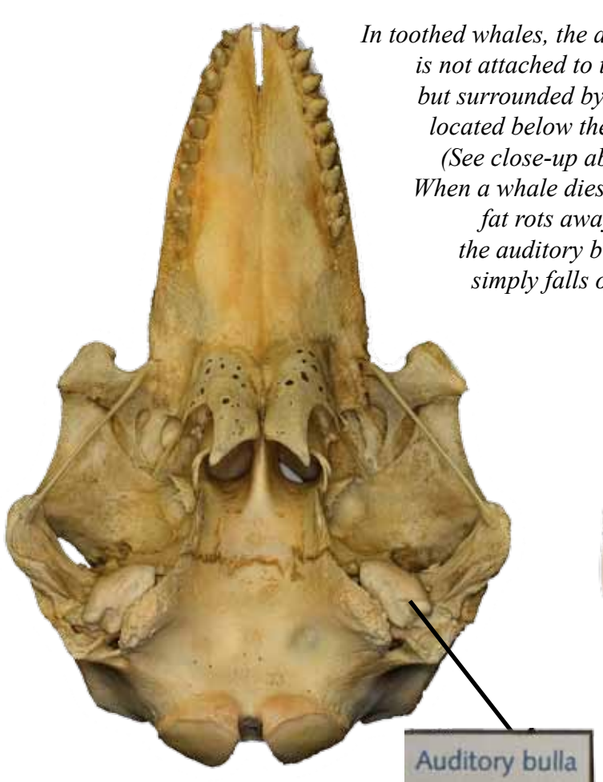


Close up view of killer (orca) whale bulla.

Pygmy Killer Whale

Killer Whale

In toothed whales, the auditory bulla is not attached to the skull but surrounded by fat and located below the skull. (See close-up above.) When a whale dies and the fat rots away, the auditory bulla simply falls off.



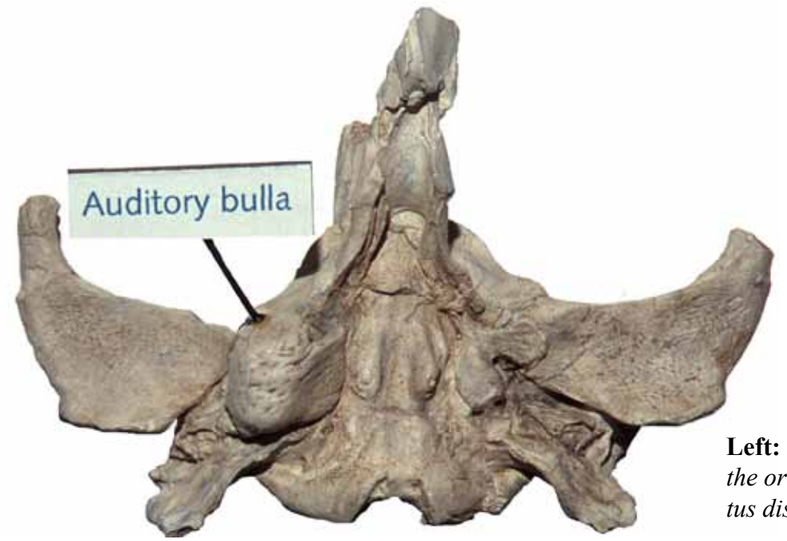
Pakicetus: Land Animal or Whale?

Knowing all of this, the reader is now encouraged to look at the first *Pakicetus* skull fragment found and identified as a walking whale in 1983 (below). Notice that the right bulla is attached to the skull and the left bulla has broken off. If you found this *Pakicetus* skull fragment, would you have called it a whale or a land mammal? Why?

You may be surprised to learn that in 1983, Dr. Gingerich said the skull fragment of *Pakicetus* (below) was "***unequivocally*** *that of a primitive* [toothed] *cetacean* [whale]."[5]

Do you agree that the skull fragment below is unequivocally that of a toothed whale? Why or why not?

If you were *not* supplied these photos of whales and land animals in the original report that Dr. Gingerich wrote, would you have been able to corroborate or disprove Dr. Gingerich's claim? (Dr. Gingerich did not supply comparative images of whales and land mammals in his original 1983 report to make this issue clear to his readers.)

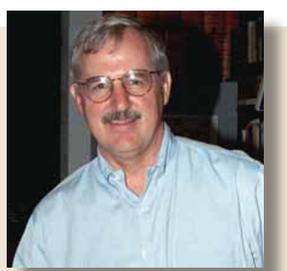


Left: *Underneath view of (a copy) of the original skull fragment of Pakicetus discovered by Dr. Gingerich.*

1983-Original Article:

"*The basicranium* [skull fragment above] *of Pakicetus is unequivocally that of a primitive cetacean* [whale]."[5]

— Dr. Gingerich



Ambulocetus: Land Animal or Whale?

