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The Giant Squid, *Architeuthis dux* Steenstrup, 1857 (Mollusca: Cephalopoda): The Making of an Iconic Specimen

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Abstract

In 2004 the Natural History Museum, London (NHM) acquired an 8.62m long specimen of the giant squid *Architeuthis dux* Steenstrup, 1857. Complete giant squid are rare in museum collections and the chance to obtain a live-caught specimen with the potential for molecular analysis was an amazing opportunity. Also it was, and still is, the largest fluid preserved specimen at the NHM and although the preservation and storage presented numerous challenges, the squid's public appeal as well as its scientific value has exceeded all expectations. I aim to show here the importance of such a specimen for the Museum collection, the difficulties met and overcome in all stages of its curation, as well as the numerous ways in which the squid has been used. These include such areas as education, the arts, exhibition, fund raising and public outreach, and its importance for the cephalopod research community.

Introducing Archie

The giant squid, named 'Archie' by the British press, was caught as part of a bottom trawl by the Falkland registered trawler John Cheek, on 15 March 2004 at a depth of 220m, 15.6km (9.7 miles) north west of Port Stephens Settlement, and about 2km offshore. The captain of the ship donated the specimen to the Falkland Islands Government Fisheries Department, who in turn donated it to the Museum with the stipulation that it be put on public display.

The specimen was frozen and then shipped to the NHM where it was kept in a freezer for six months, while museum staff and cephalopod researchers from around the world were consulted about the best methods and techniques available for the preservation of such a large deep-sea squid. As the specimen was still frozen, several tissue samples were taken for future molecular analysis. After considerable discussion I decided to go for the tried and tested method of fixation in 10% formol-saline solution and then preservation in 4% formol-saline solution (Lincoln & Sheals, 1979; O'Shea, 2003).

Before the fixation process, the specimen needed to be defrosted for four days, and during this time the specimen was closely monitored and ice packs were added when needed to stop the delicate arms and tentacles from rotting before the denser mantle and head regions had fully defrosted.

It was only when defrosting was complete that the specimen was measured in its entirety; at 8.62m, this *Architeuthis* is one of the largest, most complete, specimens in a museum collection (fig. 1). It was confirmed that Archie was, in fact, female and further measurements and photographs were taken for research purposes. The specimen was then injected with approximately 15 litres of 10% formol-saline solution and placed, extended, in a specially constructed fixing tank where it remained for eight weeks to allow for full uptake of the fixative. It was subsequently transferred to a 9m long display tank and kept in 4% formol-saline. The display tank was situated in the basement store, or Tank Room as it is more commonly known, in the Darwin Centre Spirit Building which houses the Museum's fluid preserved collections.

The Tank Room was chosen as a location for the squid as the room offered formalin-monitoring equipment along with an air ventilation system to help detect and control the environment in case of a formalin leak or spillage. Guided public tours are taken through this room several times a day, so, in line with the acquisition agreement, the specimen is on public display without being in one of the Museum's exhibition galleries, which would have required extensive modification and building work if it was to house such a large quantity of formalin. The tank was designed and constructed in consultation with *Casco Ltd.* who produce the tanks for Damien Hirst's formalin preserved art pieces, so that the specimen could be viewed by the public while on permanent display. Casco were chosen because it was the only company who could guarantee a tank containing formalin for a 50-year period and could show that the tank was strong enough to withstand

Fig. 1. Measuring and imaging the specimen.

any damage that could occur to such a display specimen. The tank was designed with large lid panels, sealed with silicon sealant to prevent escape of formalin vapour, which can be easily removed to allow access for research or conservation work.

Why is Archie such an important specimen?

