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Kondakovia longimana Filippova, 1972 (Cephalopoda: Onychoteuthidae) from the Indian Ocean sector of the Southern Ocean

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Abstract: Two specimens of *Kondakovia longimana* were recently obtained from the Indian Ocean sector of the Southern Ocean. One specimen, damaged but near the known maximum size , was found floating on the surface, and the other, a male subadult specimen, was captured by a pelagic trawl. Examination of the specimens, histological sections and analyses of tissue samples revealed that the muscular tissues of the tentacular stalks and the mantle contain a large amount of ammonium, more than 328 mM, a quantity that far exceeds that of *Moroteuthis ingens* (206.9 mM) and *Moroteuthis robsoni* (199.6 mM) from the South Tasman Rise. Catch data and published records suggest that the juveniles and subadults of *K. longimana* feed on krill in the epipelagic zone.

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Introduction

Kondakovia longimana Filippova, 1972 was described from three female specimens captured in the Scotia Sea. Subsequent reports record the species in the diets of many predators from various parts of the Southern Ocean (Clarke 1980, Clarke *et al.* 1980, Clarke & Prince 1981, Clarke *et al.* 1981, Clarke & MacLeod 1982a, 1982b, Thomas 1982, Offredo *et al.* 1985, Nemoto *et al.* 1985, 1988, Adams & Klages 1987, Rodhouse *et al.* 1987, 1990, Green *et al.* 1991, Green & Burton 1993) although reports on net caught specimens are few. In addition to the original report of Filippova (1972), Nemoto *et al.* (1985, 1988) and Rodhouse (1990) reported on catches from South Georgia. Lubimova (1985) reported, without details, catching the species in the Pacific Southern Ocean from 56–68°S, the Atlantic Southern Ocean at 60°S and in the waters of the Antarctic Convergence in the Indian Ocean. This paper reports the result of studies on two specimens of *K. longimana* recently obtained from Prydz Bay, Antarctica.

Materials and methods

Specimen 1 was found dead, floating on the surface in a large polynya at 63°04.76'S, 62°56.01'E on 14 October 1985, by the RV *Nella Dan* of the Australian National Antarctic Research Expeditions (ANARE). It was being fed upon by Antarctic petrels (*Thalassoica antarctica*) and snow petrels (*Pagodroma nivea*). It was collected and subsequently lodged in the Museum of Victoria (MOV) (Reg. No. F71537).

Specimen 2 was captured on 11 February 1991 at 66°32.11'S, 69°01.89'E, from RSV *Aurora Australis* in an International Young Gadoid Pelagic Trawl (IYGPT) fished at 48 m through a krill swarm where the water depth was 1733 m. Fresh tissue samples were taken from the mantle and the tentacular stalk and frozen at -20° for analysis of ammonium content. The specimen was then fixed in 10% buffered formalin aboard the ship and stored in 70% ethanol. Preserved tissue samples from the mantle and tentacular stalk were also taken for sectioning and histological examination. Sections (4 µm thick) were cut and stained with haematoxylin and eosin. The specimen carries the MOV Reg. No. F71538.

For the analysis of ammonium content, each sample (3–6 g) was macerated with 250 ml water, and total volatile base nitrogen was determined as described by Pearson (1976). A 200 ml aliquot was steam distilled in the presence of magnesium oxide. The distillate was collected in boric acid solution and the volatile bases were titrated with 0.05 M sulphuric acid. A portion of the extract was diluted 200-fold and ammonium nitrogen was determined by the salicylate-dichloroisocyanurate colorimetric method of Dalpont *et al.* (1974). For comparison, frozen tissue samples of *Moroteuthis robsoni* and *M. ingens* were also analysed for NH^3 by the same technique. The measurements, indices and description used are standard (Roper & Voss 1983).

Results

Specimens

Both specimens were damaged. Specimen 1 lacked the posterior end, but was estimated to have been about 830 mm ML. The visceral mass and the distal portions of all arms of the specimen were missing. The surface is papillate with most of the skin missing but the colour of the existing skin is reddish brown. Specimen 2 was cut into three pieces by the trawl during capture.

Table I. Measurements (mm) and indices (%) of two specimens of *Kondakovia longimana* from Prydz Bay.

