Eco-Epidemiological Model in The Interaction of Pelecanidae Birds and Tilapia Fish

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Abstract. Here in this article, we construct an eco-epidemiological mathematical model which describe an interaction between Tilapia as prey, Pelecanidae as predator and Vibrio vulnivicus as a bacterium that spread disease among Tilapia. The disease might be transferred into Pelecanidae from predation interaction. The model constructed as a five-dimensional non-linear ordinary differential equation. We analyze the existence and local stability of the equilibrium points using linearization with a Jacobian matrix. Some numerical simulations are given to give some interpretation to understand how these parameters affect the dynamic of the model. We find that when the disease spread among Tilapia uncontrolled, then the extinction on Tilapia and Pelecanidae might appear.

Keywords : Tilapia, Pelecanidae, Vibrio Vulnivicus, Eco-Epidemiological.

1 Introduction

Ecological and epidemiological mathematical models are fields of mathematics and biology which discuss several biological phenomena such as competition and predation between two species. Predation interaction can say as an interaction between predator populations and prey populations. In predation among animals, predators are mostly larger than prey. The simplest predator and prey model involving two species, namely one predator species and prey species was first introduced by Lotka in 1910 [1] and Volterra in 1926 [2] which is now better known as the Lotka - Volterra model. Based on the Lotka - Volterra model, when both species exist, a decrease in the number of prey populations and an increase in the name of predatory populations occur at a rate proportional to the frequency of encounters between individuals in both species [3]. Until today, many mathematical models have constructed by many authors based on the Lotka - Volterra model, such as [4], [5], [6]. In the other hand, there are several models which also combine the predatory models with diseases among prey or predator populations, such as in [7], [8], [9], [10], [11].

The eco-epidemiology model is a model that studies the spread of infectious diseases in a population in a hierarchy in an environment. Disease factors in the predator-prey system were first introduced by Anderson and May [12] who examined the study of disease control factors by selecting parameter values determined by various biological properties of the relationship between individual parasites and their hosts and interactions between these populations. The phenomenon that describes where the prey population is affected by the disease is explained by Chattopadhyay and Bairagi that occur in the Salton Sea, California [13].

In this paper, we will discuss the eco-epidemiological model on the interaction of Pelecanidae birds and Tilapia fish that have been attacked by poisoning due to the bacteria