Stock- Recruitment relationship

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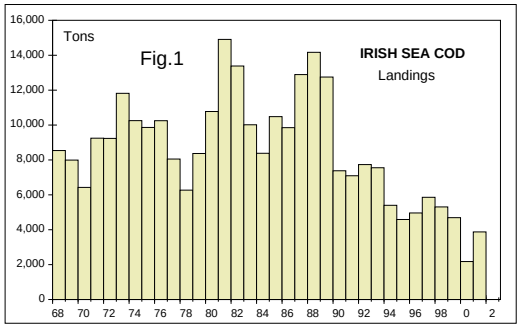
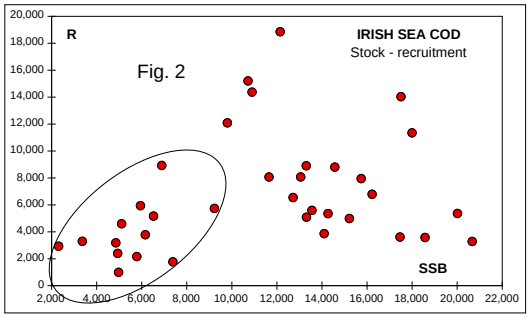
This is the relationship between the size of the spawning stock and the resulting recruitment. It is generally accepted that if there is no spawning stock, there will be no recruitment. But HOW the recruitment is related to the size of the spawning stock is still not fully clarified. The conventional approach is to plot recruitment against the spawning stock, as if they were **absolute** figures (sizes).
But they can hardly be absolute: Ocean conditions, food availability, competition from other species etc. are constantly changing. In one period, stock size of 100.000 tons can be big, at maximum size, fully utilising its resource, in other period a stock of 50.000 tons is 'filling' the resource and can be considered to be of maximum size, relatively speaking. Both stock and recruitment, are **relative** sizes and cannot be plotted in an linear way.

Cod in the Irish Sea



To investigate the stock- recruitment relationship the cod stock in the Irish Sea is used as an example.
Fig. 1 shows the catch of cod in the Irish sea 1968-2001. The catch is oscillating in a regular pattern in the whole period, but the general catch is decreasing after 1990, that is when quota restrictions set in and 'disturb' the landing figures (non-reporting, black landings, discards) and thereby the spawning stock estimate, and recruitment.

Usual approach:



The usual approach is to treat both the spawning stock and the recruitment as absolute figures.

Fig. 2 shows the classical plot used by ICES to show the relationship between spawning stock (SSB) and recruitment (R). R is plotted against SSB irrespective of time. It is difficult to see a distinct pattern in the points. The points inside the circle are from the period after 1990 when the catch is controlled by quotas, not by the size of the stock.

Another approach is to treat spawning stock as relative sizes:

When changes in spawning stock and recruitment are plotted over time it can be seen that they oscillate in a regular manner and in this case, in opposite phase.
It is accepted that a big stock results from good recruitment few years earlier, but the figure also clearly shows that when the spawning stock is large, the recruitment is low.

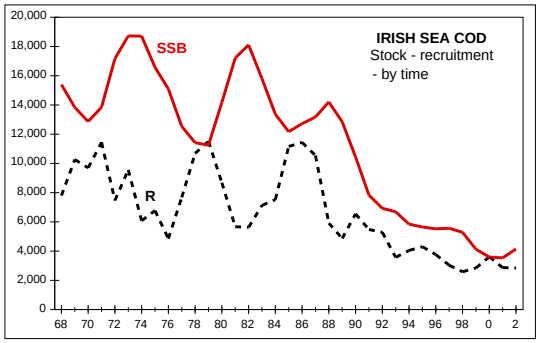


Fig. 3 shows spawning stock (SSB), upper line, and recruitment (R) by time (three year running average). The spawning stock oscillates in a regular manner until 1990. The recruitment swings regularly in an opposite phase. This can be regarded as a self-regulation of the stock size: When the (spawning-) stock is big there is no room for recruits.

