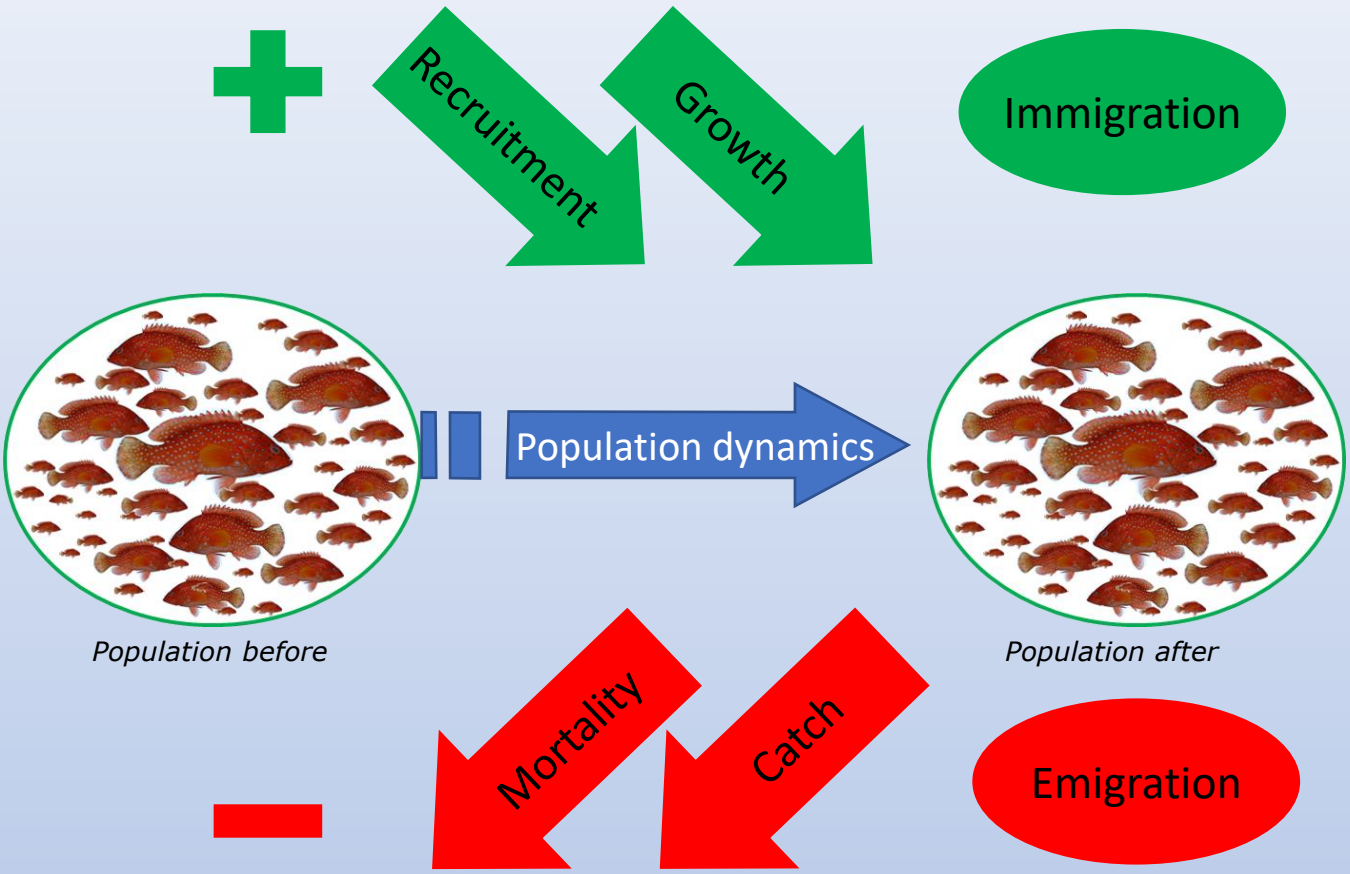
# Populations

## — Overview —




The ***green*** items above increase the size of a population
The ***red*** items above decrease the size of a population

Click on the image above or headings below to navigate to those pages. From any page in this section, click on the title to return.

