UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

MATHEMATICAL MODELLING OF FISH AND PREDATOR BASED ON LOGISTIC AND VON BERTALANFFY GROWTH MODELS

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IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL

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ABSTRACT

A mathematical model is considered to study the relationship of fish and predator with the different values of birth and death parameter for predator population and different values of harvesting rate of fish. The logistic and Von Bertalanffy growth models are used to study this relationship. The relationship can be interpret by sketch a graph of prey and predator versus time using MATLAB software. The difference values of birth and death parameters may be affect the predator population. The predator models corresponding to prey growth models have been solved analytically by using separation of variable and partial fraction techniques. The stability of non-coexistence equilibrium points for non-linear logistic and Von Bertalanffy growth models can be identify based on the graph of vector fields and trajectories. By using the formula of Maximum Sustainable Yield (MSY), the value of harvesting or fishing rate that can kept the population of prey above sustainable level can be obtain.

1 INTRODUCTION

1.1 Research Backgroud

Fishing has a lot of benefits to human beings. It serves as food, creates job opportunities and generates income. In general, it has great impact on socioeconomic and infrastructure development of a country. As result, the demand for fish increases from time to time leading to over fishing including the spawning fishes and this may lead to a decrease in their population and finally to extinction, if no remedial action are taken. Researcher and scientist devise strategies to prevent the extinction of renewable resources such as fishes by harvesting only optimum yield while maintaining the renewable resources above sustainable level.

In doing so, researchers and scientists use mathematical models to examine the interactions among populations and to predict the population size in the long run following successive harvests, parallelly ensuring maximum sustainability of the population. The interaction of population dynamic in an environment can be modelled by autonomous differential equation or system of autonomous differential equations. Many differential equations especially, non-linear differential equations have no analytical solution, but in such cases the qualitative approach together with numerical method insights the behaviours of its solution.

Furthermore, some theoretical mathematical aspects of prey predator interaction have been introduced with an assumption that "the interaction of predation leads to a little or no effect on growth of the prey population". By considering that the prey population grows following Logistic and Von Bertalanffy and describing the dynamics of predator population.

The interaction of natural communities such as preys and predators is complex and it may lead to various outcomes. Studying how predators affect the prey populations and vice versa and what stabilizes prey-predator interactions and what prevents their extinction is an important and interesting biological phenomenon.