	Specimen 1	Specimen 2
Sex	indet.	male
ML	(mm) 830 (approx.)	355
Wt (gm)	–	1575
MW1I	31.3	29.6
MW2I	33.7	30.4
MW3I	–	23.1
FLI	–	43.1
FWI	–	53.0
FBLI	–	40.0
A1LI	–	62.8
A2LI	–	88.7
A3LI	–	87.3
A4LI	–	94.4
CLI*		30.4
CLI**		26.5
URL	2.29	3.04
LRL	2.65	2.99

*Including the oval fixing pad on the carpus.
**Excluding the oval fixing pad on the carpus.

The reconstructed specimen was relatively intact with only the right tentacle missing and some damage to the tips of all arms.

The specimens generally match the original description of Filippova (1972). However, slight discrepancies exist in the tentacular clubs. In Specimen 1, there are eight knobs and nine suckers on the fixing pad of the right club, and 10 knobs and nine suckers on the left club. In Specimen 2, the fixing pad of the left club possesses 11 knobs and 10 suckers, the right tentacle is missing. Both specimens possess 32 hooks on the tentacular clubs. According to Filippova (1972), the specimens she studied possess 10 suckers and seven knobs on the right club, 10 knobs and nine suckers on the left club, and 33 hooks on each club. Clarke (1980: textfig.59 & 67) reported that for specimens of 100–750 mm ML, the numbers of hooks on clubs were 30–37 with majority being 33, and the number of knobs on the fixing pad were 8–13 with the majority being 10.

Specimen 2 is a male, with a penis about 100 mm long. There are no spermatophore rudiments in Needham's sac. The stomach is empty . Table I shows the measurements and indices of both specimens.

Tissue

Histological sections of the tentacular stalk and mantle of Specimen 2 show loose muscular structure with many spaces between bundles of muscular fibres (Fig. 1). The extent of the spaces appears to be intermediate between the highly reticulated tissue of *Mastigoteuthis* sp. and the densely muscled tissue of *Todarodes sagittatus* shown by Clarke *et al.* (1979).

The analyses of the tissue samples reveal that the ammonium (NH^4-N) content of the tentacular stalk and the mantle tissues is 329.4 mM, with the total volatile base nitrogen (TVBN), which is the ammonia plus methyl amines, being 332.0 mM.

