

Project: AFI 6/33

DID ANTARCTIC OCTOPUSES COLONISE THE DEEP SEA?

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Location: Scotia Arc, aboard the RRS *James Clark Ross*

Rationale:

This project uses octopuses as model organisms to test the hypothesis that the Antarctic has acted as a centre for evolutionary innovation and radiation and as a source of taxa that have invaded the deep sea. It is likely that the deep-sea fauna was depauperate following extinction events associated with past global climate change causing, for example, deep-ocean oxygen minima. Such events have been recorded from the Late Cretaceous and Palaeocene/early Eocene, prior to the opening of the Drake Passage. The subsequent development of deep-water connections between the Southern Ocean and the major oceans which surround it would have facilitated the expansion of biogeographic boundaries. This study aims to characterise the micro- and macro-evolutionary processes of endemic Antarctic octopod fauna and the macro-evolutionary processes of the deep-sea octopod fauna using molecular methodologies. Bayesian analytical procedures incorporating fossil constraints will then be used to estimate the divergence times of these taxa thereby providing a means of testing the hypothesis that, in evolutionary history, Antarctic taxa invaded the deep sea.

Work at sea:

A large collection of tissue samples of our target groups from the deep sea and Antarctica have already been collected in previous cruises. The specific objective of this cruise for our work was to target three species of octopus, *Pareledone charcoti* (peak abundance 100m depth), *Pareledone turqueti* (peak abundance 100-200m) and *Adelieledone polymorpha* (peak abundance 250-350m), for the micro-evolution (i.e. population genetics) component of this project. An otter trawl was used primarily to capture octopus due to its relatively large sampling area and the fact that it can be trawled quickly (4 knots) which prevents octopus from swimming out of the net. Some samples of these species were also captured by Agassiz trawling conducted by JCR 144. Two locations were targeted: Elephant Island and the South Orkney Islands.

Upon capture, octopus were placed immediately in ice cold fresh water to prevent their skin from detaching (which occurs quickly in warm water). A small tissue sample was taken from the mantle of each octopus and placed immediately in 70~80% ethanol for preservation for DNA extraction. Every octopus was then fixed in 5-6% formalin for 4 days, before being heat sealed in a plastic bag containing 4% formalin, and packed in UN approved barrels for transport back to Queen's University, Belfast for morphometric studies.

Preliminary results:

295 cephalopods were caught during the cruise; 3 squid and 292 octopus. 260 individuals were caught using the otter trawl and a further 35 using the Agassiz trawl. At least 10 species of octopus were caught.