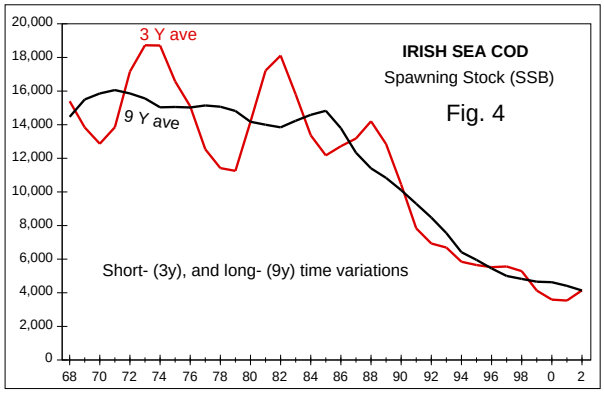


Fig. 4 is a plot of the spawning stock by time. Filtering the data using running average makes the basic oscillations to stand out.
High frequency (short time) noise is removed by 3-year running average. Low frequency (long time) variations appear using 9-year running average.

It can be seen that **the spawning stock oscillates around the long term average**.

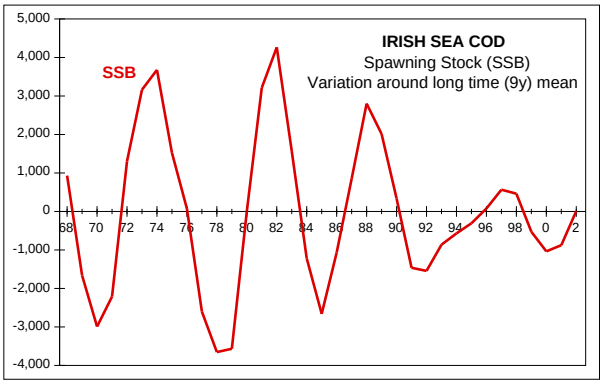


Fig. 5. The difference between the 3-year average and the 9- year average (3 ave - 9 ave) represents the **relative short time oscillation** of the spawning stock.

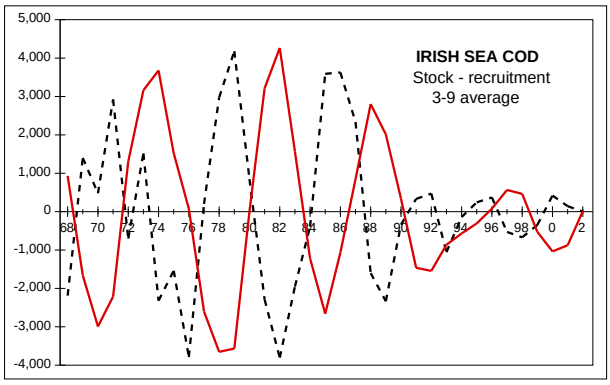


Fig. 6. Putting spawning stock and recruitment on the same axis and scaling them to equal amplitude shows the relative oscillations of the spawning stock and recruitment on the same time scale. Result:
Spawning stock and recruitment oscillate in anti-phase.

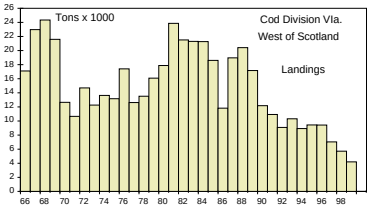
Therefore, the statement that it is necessary to have a large spawning stock to secure a good recruitment, is at the best doubtful.

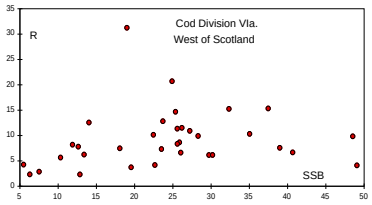
The results from this manipulation do not support the hypothesis that a large spawning stock secures a good recruitment. On the contrary. What we see is that from 1968-1990, the (spawning-) stock is fluctuating, trying to adjust to the environmental and biological conditions, fishing pressure included. Interestingly, the stock oscillates under constant high (relative to now) fishing pressure. It does not take the course either up or down. This proves that **fishing by itself does not determine the fate of the stocks**. That again explains the poor results of 'managing' fish stocks by reducing the fishing pressure.
After 1990 the fluctuations in both spawning stock and recruitment almost disappear. At the same time the landings (and the size of the spawning stock) decrease at a constant rate. This happens at the same time 'management' starts. Is this coincidence or is it a causative effect? There is only one way to find out: Introduce 'free fishery' without quotas and TAC's against correct catch reports.

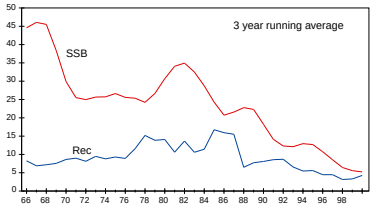
Here are some examples of this method when used on other stocks:

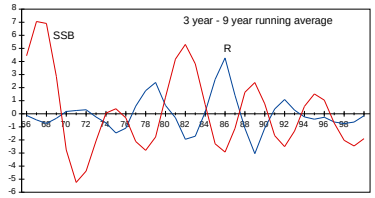
Oscillations in fish stocks seem to be the rule and SSB and recruitment are in most instances in opposite phase.

