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Glossary of Terms

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GLOSSARY OF FISHERY TERMS

This Glossary of terms is largely a compilation from similar documents prepared by the International Commission for the Conservation of Atlantic Tunas, and the U.S. Pacific Fisheries Management Council. It is a general guide for definition of terms or acronyms commonly used in ISC documents.

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A

Abundance Index

A quantitative measure of fish density or abundance, usually as a time series. An abundance index can be specific to an area or to a segment of the population (e.g., large fish), or it can refer to abundance stock-wide; the index can reflect abundance in numbers or in weight (biomass). Most abundance indices currently used by the SCRS are based on standardized CPUE data, although fishery-independent abundance indices based on scientific surveys have also been used. Typically, abundance indices are in relative units (as opposed to measuring absolute abundance), and simply indicate relative changes in abundance over time.

ADAPT

A stock assessment computer model based on VPA and tuning of abundance indices. The underlying population model is age-structured. **(**

Age of Maturity

The age when 50% of the fish of a given sex are considered to be reproductively mature.

Age of Recruitment

The age when fish are considered to be recruited to the fishery. In stock assessments, this is usually the youngest age group considered in the analyses, typically age 0 or 1.

ASPIC

A stock assessment computer model based on Schaefer´s form of the production model, with non-equilibrium tuning of biomass-based abundance indices. The underlying population model is aggregated biomass

Asymptotic Length ($L\infty$)

The maximum size that fish of a given species could reach on average if they lived forever. Sometimes it is mistaken as representing the largest observed size for the species.

B

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Bx%

Threshold biomass (B) levels used to determine stock status. x% refers to the level of available biomass above the unfished biomass (size of fish stock without fishing).

Bo

Unfished biomass; the estimated size of a fish stock in the absence of fishing. (see Virgin Biomass)

Biological Reference Point (BRP)

A benchmark against which the abundance of the stock or the fishing mortality rate can be measured in order to determine its status. These reference points can be Limits or Targets, depending on their intended usage.

Biomass (B)

Refers to the abundance of the stock in units of weight. Sometimes, "biomass" refers to only one part of the stock (spawning biomass, exploitable biomass) but this distinction is not always made.

Biomass at MSY (Bmsy)

A biological reference point. This is the long-term average biomass value expected if fishing is at F_{MSY}

By-catch

Catch of species other than the intended target species in a fishing operation. Bycatch can either be discarded or landed.

C

Catch (C)

The total number of fish caught by fishing operations (sometimes "catch" is used to denote the weight of fish caught). Catch should pertain to all fish killed by the act of fishing, not just those fish that are landed.

Catch-at- Age

The estimated number of fish caught, tabulated by fish age and year of capture (and by other strata such as gear or nation). Catch at age is typically estimated for tunas and billfishes using age-length keys or cohort slicing.

Catch-at-Size

The estimated number of fish caught, tabulated by size class and by other strata such as gear, nation and quarter. Catch at size is typically estimated for tunas and billfishes using size composition samples from catches.

Catchability (q)

The fraction of the stock which is caught by a standardized (effective) unit of effort. It is also used as the constant of proportionality that relates effective effort to fishing mortality (q x f = F) or as the constant of proportionality that relates an index of abundance to absolute stock size (I = q x N). Catchability is affected by fish availability. Thus, specific climatic conditions may result in increased or decreased availability of the fish. This would lead to increased availability of the fish affecting catchability and, thus, increased (decreased) fishing mortality rate with the same fishing effort.

Catch per Unit Effort (CPUE)

The amount of catch that is taken per unit of fishing effort (e.g., number of fish per lingline hook-month). Nominal CPUE is often used as a measure of the economic efficiency of a type of gear. Standardized CPUE is normally used as an abundance index for "tuning" or fitting assessment models. Sometimes referred to as **catch rate.**

Catch Rate

See **Catch per Unit Effort.**

Cohort

Fish born in the same time period, usually a year. For instance, the 1987 cohort would refer to fish that are age 0 in 1987, age 1 in 1988, and so on.

E

Effective Effort

Measures of fishing effort such as hooks per day of fishing that have been standardized so that the measure is proportional to the fishing mortality rate that the gear (s) impose on the stock of fish. Controls purported to limit effective effort imply that the fishing mortality rate is to be limited.

Effort (Fishing Effort, f)

A measure of the intensity of fishing operations. How fishing effort is defined depends on the type of fishery (gear) and often on the type of information available. For longline fisheries, effort is usually defined in units of number of hooks or in hook-hours. For purse-seine fisheries, effort is often defined as days fished (time fishing plus search time)

Exploitable Biomass

Refers to that portion of a stock's biomass that is available to the fishing gear.

