Fish Population Dynamics

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Analytical models

- A basic feature of analytical models as developed by, among others, Baranov (1914), Thompson and Bell (1934) and Beverton and Holt (1956), is that they require the age composition of catches to be known. For example, the number of one year old fish caught, the number of two year old fish caught, etc. may form the input data.
- The basic ideas behind the analytical models may be expressed as follows:
- 1) If there are "too few old fish" the stock is **overfished** and the fishing pressure on the stock should be reduced
- 2) If there are "very many old fish" the stock is **underfished** and more fish should be caught in order to maximize the yield

- The analytical models are "*age-structured models*" working with concepts such as mortality rates and individual body growth rates.
- The basic concept in age-structured models is that of a "*cohort*". To put it simply, a "cohort" of fish is a group of fish *all of the same age belonging to the same stock*. (We shall further elaborate on the definition of a cohort in Chapter 4.) For example, a cohort of the threadfin bream, (*Nemipterus marginatus*) could be all the fish of that species that hatched from June to August in 1976 near Tanjung Pinang in the South China Sea. Suppose there were one million specimens in that cohort. After August 1976 the original one million fish would gradually decrease in number because of deaths due to natural causes (predation, diseases, etc.) or fishing. However, while the number of survivors of the cohort decreases with time the average individual body length and body weight increase.


