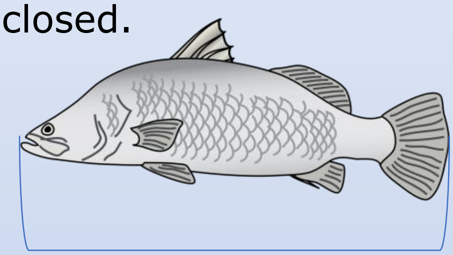
Growth

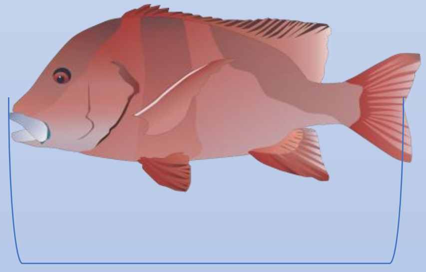
— Measuring fish —

Not all fish are measured equally. Different species of fish have different shaped tails that require different ways to measure them. What about crabs prawns and squid? How do you measure a fish that has already had the head removed?

For finfish with a rounded tail, the most common measurement is total length – from the closed mouth to the tip of the tail. The mouth should be closed.



For finfish with a forked tail, the most common measurement is caudal fork length – from the closed mouth to the fork of the tail.



For finfish with a tail that is easily damaged, the most common measurement is the standard length – from the closed mouth to the last caudal vertebra.

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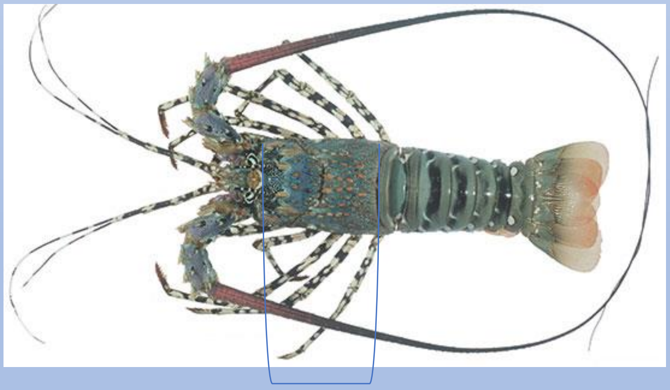
Growth

— Measuring fish —

If sharks have been tailed and gutted we measure the partial length (PAR) – from the real gill slit to ventral insertion of the caudal fin.

Bivalve molluscs are measured to shell length – the distance across the widest part of the shell, perpendicular to the height of the shell.

Crustaceans are measured using either carapace length (prawns and lobsters) or carapace width (crabs).



Squid are measured by the length of the mantle.

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Growth

Measuring growth

There are several methods **to measure growth of fish and invertebrates**. The two most common methods are **tag and release** studies and **estimating the age** of the animals.

Tag and release: Animals are caught, measured, tagged and released into the wild. When they are recaptured, another measurement is taken which shows how much it grew in the time it was at liberty. Each tag has a unique number on it so that it can be compared to length measured at the time of tagging.

By collecting a large number of tag recapture measurements, average annual growth rates for different sizes animals can be calculated, and a growth curve calculated by models.

Some examples of tags used on different species are shown below

From https://doi.org/10.2983/035.035.0314

Growth

Measuring growth

Estimating age

Fish have bones in their head called **otoliths** that have rings that can be used to estimate their age. Like growth rings on a tree, for many species these growth ring are laid down annually. If it is shown through **age validation** that rings are laid down annually, counting the number of rings will give you an estimate of the age of the fish. Other animals have different "hard parts" that are used for estimating age such as the vertebrae of sharks.

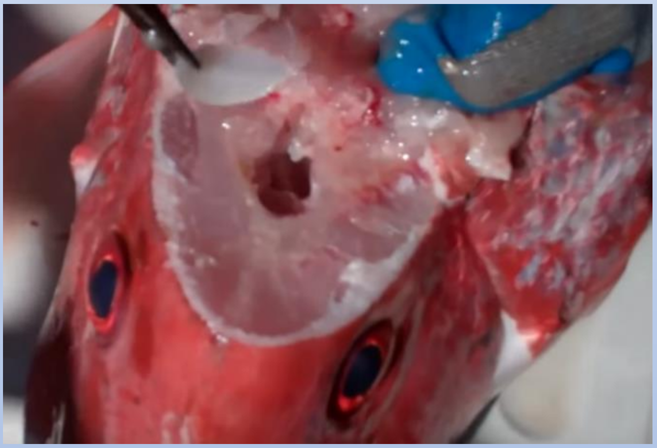
Growth generally follows the shape of the **growth curve** shown below. This can be described by a growth equation called the **Von Bertalanffy growth function** or **VB curve**, which literally shows the average the length of a fish at a certain age. The different parameters of the **VB curve** are important inputs into stock assessments.

