

ZC-8 Individual Animal Report Excerpted from:

2005 Ketten, D. R., Beaked Whale Necropsy Findings for Strandings in the Bahamas, Puerto Rico, and Madeira, 1999-2002. WHOI Technical Report WHOI-2005-09. pp. 1-38 at

<http://www.whoi.edu/csi/images/WHOI-2005-09.pdf>

Specimen ID/sex: 8-ZC male 16 feet total length

Species: *Ziphius cavirostris*

Date of stranding: reported 15/03/00 or 16/03/00; collected 17/03/00

Location: Water Cay in the Burrows Group/Abaco, Bahamas/26.26N/77.47W

Preliminary condition: Code 1-2/Live-fresh

Analyses to date: Field dissection/CT scans/Laboratory dissection

Tissue Dispositions:

Two ears preserved in formalin-Ketten

Head/frozen - Ketten

All other tissues - Balcomb

Observations/ other observers:

March 15 @ time unknown, fishermen reported two 18 foot whales stranded in the Burrows Group (26 26N 77 46W). Ken Balcomb flew over the island on March 16 and saw a whale on shore at Water Cay in the Burrows Group, but none in the water. Later information suggests the first two whales were both *M. densirostris* that later escaped. Therefore the exact time of stranding and death of the whale that was actually retrieved near the same location is unknown. Ken Balcomb and Dave Ellifrit collected the head of a male goose-beaked whale (*Ziphius cavirostris*) on 17 March, 2000. It had been mauled by sharks; the dorsal fin, flippers and tail were missing, and it was partly exsanguinated. The head was frozen on March 17, at 2000 hours local time.

Observations/Ketten/Cranial/Temporal regions:

All observations noted below were photo-documented, and the observations are based on both the field dissection observations and on available CT data.

The partially thawed head of this specimen was dissected by D. Ketten with assistance from D. Nowacek on March 21, beginning at 0900. The dissection was filmed by K. Balcomb and H. Peckham. N. Hauser observed and kept field records for this document. The total dissection time and exposure of the head to ambient air temperatures was approximately 3 hours. The head was placed on a dissecting platform with the ventral surface up. All tissues appeared to be in excellent condition. Following the extraction of the temporal bone, the head was repackaged and refrozen.

The head was partially flensed but all soft tissues and peribullar tissues are intact. The dissection began with a 5 cm lateral, longitudinal incision on the right side of the animal adjacent to the external meatus. The incision exposed the fibrous sheath of the external canal. The canal was bisected approximately 1 cm. medial to the surface in order to examine the canal interior. The exposed segment showed two significant elements: there

was blood in the canal lumen and the walls of the meatal canal are well developed. The inner lumen is moderately narrow and lined with conventional, pigmented epithelium. Blood in the lumen was fresh and fluid. Surrounding this core is a distinct fatty layer with a radius of approximately 2.7 mm. This is a unique and exceptional finding for odontocetes that has important implications for ziphiid reception paths. The canal was pursued medially and fully dissected. It tapered noticeably and appeared to terminate several cm distal to the tympanic bulla. Segments of the canal were extracted and preserved in formalin. The boundary tissues in some segments when injected with formalin swelled and doubled in size, suggesting that this is cavernous tissue.

An anterior-posterior incision paralleling the mandible revealed a moderate amount of bruising in the lateral mandibular fats. No similar hemorrhage was found in the soft tissues on the medial face of the mandible. The mandible itself was normal with no indication of hemorrhage or contusion, nor was there any evidence of prior fracture or osteolytic processes.

The peribullar plexus of the right ear is well preserved and extensive. There is a moderate but not exceptional effusion of the plexus. The corpus cavernosum has a deep burgundy colouring, but it is unclear whether this is a normal condition for fresh tissue in this species. As in most odontocetes, there is a posterior cartilaginous pad that is interposed between the hyoids and the tympanic prominences. In this specimen, the cartilage is clean with no evidence of contusion or hemorrhage.

