Introduction

fish5105yieldrec Yield per recruit analysis

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Background - the development of cohorts in numbers

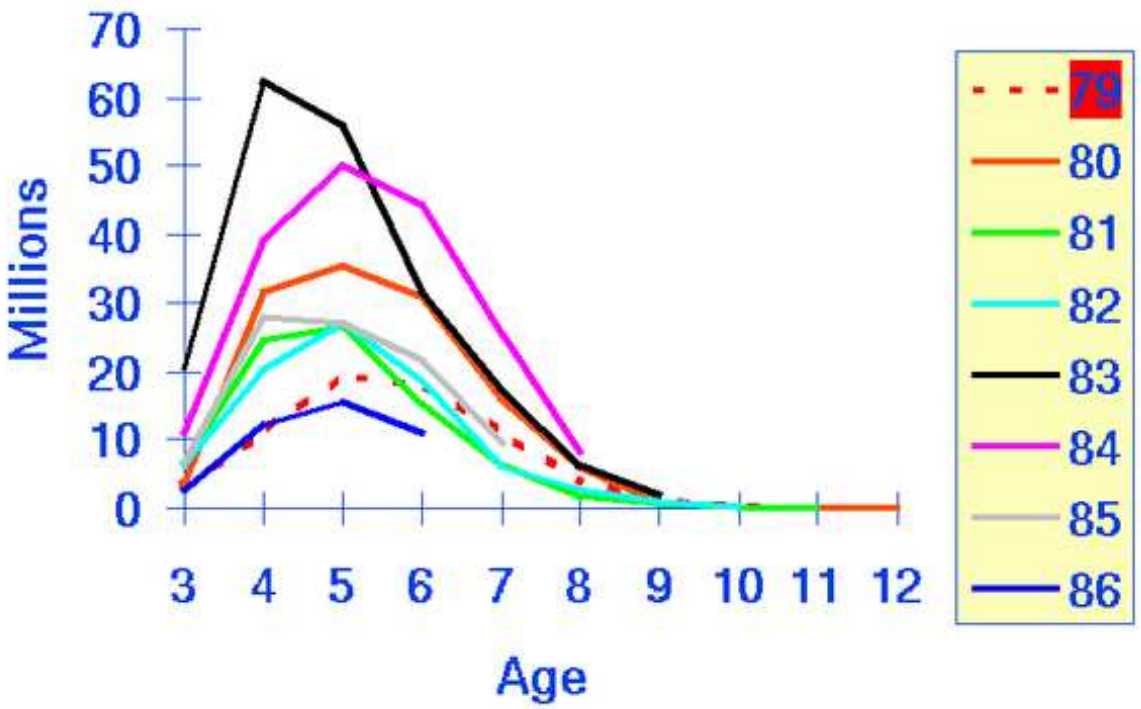


Figure : I-Cod catches in numbers at age from several cohorts.