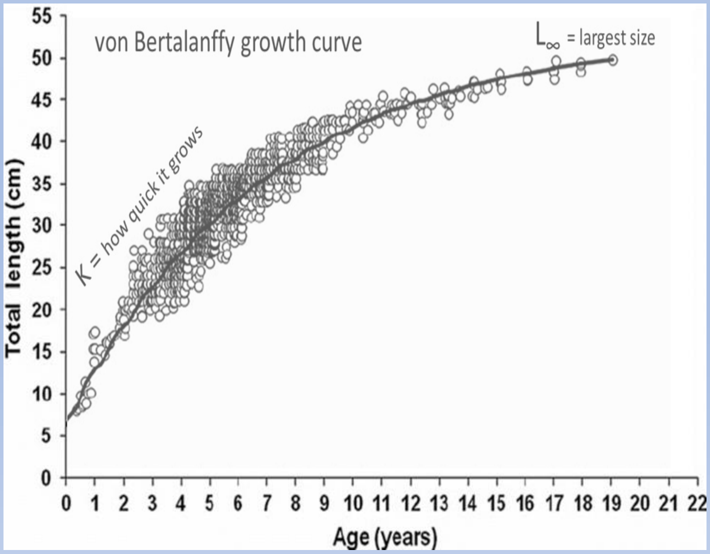
VB curve

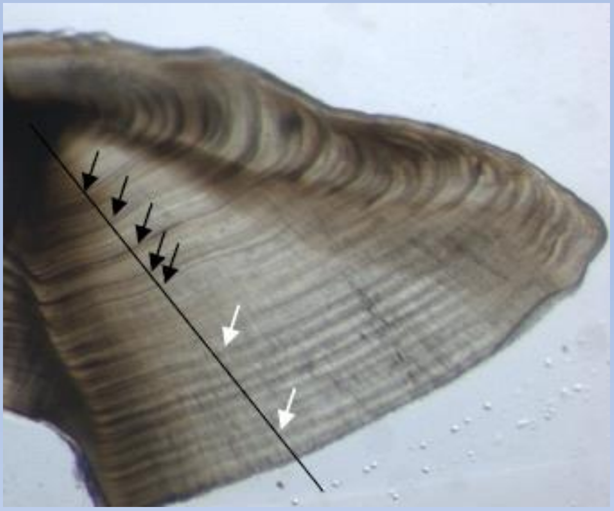
$$L_t = L_\infty(1 - e^{-K(t-t_0)})$$

where

L_t = length at age t
L_∞= theoretical maximum length
K = the growth coefficient
t = age in years
t_0 = theoretical age at length zero







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Growth

— Length-weight relationship —

Meaning: How an animal's weight increases with its length.

Symbol: ***W*** stands for Weight

L stands for Length

a and ***b*** constant parameters calculated from the data

As a fish grows in length, it naturally increases in weight.

But, not all fish of the same species will grow at the same rate. It can depend on:

- Gender
- Food
- Disease
- Water temperature
- Competition for food

To get a length-weight relationship, you need to measure the length and weights of a large sample of fish from across a wide range of lengths (raw data) and then fit a line using the length weight relationship formula those to the data.

