ARCHITEUTHIS BUOYANCY AND FEEDING

Here we present a little scientific evidence supporting our contention that Architeuthis is a rather passive beast, rather than aggressive hunter, much like the Humboldt squid. Within its tissues *Architeuthis* balances the ration of ammonium ions to sodium ions to achieve buoyancy. The sodium ion (Na^+) has a relative atomic mass of 23 amu, while the ammonium ion (NH_4^+) has a relative atomic mass of 18 amu; ammonium ions are therefore lighter than sodium ions. Tissues taken from various parts of a fresh *Architeuthis* individual, from the tip of the mantle through to the tips of the arms, manifest variations in ammonium- and sodium-ion levels (Figures 1, 2). The ratio of ammonium to sodium has a maximum in the mantle and a minimum at the arm tip — it is not constant throughout the tissues. This implies that (the adult) *Architeuthis* suspends itself in the water column at an oblique angle, rather than on the horizontal plane. The animal's fins and mantle would be up, its arms down, and the two long tentacles would drop almost vertically, clasped together, with their distal, expanded clubs acting as tongs would do, plucking prey from the water column many metres away.

A crude test for the presence of ammonia in *Architeuthis* tissues has been detailed elsewhere online, but the technique entails cutting a small piece (~ 1 cm cubed) of tissue and placing it into a narrow-necked flask (test tube or other such glass container), to which several crystals of caustic potash (potassium hydroxide) are added, the container heated, and emissions sniffed; if ammonia is present you'll smell

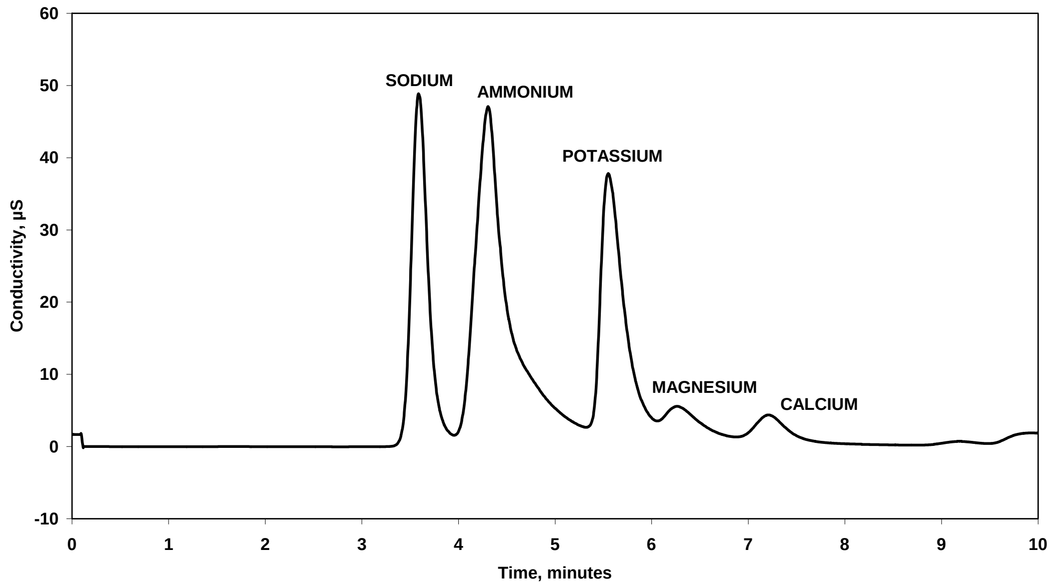

Figure 1: Example chromatogram showing the peaks related to each cation.

it. Using this test suggested that *Architeuthis* suspended itself at an oblique angle in the water column, rather than swimming parallel to either seafloor or surface. A more analytical approach to determining relative ammonia levels in various parts of the *Architeuthis* body was undertaken on a fresh-dead (recently caught and frozen) specimen.

