Genetic diversity of the tiger prawn *Penaeus monodon* in relation to metal pollution at the Tanzanian coast

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Pollution of coastal ecosystems is currently a world wide problem. This environmental problem is inevitable in developing countries such as Tanzania that largely depend on extractive industries from natural resources for economic development. Previous studies reported the inefficiency of waste treatment facilities in the country to contain harmful trace metals (Kihampa, 2013), and hence the growing industrial sector and coastal urban population is likely to aggravate the contaminantion of the coastal areas. Accumulation of metals in coastal waters can disrupt migration patterns and induce genotypic selection of torelant and elimination of intorelant genotypes (Mussali-Galante et al., 2014). High levels of metals in coastal waters can also significantly reduce the population size, leading to inbreeding and genetic drift. This affects the genetic variability of the population, which is the basis for adaptation. Metal pollution which has been reported in various sites in the country (Kruitwagen et al., 2008; Rumisha et al., 2012), may affect prawn fisheries. This study was conducted to assess the genetic variability of tiger prawns in relation to metal pollution along the Tanzanian coast. Approximately 159 individual tiger prawns and 120 sediment samples were collected from eight sites along the coast for analysis of trace metals and genetic diversity. Our results show insignificant correlation (Spearman's rank correlation coefficient (r) = -0.28) between gene diversity by loci of tiger prawns at the Tanzanian coast and the degree of contamination at different sites which ranged from low to moderate. Comparisons were also made for individual metals, because the index for degree of contamination is a measure of total metal content at a site. Results showed that the average gene diversity was insignificantly correlated with the measured elements. However the effective number of alleles (Ne) was significantly negatively correlated with Co, Cr and V enrichment (r between Ne and Co, Cr, and V, was -0.76, -0.81, and -0.71, respectively). The number of alleles was also negatively correlated with the concentration of Cu in tissues of tiger prawns (r = -0.85). The moderate degree of genetic differentiation measured between sites (mean Fst= 0.069), could account for the lack of association between the average gene diversity and the level of metals in the environment and tissues. Five out of the 13 microsatellite loci analysed, showed an average migration rate of at least 2, suggesting that, there is moderate gene flow across the coastline. Migration between low and moderately contaminated sites masks the effects of pollutants on gene diversity, because migrants contrubute alleles to the receiving population. A much clear pattern is anticipated when more loci will be analysed. Neverthless, the present results provide preliminary information on the patterns of genetic diversity in relation to metal pollution on the Tanzania coast.

References

Kihampa, C., 2013. Heavy metal contamination in water and sediment downstream of municipal wastewater treatment plants, Dar es Salaam , Tanzania. Int. J. Environ. Sci. 3, 1407-1415. doi:10.6088/ijes.2013030500011

Kruitwagen, G., Pratap, H.B., Covaci, A., Wendelaar Bonga, S.E., 2008. Status of pollution in mangrove ecosystems along the coast of Tanzania. Mar. Pollut. Bull. 56, 1022-1042. doi:10.1016/j.marpolbul.2008.02.018

Mussali-Galante, P., Tovar-sánchez, E., Valverde, M., Rojas, E., 2014. Genetic Structure and Diversity of Animal Populations Exposed to Metal Pollution. Rev. Environ. Contam. Toxicol., Reviews of Environmental Contamination and Toxicology 227, 79-106. doi:10.1007/978-3-319-01327-5

Rumisha, C., Elskens, M., Leermakers, M., Kochzius, M., 2012. Trace metal pollution and its influence on the community structure of soft bottom molluscs in intertidal areas of the Dar es salaam coast, Tanzania. Mar. Pollut. Bull. 64, 521-531

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