

Mathematical Modelling of a Predator-Prey(Sea Stars-Mussels) Interaction Using Lotka Volterra Equations and its Modifications.

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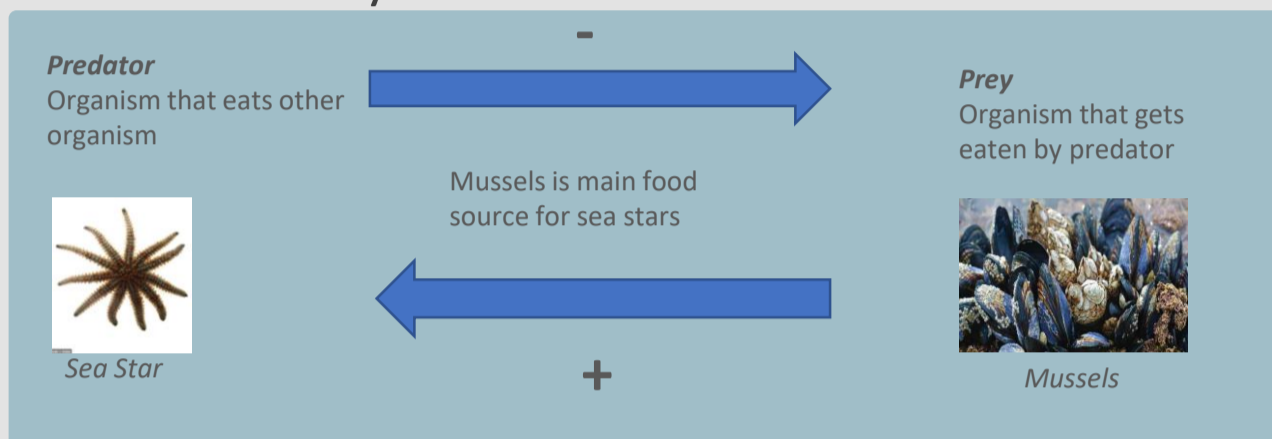
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Introduction

- ❖ The Lotka Volterra system of equations models the variation in population dynamics of two species, predator and prey.

Predator-Prey Model

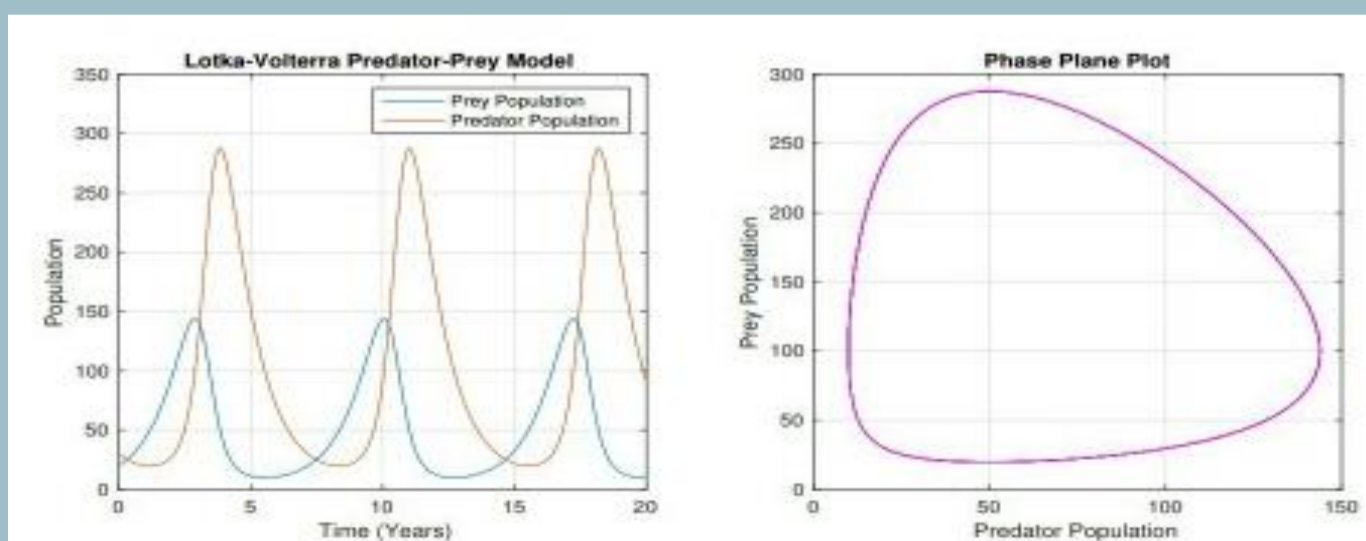


- ❖ The study of predator-prey interactions between marine mammals and fisheries with a mathematical LV model is limited