Above: *Original skull fragments of Ambulocetus. This fossil was found as a block in stone with the auditory bulla attached. Many parts were missing indicating that the skull flesh had rotted away*

You may be surprised to learn that the other major walking "whale" called *Ambulocetus* (above) was also found with the auditory bullae *attached* to the skull.[7] This animal was partially disarticulated with some of the bones spread about while others still in proper position.[8] Many parts of the skull were missing suggesting that the head was coming apart and rotting when fossilized.

Since the bulla of *Ambulocetus* was attached to the skull, this would suggest that this animal was not a whale or walking whale but simply a land mammal.

Initially, Dr. Thewissen thought the auditory bulla was shaped like a whale's auditory bulla, but he does not necessarily believe that anymore. He revealed in an interview that the bulla was likely from a land animal. In fact, he said it functioned more like a mole rat. (See Appendix F.)

All told, this would indicate that *Ambulocetus*, like *Pakicetus,* was a land animal. Because of these facts, one can make a strong case that both of these "walking whales" were simply land mammals and should be displayed with large external ears, as in any ordinary land mammal.

SUPPLEMENT

Footnotes:

1. Au, W. W. L., Popper, A. N., & Fay, R. R. (2000). Hearing by whales and dolphins. New York: Springer, p.59. "External pinnae are absent in Cetacea, although vestigial pinnal rings are found embedded in the subcutaneous fat near the external meatus in some individuals."

2. Marshall Cavendish Corporation (Corporate Authors). (2010). Mammal Anatomy: An Illustrated Guide. New York: Marshall Cavendish, p. 29. "Dolphins and whales do not have external ears as most other mammals do. Two tiny openings lead from the outside directly to the hearing organs, but they are largely non-functional. Instead toothed whales hear by channeling sound through the jaw to the inner ears."

3. Au, W. W. L., Popper, A. N., & Fay, R. R. (2000). Hearing by whales and dolphins. New York: Springer, p.59. "In general, odontocete external canals are plugged with cellular debris and dense cerumen, becoming progressively narrower, and ending in a blind caecum that has no observable connection with the tympanic membrane or temporal bones."

4. Pendick, D. (November 7, 1992). Better traces of whale pedigree discovered. *Science News*, Vol 142, No 19, p. 309. "Gingerich determined that *Pakicetus* did not seem to have the necessary equipment for underwater hearing. Also, the whale ancestor's remains were found with those of land mammals. This evidence suggested that *Pakicetus* had an amphibious life style." "... the structure of the middle-ear bones—the first recovered for *Pakicetus*—are also decidedly uncetacean, Thewissen notes."

5. Thewissen, J. G. and Hussain, S. T. (February 4, 1993). Origin of underwater hearing in whales. *Nature*, Vol 361, p. 444. "*Pakicetus* was not fully aquatic, as has been previously suggested." "*Pakicetus* is the only cetacean in which the mandibular foramen is small as is the case in all terrestrial mammals." "The external ear bears strong resemblance to that of terrestrial mammals (no involvement of the lower jaw)."

6. Gingerich, P. D., Wells, N.A., Russell, D.E. and Shah, S. M. (April 22, 1983). Origin of whales in epicontinental remnant seas: new evidence from the early Eocene of Pakistan. *Science*, Vol 220, pp. 403-405. "In terms of function, the auditory mechanisms of *Pakicetus* appear more similar to that of land mammals than it is to any group of extant (living) marine mammals." "There is no indication of vascularization of the middle ear to maintain pressure during diving, and early whales were probably incapable of diving to any significant depth." "There is a distinct fossa for the tensor tympani muscle in *Pakicetus*." "The presence of a well developed fossa for the tensor tympani indicates that *Pakicetus* almost certainly retained a functional tympanic membrane."

7. Interview with Dr. Hans Thewissen, Northeast Ohio Medical University, for upcoming video tentatively titled The Emergence of Eocene Whales, conducted in August 2013, by author. "The skull of *Ambulocetus* came as one big block that had indeed the skull with both ear bones attached to it. As we took the skull apart to take the rock off of it, the ear bones also came off. So we have them now separate."

8. Thewissen, J. G., Hussain, S. T., & Arif, M. (January 01, 1994). Fossil evidence for the origin of aquatic locomotion in archaeocete whales. *Science*, 263, 5144, 210-2. "The best specimen is a partly articulated skull and skeleton of *Ambulocetus*. It was found in a silt and mudstone bed, scattered over an area of approximately 1.8 m^2."

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