GLOSSARY

FISHERIES SCIENCE TERMS AND ACRONYMS

Biological Reference Points (BRP): Theoretical levels of fishing mortality and/or biomass that serve as threshold rates (F) or states (biomass) to be avoided (limit reference point, LRP) or maintained (target reference point, TRP).

B0: The average spawning biomass in the absence of fishing, usually derived based on steady-state (equilibrium) assumptions about population dynamics.

BMSY: The biomass level producing maximum sustainable yield (MSY) at equilibrium. Can be achieved by fishing at a constant rate F = FMSY.

Cohort: A group of fish born at the same time.

Coefficient of variation (CV): A measure of relative uncertainty for a quantity of interest. Defined as the standard deviation (SD) divided by the mean.

Depletion: The amount of biomass remaining relative to the average unfished level (B0, defined above). Lower values of depletion mean lower biomass.

Fishing mortality rate (F): Continuous annual rate of loss of fish from a population due to fishing. F is usually reported for most selected ages(s) or length(s), but occasionally as an average over an age range that is vulnerable to the fishery. In discrete terms, F = 0.225 per year corresponds to a total annual harvest rate of 20% or a survival rate from fishing of 80%.

FMSY: The fishing mortality rate resulting in equilibrium biomass of BMSY and, therefore, a yield corresponding to the maximum sustainable yield (MSY). The particular value of FMSY depends mainly on natural mortality, stock-recruitment productivity, and the difference between the ages at maturity and selection by the fishery.

Harvest control rule (HCR): Quantitative rules used to translate stock assessment outputs of stock status into fishing regulations such as fishery openings and harvest quotas. Common HCRs prescribe levels of fishing mortality (F) for a range of values of estimated stock biomass levels. The specific forms of HCRs are defined by operational control points (OCPs).

Maximum sustainable yield (MSY): A theoretical quantity expressing the largest annual catch that could be taken annually (and indefinitely) from a stock under steady-state ecological and environmental conditions.

Management procedure (MP): A specific rule for translating routine monitoring data into fishing regulations. Typically involve data collection, stock assessment models, and harvest control rules.

Management Strategy Evaluation (MSE): An iterative process for designing robust fishery management systems. Combines stakeholder engagement with computer modeling frameworks consisting of: (1) quantitative objectives, (2) an operating model representing natural dynamics of fish population(s), fisheries, and monitoring system errors; (3) alternative management procedure options, and (4) performance indicators quantifying the degree to which management procedures meet the objectives.

Natural mortality rate (M): continuous annual rate of loss of fish from a population due to predation, disease, cannibalism, etc. In discrete terms, M = 1.4 per year corresponds to a total annual loss of 63% or a survival rate of 27%.

Objectives: Statements about fishery characteristics that people care about the most and that all warrant consideration. Example statements might take forms such as, "maintain spawning biomass above BMSY", "maximize fishing opportunities", "maximize spawning habitat occupancy", "meet FSC fishery goals", etc.

Operational control point (OCP): Levels of estimated biomass and/or fishing mortality used to define a harvest control rule (HCR). In practice, OCP are estimated by stock assessment models.

Operating model (OM): Quantitative simulation model representing fish population dynamics (recruitment, mortality, growth, movement, etc). OMs are used to test robustness of management procedures under alternative hypotheses for population dynamics.

Performance indicators (PI): Quantitative measures derived from computer simulations, used to evaluate MP performance against specific Objectives. A PI for "maximize fishing opportunities" could be the proportion of years that a simulated fishery is open.

Projection: An simulation of the future state of the fish population under a specific operating model (OM) scenario.

R0: The average level of annual recruitment when the spawning stock biomass is at B0.

LANDMARK

Recruits/recruitment: A group of fish entering the population (or spawning population, or fishery) in the same year. Recruitment usually refers to new members entering a fish population at the same age (for herring, this age = 2 years). Recruitment is reported at a specific life stage, often age 0 or 1, but sometimes corresponding to the age at which the fish first become vulnerable to the fishery.

Recruitment deviation: The difference (on logarithmic scale) between the recruitment in a given year and the stock-recruitment relationship.

Simulation: A computer-based model of a fish population, fishery, and decision-making system. Simulations provide an environment for testing expected MP performance under non-equilibrium conditions.

Simulation replicate: Simulation model output under a single set of assumptions and model parameter values drawn at random from a set of statistical distributions.

Standard deviation (SD): A measure of absolute variability within a sample.

Stock assessment: A quantitative analysis for interpreting observed fishery data given assumptions about fish population dynamics and the forms of observational errors. Typical outputs are estimates of biomass, recruitment, fishing mortality, and current status for a fish population.

Trajectory: A single time series of annual (historical and future) values for any metric relevant to a fish population or fishery. Typically includes biomass, recruitment, harvest rate, and catch.
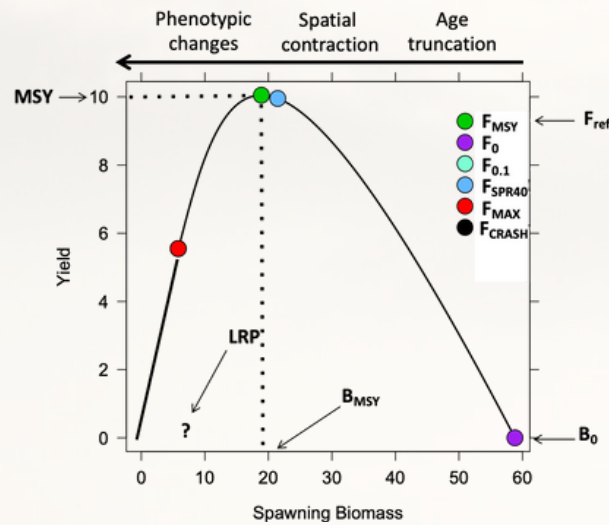
Figure 2. Equilibrium yield (surplus production) curve, illustrating the relationship between potential yield and spawning biomass. This relationship provides the theoretical basis for biological reference points related to fishing mortality and biomass (e.g. B_{MSY}, F_{MSY}, F_{ref}, and fractions of B_0).
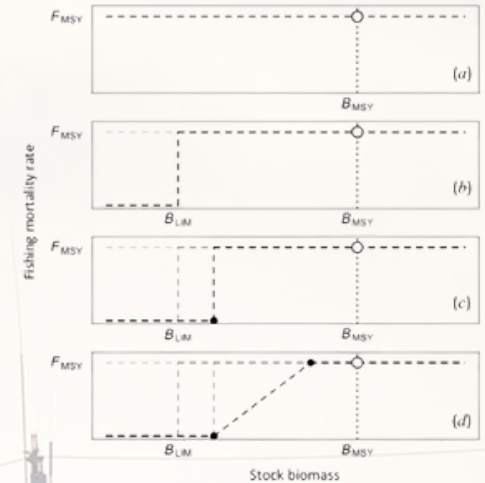
Figure 3. Evolution from equilibrium-based BRP to a harvest control rule based on OCPs. (a) F_{MSY}, B_{MSY} is the basis for most BRP used in management, (b) biological limit reference point B_{LIM} adopted to protect against possible stock collapse, (c) avoiding B_{LIM} with high probability in presence of stock assessment error and implementation uncertainty requires the first OCP (black circle), and (d) in some cases a second OCP is established at or below B_{MSY} to encourage more rapid recovery toward B_{MSY}. (Figure from Cox, Kronlund, Benson. 2013. Environmental Conservation 40(4): 318-328).

Figure 1. The management strategy evaluation cycle.