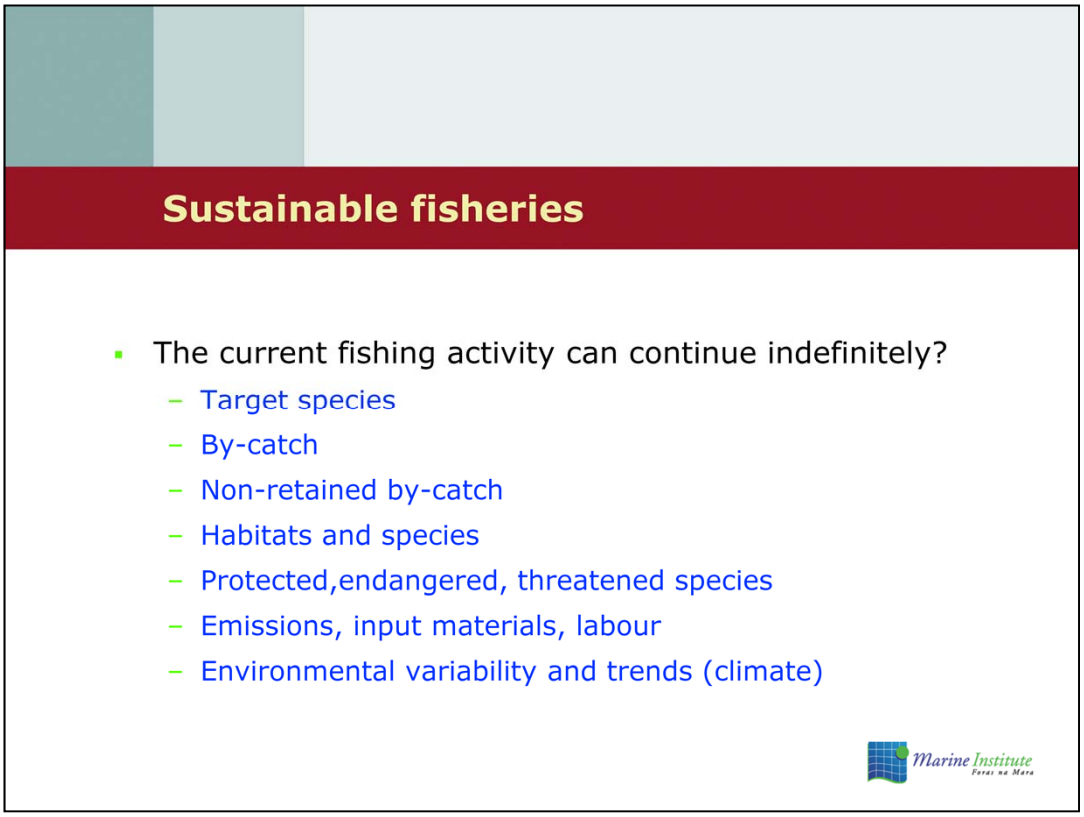
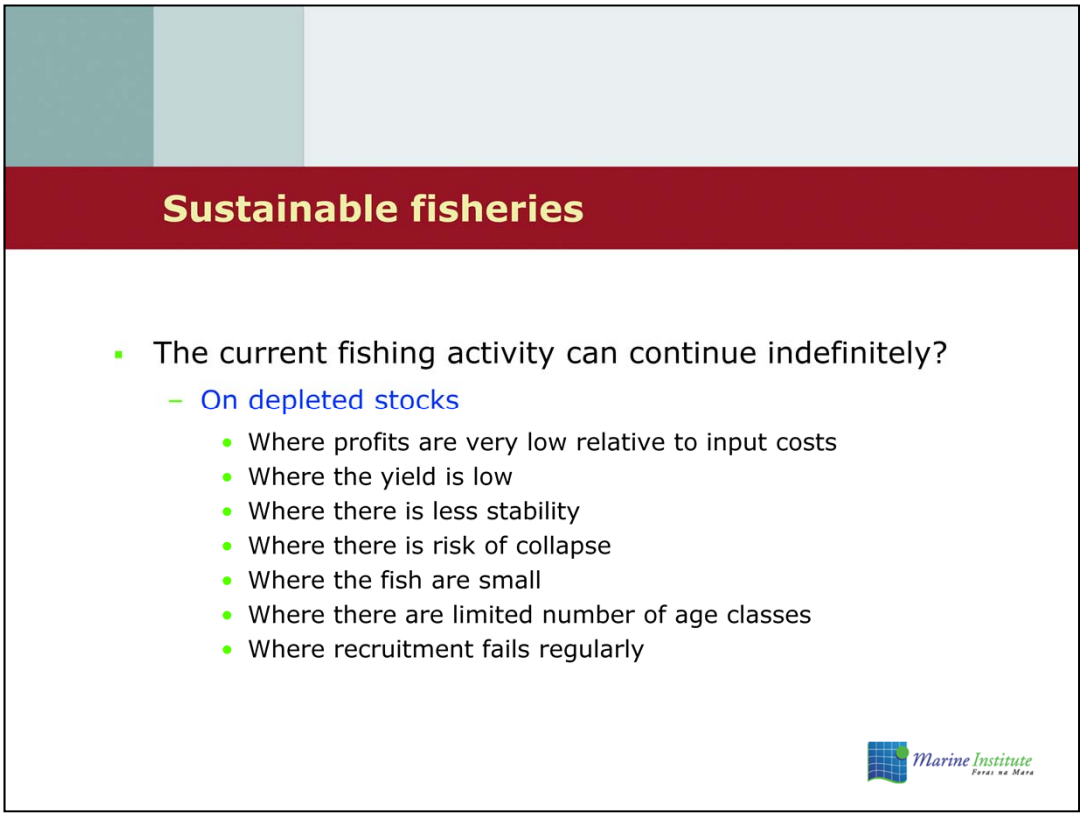
The word sustainable is used widely is discussion about fisheries. It is important to clearly define and have a benchmark and standard for what is meant by sustainable fisheries.



