The influence of bioavailable copper and zinc concentrations on metallothionein levels and DNA damage in the polychaete *Nereis (Alitta) virens*

**Pini, J. M., Richir, J. and Watson, G. J.**
Institute of Marine Sciences, School of Biological Sciences, University of Portsmouth, UK
Contact: Jennifer.pini@port.ac.uk

---

**Introduction**

- The King ragworm, *Nereis (Alitta) virens* (Fig. 1), is an ecologically and commercially important polychaete species of soft sediment inter-tidal communities throughout the northern hemisphere and is known to be impacted by various anthropogenic activities.
- Metals such as copper (Cu) and zinc (Zn) are naturally present in the ecosystem but can accumulate in the sediment at high levels due to industrial activities and therefore have an impact on polychaete species.

**Aim**: To establish (1) the resistance capacities by the induction of detoxification processes and (2) the level of DNA damage in a population of *N. virens* exposed to environmentally relevant metal concentrations based on an integrated multi-biomarker approach.

---

**Experimental design**

Duration: 9 months with sampling every 3 months

**Metal sediment spiking approach** using target concentrations based on environmentally relevant metal concentrations from low (Poole Harbour), medium (Tamar Estuary) and high (Falk Estuary) contaminated UK sites. Experimental concentrations are shown for month 3 (± SEM).

<table>
<thead>
<tr>
<th></th>
<th>Low (mg kg⁻¹)</th>
<th>Medium (mg kg⁻¹)</th>
<th>High (mg kg⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{Cu})</td>
<td>70</td>
<td>120</td>
<td>575</td>
</tr>
<tr>
<td>(\text{Zn})</td>
<td>197 ± 42</td>
<td>322 ± 35</td>
<td>615 ± 26</td>
</tr>
<tr>
<td>(\text{Cu} + \text{Zn})</td>
<td>62 ± 13</td>
<td>81 ± 6</td>
<td>563 ± 25</td>
</tr>
<tr>
<td></td>
<td>173 ± 34</td>
<td>188 ± 21</td>
<td>607 ± 31</td>
</tr>
</tbody>
</table>

---

**Results & discussion**

**MTs**

MT concentrations increased from month 3 to month 6 and decreased from month 6 to month 9 in all treatments except in low zinc and medium zinc (Fig. 2) revealing the induction of detoxification processes.

**DNA damage**

Data indicated high DNA damage in high copper, high zinc and high copper & zinc combined treatments. The maximum DNA damage was obtained in the high copper & zinc combined treatment after three months of exposure with 36.44% (Fig. 4).

**Influence of metal bioavailability on MTs**

**Influence of metal bioavailability on DNA damage**

**Conclusion**

- MTs analysis revealed that *N. virens* were capable to induce metal defence mechanisms through the activation of detoxification processes.
- High copper & zinc combined treatments showed the greatest impact revealed by high DNA damage. Similar levels of DNA damage were found in *N. virens* inhabiting the Tamar Estuary.
- Environmentally relevant concentrations of Cu and Zn can lead to high levels of DNA damage while inducing metal resistance capacities.
- Relationships between MTs or DNA damage with metal bioavailability varied over time.
- MTs and especially DNA damage prove to be sensitive endpoints when evaluating the impacts of metal contamination on marine invertebrates.

---