It is well-known that cohorts of fish enter fisheries and subsequently die

Mean weight at age in catch

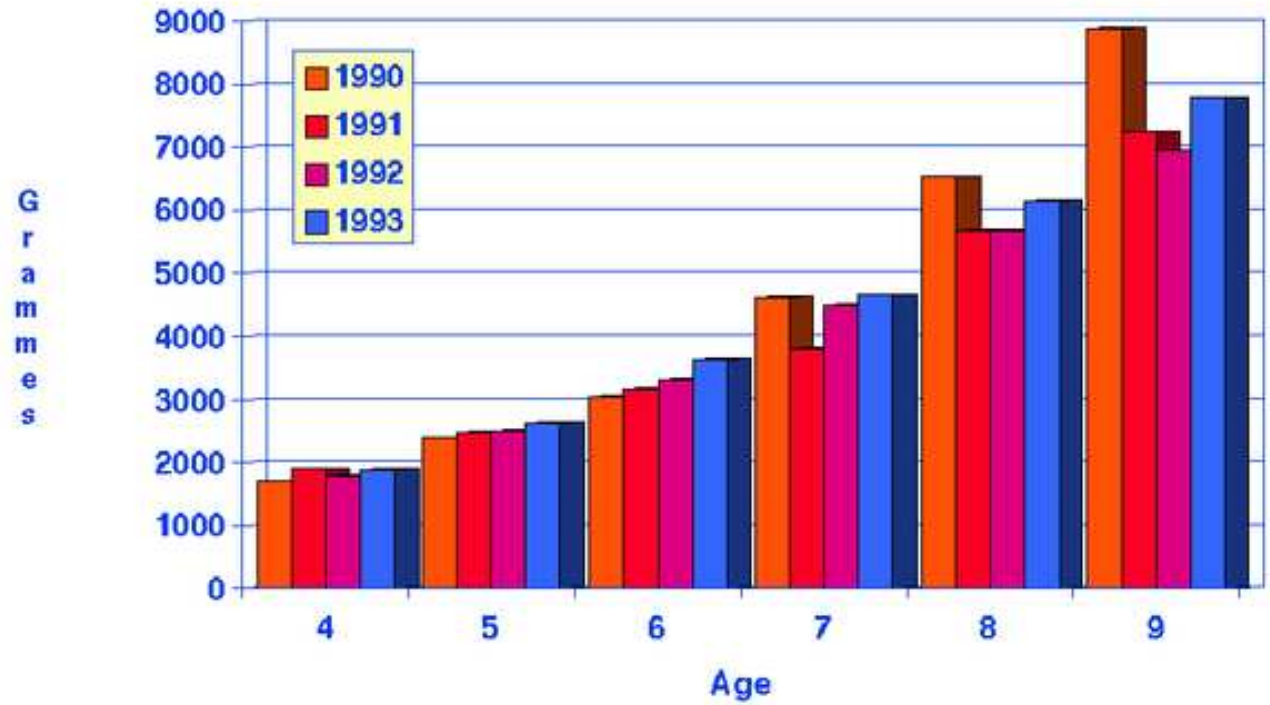
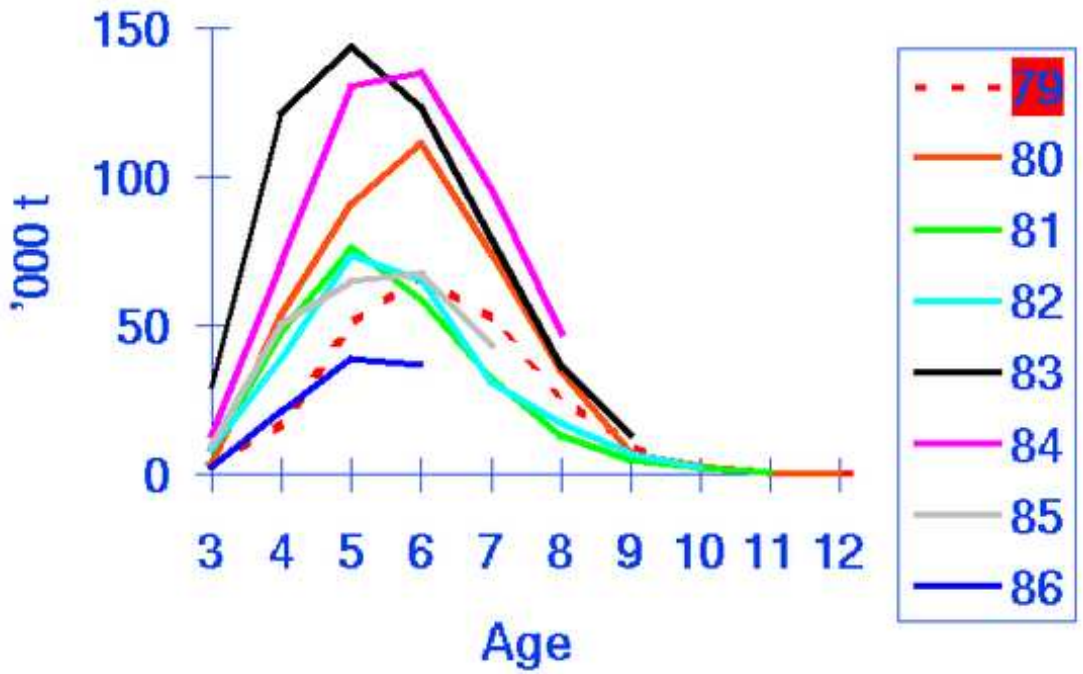


Figure : I-Cod Mean weight at age in catch

The mean weight at age in the catches needs to be taken into account.

I-cod: Catch in weight



When weight at age in the catch is multiplied by catches in numbers at age the resulting catches in weight at age are quite illustrative.
It is seen that the tonnes caught (or landed) peak at different ages from the numbers.
One must question whether reduced fishing pressure on young fish would lead to considerably greater catches of older fish.