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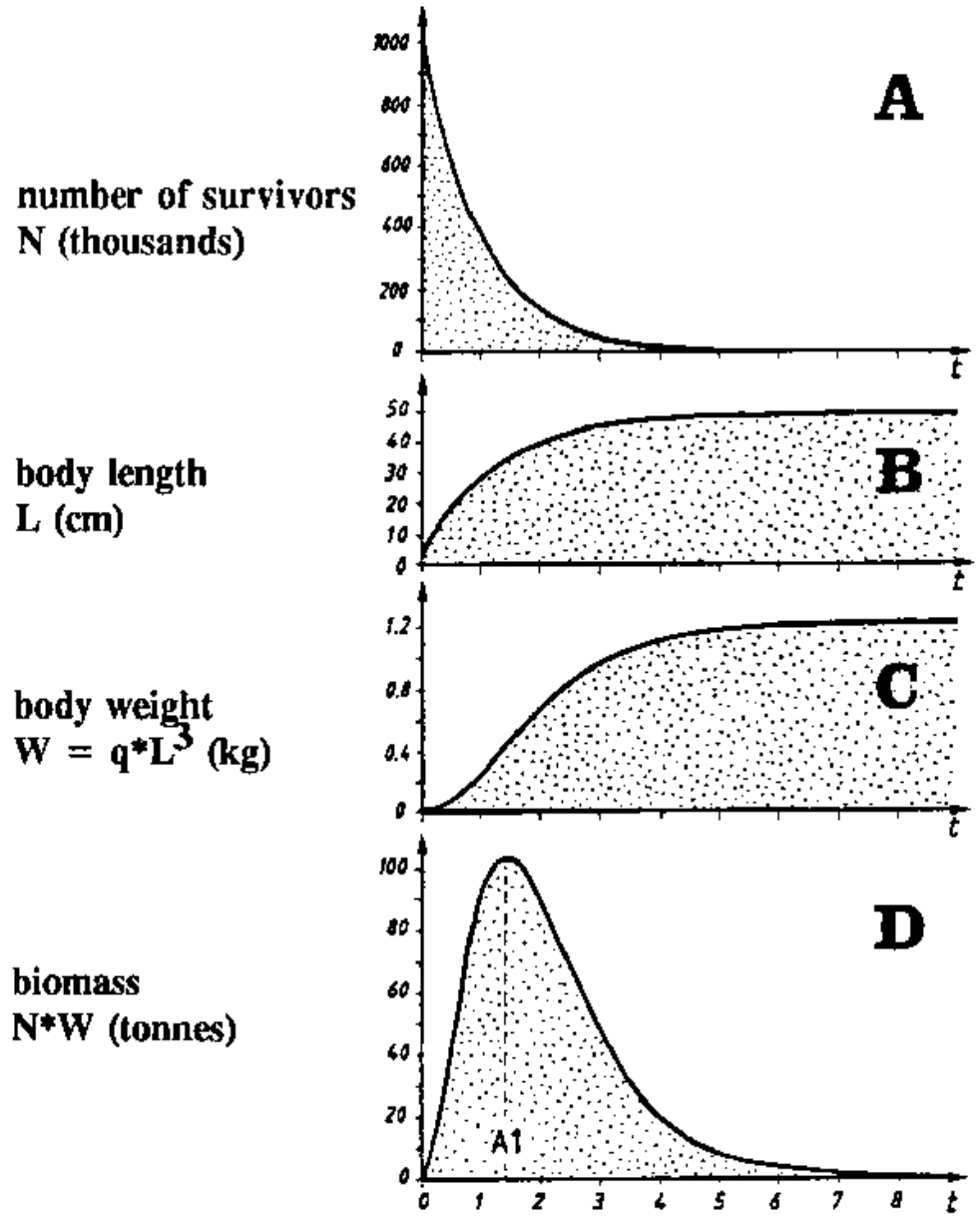
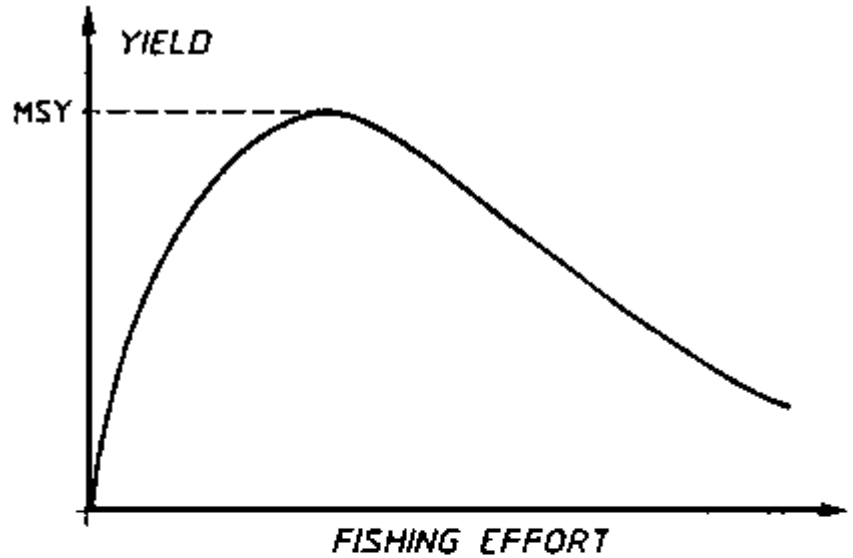
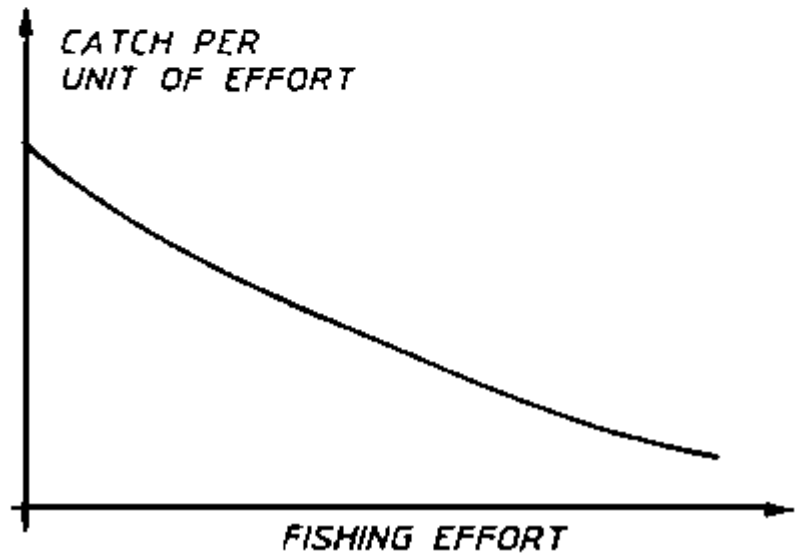

number of survivors
N (thousands)
1000
800
600
400
200
0
t
A
body length
L (cm)
50
40
30
20
10
0
t
B
body weight
W = q*L3 (kg)
1.2
0.8
0.4
0
t
C
biomass
N*W (tonnes)
100
80
60
40
20
0
A1
0 1 2 3 4 5 6 7 8 t
D
age of cohort

- The implication is that the fish should neither be caught too young nor too old. If the fish are caught too young there is "*growth overfishing*" of the stock.
- There are thus two major elements in describing the dynamics of a cohort:
- 1) The average body growth in length and weight
  2) The death process

Holistic models

- In situations where data are limited, for example, when starting up the exploitation of an hitherto unexploited resource, or in cases of limited capability of sampling, one may not have input data of the quality and in the quantity required for an analytical model. One solution would be to start up the collection of the data types required for the analytical approach and then wait until a sufficient amount is available. This approach is, of course, recommendable, because it solves the problem in the long run, but that may take years, while often advice on an exploitation or development strategy may be needed now. The approach taken in this manual is that no matter which type of data you have, there is always some information to be extracted from it, and that advice based on an analysis of a limited data set is usually better than complete guesswork.


YIELD
MSY
FISHING EFFORT


CATCH PER
UNIT OF EFFORT
FISHING EFFORT