IMPORTANCE OF SPATIAL FACTORS AND TEMPORAL SCALES IN ENVIRONMENTAL RISK ASSESSMENT IN MARINE ECOSYSTEMS

GREBENKOV A., LINKOV I., ANDRIZHIEVSKI A., LUKASHEVICH A., & TRIFONOV A.

Joint Institute of Power and Nuclear Research, IPEP, 220109, Minsk, Belarus, greb@sosny.bas-net.by

Coastal areas adjacent to the Black Sea, particularly in Crimea, have suffered from inappropriate human activities, poorly regulated industry and former naval bases. Industrial and municipal wastewater pollutants draining into the three major European rivers (the Danube, Dniestr, and Dnieper) and dumping in the open sea result in an enormous increase in contamination level of ecosystems of the Black Sea. In spite of this, Crimea and its adjacent waters is still a globally important center of biological diversity, with an enormous and exciting range of habitats within a comparatively small area. The problem now is to evaluate economically feasible remediation and ecologically sustainable cleanup/reuse alternatives for the most contaminated sites of this area. One of the principal methodological components of such evaluation is a risk-based decision protocol that provides support in analysis of ecological value and reuse options for a chosen site. This paper presents the results of development of a spatially explicit risk assessment technique to be implemented as a part of the decision-making process and gives an example of its application to contaminated marine ecosystems. The model is suggested that takes into account several principal assumptions: (i) spatial heterogeneity of contamination of forage is known and mapped within known location of receptor's habitat, and (ii) the receptor's movement and timescale are determined by location, volume and attractiveness of local habitat and forage resources. This implies two models: Spatially Explicit Exposure Assessment Model that calculates internal exposure resulting from ingestion of contaminated feeds, and Probabilistic Receptor Migration Model that generates motivation of behaviour of a receptor while feeding. In the first model, time-dependent accumulation of contamination in receptor's tissue is defined by the differential balance equation that takes into account forage consumption rate and excretion rate. In the second model, the velocity of receptor's migration in each cell is inversely proportional to the forage volume and habitat quality presented. The model allows depicting the receptor's migration traces within habitat area. The model also gives possibility to implement two principal algorithms. The basic or deterministic algorithm is when the receptor migration within habitat area is equiprobable and the concentration fields of contaminants in forage resources are averaged all over the migration area. The semi-probabilistic algorithm reflects the probability of the receptor's presence and duration of presence in the given zones taking into account habitat quality and attractiveness of various forage resources in these zones. The spatial distribution of concentration of the contaminants in forage resources of habitat area is also taken into account. The later algorithm allows revealing many interesting effects that may specify exposure assessment, e.g., some data on incorporated activity and their deviation depends on configuration of migration zone. It was shown in model calibration study that exposure estimates for fish, anthozoans and other aquatic populations in areas containing spatially localized contaminants are functions of spatial factors, such as the receptor's average foraging area, the size of the habitat, and the specific distribution of contamination. We present a software prototype that calculates accumulation of polychlorinated biphenyls by fishes and their higher order predators, including humans. This study was partially supported by GEF/UNDP and NATO.