Many fishing activities could be said to be sustainable in that they continue indefinitely. Many inshore fisheries are traditional and have been operating for a long time so they must be sustainable? This is a weak definition and an unambitious benchmark;

-The target species could be depleted but fishing continues (stable but depleted)

-It is no longer acceptable to only consider the target species in fisheries management. The effect of fisheries on other species and habitats, the input costs and carbon footprint should be considered.



Fishing stocks that are depleted (biomass is only a small proportion of what it was before fishing started) is unsustainable because of the instability and uncertainty that arises. There is increased risk of collapse.

Sustainable fisheries: Guidance

- United Nations Law of the Sea (1982):
  - Call for an Maximum Sustainable Yield (**MSY**) approach
- Johannesburg Declaration (2002):
  - Call for stock re-building to **MSY**
- CFP (2002), European Commission (2006)
  - Implementing Sustainable fisheries through **MSY**
- Marine Strategy Framework Directive (2008)
  - **MSY** and **MSY** indicators

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The international benchmark and targets now defined in EU Directives with respect to sustainability is Maximum Sustainable Yield (MSY). This is the average catch that can be taken from the stock over the long term without affecting the productivity (reproductive capacity, growth) of the stock. Its not a new concept.

Sustainable fisheries: Guidance

- Sustainable fisheries are those which maintain stock biomass at a level where its productivity is maximised and the resulting surplus production results in maximum yields in the long term (sustainable)
- Is the fishery living off interest or dipping into capital?
  - Capital = stock biomass
  - Interest = surplus production
- Where capital is reduced earnings from interest declines!

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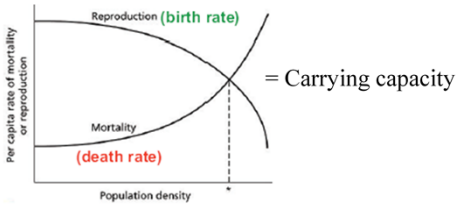
When biomass is maintained surplus production is generated that can be taken in the fishery without depleting the biomass in the long term.

Surplus production: The Concept

- Fish stock don't continue to increase in the absence of fishing
- As their populations increase their reproductive rate declines and natural mortality rates increases
- There are so called *density dependent processes* that act to limit population growth. There is a 'carrying capacity'
- When fisheries start to take fish from the stock ('fishing it down') it releases the density dependence and increases productivity .. up to a point!