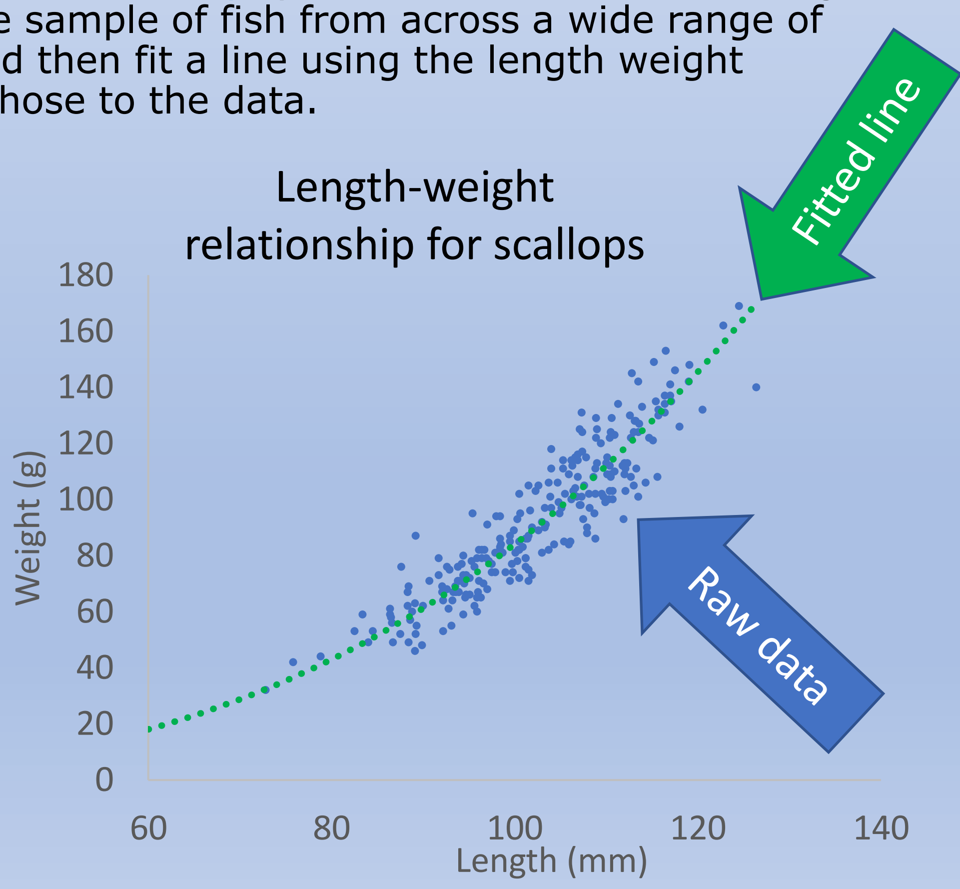
$W = a \times L^b$

Where

W = weight

L = length

a and b are constants calculated from the data



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Growth

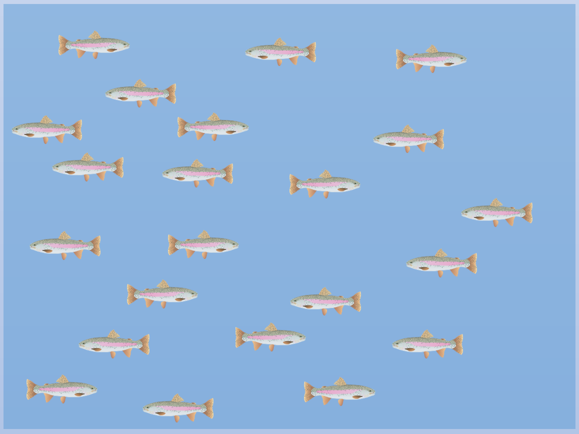
— What affects growth —

Growth rates vary between species, stocks and genders. Growth can also be affected by **environmental factors** and **density-dependent factors**.

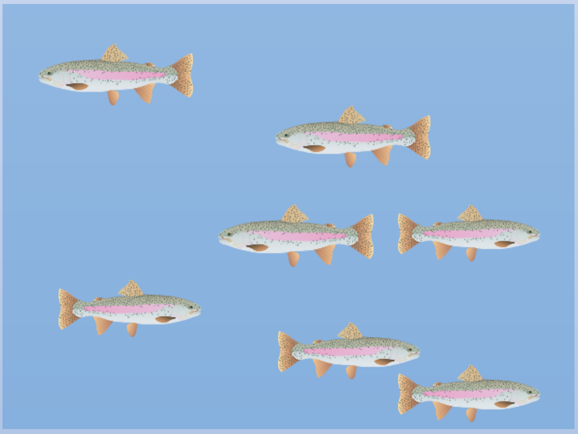
Examples of **environmental factors** that can affect growth include water temperature, water quality and food availability. In general, up to a certain point growth rate increases with temperature.

Density-dependent factors are factors that that affect growth of a population by influencing individual **growth**, **reproduction**, **mortality** and **migration**. The lower the density, the higher the **growth rate** because there is less competition for food, shelter, decreased susceptibility to parasites or disease. This is part of the reason why fish stocks are generally more productive at moderate levels of **biomass**.

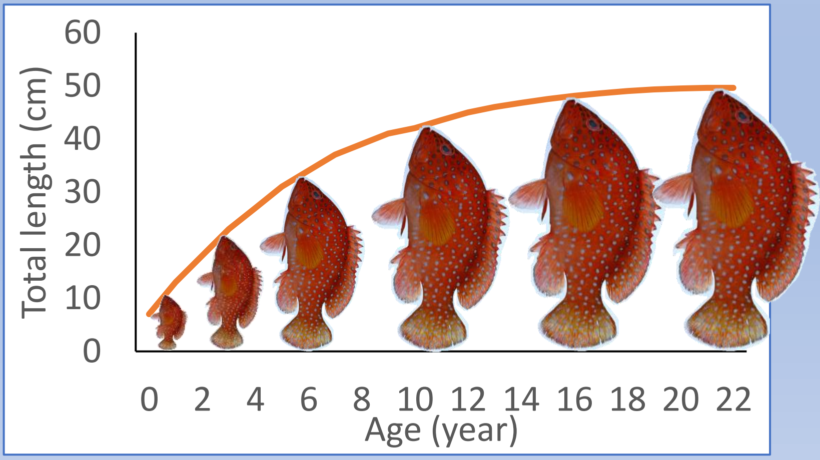
High density



Low density



Fish grow quickest when the are young. As the get older the growth rate slows to a point where they will only increase in length by very small amounts. The formula for describing growth rate is explained in another section of this document.



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