Perspectives

MRI used for non-invasive description of new octopus species

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In the North Pacific Ocean, the Emperor Seamounts are named for Japanese emperors. A new species of dumbo octopus ('dumbo' because its paired fins remind one of the ears of Disney's flying elephant; National Geographic video of dumbo octopus: www.youtube.com/watch?v=pl4pqu5FTaI&ab_channel=NationalGeographic) found there is proposed to have the English name 'Emperor dumbo'. In the language of the German scientists who describe this new octopus, the name would be 'Kaiserdumbo'.

On 5 July 2016, the German deep ocean research vessel SONNE was pulling rocks and sediments, animals and plants from one of the Emperor seamounts, from a depth of more than 4000 meters. On that day, one of the steel nets included a pink octopus, 29 cm in length [1]. It happened that the zoologist on the research team, Dr. Alexander Ziegler from University of Bonn, had a special interest in digital three-dimensional (3D) imaging of invertebrates. He recognized the dead animal as a dumbo octopus, likely an unknown species. The octopus was placed in a tub of cold seawater; external features were photographed and measured,

including a close up of the suckers which averaged 71 per arm (Figures 1-3), and a bit of tissue was collected from a damaged arm for DNA sequence analysis. Rather than follow the traditional taxonomic practice of dissecting the internal organs, he planned to fully visualize the animal non-invasively. Thus, this rare species would be intact and without any tissue staining (including contrast agents) for potential future studies.

Figure 1. *Emperor dumbo octopus. Dorsal view of specimen before fixation showing one eye and two fins with arms pointing upward. (Photo by Alexander Ziegler; uploaded from MorphoBank.) [2]*

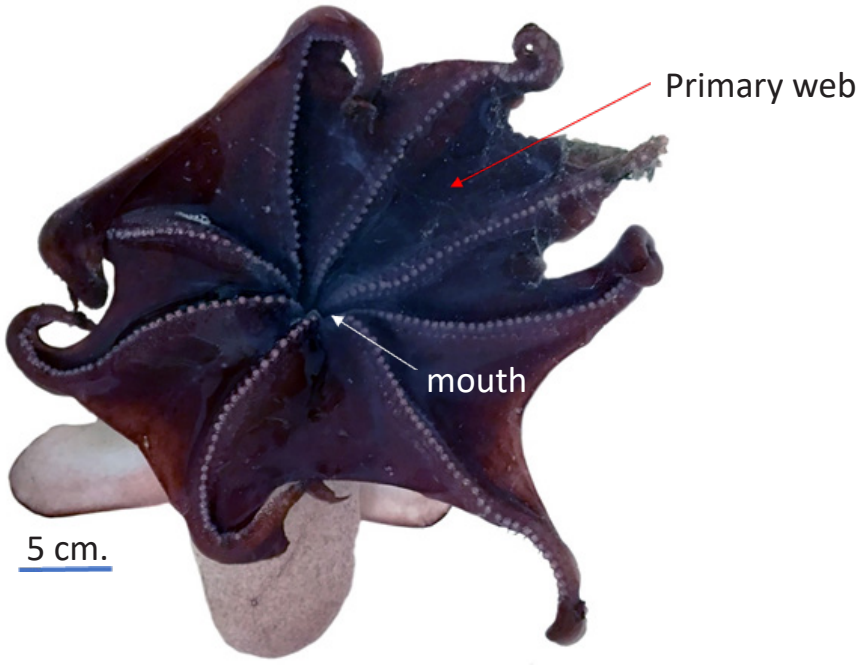

Figure 2. *Emperor dumbo octopus. Ventral view of specimen before fixation showing open webbed arms around central mouth. (Photo by Alexander Ziegler; uploaded from MorphoBank.) [2]*

Figure 3. *Emperor dumbo octopus. Lateral view of section of arm showing the suckers. (Photo by Alexander Ziegler; uploaded from MorphoBank.) [2]*

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In April of 2021, Ziegler and Christina Sagorny (a former graduate student) published their holistic description of this previously unknown species [2]. As octopi are mostly soft tissue, magnetic resonance imaging (MRI) was the key technology they utilized. But the animal also has a beak and rasping tongue (radula) made of chitin, and so they also utilized computerized tomography (CT). Datasets acquired from these two methods allowed generation of 3D models of internal organs and systems.

The animal was fixed in formalin (10%) for MRI. Scanning was done at the German Center for Neurodegenerative Diseases in Bonn with a 7-T high-field Magnetom clinical MR system with a 600-mn magnet bore, with acquisition over 17 hours. Data reconstruction used the software syngo MR B17 (Siemens). We believe this to be the first MRI study which images all of the viscera of a deep-sea octopus.

For micro-CT, the specimen was transferred to an ethanol (70%) solution. Scanning was done by the paleontologists at the University of Bonn with a Phoenix v/tome/x s 180/240 CT system, with an acquisition time of about 1.5 hours. Reconstruction of the 16-bit images was done with Phoenix datos/x 2.7 software.