Exploitation pattern

The distribution of fishing mortality over the age composition of the fish, determined by the type of fishing gear and spatial and seasonal distribution of fishing, and by the growth and migration of the fish. In other words, it is the combined effect of gear selectivity and fish availability. The pattern can be changed by modifications to fishing gear: for example, by increasing mesh or hook size or by changing the ratio of harvest by gears exploiting the fish (e.g.,

gill net, trawl, hook and line). The pattern can also change due to changes in fishing practices such as avoidance of areas where juveniles reside.

Exploitation Rate

The proportion of a stock at the beginning of a given time period that is caught during that time period (usually expressed on a yearly basis). For example, if 220,000 fish were caught during the year from a stock of 1 million fish alive at the beginning of the year, the annual exploitation rate would be 0.22.

F

$F_{0.1}$

A biological reference point. This is the fishing mortality rate at which the increase in equilibrium yield per recruit in weight for an increase in a unit of effort is 10% of the yield per recruit produced by the first unit of effort on the unexploited stock (i.e., the slope of the yield per recruit curve for the $F_{0.1}$ rate is only $1/10^{th}$ of the slope of the yield per recruit curve at its origin). Originally, $F_{0.1}$.was intended as an economic reference point, measuring where additional investment into effective fishing effort would produce a 10% marginal gain in yield per recruit. It later evolved into a conservative reference point for yield optimization because $F_{0.1}$ results in almost as much yield per recruit as F_{Max} does, but at lower levels of fishing mortality.

F= 0

Fising mortality equals zero (no fishing).

Fmax

A biological reference point. This is the fishing mortality rate that maximizes equilibrium yield per recruit. F_{MAX} is the fishing mortality rate that defines growth overfishing. In general, F_{Max} is different than F_{MSY} (F that maximizes sustainable yield), and is usually higher than F_{MSY}, depending on the stock-recruitment relationship. By definition, F_{Max} is always higher than $F_{0.1}$**.**

Fmed

A biological reference point. This is the fishing mortality rate corresponding to an equilibrium SPR equal to the inverse of the median observed survival ration (ratio of recruits to parental spawning biomass). That is, a stock exploited indefinitely at F_{med} should be able to replace itself with an abundance close to the observed historical median**.**

F_{MSY}

A biological reference point. This is the fishing morality rate which, if applied constantly, would result in Maximum Sustainable Yield (MSY). F_{MSY} can be estimated in two ways: (1) From simple (biomass-aggregated) production models (e.g., ASPIC, PRODFIT) and (2) from age-structured models that include a stock-recruitment relationship (e.g., ASPM**).**

fpt (f_{MSY})

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A biological reference point. This is the effective fishing effort corresponding to F_{MSY}. F_{opt} is often reported as one of the main outputs of production models.

$F_{x\%}$($F_{x\%spr}$)

A family of biological reference points. $F_{x\%}$ denotes the fishing mortality that will reduce the equilibrium spawning potential per recruit to x% of what it would be without any fishing (or, equivalently, it is the F that results in x% equilibrium spawning potential ratio). Reference points of this kind are often used as proxies to other biological reference points that require more information about the relationship between stock and recruitment. For example, based on simulation studies for ground fish stocks, $F_{20\%}$ has been recommended as a default proxy for recruitment overfishing and $F_{35\%}$ as a proxy for F_{msy}

Fecundity

The number of eggs produced on average by a female of a given size/age. Fecundity information is often used to compute spawning potential.

Fish Aggregating Device (FAD)

Artificial or natural objects place on the surface that attract several species underneath, thus increasing their catchability.

Fishing Mortality Rate (F)

Portion of the total mortality rate that is due to fishing. Fishing mortality is usually expressed as an instantaneous rate, as discussed under Mortality Rate, and can range from 0 per year (for no fishing) to high values such as 1.0 or more per year. Fishing mortality should reflect all deaths in the stock that are due to fishing, not just those fish that are actually landed. It is common practice to refer to F as a scalar value but it would be more appropriate to refer to it as a vector. That is, it is important to consider how F is distributed among age groups (i.e. what the exploitation pattern is). For instance, and F value of 0.5 for a stock exploited by purse seines that target small fish would have very different consequences than an F=0.5 for the same stock exploited by longlines targeting large fish. Sometimes referred to in "shorthand" as **Fishing Mortality.**

Fishing Pattern

See Exploitation Pattern. Sometimes this term is also used in reference to the way in which fishing operations are conducted.

