

## TRACE METALS ENROUTE WASTEWATER AND THEIR TOXICITY TO MARINE FISH USING GAUSSIAN MODEL

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### Introduction

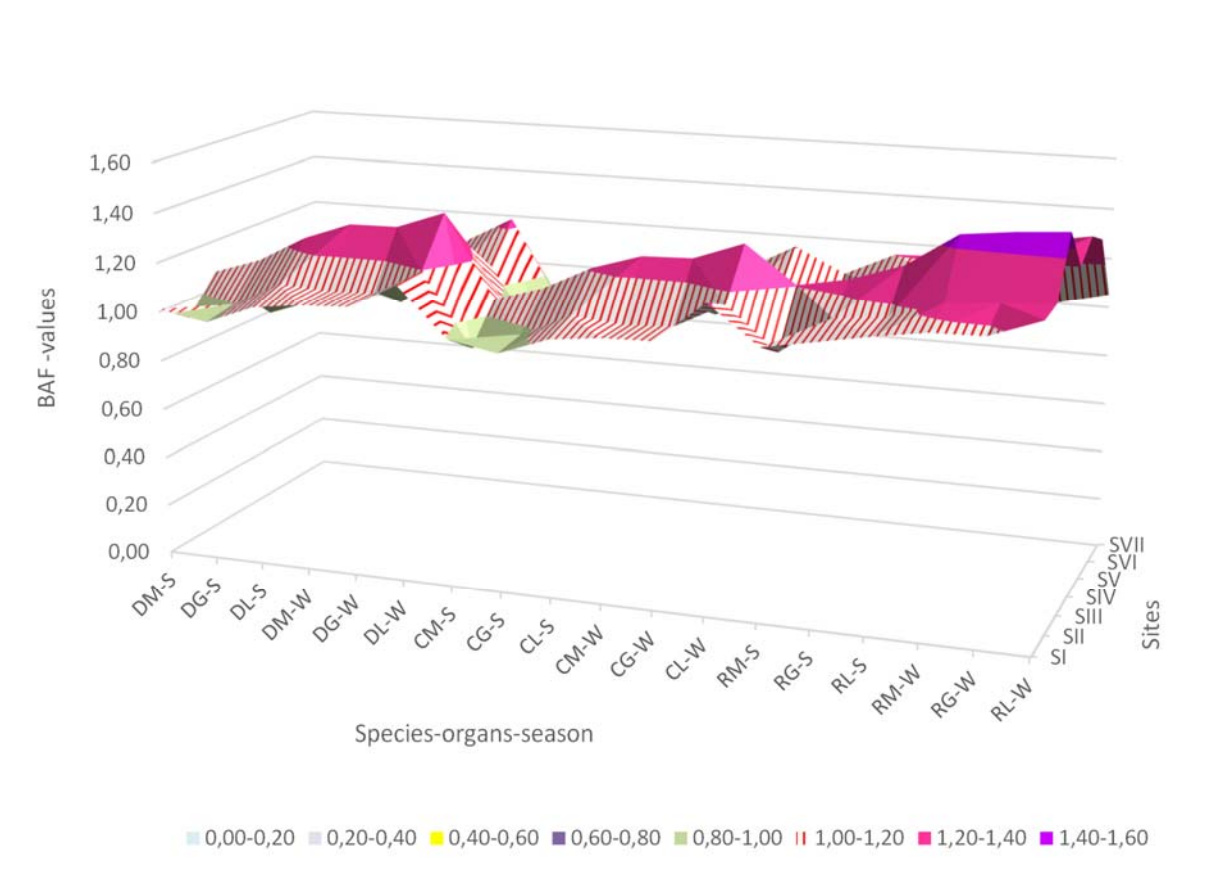
Trace metals is found to cause serious threats to the marine fish across the globe due to the domestic and industrial wastes discharges from the drain outfalls into the sea. The wastewater discharged into the sea depends on the dispersal of effluent due to water current. The characteristic features of dispersed effluent in the shallow seas made the wastewater buoyant to the surface, gradually dispersed and mixed with seawater when they entered the marine bodies. This was validated by the Gaussian model that quantified the intensity of trace metals concentrations and the pathway of wastewater into the marine environment. This study also determined toxicity and bioaccumulation in the marine fish at different trophic levels.

### Methods

This study chose permanent concrete drain outfalls (SI-SVII) constructed along the Kuwait Coast that lets wastewater into the marine environment (Figs. 1-2). Standard methodology (APHA, 2012) was followed to determine trace metals concentrations in the wastewater and selected three commercial fish, *Crenidens crenidens* F., *Diplodus sargus sargus* L, and *Rhabdosargus sarba* F., inhabiting the drain outfalls besides, following the quality control measures. Site maps (Figs. 1-2) were superimposed with the corresponding coordinates and dependent variables incorporated in the DESCAR-3.2 program to obtain the direction and dispersion of trace metals concentrations that dispersed into the sea. Fish samples were digested in the microwave digester (Ethos 1, Milestone, Italy) and trace metals determined in the ICP-MS. Total mercury (Hg) in the fish was analyzed using a direct mercury analyzer (DMA-80, Milestone, Italy). Quality control was assured by using reference material (CRM: DORM-4 fish, NRC, Canada). These selected fish were subjected to toxicity (LC<sub>50</sub>) and bioaccumulation (BAF) tests following the methods of El-Moselhy *et al.* (2014), Patrice and Greg (2011) and (USEPA, 1993). Trace metals bioaccumulation factor (BAF) was evaluated by exposing the selected fish for 30d exposure in each tank (APHA, 2012).

### Results

Wastewater discharged from the concrete drain outfalls into the marine ecosystem (Figs. 1-2). High trace metals concentrations in wastewater was in the sites SI>SIV>SII>SVI>SV>SIII>SVII during winter than in the summer seasons (Fig. 3). DESCAR-3.2 validated the dispersion of wastewater from each drain outfalls, off the six Kuwait Coast. Among the three test species, trace metals concentrations was found high in *R. sarba* followed by *D. sargus* and *C. crenidens* (Fig. 4). Observation showed high trace metals concentrations in the sequence of liver>gills>muscles tissues irrespective of the sampled fish (Fig. 5). Toxicity tests showed high sensitivity of Hg than the other trace metals in *C. crenidens* when compared to *D. sargus* and *R. sarba* (Tables 1-2). An exposure study (72 h) validated by Probit



**Fig. 6** Bioaccumulation Factor (BAF) analysis of fish and during the summer and winter seasons  
 D: *Diploodusargus*; C: *Crenidensrenidens*; R: *Rhabdosargusarba*; M: muscle, G: Gills, L: liver; S: summer; W: winter

## Conclusion

This study validated the angle, distance and the intensity of trace metals concentrations in wastewater dispersed from the drain outfalls and, in line with the site-wise and seasonal variations using the DESCAR-3.2 program. Toxicity and bioaccumulation factor (BAF) in the sampled fish was  $>1$  but, showed no detrimental effects due to the adaptation and migration of these fish in the contaminated wastewater and clean waters, respectively. This study indicated a voluminous amount of wastewater discharged from the drain outfalls and hence, a proper treatment of wastewater is suggested before it is let out into the sea.

## References

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