The Cod west of Scotland.

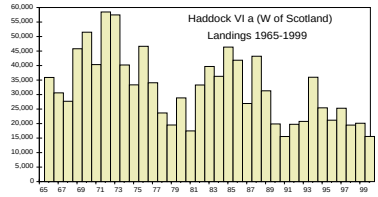


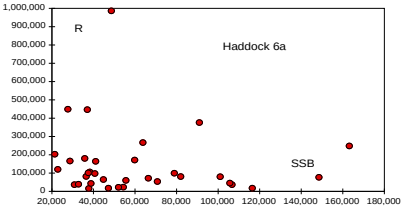


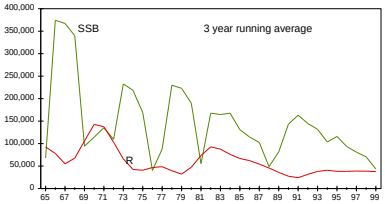


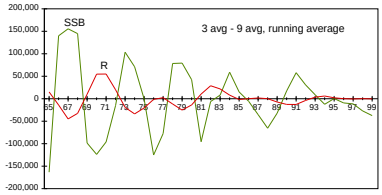


Haddock west of Scotland

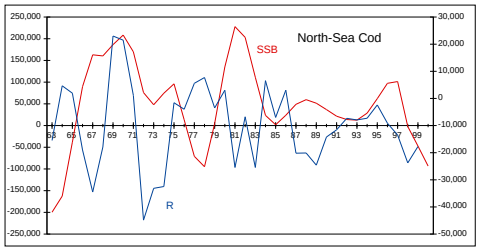




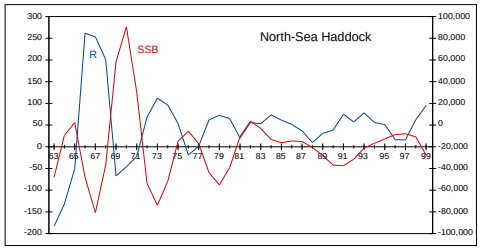




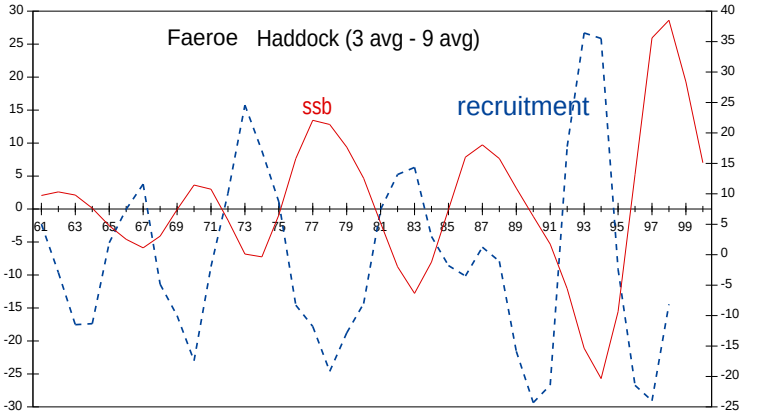
North Sea Cod

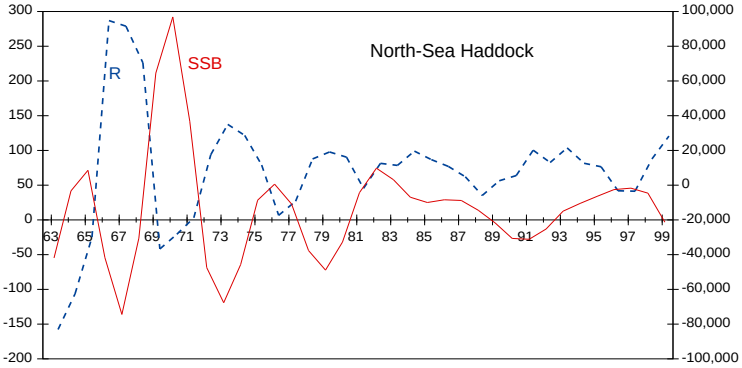


North Sea Haddock



Faroe haddock and North-Sea haddock compared by time





Faroe - Cod, Haddock and Saithe