Table 5.1 Octopus and squid caught during the cruise

Date	Station	Event	Trawl	Depth	Cephalopods caught*
28/2/06	Falkland trough	FT-AGT-1	Agassiz	~1000 m	1 × <i>Semirossia patagonica</i>
04/3/06	Livingston Island	LI-AGT-4B	Agassiz	~200 m	3 × <i>Pareledone</i> sp.
06/3/06	Deception Island	DI-RGBT-1	Otter	~200 m	7 × <i>P. turqueti</i> 2 × <i>P. cornuta</i> 10 × <i>P. charcoti</i>
11/3/06		DI-RGBT-2	Otter	~200 m	7 × <i>P. turqueti</i> 2 × <i>Benthoctopus</i> sp. 1 × <i>P. aurata</i> 3 × <i>P. sp.</i>
12/3/06	Elephant Island	EI-AGT-2	Agassiz	~1000 m	3 × <i>P. turqueti</i> 1 × <i>P. aequipapillae</i>
		EI-AGT-4	Agassiz	~200m	4 × <i>P. charcoti</i> complex 5 × <i>P. turqueti</i> 3 × <i>P. cornuta</i>
13/3/06		EI-AGT-3	Agassiz	~500 m	1 × <i>P. turqueti</i> 1 × <i>A. polymorpha</i>
		EI-RGBT-4	Otter	~100 m	1 × <i>Megaleledone</i> sp. 1 × <i>P. turqueti</i>
14/3/06		EI-RGBT-3	Otter	~100 m	11 × <i>P. charcoti</i> 7 × <i>P. charcoti</i> complex 1 × <i>P. turqueti</i>
		EI-RGBT-5	Otter	~100 m	3 × <i>P. turqueti</i> 1 × <i>P. cornuta</i> 8 × <i>P. charcoti</i> complex
		EI-RGBT-6	Otter	~300 m	11 × <i>P. turqueti</i> 2 × <i>A. polymorpha</i> 3 × <i>P. charcoti</i> 2 × squid
		EI-RGBT-7	Otter	~100m	2 × <i>P. charcoti</i> 4 × <i>P. turqueti</i>
		EI-RGBT-8	Otter	~100m	8 × <i>P. charcoti</i> complex
		EI-RGBT-9	Otter	~100m	14 × <i>P. charcoti</i> complex 2 × <i>P. turqueti</i>
		EI-RGBT-10	Otter	~100m	80 × <i>P. charcoti</i> complex 1 × <i>A. polymorpha</i> 3 × <i>P. turqueti</i>
17/3/06	Powell Basin	PB-AGT-1	Agassiz	~1500m	1 × <i>Thaumeledone</i> sp.
18/3/06		PB-AGT-3	Agassiz	~500m	4 × <i>P. turqueti</i>
		PB-AGT-4	Agassiz	~200m	1 × <i>P. turqueti</i>
23/3/06	Signy	SG-RGBT-1	Otter	~250m	1 × <i>Megaleledone</i> sp. 5 × <i>P. turqueti</i> 11 × <i>P. charcoti</i>
24/3/06		SG-RGBT-2	Otter	~150m	12 × <i>P. charcoti</i> 1 × <i>P. turqueti</i>
		SG-RGBT-3	Otter	~150m	7 × <i>P. charcoti</i> 1 × <i>P. turqueti</i> 2 × <i>Megaleledone</i> sp.
27/3/06	Southern Thule	ST-AGT-4	Agassiz	~200m	2 × <i>P. turqueti</i>
28/3/06		ST-AGT-2	Agassiz	~1000m	1 × <i>Pareledone</i> (new species?)
5/4/06	South Georgia	SG-AGT-4	Agassiz	~200m	1 × <i>A. polymorpha</i> 3 × <i>P. sp.</i>

* Cephalopod species identifications to be confirmed/continued at Queen's University, Belfast.

Initial investigation suggests that *P. charcoti* (Fig. 1) was caught in good numbers at both Elephant (~130) and South Orkney islands (~30). *P. turqueti* were present in smaller numbers (34 and 7 respectively) and *A. polymorpha* were very rare, with only 4 individuals collected at Elephant Island and none from the South Orkney Islands.

Species within the genus *Pareledone* are very difficult to distinguish from one another and thus further microscopic identification and dissection of the individuals caught will continue at Queen's University in Belfast (morphometrics) and the British Antarctic Survey (molecular). Information from previous cruises suggests that the final number of species will be closer to 20 after identification via microscopic examination and dissection.

The 3 octopus caught at Southern Thule, South Sandwich Islands are of particular interest due to the fact that no octopus have been caught there previously by the PI, Louise Allcock, despite extensive trawling. Initial observation of one of these individuals suggests that it may be a new species due to unusual characteristics, including chromatophores covering the ventral mantle, a character commonly used in species delineation.

The *Thaumeledone* individual caught at the Powell Basin from 1500 m is also of great interest. The distribution of the 2 known *Thaumeledone* species (*T. peninsulae* and *T. gunteri*) from this region of Antarctica is unknown and thus the identification and molecular sequencing of this individual will aid in determining the extent of these species.



Fig. 1. *Pareledone charcoti* and *Pareledone* sp. from Elephant Island