The MRI showed the reproductive system to be that of an adult male. A virtual section through the 3D MRI database is shown (Figure 4). The large eyes at top and bottom, and pair of fin cartilage/muscle toward the left, are helpful for orientation. The internal organs are shown in a volume rendering view, emphasizing the gastrointestinal and cardiovascular systems (Figure 5; oblique posterior).

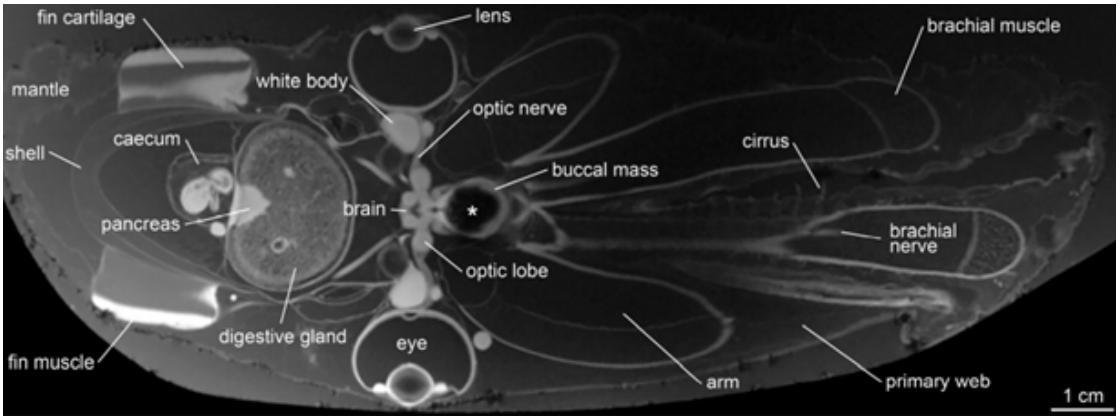

Figure 4. *Virtual section of Emperor dumbo octopus through the 3D MRI dataset with anterior facing right. (Credit: Ziegler and Sagorny, BMC Biology, 2021) [2]*

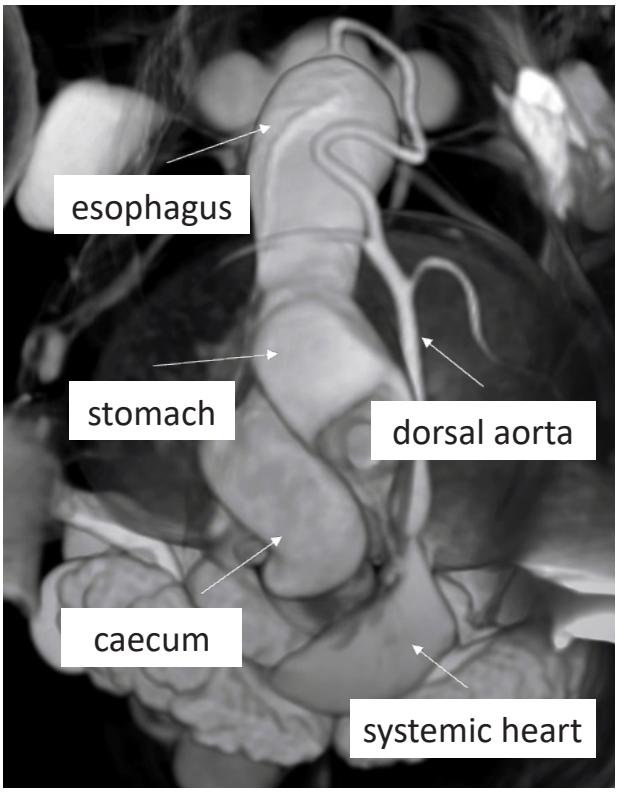

Figure 5. *Volume rendering of Emperor dumbo octopus viscera, ventral view, with anterior facing up. (Credit: Ziegler and Sagorny, BMC Biology, 2021) [2]*

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The work of Ziegler and Sagorny demonstrate the power of current and complementary imaging techniques to fully characterize deep sea animals in a non-destructive manner. Since these animals are so rare, yet likely so diverse, maintaining their physical integrity for future study is a major advantage of these MRI and CT technologies.

The paper was published as open access, with data deposited in, and made publicly available through, the MorphoBank and GenBank projects.

References

1. DeWeerdt S. Seeing inside the newly discovered Emperor Dumbo Octopus. Hakai Magazine: coastal sciences and societies [Internet]. 2021 April 22[cited 2021 Aug 11]: [about 4 minutes]. Available from: https://www.hakaimagazine .com/news/seeing-inside-the-newly-discovered-emperor-dumbo-octopus/

2. Ziegler A, Sagorny C. Holistic description of new deep sea megafauna (Cephalopoda: Cirrata) using a minimally invasive approach. BMC Biol 2021;19:81. doi: 10.1186/s12915-021-01000-9.