Fishing Power

Refers to the efficiency of a fishing unit, usually a vessel, in capturing fish. The fishing power of individual fishing units can change over time (typically increasing) in response to technological developments in fishing gear, engines or sonar equipment, and adjustments to fishing practices.

Fish Stock

This term usually is used to imply that the particular stock is more or less isolated from other stocks of the same species, and hence, self-sustaining and from which catches are taken in a fishery.

Fork length (FL)

A fish size measurement. Projected straight distance measurement from the tip of the fish's snort to the fork of the tail.

Fully Exploited

This term is usually used to indicate that the stock is not being over-exploited nor underexploited. This can be interpreted in an equilibrium yield sense as fishing at F_{MSY}, or in a yield-per recruit sense as fishing at F_{max}.

I

Incidental catch (or species)

Catch or species caught when fishing for the primary purpose of catching a different species.

L

Limit Reference Point

A benchmark that should not be exceeded with any significant probability according to a given set of management objectives. According to the UNIA, F_{MSY} should be a limit reference point.

M

Maturity

Refers to the ability, on average, of fish of a given age/size to reproduce. Maturity information, in the form of percent mature by age/size, is often used to compute spawning potential.

Maximum Sustainable Yield (MSY)

The largest average yield (catch) that can be taken in the long-term from a stock and corresponds to the yield expected when fishing at F_{msy}.

Minimum Size

A fishery management control measure intended to minimize the catches of small fish. Such a measure is often based on yield-per-recruit considerations such as avoiding growth overfishing, and aimed at altering the exploitation pattern so that young fish are given a better chance to grow before becoming vulnerable to fishing.

Mortality Rate (instantaneous)

Fraction (e.g. 0.3 or 30%) of fish dying in a year from different causes, such as fishing or natural factors. Because fishing and natural mortality happen continuously throughout the year, it is not straightforward to use these fractions in an additive way. Expressing these processes as instantaneous rates (i.e. as the fractions that die in infinitesimal periods of time) facilitates the stock assessment analysis computations on an annual basis, even when the catches take place daily. Instantaneous mortality rates of 0.1, 0.5 and 1.0 are equivalent to 10%, 39% and 63% mortality.

MULTIFAN-CL

A stock assessment computer model with length-based separable models and tuning of abundance indices. The population model is length/age-structured.

N

Natural Mortality Rate (M)

That portion of the total mortality rate that is due to causes other than fishing (e.g., predation, disease, cannibalism, and perhaps increasingly, environmental degradation such as pollution). These causes of death are usually lumped together for convenience, because they are difficult to separate quantitatively. Sometimes natural mortality is confounded with losses of fish owing to emigration.

Nominal

Refers to quantities as they are reported, before any analyses are performed to transform/standardize them. Nominal catch is the sum of catches that have been reported as round weight or, equivalent, the landings (nominal catches do not include such measures as unreported dead discards). Nominal effort pertains to measures of fishing effort or vessel carrying capacity that have not been standardized. When catchability changes, e.g., through changes in gear technology or operations, trends in nominal effort can give a misleading picture of trends in exploitation.

Numbers at age (N)

The number of fish in each age class in the stock at a particular point in time. Age-structured assessment models aim at estimating these quantities.

O

Overfished

Overfished means that the abundance of the stock is “too low,” and whose size is sufficiently small to warrant rebuilding. This term is used for a condition in which the estimated stock biomass is below a limit biological reference point that is used as the signpost for declaring an ‘overfished condition”.

Overfishing

This term generally means that the fishing mortality being exerted on the stock is "too high," and jeopardizing the capacity of the stock to produce a level of sustainable catch, e.g., MSY. This term is typically used when estimated F is above a limit biological reference point that is used as the signpost that defines "overfishing". Usage of the term is not limited to "growth overfishing" situations: it can also be used when there is recruitment overfishing or other types of overfishing.

P

Population

A group of fish of one species which shares common ecological and genetic features. The stocks defined for the purposes of stock assessment and management do not necessarily coincide with self-contained populations.

Production Model

A population model with simple mathematical functions that depict how the population biomass changes from year to year (or, how biomass changes in equilibrium as a function of fishing mortality). The simplest production model aggregates all of the biological characteristics of growth, natural morality and reproduction into a simple, deterministic function using three or four parameters. Production models are primarily used in simple data situations, where total catch and effort data are available but age-structured information are either unavailable or deemed to be less reliable (although some versions of production models allow the use of age structured data). **)**

R

Recruitment

The amount of fish that first become vulnerable to the fishery each year due to growth and/or migration into the fishing area.

