

Developing new tools for identifying indicators of anthropogenic changes: age determination in a widely distributed marine benthic polychaete

Introduction

- Cosmopolitan polychaete *Nephtys* inhabit marine sediments in UK waters; they are important constituents of many estuarine and marine soft-bottom communities (Zajac and Whitlatch, 1988)
- Marine benthic communities can be affected by natural or anthropogenic activities. The chemistry of polychaete jaws may be influenced by several factors such as water chemistry, feeding habits and sediment composition (Erikson and Elfman, 2000)
- Growth rings in the jaws of *Nephtys* have been utilised to determine population structure, spawning and survival rates
- Partial or total reproductive failure can occur in response to adverse conditions such as pollution. This will be reflected in the age structure of population
- *Nephtys* were sampled from impacted sites (such as dredging disposal, former sewage sludge and aggregate extraction sites) and compared for differences in growth ring structure and elemental composition.

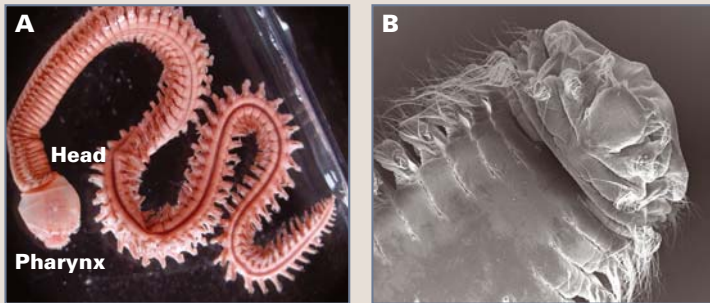


Figure 1: (A) Entire *Nephtys* polychaete showing head and pharynx, 8 cm in length. (B) Scanning Electron Micrograph image showing head of *Nephtys* polychaete.

Materials and methods

- Chitinous jaws of the polychaete *Nephtys* were extracted from animals collected from a range of impacted sites
- Jaws were processed and carbon coated for scanning electron microscopy (SEM) using standard protocols. Images were analysed to count and compare growth rings between sites
- X-ray microanalysis was conducted on jaws to generate elemental profiles.

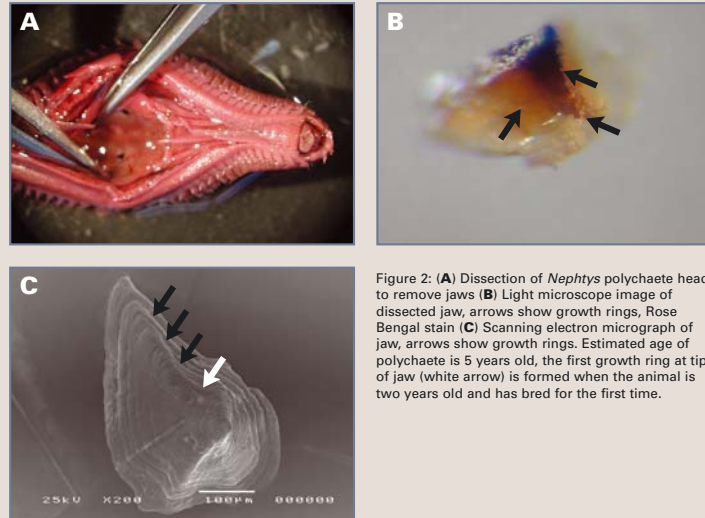


Figure 2: (A) Dissection of *Nephtys* polychaete head to remove jaws (B) Light microscope image of dissected jaw, arrows show growth rings, Rose Bengal stain (C) Scanning electron micrograph of jaw, arrows show growth rings. Estimated age of polychaete is 5 years old, the first growth ring at tip of jaw (white arrow) is formed when the animal is two years old and has bred for the first time.

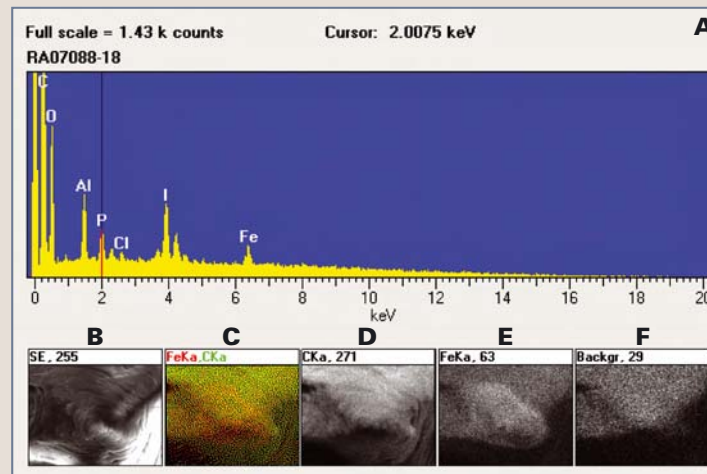


Figure 3: (A) X-Ray microanalysis of sample, spectrum displays peaks generated by the elements that are present within sample. (B) Secondary electron image showing area analysed at the tip of jaw (C) Map displaying the areas where the elements are present within the sample, red corresponds to iron and clearly shows the iron accumulating at the tip of the jaw, green corresponds to carbon which is present throughout the jaw (D) X-ray profile of carbon within the sample, 271 counts were detected within the sample (E) X-ray profile of iron within the sample, 63 counts were detected within the sample, iron can be seen accumulated at tip of jaw (F) X-ray profile of background noise generated during the analysis, 29 counts were detected, less than the counts generated by elements of interest indicating background noise did not affect the analysis.

Results

- Growth rings examined demonstrated that that the polychaetes were between 2 and 7 years
- Elemental composition of jaws was compared to trace metal data collected from sediments in the sampling area
- Jaws from heavily impacted sites showed higher levels of Iron and Aluminium; these elements could be mapped as being present with the jaws.

Future work

- Comparisons will be made between *Nephtys* polychaetes sampled from impacted sites and non-impacted sites to determine differences between elemental composition and age structures
- Indicator research work has the potential to complement traditional monitoring tools and to provide a better understanding of the ecological processes occurring in areas affected by anthropogenic and natural disturbance.

Acknowledgment

This research is funded by Department for the Environment, Food and Rural Affairs (Defra) under contract ME 4118.



Authors would like to thank Professor Peter Olive (University of Newcastle upon Tyne, UK) and Dr Guillermo San Martin (Universidad Autonoma, Madrid) for valuable comments for this work.

References

- Olive, P. J. W. (1977) The life history and population structure of the polychaetes *Nephtys caeca* and *Nephtys hombergii* with special reference to the growth rings in the teeth. *JMBA* 57 p133-150.
- Zajac RN and Whitlatch RB (1988) Population ecology of the polychaete *Nephtys incisa* in long island sound and the effects of disturbance. *Estuaries* 11:117-133.
- Eriksson, M. and Elfman, M. (2000). Enrichment of metals in the jaws of fossil and extant polychaetes - distribution and function. *Lethaia*, 33: 75-81.