Chapter 8

Conclusion and Scope of Future Studies

8.1 Conclusion

In real world it is seen that the density of any population is different for different species. Therefore the functional responses are different for different prey-predator relationship. Considering the fact in Chapter 2, different functional responses have been introduced for generalist predator in predator and predator in prey. Also, a density dependent mortality rate for predator and generalist predator has been introduced with intra-specific competition for generalist predator. In this context, this chapter is significantly differs from other works in this area.

Sometimes it is seen that one species ate two different species which also interrelated by prey-predator relationship. Based on the fact, in Chapter 3, a prey-predator model with three species has been described where the prey has two predators which are also related in a prey-predator relationship. Like the previous model, various types of functional responses have been considered for predator and generalist predator. Generalist predator has a demand for food of human life, that is why we have considered harvesting effort for generalist predator.

In ecological system, some regions are refuge regions for predators. For that reason, in Chapter 4, refuge region has been considered for predator. Also

different functional responses have been introduced in the formulated model. Density dependent mortality rate for prey, predator and generalist predator have been considered. As refuge region is a different environment, so different birth rates and different carrying capacities have been introduced for the prey populations in the refuge region. In this context, this research work is different in compare to other works in this area. In addition, migrations of the prey populations between two regions have been included here.

In Chapter 5, we have formulated the mathematical model on prey-predator relationship in a reserved region. A food chain has been considered with a reserve region of predator. A study of potential effects of generalist predator in a predator and predator in a prey has been introduced with Beddington-DeAngelis functional response and Holling type II functional response respectively. The density-dependent mortality rates for prey and generalist predator have been assumed. Depending on different environments, different consumption rates of predator populations also have been considered here.

An ecological food chain model has been presented in Chapter 6 based on Beddington-DeAngelis type functional response. The relationship between prey-predator populations has been presented using Holling-Tanner. Harvesting is also essential for human needs. Also gestational delay is a natural phenomenon. For that reason, harvesting effort on prey has been considered in the designed model with gestational delay of predator.

In Chapter 7, a prey-predator model has been introduced with stage structure of predator. Sometimes the prey populations are different for mature and immature predators. Considering the fact, different preys have been considered for immature predator and mature predator. Consumption rates of prey by the immature predator and mature predator have been described by suitable function with an ecological phenomenon. Both preys obey logistic growth rate. Also, the different growth rates and different carrying capacities for the different prey populations have been described. In this context, this research work is completely different in compare to other research works in this area. Also, it has been considered that immature predator transforms to mature predator

in a constant rate, which is chosen as bifurcation parameter. Mortality rates of immature predator and mature predator are also considered as different. For each and every model, the local as well as global stability around its interior equilibrium point has been discussed with a numerical example. Also all the proposed models have been analyzed with some geometrical representations. From, the derived results it is seen that the results are not only feasible but also have great impacts on ecological systems from the biological and social points of view.

8.2 Future Studies

The present thesis have been offered with some prey-predator models to describe real-life phenomenon. Some new attempts can be studied by considering real world ecological problem as the future outlooks. Some scopes are listed as follows:

1. There are some endanger species in an ecological system. The study can be made for those species to preserve them fulfilling the demand of mankind using optimal control.

2. In this thesis, the arbitrary data are considered to analyze the formulated models. The data can be taken from the field survey with new functional response can be chosen as the future study.

3. Such prey-predator models can be applied to construct the disease control model, based on the real-life scenario.

4. Instead of constant harvesting, one can apply the harvesting rate depends upon some parameters like growth rate. Also demand of any species is different in different seasons. So discrete harvesting can also be applied as the harvesting rate.

5. Prey-predator model can be applied to the study of hybridized species as after the crossover with changing their feeding habits.

6. In any model, some parameters can be considered as uncertain parameters like fuzzy or random etc.

7. Many avenues are available from this thesis as the future studies. Researchers can develop the concept of "Effects on prey-predator with different functional response" by introducing gestation time delay on generalist predator. Another direction is that one may also introduce fuzzy harvesting rate on generalist predator in this chapter.

8. The main theoretical results have been demonstrated by numerical simulation with hypo-theoretical parameter values. We expect to get some real data sets to verify the validity of our system. Hence, future research work is necessary to achieve the needs in this direction.

9. In entire life cycle, a species passes through different stages. For simplicity, we consider two main stages of predator. One may extend considering all stages of a predator's life cycle which will show much better results closer to the real situation.