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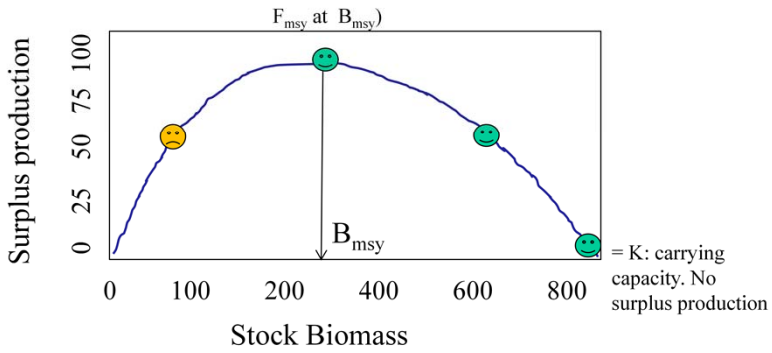
In unfished situations stocks do not continue to grow. There are limits imposed by environmental carrying capacity and biological interactions and competition between fish of the same species and across species. If fish are taken by the fishery these interactions become less and growth and production increases.

Surplus Production: the interest on capital !



- Sustainably land 100 units for a biomass of 300 units
- Biomass at any level other than B_{msy} results in lower surplus production; but for different reasons on either side of B_{msy}

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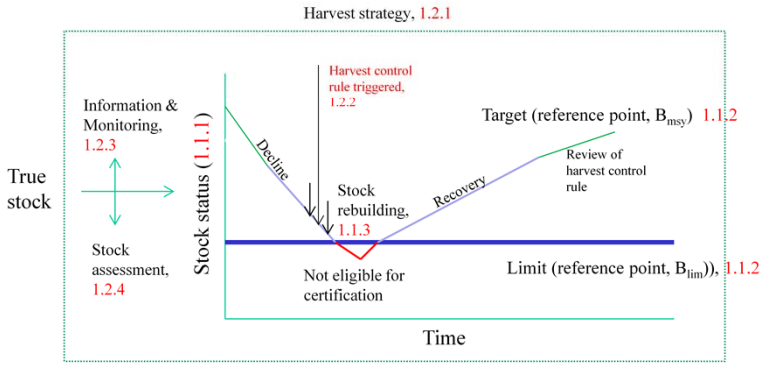
The simplest form of the relationship between surplus production and stock biomass shows the surplus increasing as biomass increases up to a point. At biomass levels higher than this surplus production is lower. The stock should be maintained at biomass which gives highest surplus production and the highest sustainable yield (MSY). Fishing should be at a level that allows this to occur.

Surplus Production and Harvest strategy



Any harvest strategy should be built around the idea of managing biomass or an indicator of biomass at levels close to that which will give MSY. That's the target. On the other extreme if biomass is very low there is a risk of collapse and . The strategy should avoid that position. In practice there are two main difficulties: the first is primarily a scientific problem of identifying the true position of the stock. There may be many different views on stock status and very many different ways of assessing it. Secondly, what management measures will be taken when the stock status is observed to decline. It is always better to have a prior agreement on this rather than pulling a 'rabbit out of the hat'. The difficulty of achieving such agreement should not be underestimated. In Ireland today we are observing the decline of a number of stocks but have not yet decided what measures to take to stop such decline!

The above strategy is adapted from the Marine Stewardship Council standard. This standard certifies fisheries as sustainable and allows product to be sold under its 'sustainablility label'.

Approaches in Ireland to maintaining shellfish stocks at Bmsy

Stock	Measures	Stock status	Success?
Lobster	87mm, 127mm, v-notch	Indirect evidence: egg production (per recruit) is low	Anticipate better recruitment resulting from 127mm.
Razor clam (Irish Sea)	Vessel weekly TAC	Depleted and declining	No. Decline continues
Razor clam (West coast)	MLS, TAC in some cases	Stable and productive?	'Early days'!
Shrimp	Closed season	Little evidence. Growth overfishing if grading is not implemented	Unclear. Recruitment is variable. Fishing when B is low is an issue
Brown Crab	130mm	Stable and productive	Probably. Growth overfishing due to clawing
Oyster	76-78mm, seasons	Depleted and stable	No. Should be subject to recovery measures
Crayfish	110mm, closed areas	Depleted and stable	No. Should be subject to recovery measures