Giant squid are found in all the world's oceans (Roper, 1998; Ellis, 1998) and although not believed to be rare in nature (Ellis, 1998), it was only in 2004 that scientists were able to image a live giant squid in the wild (Kubodera & Mori, 2005). Since giant squid are thought to spend most of their lives at depths of 300-1000+ meters (Roper 1998), and the majority of specimens are recovered from sperm whale stomach contents or are from individuals that have washed up on beaches (Roper & Boss, 1982; Clarke, 1996), complete museum specimens are rare. Prior to Archie, the NHM collection contained no complete squid but comprised around 50 partial specimens (mostly from stomach contents) including one that had washed up on a Scarborough beach in 1964. While these have been useful for some distribution/morphological studies they

provide limited opportunities for some modern scientific investigations, for example, before 2004 the NHM did not have any *Architeuthis dux* material suitable for DNA analysis. By storing tissue in -80ºC freezers in the Molecular Collection Facility and in 100% ethanol in the general collections the Museum is now able to provide easy access over the long term to samples that can be used for molecular studies. Lastly the sheer size of this species, *Architeuthis dux* are thought to reach up to 14m length for females and up to 10m for males (O'Shea & Bolstad, 2008); having such a charismatic and awe-inspiring specimen was a great chance to entice new audiences into the Museum.

Difficulties

This is the largest specimen ever to be preserved in fluid at the NHM and provided the curatorial staff with several challenges. The first difficulty that the department faced was whether we should accept the specimen since it was donated with the stipulation that it be put on public display. After discussing this among colleagues and senior management, we felt that the benefit as a scientific resource and the potential for the specimen to become a visitor attraction outweighed the cost and challenges of putting the specimen on public display. It was also difficult to balance the priorities of the Science Group together with those of Front of House and Public Engagement. The research and curatorial staff were adamant that while the squid was indeed a huge visitor attraction its primary function was as a research specimen. This impacted on how and where the specimen was stored and also how the public could view it. We also were challenged to maintain appropriate health and safety standards at all stages of the fixation and preservation process since formalin is a hazardous chemical. Staff wore protective clothing and respirators and worked in 15 minute shifts, to reduce such risks. The logistics of planning such a large operation were very complicated, and organising deliveries, staff time and restricting access to areas of the Museum (including some public areas) required detailed planning and close collaboration with a wide range of people and departments. There was also a large cost to the project in staff time, materials, equipment, chemicals and the tank itself. To make sure that I achieved my aims within budget but to a high scientific, aesthetic and health and safety standard meant keeping a close eye on all aspects of costing, timings and budgets.

Scientific uses

The major scientific value has been the availability of tissue samples for molecular analysis which have been sent out to research institutions across the world. A sample that was sent to Dr. Tom Gilbert at the University of Copenhagen was used in a recent phylogeography and population mitogenetics study for an MSc project by Inger Winkelmann (Winkelmann, 2011). In the past it has been suggested that there have been up to 21 species of giant squid (Clarke 1966), however many descriptions were based on poorly preserved specimens and collection locality data (Roper, 1998; Ellis, 1998). More recent works have suggested that there are either three (Nesis, 1982) or one (Roeleveld, 2000) globally distributed species. Using a single marker from mitochondrial-DNA, Winkelmann's study strongly suggests that the family Architeuthidae consists of one pan-global species of giant squid, *Architeuthis dux.* The species show unusually low levels of mitochondrial nucleotide diversity suggesting that in the past there has been a population bottleneck or, alternatively, sudden population inflation. Also the data shows a lack of discernable population structure, with no difference between populations from regions as far apart as Florida and Japan. This is typical of a highly migratory species, and given the fact that previous isotope studies suggested that adult *Architeuthis dux* do not travel great distances (Guerra et. al., 2010) it is most probable that this migration is through a pelagic paralarval stage that disperses via the global thermohaline circulation, sometimes known as the Great Ocean Conveyer.

Specimen capture data from a live caught individual also adds to the growing number of precise distribution and depth data available for analysis, especially important when so many of the known specimens are recovered from stomach contents or found washed up. A further unforeseen benefit following the acquisition, was that correspondence and collaboration with fisheries staff at the Falkland Islands Government Fisheries Department has increased, leading to the donation of further cephalopods to the NHM including newly described type material.

