



Bioaccumulation of contaminants by lugworms and ragworms: feeding makes the difference

It is generally acknowledged that only a part of sediment-bound contaminants is available for uptake in biota. Risk assessments based upon contaminant concentrations in whole sediments are, therefore, merely a “worst-case” estimation. Chemically based extraction techniques are often proposed (porewater, fast desorbing fraction) in order to yield a better estimate of the bioavailable fraction of sediment-bound contaminants. These techniques ignore the fact that organisms vary widely in ecological characteristics and consequently in the way they are exposed. To illustrate this, we have exposed two polychaete worms with a different ecology to several contaminated sediments.

Methods

The species tested were the ragworm *Nereis virens* and the lugworm *Arenicola marina*. Both are infaunal species living in burrows, but *N. virens* is a predatory species, whereas *A. marina* is an obligate sediment-feeder. It may be expected that *N. virens* is exposed through the porewater, while *A. marina* is exposed through ingestion of the sediment.

Both species were exposed to contaminated field sediments under static conditions in the laboratory for 28 days. The fast desorbing fractions of dioxin, PAH and PCB were extracted from the sediments using XAD resin. Metals were analysed in porewater separated from the sediment by centrifugation. To facilitate comparison, all concentrations are expressed on a dry weight basis.



Nereis virens



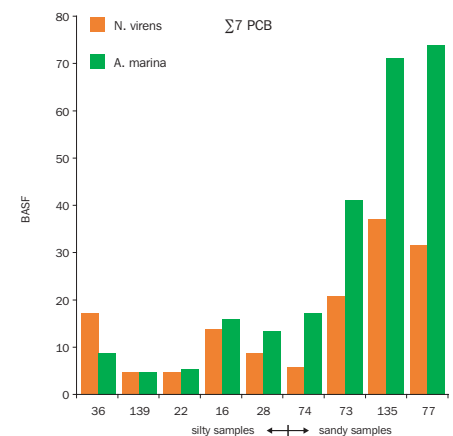
Arenicola marina

Results

- For most organic compounds a good correlation was found between whole sediment concentration and fast desorbing fraction in the sediment.
- Heavy metal concentrations in the porewater did not correlate with whole sediment concentrations.
- Accumulation of contaminants in *A. marina* and *N. virens* did not correlate with whole sediment concentrations.
- Accumulation of some PCB (5 out of 7) in *N. virens* correlated with the fast desorbing fraction.
- For most contaminants, concentrations in *A. marina* were higher than in *N. virens* (see Table).
- The difference between the two species is most pronounced on sandy sediments, where *A. marina* actively feeds (see Figure).

Parameter	<i>A. marina</i>	not significant	<i>N. virens</i>
PAH	Acenaphthylene	Dibenz(a,h)anthracene	Acenaphthene
	Anthracene	Fluorene	
	Benzo(a)anthracene	Naphthalene	
	Benzo(a)pyrene		
	Benzo(b)fluoranthene		
	Benzo(g)h)perylene		
	Benzo(k)fluoranthene		
	Chrysene		
	Fluoranthene		
	Indeno(1,2,3-cd)pyrene		
PCB	PCB28	PCB52	
	PCB138	PCB101	
		PCB118	
		PCB153	
		PCB180	
Dioxines	WHO TEQ		
Metals	Arsenic	Chromium	Zinc
	Cadmium	Copper	
	Lead		
	Nickel		
	Selenium		

Summary of differences in accumulation between *A. marina* and *N. virens*. Significance tested with Wilcoxon signed rank test.



Biota-to-Sediment-Accumulation-Factors (BSAF) for $\Sigma 7$ PCB showing the difference between the sediment-feeding *A. marina* and the predatory *N. virens* in relation to sediment texture.

Discussion

- Sediment-bound contaminants are accumulated to a greater extent by the sediment-feeding *A. marina*, compared to the predatory *N. virens*.
- Ecological characteristics (mode of feeding) and physiological characteristics (PAH metabolism by *N. virens*, but not *A. marina*) play an important role.
- Sediment characteristics are probably more relevant in ecological sense than in chemical sense.
- Chemically based estimates of bioavailability do not have an ecological basis.