What is a fish stock
How much fish is in a stock
Fish growth
New fish entering the stock
Sources of mortality
Migration

# Populations

## Simple concept – complex words

**These things change the size of a fish population**

### Things that make a population go up:

- New groups of young fish that enter — Recruitment
- Fish growing in length and weight — Growth
- Fishing coming from another place — Immigration

### Things that make a population go down:

- Fish dying of old age or being eaten — Natural mortality
- The catch taken by people fishing — Fishing mortality
- Fishing leaving to go to another place — Emigration

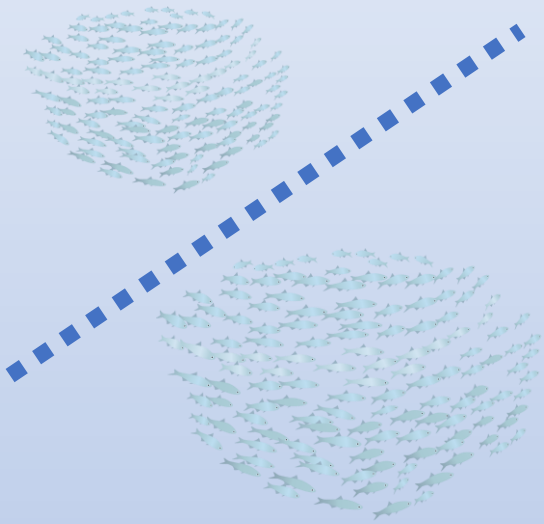
### Other words to describe fish populations:

- The unit of a fish population that we manage — Stock
- The weight of fish in a stock — Biomass
- The portion of a stock caught by fishing effort — Catchability
- How big a fish is for a given length — Length-weight
- The changes that occur to a fish in its life — Life-cycle
- How many eggs a female can carry — Fecundity

# Populations
## — Stock —

Definition: A **fish stock** is a local sub-population of fish. This means that they do not mix or breed much with other stocks. So, fish within a stock are genetically similar and because they live in similar environments, they usually have similar biological parameters such as growth, recruitment and mortality. For this reason fish are often managed as a stock as opposed to as a species.

Fish stocks are often separated by natural boundaries that can block fish from mixing with a neighbouring stock.

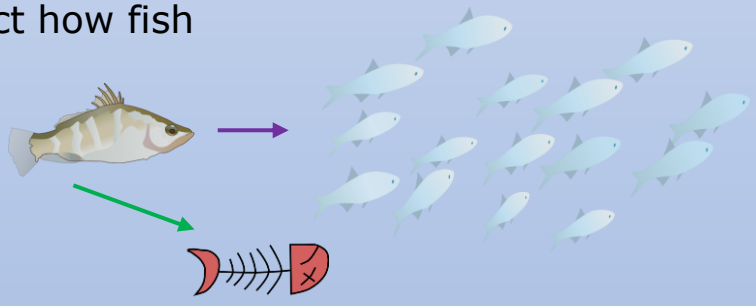


Some examples of natural boundaries between fish stocks:

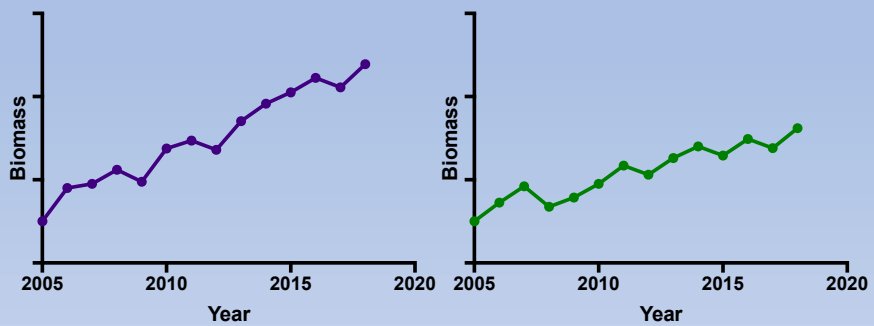
- Separate rivers or lakes
- Land or distance that fish cannot swim over
- Water depth
- Temperature
- Saltwater versus freshwater

Scientists measure the following 3 main factors to understand and predict how fish stocks change.

1. Recruitment or birth rate
2. Mortality or death rate
3. Growth rate



Similar to human populations, the birth rates and death rates of the fish are some of the most important information fishery scientists need to estimate for the fishery.




High birth and survival rates might mean the population grows *quickly*.

Low birth rates or high death rates might mean the population grows *slowly*.

# Populations

## — Types of Biomass—

There are a number of different ways that biomass is referred to in stock assessments and harvest strategies. These include:

**Spawning Stock Biomass (SSB)** – Spawning biomass is the total weight of the stock that is capable of breeding. Sometimes this only includes females, known as the **female spawning stock biomass**.