Archie in the Media

When the specimen was first displayed in the Tank Room (fig. 2) it attracted immediate interest from worldwide media. In the weeks immediately after the opening there were five pieces of TV coverage, eight pieces of radio coverage, 38 pieces of print coverage (with a combined circulation of over 13 million readers) and 20 pieces of web-news coverage. The specimen also featured in the BBC television programme *Museum of Life* when a partial colossal squid specimen, *Mesonychoteuthis hamiltoni* Robson, 1925, was added to the display tank in 2006. Media attention is ongoing.

Public engagement

Archie has been used in a variety of public engagement programmes to promote NHM science to a wide and diverse audience. Visitors can see the specimen by joining a daily behind the scenes spirit collection tour. The squid has also been the subject of talks and tours including the *Nature Live* programme, a daily show which allows the audience to listen to, and ask questions of, museum scientists; talks and tours for Museum members; external scientific societies; corporate/ fundraising events; and families at the *Dinosnores* children's sleepover events. Archie was also highlighted in the Museum's 2010 *Deep* exhibition and the online video of the preservation process remains the NHM's most watched video, with over 182,165 views to date (NHM, 2006).

Fig. 2. Archie on display in the Tank Room of the Darwin Centre. © This image is copyright of the Natural History Museum, London.

Educational uses

The giant squid is a great starting point for talking to students about a range of topics including specimen preservation, the importance of museum collections, NHM research, adaptation to habitat, taxonomy and behaviour. With the inspiration of the giant squid, students become interested and engaged with the learning process and more complex ideas can then be further explored. Curators at the NHM have used the giant squid as a tool in teaching programmes and workshops with primary, secondary and university students. This includes our A-level taxonomy days and physiology/dissection workshops. To support these learning opportunities, the Museum learning team commissioned a life size fabric model of the squid. This has allowed the anatomy and physiology of a squid to be easily demonstrated (and indeed the model can be handled by students) to a large school group in any area of the Museum, not just the Tank Room. Currently the model is used in the primary school *Variety Show* workshop as well as *Nature Live* talks, *Dinosnores* and other family/educational events.

Arts and humanities

Archie has also provided inspiration for people in the field of arts and humanities. The specimen has been depicted by artists using various media, for example: Alice Shirley from Central St. Martins College of Art drew the specimen life-size in squid ink; Clara Drummond from The Prince's Drawing School who exhibited her work in *galleriBOX* Gallery in Iceland; and Sophie Wiltshire from the Royal College of Art whose

graduate show featured the giant squid painted on ceramic tiles. The specimen was also celebrated in the poem *Squiddity* by Abigail Curtis a Lecturer at York University (Curtis, 2012) and was the central character in the novel *Kraken* by China Miéville (Miéville, 2010).

In the future

I hope that in the future, Archie will continue to be used to generate new scientific knowledge and to increase public understanding of the natural world and the role of museums in science. Some possible projects include:

- Further DNA analysis for taxonomic/population studies
- Removal of beak/statoliths for study
- Preparing a mould of the beak and making casts for teaching/exhibition

Conclusions

After successfully completing the preservation and display of Archie, assisting a variety of end-users across varied projects and developing a range of programmes and themes around the specimen, much has been learnt about the preparation and making of an iconic museum specimen. Firstly, when considering accepting and displaying specimens it is good not to limit options for display, research or outreach purposes as it is hard to predict fully how the specimens might be used. When planning such a project, taking account of other peoples' points of view (e.g. curation, learning, exhibition) helped to maximise the wider benefits. Such donations may be unexpected but time must be taken to prepare and seek advice so that no opportunities are overlooked. In addition, although such acquisitions can be costly in terms of money and staff time, the resulting outputs and profile-raising can be wide-ranging and far exceed what was initially expected. Even though a specimen may not be new it can always be presented in new ways to help put across differing messages and ideas that may be highlighted in upcoming exhibitions or events. It is also not necessary for a specimen to be large or rare to be iconic. Such a specimen needs to have a 'wow factor' or to be displayed in such a way that it catches the attention and allows the viewer to be drawn in and engage with the item and any themes/ideas around it. Lastly, try to make the most of opportunities, foster links and build relationships with donors and sister organisations as iconic specimens can come from the most unexpected sources.

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