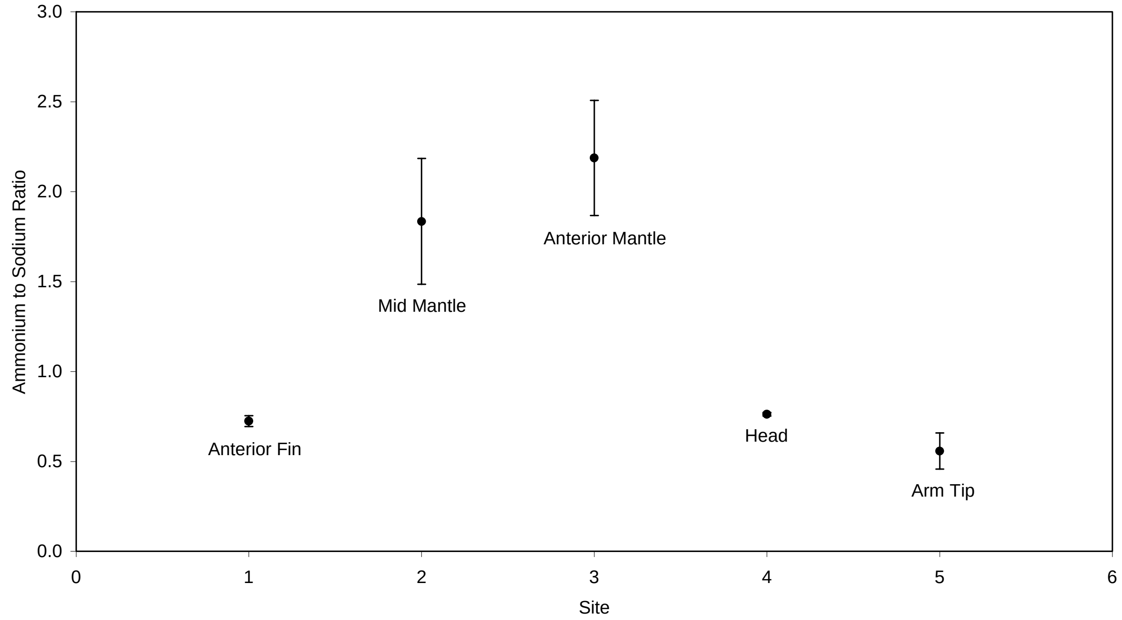

Figure 2: Ammonium to sodium ratio with tissue site.

The mean ratio of ammonium to sodium ions (n = 4) was determined for each tissue sample. The ratio of ammonium to sodium has a maximum in the mantle and a minimum at the arm tip, indicating that levels of ammonium and sodium are not constant through out the tissues and that *Architeuthis* is oriented in the water column at ~ 45° angle, mantle up, arms down.

This theory finds quite independent support in an observation made by Mike Smith, the skipper of a New Zealand registered fishing vessel, F.V. *Cook Canyon*. Mike observed on his depth sounder, and captured in his net an *Architeuthis*. On his depth sounder a large structure was observed, suspended at an angle of about 45° in the water column, about 5–10 metres above a school of hoki. Upon retrieval of the net it was deduced that this large echo-sounding object was the mature *Architeuthis* in the net.

For *Architeuthis* to orient itself naturally at an oblique angle in the water column it would prove difficult for it to feed in any way other than by dangling its tentacles below in search of prey. Being so long and delicate (~ twice the length of the mantle and head combined), it would prove difficult for mature animals to co-ordinate propulsion of these structures to prey items ~ 8 metres away. It is far more likely that mature *Architeuthis* feed by suspending the tentacles into schools of fish below, clasping them together and leaving only the distal-most tentacle clubs free (Figure 3–5), splayed out like tongs to clutch any prey that inadvertently swims between or touches them. The structure of the tentacle stalks supports this theory. They have alternating, opposite sucker and studs distributed the length of each tentacle — opposing suckers fit neatly into studs. This character would be quite redundant were the tentacles not held closely together (Figure 3). Further structures, here referred to as ‘Lu bumps’, run the length of the flattened, inner face of the tentacles, which would assist in their interlocking by providing a rough texture (as opposed to a smooth surface).

