

# **Maximum Sustainable Yield & Maximum Economic Yield**

# Introduction

- In population ecology, Maximum Sustainable Yield (MSY) or surplus production is the highest theoretical equilibrium yield that can be continuously taken (on average) from a stock under existing environmental conditions without affecting significantly the reproduction process.
- The MSY is also called as Potential yield.
- Maximum Economic Yield (MEY) also called as economic optimal catch when relating total resources from fishing to total fishing effort in surplus production model, the value of largest positive difference between total revenues and total costs fishing with all input valued at their opportunity costs.

## Concept of MSY

- Fundamental to the notion of sustainable harvest, the concept of MSY aims to maintain the population size at the point of maximum growth rate by harvesting the individuals that would normally be added to the population, allowing the population to continue to be productive indefinitely.
- Under the assumption of logistic growth, resource limitation does not constrain individuals' reproductive rates when populations are small, but because there are few individuals, the overall yield is small.
- At intermediate population densities, also represented by half the carrying capacity, individuals are able to breed to their maximum rate.

## Concept of MSY

- At this point, called the maximum sustainable yield, there is a surplus of individuals that can be harvested because growth of the population is at its maximum point due to the large number reproducing individuals.
- Above this point, density dependent factors increasingly limit breeding until the population reaches carrying capacity.
- At this point, there are no surplus individuals to be harvested and yield drops to zero.
- The maximum sustainable yield is usually higher than the optimum sustainable yield and maximum economic yield.

## Concept of MSY

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- MSY is based on a simple and easily understood concept of how a stock reacts to fishing. It is calculated on a simple physical measure. i.e., weight of fish caught.
- In a steady state fishery, biomass declines as effort increases. The effort level corresponding to MSY being referred as FMSY. FMSY is used as biological reference point.
- MSY and FMSY could be estimated by surplus production models and by prediction models (Refer chapter on surplus production and prediction models)

## **Merits and demerits of MSY**

- MSY has been especially influential in the management of renewable biological resources such as commercially important fish.
- Maximum sustainable yield (MSY) is the largest average catch that can be captured from a stock under existing environmental conditions.
- MSY aims at a balance between too much and too little harvest to keep the population at some intermediate abundance with a maximum replacement rate.
- The main demerits are usually at MSY, the catch rate, mean size of fish, and biomass are too low, and sometimes the recruitment may become less regular as FMSY is approached.

## **Merits and demerits of MSY**

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- Because of this, there will be poorer recruitment than average recruitment year. This will have a significant impact on fishing industry.
- In such cases, if total allowable catch is practiced by a quota, there will be chances of heavy overfishing.
- According to economists, the physical maximum yield does not make economic sense because the total catch increases very little with a greater increase in fishing effort near the maximum.
- There will be high cost in effort with relatively little increase in yield.

## **FMSY & FMAX**

- In maximum Economic Yield, the catch at this level will be less than open access catch on MSY by the economic rent to the industry i.e. produces surplus will be at its maximum.

## **Limitations of MSY approach**

- Although it is widely practiced by state and federal government agencies regulating wildlife, forests, and fishing, MSY has come under heavy criticism by ecologists and others from both theoretical and practical reasons.
- The concept of maximum sustainable yield is not always easy to apply in practice.
- Estimation problems arise due to poor assumptions in some models and lack of reliability of the data. Biologists, for example, do not always have enough



## **Limitations of MSY approach**

- Biologists, for example, do not always have enough data to make a clear determination of the population's size and growth rate.
- Calculating the point at which a population begins to slow from competition is also very difficult.
- The concept of MSY also tends to treat all individuals in the population as identical, thereby ignoring all aspects of population structure such as size or age classes and their differential rates of growth, survival, and reproduction.

## Limitations of MSY approach conted....

- catch that can be taken year after year) is generally not appropriate because it ignores the fact that fish populations undergo natural fluctuations (i.e., MSY treats the environment as unvarying) in abundance and will usually ultimately become severely depleted under a constant-catch strategy.
- Thus, most fisheries scientists now interpret MSY in a more dynamic sense as the maximum average yield (MAY) obtained by applying a specific harvesting strategy to a fluctuating resource.

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