The paralytic shellfish toxin profiles and global distribution of the dinoflagellate Alexandrium minutum Halim

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The paralytic shellfish toxin profiles and global distribution of the dinoflagellate *Alexandrium minutum* Halim

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Introduction

The dinoflagellate *Alexandrium minutum* is a known producer of paralytic shellfish toxins (PSTs), saxitoxin and it's derivatives. Toxins from *A. minutum* have been linked to shellfish intoxications (PSP) at a number of locations, including sites in Taiwan, France, Australia and New Zealand, consequently posing a risk to human health.

Here we present an update on global distribution alongside an analysis of toxin profiles within *A. minutum.*

Distribution

An extensive review of literature indicates that *A. minutum* is found on all continents except for Antarctica (Figure 1).

Often, the sites of identification share certain commonalities. Typically they are sheltered enclosed or semi-enclosed water bodies.

Cyst bed formation allows for recurrent blooms within a site, fine sediments are required to retain cysts.

The tolerances which *A. minutum* displays globally are broad for both salinity and temperature allowing this species to proliferate in a range of environments. (Table 1)

Table 1: Table displaying summary of environmental tolerances from the literature.

Parameter	Value	Reference
Minimum temperature	12 °C	Vila *et al.* 2005
Maximum temperature	30 °C	Glibert *et al.* 2002
Minimum salinity	11 ppt	Ranston *et al.* 2007
Maximum salinity	46 ppt	Abdenhader *et al.* 2012

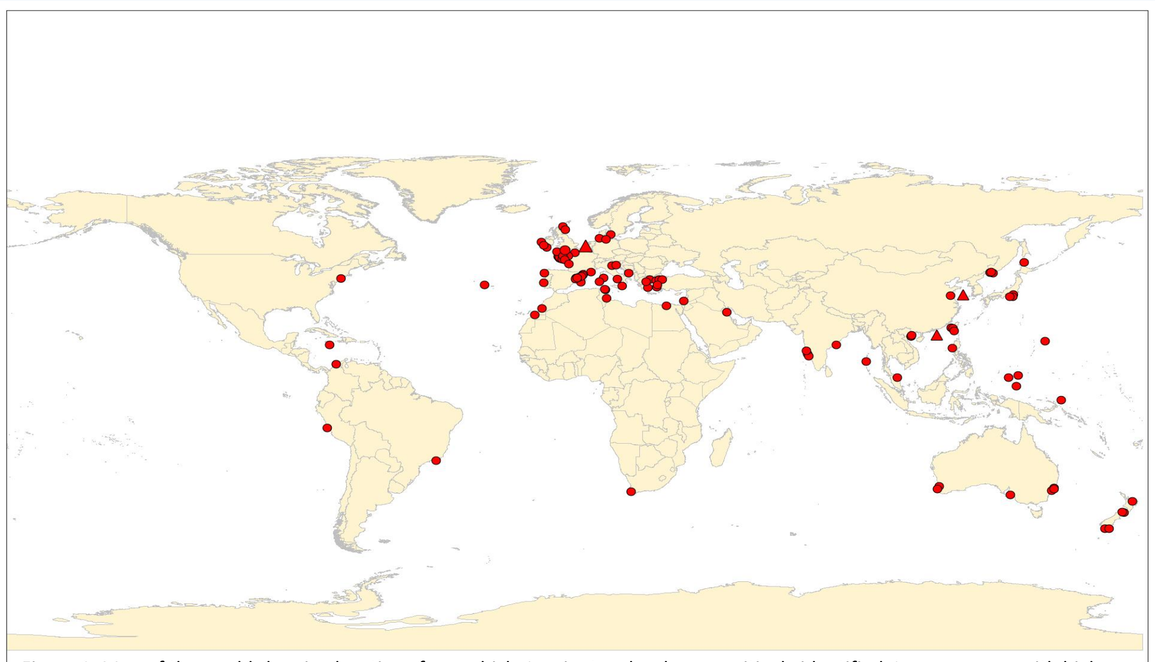

Figure 1: Map of the world showing locations from which *A. minutum* has been positively identified. In some areas with higher numbers of identification of occurrence, points may overlap. Circles denote confirmed locations. Triangles represent regions of occurrence listed in literature or reports but where original literature and definitive location is uncertain.

Toxin Profiles

Analysis by K means clustering allowed for the classification of global toxin profiles into 5 discreet groups (Table 2).

Work by Lilly *et al.* (2005) grouped global populations into 4 clades based upon LSU rDNA sequence differences. The two major ones being the Pacific and Global clades.

Representatives from the 5 clusters appeared in both major genetic clades, alongside this non-toxic populations fall into both major clades also, indicating that either the genetic driver for toxin profile is not resolved by the existing clades or toxin profile differences are environmentally mediated.

The population from Brazil clusters with one from New Zealand, this invites further study as the interrelationship between these two areas is currently unknown and the cause for the toxin profile similarity may be coincidental.

Taiwan is the most variable region assessed, with populations returning profiles which fall into multiple clusters.

Northern Europe is also a complex area with populations presenting 3 of the 5 toxin profiles. In the UK these relate to cluster 2, similar to other sites in NW Europe and Cluster 5, similar to populations from New Zealand, due to STX content.

Table 2: Table displaying summary of the toxins present in each of the determined clusters.