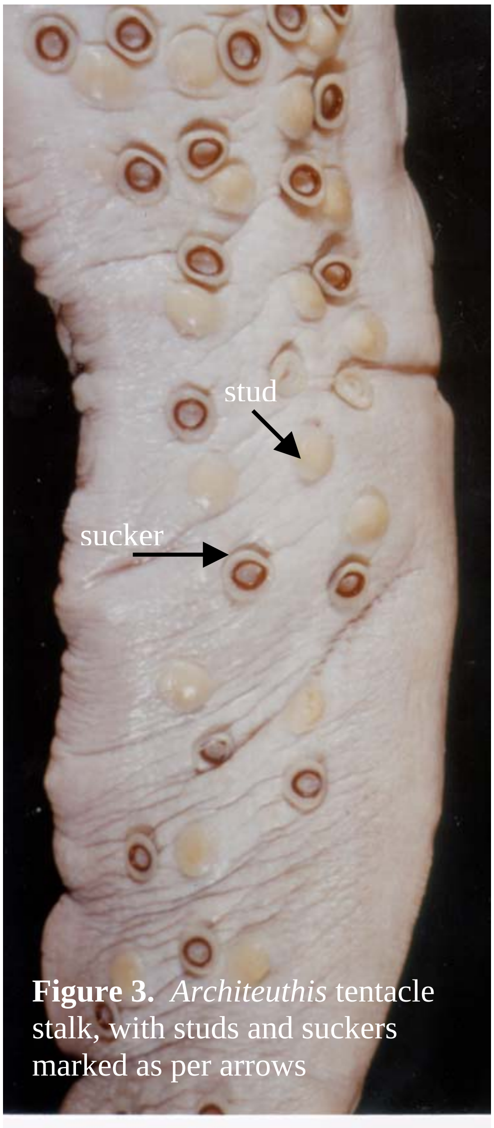

Figure 3. *Architeuthis* tentacle stalk, with studs and suckers marked as per arrows

Ammonium ion values reported for the tentacle of *Architeuthis* (Robison 1989) were considered similar to those from the arm and mantle earlier reported by Clarke *et al*. (1979). In terms of their protein and water content, the *Architeuthis* samples were much more akin to *Loligo* than to the watery, soft-bodied *Vampyroteuthis* and *Bathyteuthis* (the latter generally considered to be a slow-moving, sluggish squid).

Architeuthis has generally been assumed to be a relatively weak swimmer because of poorly developed musculature, loose structural morphology, and the low oxygen carrying capacity of its blood (Robson 1933, Roper & Boss 1982, Brix 1983). However, analysis of chemical composition patterns in mid-water fishes and crustaceans have shown high levels of protein in conjunction with low water content are correlated with higher locomotory capabilities and metabolic activity levels (Childress & Nygaard 1974, Childress *et al*. 1980, Bailey & Robison 1986). If the same is true of mid-water cephalopods, Robison (1989) concludes that *Architeuthis* may be a relatively good swimmer.

Figure 4. Lateral view of *Architeuthis* tentacular club.

Figure 5. *Architeuthis* tentacular club suckers and sucker rings.

Gut content analysis repeatedly reveals squid, fish and crustaceans are the principal components of this animals diet. Unfortunately, gut contents are so fragmented that reliable prey identification cannot be made (as the oesophagus passes straight through the brain, all food entering the system must first be cut up into tiny pieces) —

although some rather interesting information about the diet of *Architeuthis* will be published in early 2004 (Bolstad & O'Shea, in press).

