Departments of Mathematics & Computing Science

Faculty of Business & Informatics

Divine Word University

Project Proposal

Estimating Size at Sexual Maturity of Bigeye Tuna, Thunnus obesus (Perciformes: scombridae), in the Papua New Guinean Waters

MATURITY CALCULATOR

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2018

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Background

Over the past 4 months I have been engaged in a study researching about important parameters of fish biology that assist Fisheries Authorities in General make swift decisions about the Marine Resources in Regions they are responsible for. Given the time frame of the project; 4 months, I isolated my research around the Big-eye tuna species. Mainly because tuna in general is the largest economy generator for the country. The parameter I have identified and propose that would help management of Fisheries industries guarantee sustainability, is the Size at Sexual Maturity of Big-Eye Tuna.

Model Utilized

The objective of the study is to find the size at sexual maturity of the Big-eye tuna in the Western Central Pacific Ocean (PNG waters included) to quench the scientific and commercial interest. The Lysack's (1980) Mathematical model will be used to identify this

$$P_L = \frac{G}{1 + e^{-\delta(L_{50} - L)}}$$

The Lysack's (1980) Mathematical model

important constant. There are three major components; LAYSACK's 1980 model * P_L is the proportion of the mature fish at length *L*, * ***G*** is maximum attainable proportion of the mature fish in the analysis; * L_{50} and ***δ*** (the rate at which maturity is attained) are the parameters to be estimated. For most fish populations in nature, all individuals will attain maturity after a specific length (Chen and Paloheimo, 1994). In this case, parameter *G* is equal 1.

Significance to fisheries

The significance it would have on the fishing industry is such that fishing or fish harvesting bodies catching big-eye tuna of size less than this constant or parameter would release them back into the seas so that these fish are able to spawn. A management approach would be to increase the hook size for long line fishing to only catch Big eye tuna greater then this value. This approach would promote the sustainability of this tuna species in PNG waters and will protect it against extinction while promoting maximum profit benefits for

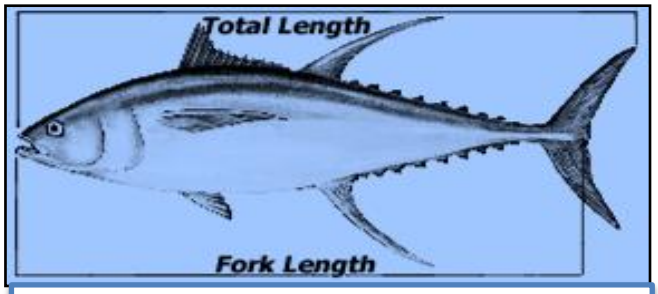


Fig 3: Fork Length of Tuna

the country. The size being measured is the fork length: the length of a fish measured from the most anterior part of the head to the deepest point of the notch in the tail fin. Fork length (FL) was measured with calipers to the nearest millimeter.

Implementation of Model

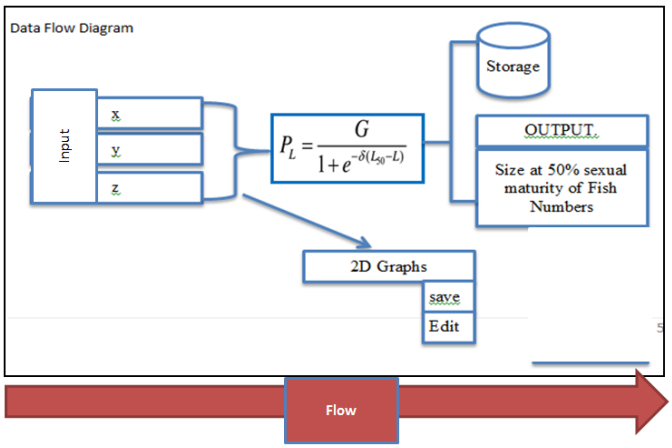
The model is implemented as a desktop simulator called the "Maturity Calculator". It would identify the size where 50% of a big-eye tuna population is sexually mature with ease. This desktop uses the Lysack's 1980 model as its underlying algorithm to calculate this parameter. The user(s) is able to input constant data

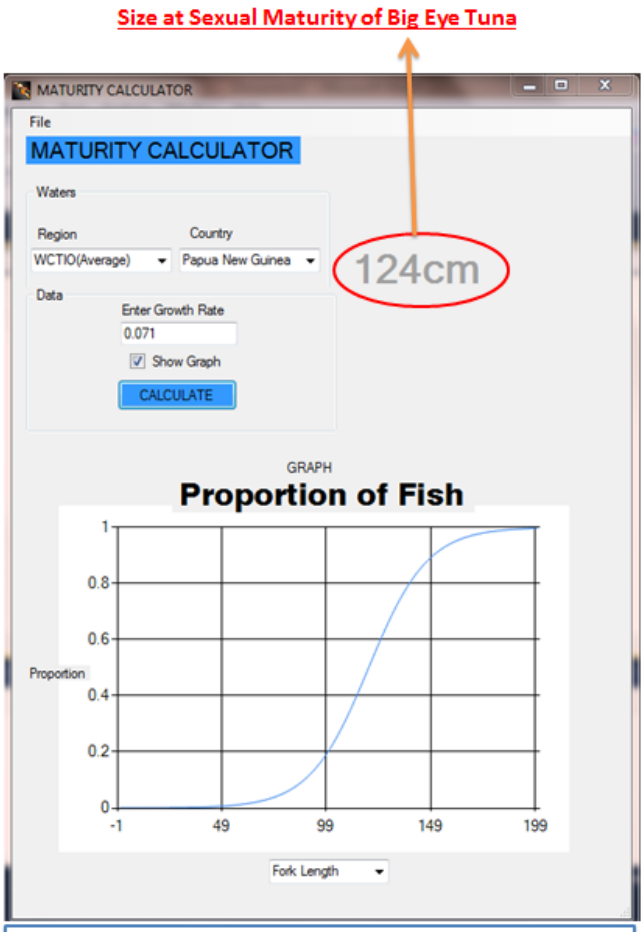
into the simulator interface: designed with important Human Computer Interaction HCI principles. When pressing the “calculate” button the underlying lysack’s 1980 algorithm will use these constants to identify the size at 50% of the big-eye tuna population that is sexually mature. The data is simultaneously used to generate linear 2D graphs to amplify the quality of the output whilst providing the user with options of saving and editing the graph. This information is saved for later reference on the hosting machine.

The constants that were used to simulate the functionality of the calculator and the proof of performance were values attained from Tuna documents acquired during research.

Significance to Author

This Maturity Calculator is my Final year project where I implemented and integrated Mathematical modeling with Computing Science in its most pure form. I propose the Calculator for Fisheries because I was privileged enough to see first-hand how mathematics can impact this industry through Tutoring of Short Courses on Mathematical Modeling for National Fisheries Staff of Papua New Guinea and the Pacific Islands at Divine Word University, Madang.





Maturity Calculator Interface.

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