- ❖ Research shows presence of 11arm New Zealand sea star in Ohiwa Harbor causing the absence of 88% mussel beds and the disappearance of 98% of mussel population

Aim:

This paper aims at the approximations of the growth of the proportion of the mussels and sea stars coexisting, using Lotka-Volterra equations and its modifications



Method

- ❖ Search for datasets on populations of the two species over a set period of time
- ❖ Tabulate the data and create necessary plot and graphs
- ❖ Use dataset for fitting Lotka Volterra model using MATLAB/Pplane
- ❖ Make assumptions and Predictions

Results

- ❖ This study has yielded results
- ❖ Over its course it has proven very difficult to find datasets whether it be online on academic study or Ecological/Biological administrations within New Zealand
- ❖ Table1 and Table 2 (Research Datasets)

Table 1

People contacted	Position	Responses
Graeme Moss	Marine Biologist (NIWA)	Unaware on any work to do with Ohiwa Harbor or predator and prey datasets
Dr James Charles Russell	Biological Sciences (UoA)	No available datasets
Dave Connell	Australian Government (AWE)	Datasets provided not of use to predator prey modelling
William Godsoe	Ecology (Lincoln University)	No available datasets
Malcolm Green	Principal Scientist(NIWA)	No available datasets
Simon Chapman	Principal ecologist (Ecology NZ)	Ecology New Zealand specialises in terrestrial and freshwater ecology and collect very little data on marine species population
Steve White	Marine Biologist (PCE)	Suggested LAWA.co.nz
Mark Johnstone	Lecturer (AUT)	Unavailable
James Hendra	Hauraki Golf project	Unavailable

Conclusion

- ❖ This study is evident that there is very limited research datasets on predator-prey interactions population and distribution not only within New Zealand but that of the world
- ❖ It has proven very difficult to search for relevant datasets necessary for modelling
- ❖ Although limited by data availability this paper helps shine a light on the unavailability of datasets
- ❖ Thus more research and data collection should take place to progress in furthermore understanding Predator Prey dynamics and the incorporation of the Lotka Volterra Equations and its modifications to then make the necessary assumption and prediction of future behaviour.

Recommendations for Future Work

- ❖ Incorporate more fieldwork study on predator-prey interaction
- ❖ Integrate population density and distribution work in finding datasets and making them available for further studies
- ❖ Create more accessible databases within New Zealand with predator prey datasets and more

Table 2

Academic Papers/Web search	Summary	Type of Data	Links
Predator-Prey Interaction Multi Agent Modelling	Simulation of biological system representing two populations	Added in predators and preys. Numbers varying from experiment to experiment and position chosen at random	https://ieeexplore.ieee.org/document/8747087
Lake Erie Fish Community Data, 2013-2015	Assesing the distribution and abundance of both predator and prey(forage)fish populations in western basinof Lake Erie	Dataset coded doctypr_html	https://data.world/us-doi-gov/3c0d0873-c041-4256-9861-d41d0b9a7f98/activity
Modelling a predator-prey Interaction	Students playing role of Predator prey represented by animal shaped pasta	Captured attempts and time as function of diffent abundances of prey	https://data.mendeley.com/datasets/hb45pv7n78/1
Predator-Prey Models applied to Ecology Data	Bayesian Analysis for predator-prey model applied to ecology considering the use of Markov Chain	Plankton dynamics(1990)-outdated	https://link.springer.com/article/10.1007/s10651-010-0134-z#citeas
Mechanics or predator-prey interactions: predict predator prey size ratio	Predicted interactions matched well with data from the most extensive predator prey database	Taxonomy (Individual Based Data)	https://datadryad.org/stash/dataset/doi:10.5061/dryad.8c40mb0
Lake Powell Fisheries Data	Identifying the species of plankton found at various location throughout Lake Powell. This follows a predator/prey relationship	Age growth table in different seasons and lab counts	https://www.kaggle.com/beamers/lake-powell-fisheries-data
Simulation data ofLotka Volterra Systems and environmental Science	Multiple Species modelling subject to earth	Comma seperated values, File ID unable to view	https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/P00MNM