The development of a cohort in numbers

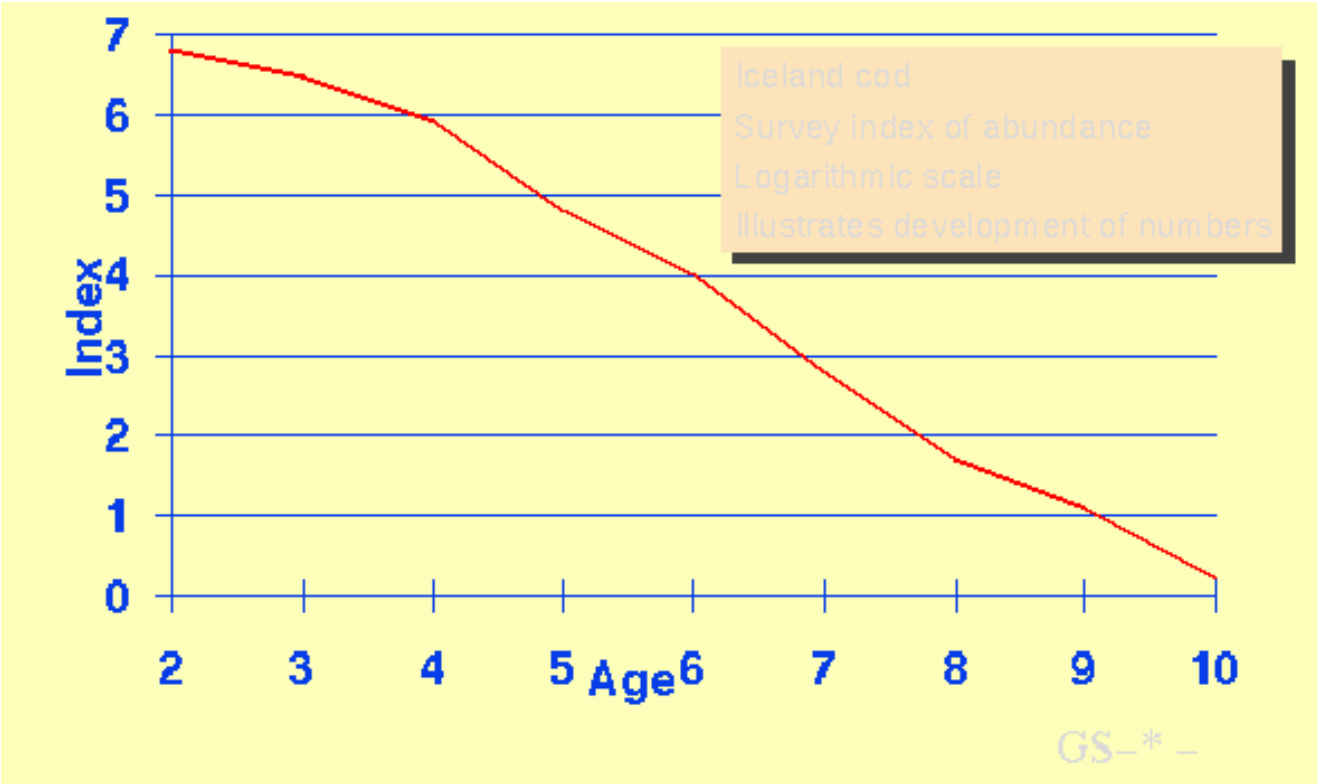


Figure : Development of average I-Cod cohort size in numbers as seen by survey indices.

Iceland cod Survey index of abundance Logarithmic scale Illustrates development of numbers

Yield per recruit

Yearclass size fixed
I.e. M not variable after this age
Numbers are reduced due to fishing and natural causes
The numbers do not increase after the cohort is born
The individuals gain weight with age
Assuming the fish have enough to eat
The biomass of the yearclass will reach a maximum
Weight x numbers =low initially, increases and ends up as zero * hence there is an age where the yearclass would be killed in aquaculture
Fishing is from many yearclasses at once
So need to estimate what proportion should be caught at each age

