

Swept area method

Introduction

- For any analytical model of fish stock assessment, qualitative and quantitative database is an essential prerequisite.
- Holistic models are recommended for the situation when there is limited scope for collecting huge data for particular fishery.
- Holistic model is simple, less data demanding, and also they do not require age or length structures of the stocks, but consider stock as a homogeneous biomass.
- Two methods followed in holistic methods are 1) swept area method and 2) surplus production model.
- In swept area method, it is assumed that the area swept by the trawl is representative for the entire area over which the fishes are distributed. Surplus production method uses catch per unit of effort (fish caught per hour trawling).

Swept area method

- Trawl net is a conical bag with a wide mouth fitted with otter boards for horizontal opening and floats and weights for vertical opening.
- This net sweeps the sea bed over a wide area. The tail end of the gear where the fishes are collected is called “codend”.
- Trawl nets are dragged on the sea floor are called “bottom trawls”.
- The mean catch (either in weight or in numbers) per unit of effort or per unit of area is an index of the stock abundance.
- This index is converted into an absolute measure of biomass.
- This technique is called “swept area method”.

Swept area method conted.....

- The trawl sweeps a well defined path, the area of which is the length of the path, times the width of the trawl called “Swept area” or “the effective path swept”.

The swept area ‘a’ can be estimated by following formula

$$A = v.t. h \times 2$$

Where

V = Velocity of the trawl over the ground when trawling

h = length of head rope

t = time spent for trawling

x2 = wing spread as fraction of the head rope length (0.4-0.6)

Swept area method conted.....

When exact position of the start and end of the haul are available, the distance covered can be estimated by

$$D = 60 x$$

Where

D = Distance in nautical mile,

Lat 1 = Latitude at start of haul

Lat 2 = Latitude at end of haul

Long 1 = longitude at start of haul

Lang 2 = longitude at end of haul

Swept area method conted.....

Exact latitude and longitude values can be obtained from global positioning system (GPS), a simple electronic device.

If exact positions are not available, the distance covered for an hour can be calculated from

$$D = \sqrt{VS^2 + CS^2 + 2 * VS * CS * \text{Cos} (\text{dir } V - \text{dir } C)}$$

D = distance in nm

VS = velocity of vessel (knots = nm/hr)

CS = velocity of current (knots)

dirV = course of vessel (degrees)

dirC = direction of current (degrees)

Biomass Estimation

(i) Catch in weight per unit area can be calculated by

C_w = catch in weight of a haul

C_w/t = catch in weight per hour

t = time spent for hauling (in hours)

a = area swept

a/t = area swept per hour

(ii) Average biomass per unit can be calculated by

$$\bar{b} = \frac{C_w}{a} \times 10^3 \text{ kg / m}^2$$

\bar{b} = average biomass per unit area (kg/m²)

$\overline{C_w/a}$ = mean catch per unit area of all hauls

x_1 = Fraction of biomass in the effective path swept by trawl which is actually retained in the gear (usually 0.5-1.0)

Biomass Estimation contd.....

(iii) Total biomass could be estimated for total area under investigation

$$B = \frac{\overline{(Cw/a)} \times A}{X1}$$

B = Total biomass

A = Total size of the area under investigation (nm²)

- Though swept area method is not very precise, higher precision can be obtained by increasing the number of hauls? Another way of reducing errors is to apply stratified sampling.
- Suitable stratification may reduce the variance considerably for the same number of hauls and thus improve survey efficiency.
- The distribution of many species is determined by depth and bottom type.

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