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Editorial

Editorial: Mathematical Modeling to Solve the Problems in Life Sciences

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Mathematical modeling is a great tool to understand different mechanisms related to ecology, epidemiology and related areas. It helps us to understand how to maintain ecological diversity, stop the spread of infectious diseases, sustainability under the ecological and evolutionary games. The aim of this special issue is to present some mathematical modeling study related to problems in ecology, epidemiology and evolutionary biology.

There are total 13 contributions in this special issue by the researchers from diverse fields of mathematical modeling. All contributions are focused on problems related to ecology and epidemiology. This special issue covered a vast area in mathematical modeling, which can be classified mainly into three aspects: epidemic modeling, evolutionary game dynamics, and ecological modeling.

In epidemic modeling, Okuwa et al. [1] analyzed a SIRS epidemic model with chronological age structure in a demographic steady state. They have shown that the loss of immunity has a drastic effect on the critical coverage of immunization and if the basic reproduction number is greater than the reinfection threshold, then disease control is not possible through the mass vaccination to newborns. Cui et al. [2] generalized a SEIR model by introducing an asymptomatic class and investigated the influence of wearing N95 facemasks in reducing the spread of influenza H1N1. Estimation of final size of an epidemic is very important to measure the impact of a disease. Tsubouchi et al. [3] derived an explicit form of final size equation for a vector-borne epidemic model. Yu et al. [4] have done a comparative study of Seasonal Autoregressive Integrated Moving Average (SARIMA) and Nonlinear Autoregressive Exogenous (NARX) models in predicting the incidence of schistosomiasis disease in China. Their results showed that the NARX model is more effective in forecasting; however a mixed model of NARX-SARIMA is better in comparison to the straight models.

In the context of evolutionary game, Guazzini et al. [5] studied a behavioural model based on Ultimatum Game. They have investigated how inter-group bias (‘green beard effect,’in evolutionary biology) stabilized in the human population, by estimating the magnitude of favouritism needed to overcome selfish individuals. Sato [6] has investigated the stability under cyclic allele dominance rules. Also, investigate the effect of spatial structure on the stability of phenotypic model by considering the dynamics on a two-dimensional square lattice space.

In prey-predator system, both prey and predators adjust their activities to increase their own survivability. In this context, Pal et al. [7] studied a modified Leslie-Gower model by incorporating the cost of predation fear, where predator shows hunting cooperation. They observed many interesting dynamics, like both supercritical and subcritical Hopf-bifurcation, bi-stability behavior, Bogdanov-Takens bifurcation etc. Due to the increasing number of endangered species, finding the probability of extinction is important in the context of conservation management. Saha [8] has developed a method to find the extinction probability of a general n-trophic food chain model by considering demographic stochasticity. Moreover, he has validated the developed method in two dimensional food chain model. Sasmal et al. [9] studied the impact of aposematism behavior in a prey-predator model in the context of both temporal and spatio-temporal dynamics. Individual effects of aposematism time and prey's searching efficiency in the formation of regular Turing patterns have also been discussed. Manna and Banerjee [10] have investigated the effect of gestation delay on the formation of spatiotemporal patterns in a prey-predator model in the presence of additive Allee effect. In this study, they have derived the conditions of delay-induced Hopf-bifurcation threshold, direction and stability of Hopf-bifurcation etc. Xu et al. [11] investigated a Nicholson's blowflies model with time delay and linear harvesting. They established a sufficient condition for existence of positive almost periodic solutions for their model.

In the context of aquatic ecosystem, Biswas et al. [12] investigated the selective feeding of zooplankton in the presence of environmental toxins. They assumed that phytoplankton can be infected by a free-virus and identified key parameters related to aquatic health. Finally, Hong and Ma [13] studied a class of discrete Hopfield-type neural networks model including time delay. They derived the necessary and sufficient conditions for global attractivity and stability of equilibria.

In conclusion, 13 excellent full length research articles have been provided in this special issue in the context of mathematical modeling to the problems related to life sciences. We would like to thank all the researchers who have accepted our invitations and contributed in this special issue. We are thankful to the MBE editorial assistance and all the referees for their support towards this issue.

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