Development of yield and biomass

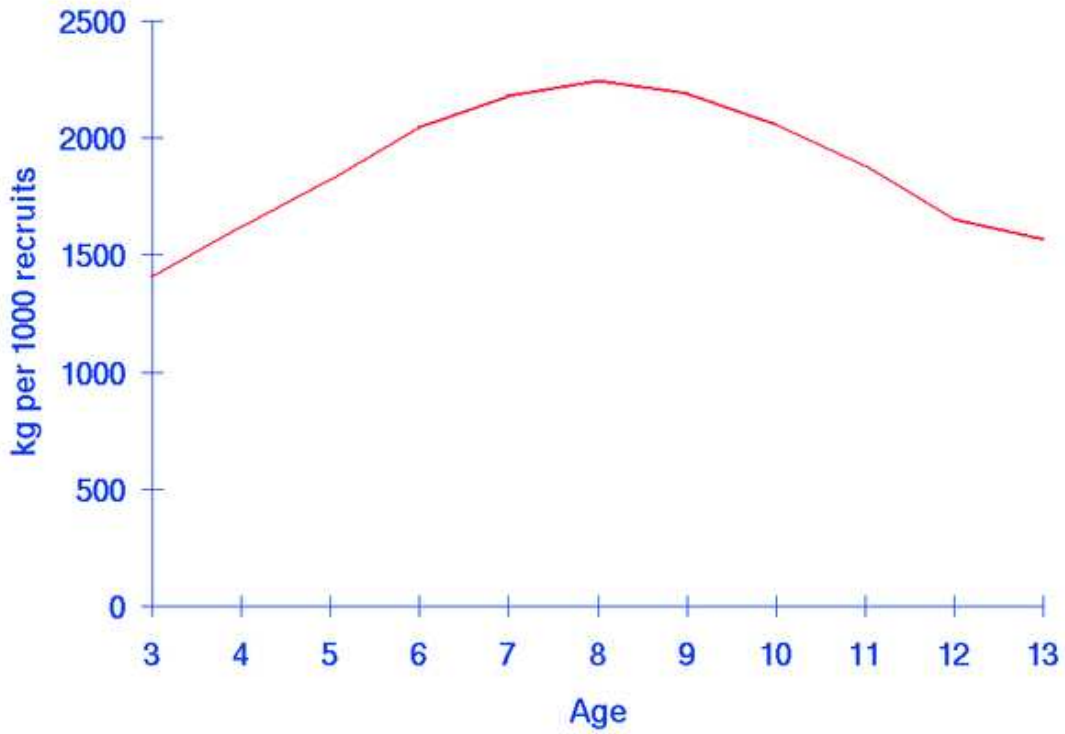
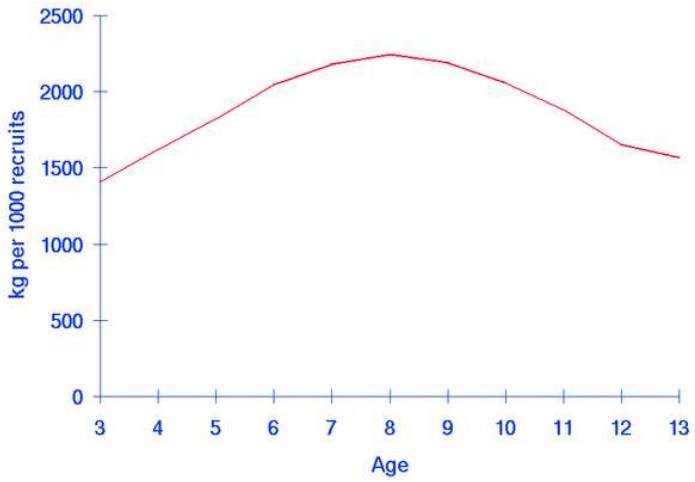


Figure : Development of biomass in the absence of fishing

Yearclass size fixed
I.e. M not variable after this age
Numbers are reduced due to fishing and natural causes
The numbers do not increase after the cohort is born
The individuals gain weight with age
Assuming the fish have enough to eat

Development of biomass in the absence of fishing

- Simple analysis - aquaculture
- Look at a single yearclass
- Consider harvesting it all at once
- Numbers develop from year to year according to: $N_{a+1} = e^{-M} N_a$
- Biomass at a given age is $B_a = w_a N_a$
- Should harvest when biomass is at a maximum (but note cost is missing)



Yield per recruit

Start with 1000 recruits (youngest age group, e.g. 3) Mean weight at age is known Know fishing mortality at each age Natural mortality known Compute catch in numbers at age three Compute catch in weight at age three Subtract natural mortality Gives survivors at end of year =number at age 4

Yield per recruit first age simplified example

Start with 1000 recruiting cod at age 3 Mean weight 1.1 kg Catch 5% of age 3 cod Natural mortality 18% p.a. 1000x0.05=50=number of cod caught at age 3 50x1.1=55 kg catch in weight at age 3 1000-50=950 survive fishing 950x0.82=779 survive the year =number of 4 year olds at the beginning of next year

Yield per recruit second age group, simplified example

Example
779 cod 4 year old Mean weight 1.6 kg Catch 29\% of age 4 cod Natural mortality 18\% p.a.
779x0.29=226= number of cod caught at age 4 226x1.6=361 kg catch in weight at age 4
779-226=553 survive fishing 553x0.82=453 survive year
Which gives the number of 5 year olds at the beginning of next year