

Stock recruitment relationship- Models used for stock recruits and parent stock

STOCK RECRUITMENT RELATIONSHIP

Introduction

- Recruitment overfishing results in when the parent stock is reduced to the extent that enough young fish are not produced to compensate the stock.
- There has been a great deal of effort devoted to determine relationship between the number of adults and the number of recruits they produce.

Recruitment

- The process by which a fish or shrimp of an age group integrates itself for the first time to the exploitable stock is known as recruitment, which is a function of age and is a progressive event.

STOCK RECRUITMENT RELATIONSHIP

Recruitment conted....

- The animals added on to the population are called the recruits.

The concept of stock recruitment relationship is related to the concept of surplus production. It is a general concept that when population becomes smaller, the reproduce success increases. The followings are the mechanisms by which the reproductive success of a fish can increase.

1. Increased growth and better fecundity of a species
2. Good food supply / individual
3. Good survival of eggs and larvae due to reduced cannibalism
4. Optimal fishing effort

STOCK RECRUITMENT RELATIONSHIP

Recruitment conted....

The recruitment pattern is affected by environment variables.

When the environment variables are at optimal level, relationship between stock and recruitment will be accurate.

Three models are used

1. Ricker bell shaped curve model
2. Beverton and Holt model
3. Cushing model

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1. Ricker bell shaped curve

In Ricker's model, it implies that if a stock becomes very large, number of recruits are reduced. The plotting of parent stock and recruits is more bell shaped. Further, this model emphasizes that a relationship between the parent stock and recruitment stock exists for all size of the spawning stock and that there is an optimum spawners stock size.

The formula used to establish relationship between parent stock and recruit stock.

$$R = P r^{a(1-P/pr)} \dots\dots\dots (1)$$

R = number of recruits

P = number of parents

STOCK RECRUITMENT RELATIONSHIP

1. Ricker bell shaped curve

contd.....

P_r = Replacement of parent stock i.e. where $P=R$.

$$= R/P \dots\dots\dots (2)$$

$$a(1-) = \log_e(R/P) = \log_e R - \log_e P \dots\dots\dots (3)$$

$$\log_e R - \log_e P = a - (a/P_r) * P \dots\dots\dots (4)$$

The above equation is linear form with a negative relationship

of the type

$$Y = a - bx, \quad Y = \log_e R - \log_e P, \quad X = P.$$

STOCK RECRUITMENT RELATIONSHIP

2. Beverton and Holt model

Beverton and Holt model suggests that when the population of parents becomes large, the increase in recruitment per unit increase in stock size becomes progressively smaller forming a sigmoid curve.

$$R = (E/E+g * R \max) * R \max$$

R = number of recruits

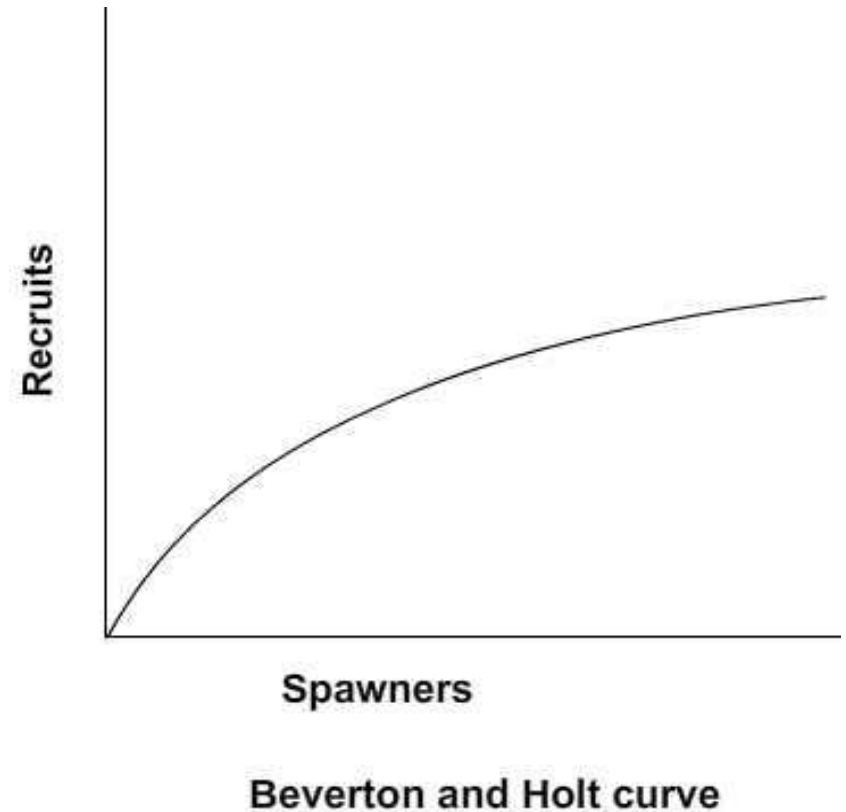
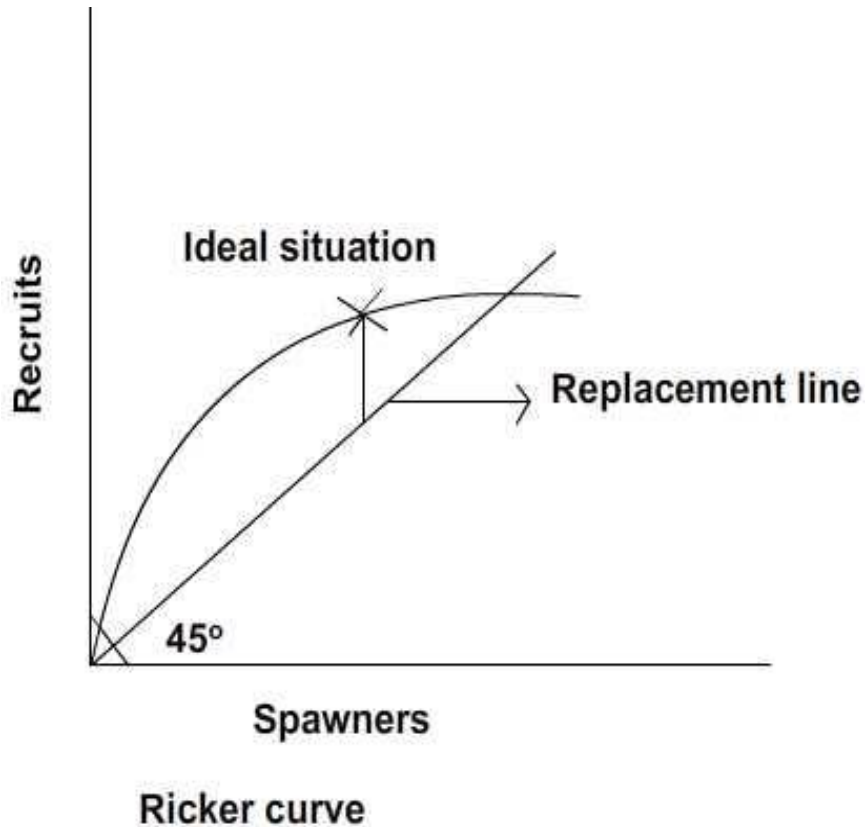
E = number of females * average egg production.