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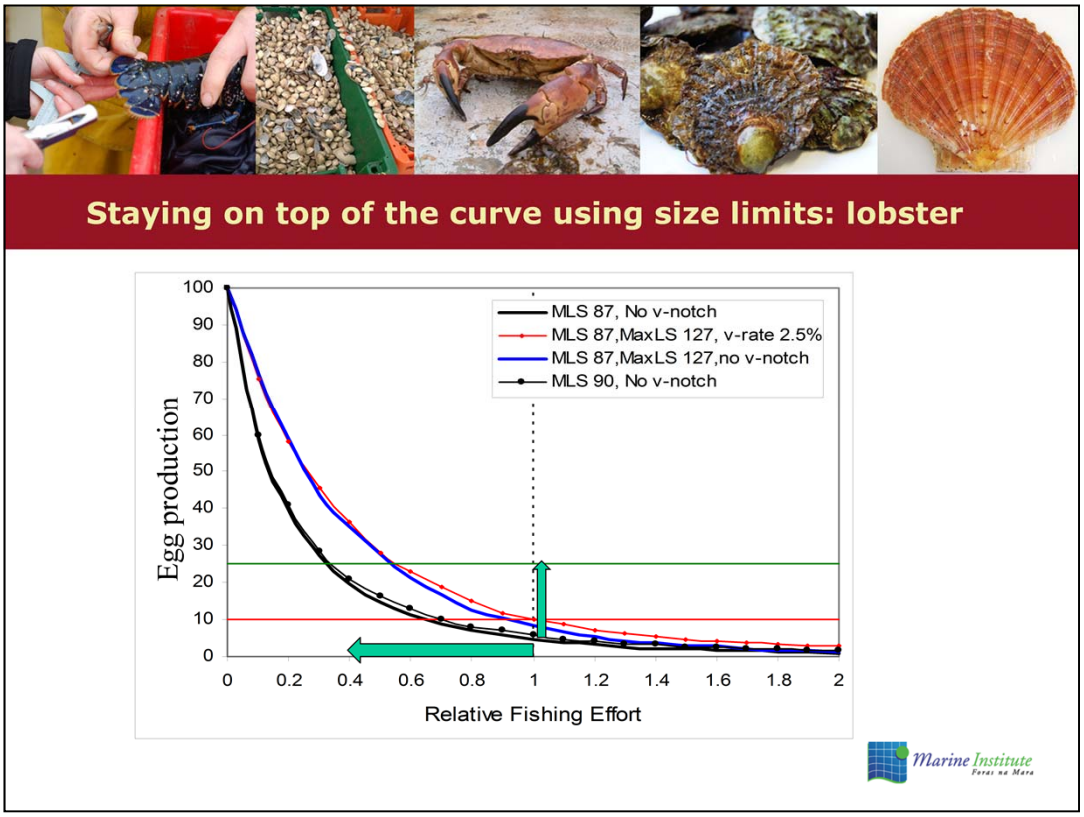
Some existing management measures, status and degree of management success in Irish shellfish fisheries.

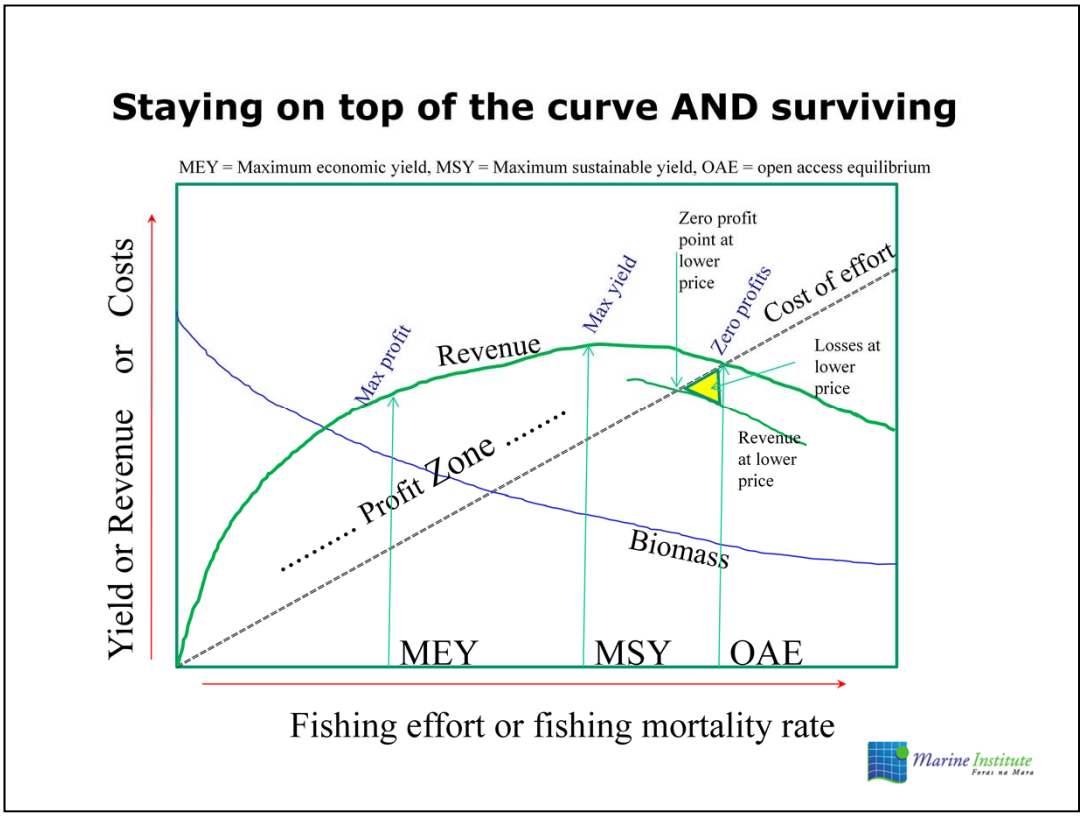
Approaches in Ireland to maintaining shellfish stocks at Bmsy