Replacement Yield

The amount of yield in weight that can be removed from a population of fish and have that stock neither increase nor decrease in biomass. When the population productivity is high under proper exploitation, then replacement yield will also be high. Conversely, when the population productivity is low, replacement yields will be low. In either case, if the actual yield removed is equal to the replacement yield, then the biomass will not change from one year to the next.

S

Selectivity

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The relative vulnerability of different age or size classes to the fishing gear. Selectivity and exploitation pattern are often used interchangeably.

Spawning Potential Ratio (SPR)

The ratio of spawning potential per recruit under a given fishing regime relative to the spawning potential per recruit with no fishing (also know as %MSP for Maximum spawning Potential). SPR's require information on natural mortality, growth, spawning potential at age and the relative vulnerability by age to fishing. If possible, spawning potential per recruit, but often spawning stock biomass per recruit (SSB/R see below) is an appropriate substitute. SPR and SSB/R are simple extensions to yield per recruit (see below) in that there are two ways in which recruitment can be evaluated. If recruits are caught, they become part of the yield (yield per recruit). If they are not caught and survive, they are part of the SPR, SSB/R. SPR is expressed as a ratio of a fished condition to an unfished condition, thus the ratio varies from 0 to 1. Additionally, empirical studies have shown that from some populations SPR's in the order of 20% to 30% may run the risk of recruitment declines, thus there is a basis of comparison between populations. Therefore, F X%SPR fishing mortality rates are sometimes used as biological reference points

Spawning Stock Biomass (SSB)

The total weight of sexually mature fish in the population (usually males and females combined, but sometimes refers to only females). This quantity depends on the abundance of year classes, the exploitation pattern, the rate of growth, both fishing and natural mortality rates, the onset of sexual maturity, and environmental conditions.

Spawning stock biomass per recruit (SSB/R)

The expected lifetime contribution to the spawning stock biomass of an average recruit to the fishery. For a given exploitation pattern, rate of growth, maturity schedule and natural mortality, and equilibrium value of SSB/R can be calculated for any level of F. SSB/R decreases monotonically with increasing F.

Stock

The term has different meanings. In general, a stock is a biological unit of one species forming a group of similar ecological characteristics and, as a unit, is the subject of assessment and management. However, there are many uncertainties in defining spatial and temporal geographical boundaries for such biological units that are 100% compatible with established data collection and geopolitical systems. For this reason, the term stock is often synonym with assessment/management unit, even if there is migration (mixing) of the same species to and from adjacent areas.

Spawner-Recruit Relationship (S-R relation)

A function that describes how recruitment varies with changes in the reproductive output (or biomass) of the parental stock. Two common forms are the Beverton-Holt and the Ricker relationships. The spawner-recruit relationship is particularly important for understanding sustainability of a stock with alternative harvesting regimes. Some stock assessment models incorporate a spawner-recruit relationship directly into the model, either explicitly (e.g. some age-structured assessments) or implicitly (most stock production models**).**

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Stock Structure

Refers to the geographical boundaries of the stocks assumed for assessment and management purposes (e.g., EPO and WPO stocks), or to boundaries that define self-contained populations in a genetic sense.

T

Target Fishing

Fishing for the primary purpose of catching a particular species or species group (the target species).

Terminal F

Refers to fishing mortality values in the last year for which data are available in a stock assessment.

Total mortality rate (Z)

The sum of natural and fishing mortality rates.

V

Virgin

Refers to an unfished condition of the stock in an equilibrium sense. For instance, Virgin Biomass is equivalent to the stock's carrying capacity.

Virgin biomass (B_0)

A biological reference point. This is the long-term average biomass value expected in the absence of fishing mortality. In production models, B_0 is also known as carrying capacity.

Virtual Population Analysis (VPA)

A stock assessment model with functions for computing historical fishing mortality rates and stock sizes by age, conditioned on catches, natural mortality, and certain assumptions about mortality for the last year and last age group. A VPA essentially reconstructs the history of each cohort, assuming that the observed catches are exact and known without error.

Y

Yield per Recruit (Y/R)

The expected lifetime yield for the average recruit. For a given exploitation pattern, rate of growth, natural mortality rate, and equilibrium condition, Y/R can be calculated for each level or F.