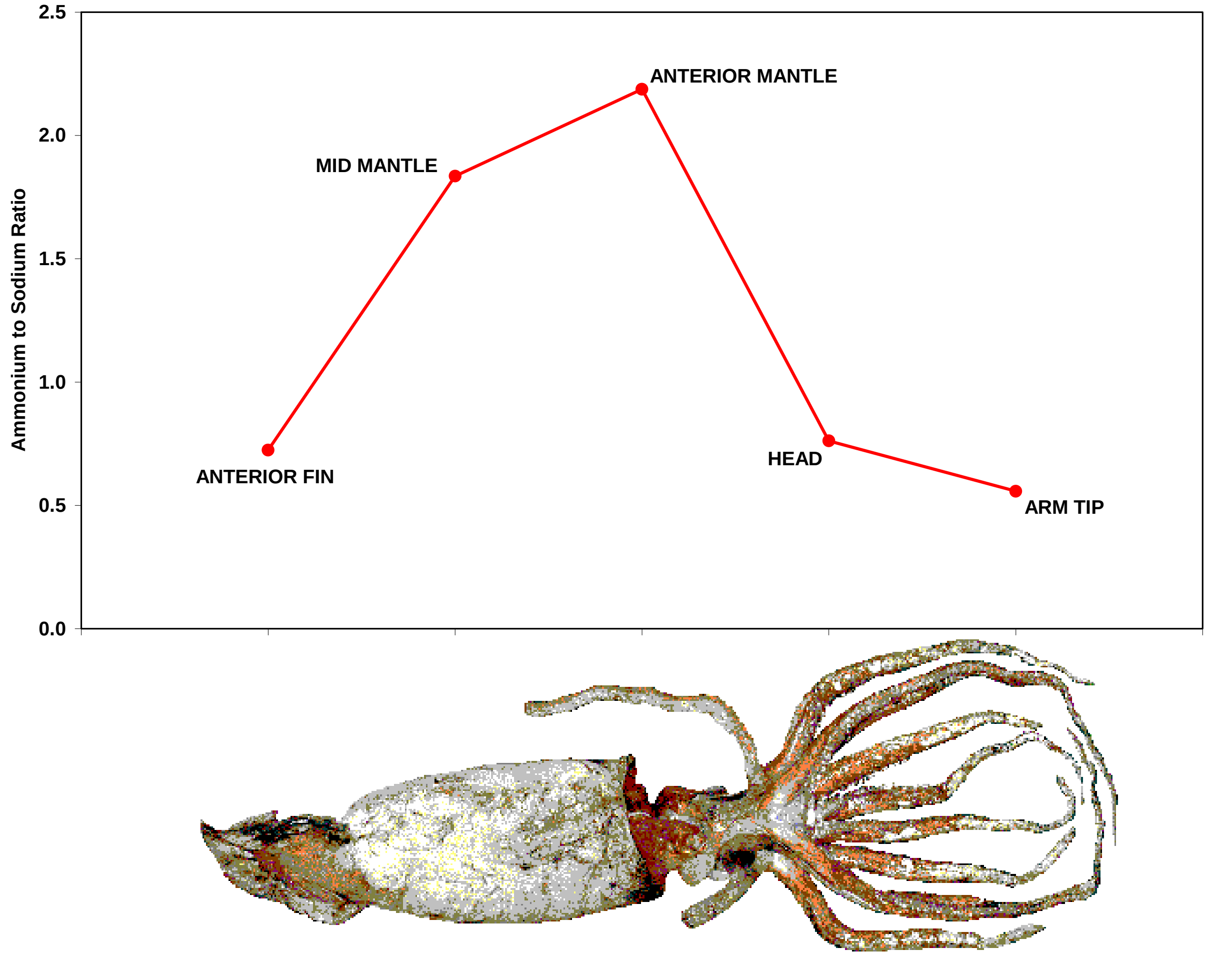

Figure 6. Schematic average ammonium-ion concentration levels throughout the *Architeuthis* body.

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