Both Eustachian tubes were partially occluded by ice crystals. Each is 10 to 13 mm in diameter and attaches to a sesamoid bone located immediately at the anterior tympanic rim. The right bulla was opened. The middle ear ossicles are intact and normally articulated. Coagulated blood occupied the round window niche but was easily dislodged with gentle irrigation. The right periotic was firmly articulated with the squamosal and the sutures had to be weakened with a sharpened chisel in order to free the periotic from its peribullar sinus. The medial face of the periotic revealed intact and well-preserved VIIth and VIIIth cranial nerves. The neural apertures were filled with blood as were the cochlear and vestibular aqueducts. The VIIIth nerve and round windows were injected with formalin and the entire periotic was placed in buffered formalin.

The left ear and mandibular regions showed more extensive hemorrhagic changes. There is a small, discrete contusion along the ventral surface of the left tympanic bone and significantly more hemorrhagic areas in the perimandibular soft tissues. Primary areas of hemorrhage extend along the ventral surface for 54 cm, from the tip of the rostrum will into the intramandibular fats. Smaller areas of hemorrhage located close to the lateral surface of the mandible were also noted. Like the right ear the peribullar regions, particularly the medial surface had abundant evidence of retro and peribullar hemorrhage. The left ear was extracted intact, injected via the round window and placed in buffered formalin in a sealed whirl pak. The head was then bagged, sealed, and returned to a local freezer.

Both the head and ears were delivered for scanning at MEEI, Boston on 30 March 2000. The frozen head was transported in an insulated box by charter and commercial airlines from Abaco to Boston on 30 March 2000 with a total transit time of 9 hours. On arrival the specimen was transported by van to the scan facility of Mass. Eye and Ear Infirmary. Scanning of this and all coincident specimens in the shipment took place over an 8 hour period between 19:30 to 0300. During that time, the ears and head were removed from

the external container. The ears were transferred to formalin filled jars for their protection; the head remained inside sealed plastic bags and was not scanned in this session. There was no evidence of thawing of any tissues during the scan sessions. Following scanning, the head was returned to the van, driven to WHOI, and placed in a -20 degree C freezer where it currently remains in a locked body bag. The ears were placed in new formalin the following day and are presently undergoing decalcification.

The ear specimens were scanned in an arbitrary plane using an ultra high resolution spiral CT protocol with 0 degree gantry tilt. One mm acquisitions were obtained; submillimeter images of the inner ear were reformatted at 0.1 mm increments from the 1 mm spiral data. Ultra-high resolution bone kernels were used for the inner ear images. 2D scan images, histograms of intralabyrinthine attenuations for the inner ears, and 3D reconstructions of target tissue segmentations were imaged and filmed.

The ears appear to be well-preserved with no evidence of freezer artifact. There is no evidence of bullar fracture in the scans but there are extensive areas of intracochlear blood. Attenuations consistent with fresh blood were observed bilaterally in the inner ear in the majority of scala tympani, in the helicotrema, and in scala vestibuli adjacent to the hook region. All cochlear apertures have external blood pools but the cochlear fenestrae are intact. Intracochlear blood is evident in the cochlear aqueduct and in the perilymphatic spaces and is most abundant in the basal turn. The auditory nerve canal is also well-imaged, like the cochlear aqueduct, because of blood deposited in these spaces. The trough evident in the inner ear canal reconstruction is coincident with an intact scala media.

Findings:

The findings from scans are completely consistent with the dissection observations; i.e. the ears are infiltrated with blood but the membranous compartments and super structure are intact. The round and oval windows are also intact. In combination with relatively limited hemorrhages in other head regions, the inner ear pathologies demonstrated on the scans are most consistent with a mild concussive event and are similar to observed pathology in ears exposed experimentally to exceptionally intense impulsive sources or relatively distant or low charge weight blast events. The inner ear observations are also consistent with a diathetic condition.

Summary: (See also laboratory dissection notes)

Good preservation/EAC hemorrhage/Discrete bruising Rt lateral mandibular fats/Retro and Peribullar hemorrhages bilateral/IAM and FR clots/Bilateral intracochlear blood/Intraductal blood bilateral/ Extensive hemorrhage Lt mandibular fats/