Stock	Harvest Rules	Stock status	Success?
Cockle	TAC, closed season, real time closure	Variable and environmentally driven	Yes. Fishing mortality is limited and lower than natural mortality
Surf clam	TAC (voluntary), closed season	Stable and productive	Yes. Landings limited.
Whelk	25mm MLS	Depleted	No. Should be subject to recovery measures
Mussel seed	Season	Highly variable	Productivity could be higher with a more precautionary harvest rate ?
Scallop	100-110mm MLS	Variable	Inshore stocks easily over fished
Periwinkle	None	Probably depleted with growth and recruitment overfishing	No. Recovery measures needed



There are many ways to maintain biomass or the reproductive capacity of stocks. In demersal and pelagic fisheries the usual method is Total Allowable Catch. This directly limits the annual rate of fishing mortality or the proportion of the biomass that is taken by the fishery. In the case of the majority of shellfish as there are no agreed measures on how catch or effort is limited these stocks are managed using technical measures. These measures prohibit the landing of certain sizes of fish. This can work where survival of discarded fish is high. However it is economically very costly; as effort and landings increase further technical measures are needed to maintain the productivity of the stock which means more of the catch has to be discarded. Discarding is costly as it costs money to catch fish that are not landed.

So there are many ways to ‘climb back the productivity curve’ but some are only effective at protecting stocks while others are effective at protecting stocks and fishermen.



So there are many ways to 'climb back the productivity curve' but some are only effective at protecting stocks while others are effective at protecting stocks and fishermen.

As fishing increases costs increase and revenue increases but as biomass declines and catch rate is reduced the cost per effort increases and the profit margin is squeezed. New management measures are critical at this stage. Importantly where the total effort is not limited effort will increase to a point where profits become very marginal. This is more likely where there is no limit on the number of boats in the fishery (open access) where nobody can afford to cut back in the knowledge that others might take their place. This point is usually referred to as open access equilibrium(OAE). At this point operations fail economically and there is a loss on investment. Temporary changes in price of fish or changes in fishing costs may change the situation slightly but the remaining operations are very exposed to small variations in price, costs and catch rate.

Approaches in Ireland to maintaining shellfish stocks at Bmsy

- Scientific evidence
  - Dependent on industry data
  - Increasing use of surveys in some stocks
  - Assessments will be increasingly in the context of MSY indicators in the future
- Harvest Control Rules
  - Reliance on Technical measures
  - Some use of TAC
    - At stock level (cockle, clam)
    - At vessel level (razor clam)
  - Generally no effort control
  - Economic viability is poorly incorporated

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In Ireland we rely on industry data for assessment of stocks although we also survey for some species.

For management we rely on technical measures to the detriment of profitability of fishing. It is likely that in many fisheries there is 'wasted effort' and that the same catch could be taken at lower effort and at lower costs.