**Virgin Biomass ($B_0$)** – this refers to the natural biomass of the stock prior to fishing. The 0 refers to time zero, the starting point.

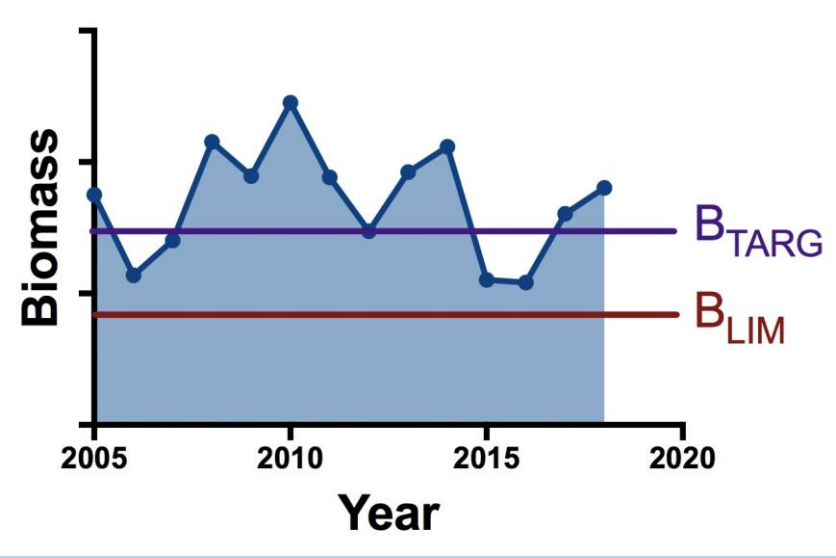
**$B_{20}$** – the biomass that is 20% of the **virgin biomass**.

**Target Biomass ($B_{TARG}$)** – the level of biomass that fisheries management is aiming to achieve.

**Biomass Limit Reference Point ($B_{LIM}$)** – the biomass that is 20% of the **virgin biomass**.

**Biomass at Maximum Economic Yield ($B_{MEY}$)** – the average biomass which corresponds to **Maximum Economic Yield**.

**Biomass at Maximum Sustainable Yield ($B_{MSY}$)** – the average biomass which corresponds to **Maximum Sustainable Yield**. See also '**Maximum Sustainable Yield**'.



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# Populations

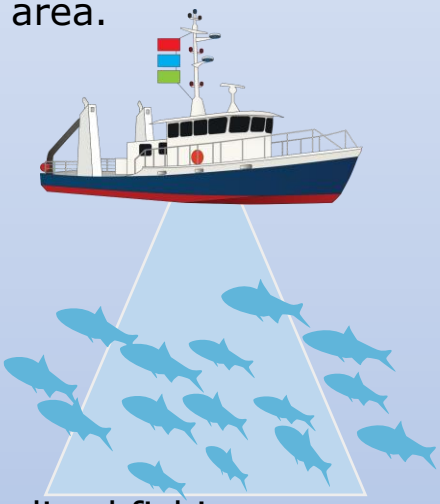
## — Measuring Biomass —

There are several way to directly measure the total biomass (***B***) of a fish stock.

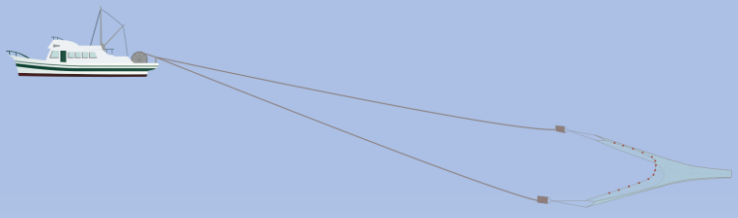
- **Tag recapture** – By tagging and releasing a large number of fish, and then recording the number recaptured, you can estimate the total number of fish in the population. This can be converted to biomass using length-frequency data and the length-weight relationship.

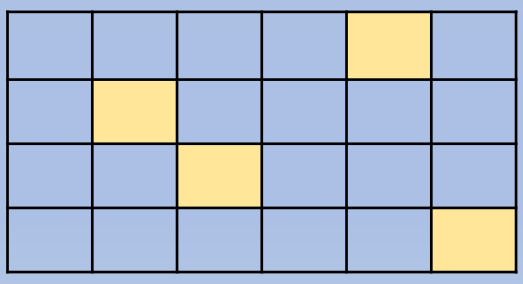
- **Egg production studies** – Combining information about the biology of a fish stock with survey data of the density of eggs in the water, biomass can be estimated for that area.

