Malaysian Journal of Mathematical Sciences 2(2): 1-10 (2008)

Biomathematics: From Daphnia to Dengue

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ABSTRACT

The study of biological and ecological systems by means of mathematical models and computer simulations has gained popularity and wide acceptance. A major impetus towards this development could be traced to the rapid advances in computer hardware and software that enables the study of large ecosystems with adequate resolution and makes possible the inclusion of refined details. The fundamental mathematical theory has also evolved significantly to support these computations. In this invited talk, we will briefly present an exposition of mathematical simulations of ecosystems subject to environmental stress such as temperature, hydro period, dissolved oxygen and toxicants to assess the impact on ecosystem health. The ecosystems concerned include daphnia, mussels, fish and mosquitoes. Daphnia is a key organism in the food chain; hence, any disturbance to the ecosystems of daphnia will have extensive impacts over the entire trophic levels above daphnia. Mussels have served as an indicator organism to reflect the degree of aquatic pollution and its impacts on the aquatic ecosystems. Fish is a major source of protein. Contamination of fish by toxicants such as PCBs and mercury has immediate implications to fish population dynamics and human health. Insights gained from aquatic ecosystem modeling and simulation provided useful concepts and approaches to mathematical simulations of the distribution of Aedes *aegypti*, a species of mosquito that transmit dengue fever. The main objective of this presentation is to demonstrate that mathematical modeling and simulations can be effectively used to study biological and ecological systems.

Key words: Biomathematics, ecological models, dengue, daphnia, mussels, fish