Cluster	Major toxins	Minor toxins
Cluster 1	GTX 1&4	GTX2&3
Cluster 2	GTX 2&3	dcGTX 2&3
Cluster 3	Neo	STX, GTX 1-4
Cluster 4	C1&2, dcGTX2/3	GTX 2&3, STX
Cluster 5	STX, GTX1-4	Neo

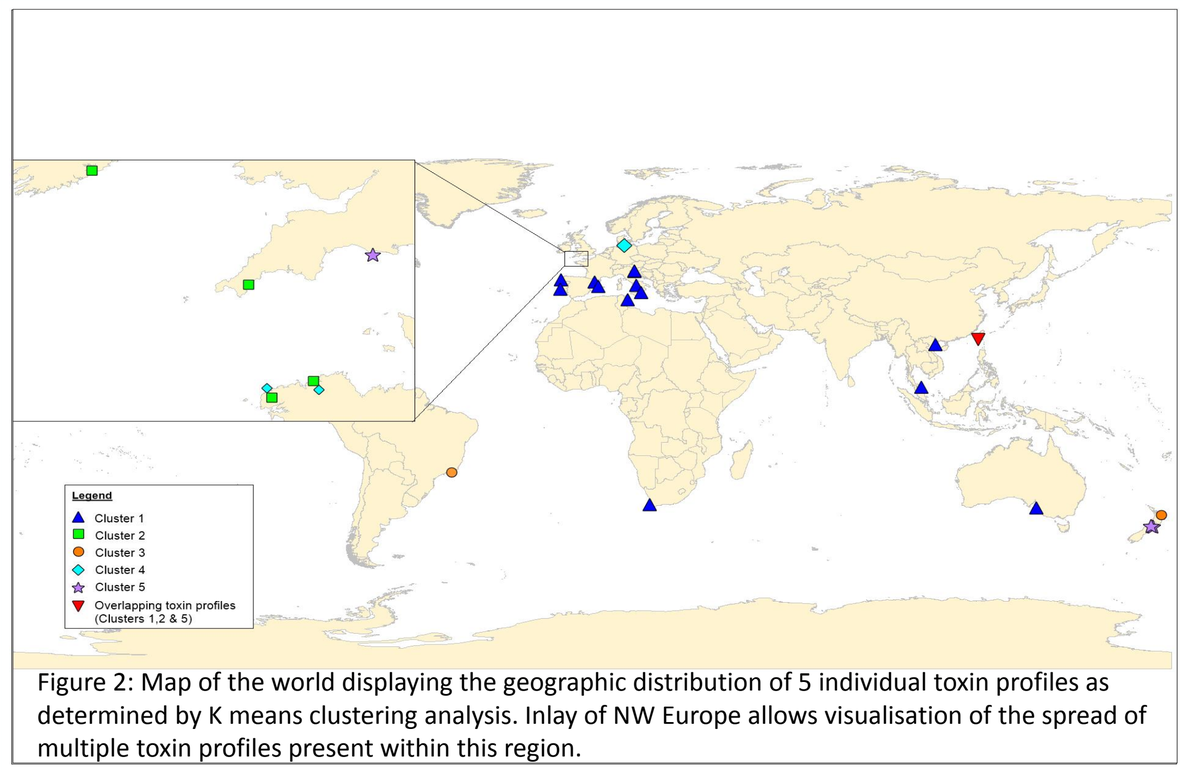

Figure 2: Map of the world displaying the geographic distribution of 5 individual toxin profiles as determined by K means clustering analysis. Inlay of NW Europe allows visualisation of the spread of multiple toxin profiles present within this region.

Conclusions

Alexandrium minutum is widely distributed globally. Populations typically occur in sheltered coastal areas. Recurrent blooms are known to be driven be cyst beds at a number of sites.

Statistical analysis of PST profiles from *A. minutum* reveals a complexity globally which is not explained by current molecular speciation, especially as non-toxic and toxic populations are mixed in the clades, as per Lilly *et al.* (2005). The population from Brazil clusters with one from New Zealand, highlighting these as populations in need of further analysis.

Taiwan and NW Europe represent areas of interest with regard to toxicity of *A. minutum* as it appears that the populations encompass multiple toxin profiles within a relatively small geographic area.

References

Abdenadher, M., Hamza, A., Fekih, W., Hannachi, I., Bellaaj, A.Z., Bradai, M.N., Aleya, L., 2012. Factors determining the dynamics of toxic blooms of *Alexandrium minutum* during a 10-year study along the shallow southwestern Mediterranean coasts. *Estuarine, Coastal and Shelf Science*, 106, pp.102–111

Glibert, P.M., Landsberg, J.H., Evans, J.J., Al-Sarawi, M.A., Faraj, M., Al-Jarallah, M.A., Haywood, A., Ibrahem, S., Klesius, P., Powell, C. and Shoemaker, C., 2002. A fish kill of massive proportion in Kuwait Bay, Arabian Gulf, 2001: The roles of bacterial disease, harmful algae, and eutrophication. *Harmful Algae*, 1(2), pp.215–231.

Ranston, E.R., Webber, D.F. & Larsen, J., 2007. The first description of the potentially toxic dinoflagellate, *Alexandrium minutum* in Hunts Bay, Kingston Harbour, Jamaica. *Harmful Algae*, 6(1), pp.29–47.

Vila, M. Giacobbe, M.G., Masó, M., Gangemi, E., Penna, A., Sampedro, N., Azzaro, F., Camp, J. and Galluzzi, L., 2005. A comparative study on recurrent blooms of *Alexandrium minutum* in two Mediterranean coastal areas. *Harmful Algae*, 4(4), pp.673–695.

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