- **Acoustic surveys** – Research vessels use specialized acoustic equipment over a school of fish to estimate the size and density of the school. Combined with a survey, this can be used to estimate the biomass confirm if it is a spawning aggregation, and what species the school consists of.



- **Fishery independent surveys** –use standardised fishing gear and a sampling plan of random shots to measure fish catch rate or density. This can then be weighed up to the total survey area to give you relative or total biomass.





Each method described above uses assumptions to fill in information about the fishery and reduce uncertainty. An example is how much the trawl net herds the fish (i.e. what is the width of the effective tow path).



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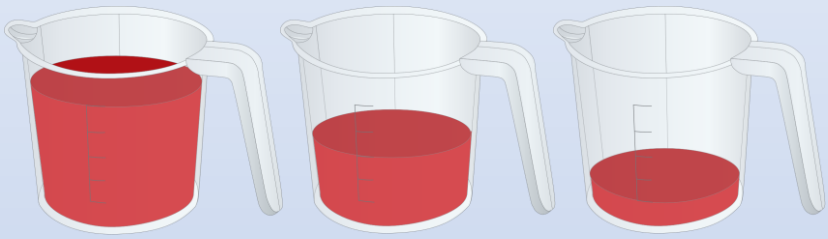
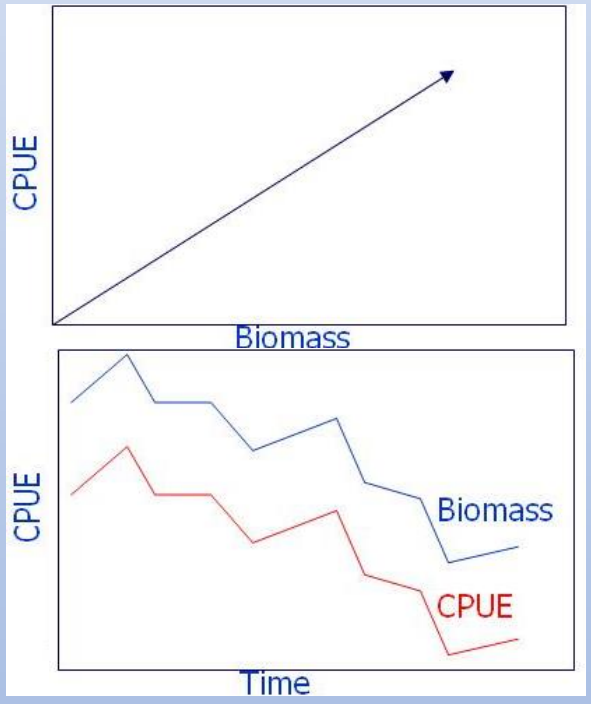
# Populations

## — Relative Biomass —

Management often uses ***relative abundance*** as a measure of changes to a stock biomass. This is often because there is too much uncertainty around assumptions required to estimate total biomass. But measures of relative biomass have their own assumption – that changes in relative biomass reflect changes in biomass.

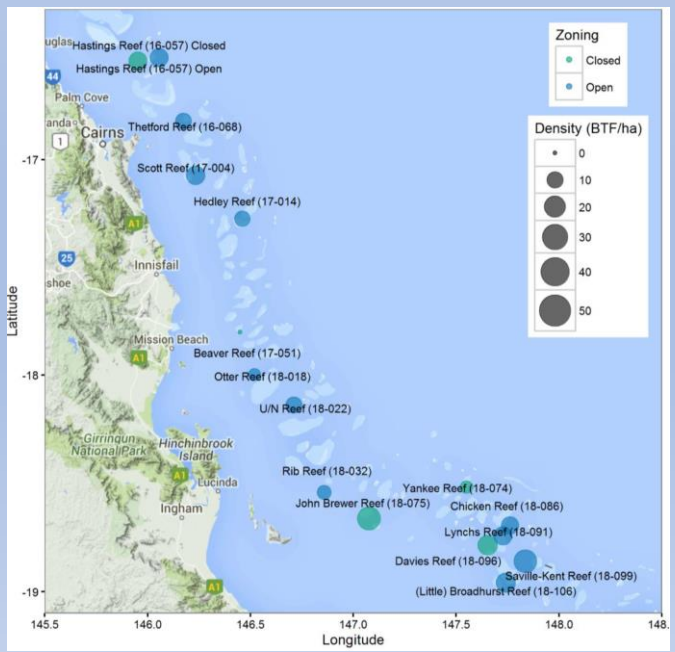
To be able to compare relative biomass between years, its important that the way they are collected and or calculated are standardised.