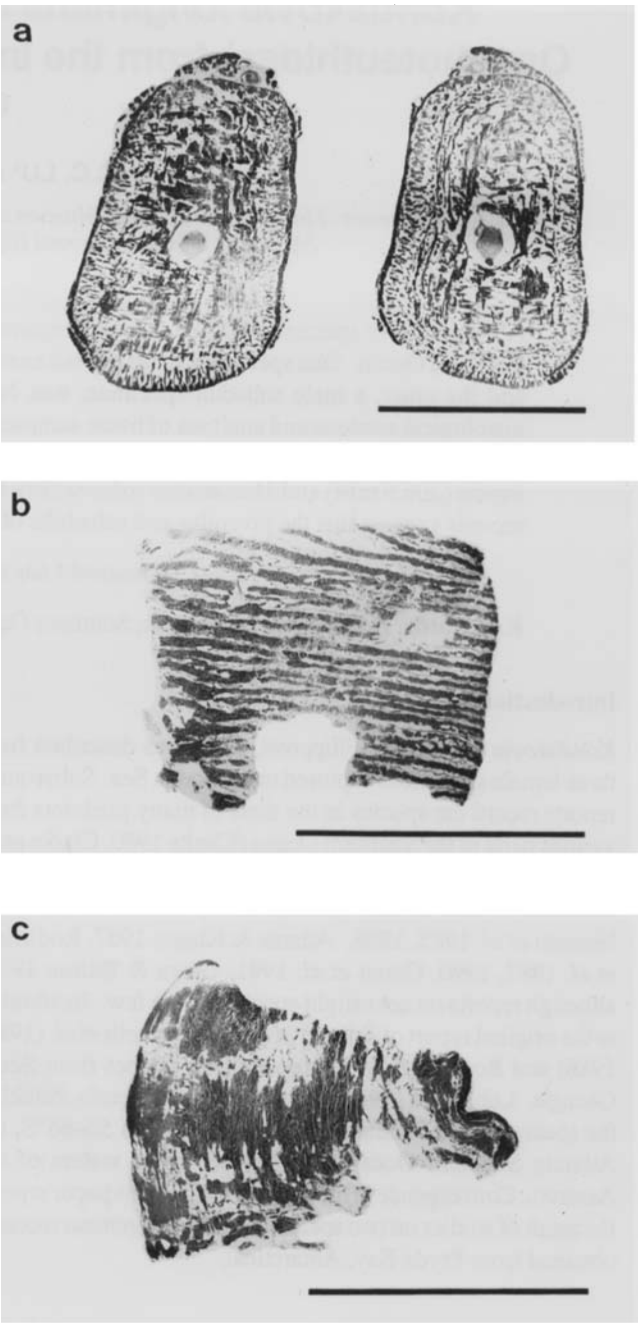

Fig. 1. *Kondakovia longimana*: **a.** cross sections of tentacular stalk; **b.** longitudinal section of mantle tissue with external surface to the right; **c.** cross section of mantle tissue with external surface to the left; scale 10 mm.

Therefore, most of the nitrogen content of the tissue is in the form of ammonium. The ammonium and TVBN values for specimens of *Moroteuthis ingens* and *M. robsoni* are 206.9 mM and 214.9 mM, 199.6 mM, and 206.3 mM, respectively.

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Discussion

Despite extensive records of *K. longimana* in the stomach contents of predators, no details of capture from the Indian Ocean sector of the Antarctic waters have been published (Roper *et al.* 1985, Lubimova 1985). This report provides such details. All previous net caught specimens, in common with this one, are from the upper strata of the water column. Larger individuals eaten by sperm whales probably live in deeper waters (Nemoto *et al.* 1985, Roper *et al.* 1985).

Although no stomach contents were recovered from the specimens, the fact that Specimen 2 was captured in a krill swarm implies that the specimen was in the process of feeding on krill near the surface (Filippova 1972, Lubimova 1985, Nemoto *et al.* 1985, 1988).

Published data indicate that *K. longimana* is important in the diets of many seabirds. Clarke *et al.* (1981) reported that this species contributed 40% by number and 81% by weight of the cephalopod component fed to the chicks of the wandering albatross in South Georgia. The corresponding figures reported by Rodhouse *et al.* (1987) were 13.0% and 7.8% by numbers and 62.2% and 54.6% by weight for 1983 and 1984, respectively. Similarly, Cooper *et al.* (1992) reported that *K. longimana* contributed 16.2% by number and 50.1% by weight of the cephalopod prey found in the chicks of the wandering albatross at Marion Island in 1988 and 1989. The finding of a floating specimen of *K. longimana* and the presence of a large amount of ammonium in the tissues of this species and, to a lesser degree, in *Moroteuthis ingens* and *M. robsoni*, is significant in the examination of the food web of the Antarctic and subantarctic waters. Tissue ammonium contents of these three species of squid have not been published previously, but fall within the range of ammonium concentrations for positive buoyant squid reported by various authors, i.e., 125 mM for mantle and viscera tissues of *Chiroteuthis* sp., and 755 mM for mantle tissue of *Taningia danae* (Clarke *et al.* 1979, Lipinski & Turoboyaski 1983, Lipinski & Jackson 1989). The high levels of ammonium in the tissues of these onychoteuthids implies that these species are at least neutrally, and perhaps positively, buoyant, and would normally float when dead (Clarke *et al.* 1979). Clarke *et al.* (1981), Clarke & Prince (1981). Rodhouse *et al.* (1987), and Cooper *et al.* (1992) suggested that the wandering albatross take at least a significant proportion of their cephalopod diet by scavenging, including food regurgitated by sperm whales. This is confirmed by monitoring the flight and frequency of ingestion of prey of wandering albatross by Weimerskirch & Wilson (1992), who conclude that these birds encounter one prey item for every 107 km travelled. Most of their prey is taken during daylight and usually single prey items are ingested. Although dead squid may not be common, wandering albatrosses are able to cover extensive distances during the day to search for them. The importance of *K. longimana* in the diet of these birds and the fact that this species has a high ammonia content and floats when dead, as we demonstrate here, provides the key link in the evidence to support Weimerskirch & Wilson's (1992) theory. The discovery of substantial amounts of ammonia in the mantle tissues of these three onychoteuthids also casts doubt on their suitability as food for human consumption without further processes.

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