G = parameter where the number of recruits, R, increases towards asymptotic level, Rmax.

STOCK RECRUITMENT RELATIONSHIP

3. Cushing model

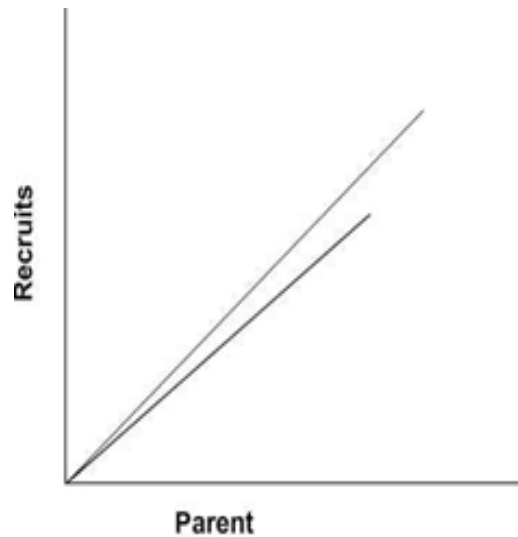
A linear curve is generated when plot is made between parents stock and recruits.



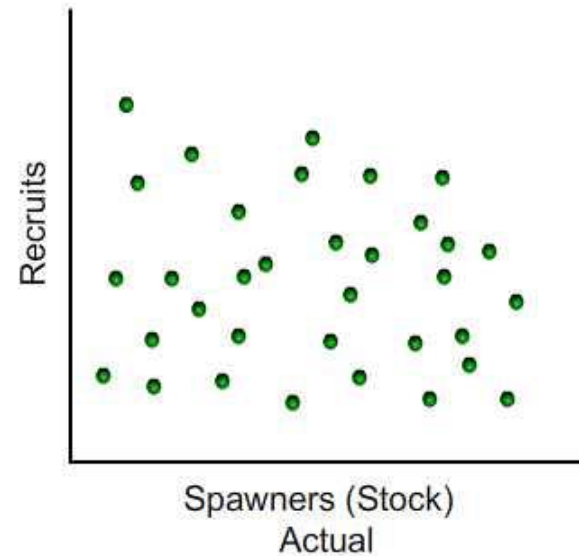
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3. Cushing model

contec



Cushing linear curve



The main bottleneck in this relationship is that environmental variables often appears to have a significant impact on recruitment success in a number of years. Thus, over a wide range of stock densities, the amount of recruitment will be loosely dependent on stock size.

STOCK RECRUITMENT RELATIONSHIP contd.....

Relative response model

- This model was developed by Alagaraja (1984).
- The aim of this model is that removal of more fish in one year leads to better survival and growth in the residual stock.
- Increasing the fishing effort leads to increase in catch and when fishing effort goes beyond maximum, the response of the stock continues to be positive but the stock will show sign of depletion. Finally this results to a nil stage (Zero level), negative response of the stock to the fishing effort.

END