At its simplest, an indicator of relative biomass could be **catch rate**, or [catch per unit effort (CPUE)]. But **CPUE** does not always change at the same rate as biomass. For example, **CPUE** targeting a schooling fish can remain high as the biomass decreases because the school contracts into a smaller school of fish of similar density to what it started as.

Indicators of relative biomass could also include measurements of density in number of animals per hectare for example.



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# Populations

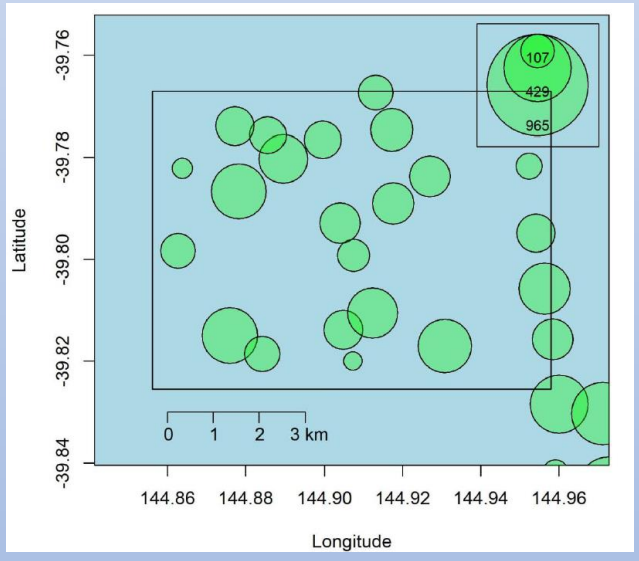
## — Absolute Biomass—

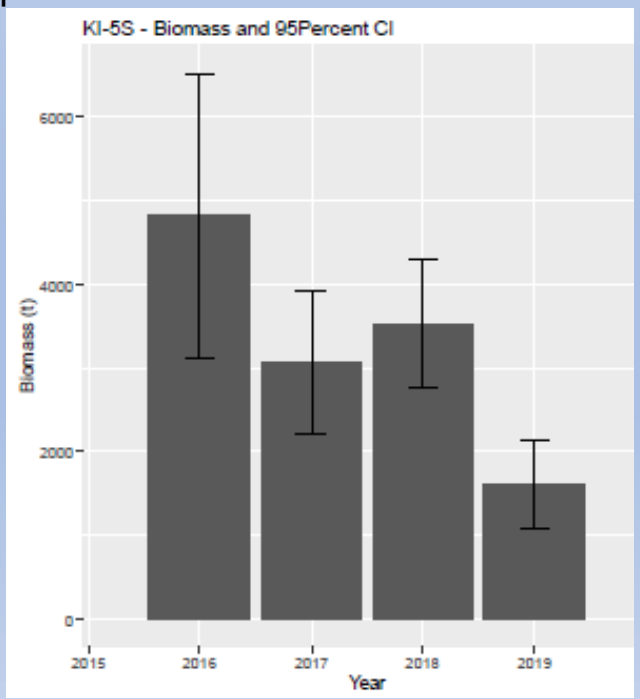
Absolute biomass is an estimate of the total weight of fish in a stock. Because we can't *count all the fish in the sea*, and that all of the methods that are used to measure biomass have any factors that we don't know, there are many assumptions that need to be made.

A good example of a survey that estimates total biomass is the annual Bass Strait Central Zone Scallop Fishery survey. That survey aims to estimate the total biomass of scallops in certain areas called beds.

The survey undertakes about 25 dredge tows in each bed, recording the start and end positions. From those positions, the length of the tow is calculated assuming it is towed in a straight line. The width of the dredge is known, so the total area covered by the dredge can be calculated.

It is not known what proportion of the scallops that the dredge passes over are caught, so it is assumed that the dredge catches 33% of them. So the catch in each tow is multiplied up to account for that and combined with the area of the tow to calculate the density of scallops in kg per square meter.




It is then assumed that the average density of all tows in a bed is representative of the bed, and the total biomass calculated by multiplying the average density by the total area in square meters.



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