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Biological Reference Points for Use by ISC¹

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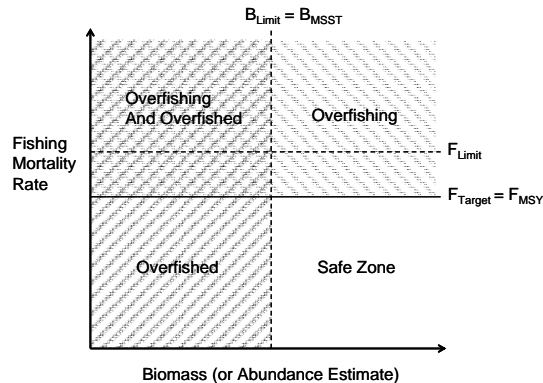
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What are Biological Reference Points and why do we need them?

Biological reference points (BRPs) are stock-specific benchmarks that are essential for application of the precautionary approach to fishery management. For HMS, typically stock abundance and fishing mortality rate (e.g. B_{MSY} , F_{MSY} , $F_{0.1}$) BRPs are computed for each stock and compared to current levels of stock abundance and fishing mortality rate in order to determine the stock's relative health. Because BRPs are linked to stock production, they provide a means of quantitatively measuring the effect of fishing on the stock and for determining desired level of stock maintenance. The FAO Code of Conduct for Responsible Fisheries identifies two categories of BRPs, target reference points and limit reference points, each having specific roles in determinations of stock status.

Figure 1 illustrates the relationship between fishing mortality rate and abundance, and how the target and limit values are used to determine overfishing, overfished and safe status of an exploited stock.

Figure 1. Schematic illustrating the use of management reference points.



What are target reference points?

Target reference points are benchmarks intended to achieve management objectives, and represent desirable outcomes to be attained (e.g., optimum yield). They should not be exceeded on average, or more than 50% of the time. Examples are:

- MSY maximum sustainable yield
- F_{MSY} fishing mortality rate associated with maximum sustainable yield
- B_{MSY} stock biomass associated with maximum sustainable yield
- SSB_{MSY} spawning stock biomass associated with maximum sustainable yield

$F_{0.1}$	F_{MSY} proxy reference point defined by a line having a slope 0.1 times that of the yield per recruit (Y/R) curve near the origin (yields near maximum Y/R with significantly less effort than needed to achieve maximum Y/R)
$B_{0.1}$	associated stock biomass
$SSB_{0.1}$	associated spawning stock biomass
$F_{30\%}$	fishing mortality rate producing 30% of the maximum spawning potential in the absence of fishing
$B_{30\%}$	associated stock biomass
$SSB_{30\%}$	associated spawning stock biomass
$F_{40\%}$	fishing mortality rate producing 40% of the maximum spawning potential in the absence of fishing
$B_{40\%}$	associated stock biomass
$SSB_{40\%}$	associated spawning stock biomass

What are limit reference points?

Limit reference points are benchmarks intended to constrain harvests so that the stock remains within safe biological limits. The probability of exceeding limit reference points should be low, i.e. close to zero. When a limit reference point is exceeded, it triggers significant limitations on the fishery in order to rebuild the stock. Examples of limit reference points are:

$F_{20\%}$	fishing mortality rate producing 20% of the maximum spawning potential in the absence of fishing
$SSB_{20\%}$	associated spawning stock biomass
F_{MAX}	fishing mortality rate that yields maximum yield per recruit
SSB_{MAX}	associated spawning stock biomass
$F_{SSB-Min}$	fishing mortality rate that prevents the SSB from declining below the minimum observed SSB
SSB_{Min}	associated spawning stock biomass
$F_{SSB-10th}$	fishing mortality rate that prevents the SSB from declining below the 10th percentile of observed SSB
SSB_{10th}	associated spawning stock biomass
$F_{SSB-25th}$	fishing mortality rate that prevents the SSB from declining below the 25th percentile of observed SSB
SSB_{25th}	associated spawning stock biomass

What BRPs are used by international HMS organizations in the Pacific area?

International HMS organizations have traditionally been chartered with Maximum Sustainable Yield (MSY)-linked conservation goals. As a result, they lean towards MSY-based target reference points.

The **IATTC** has not formally adopted specific target or limit reference points for management. Because its charter references **MSY**, **MSY** or the Average Maximum Sustainable Yield (**AMSY**) has traditionally been estimated and used for consideration in management decisions. Recently, the IATTC staff has also provided, whenever possible, estimates for several other potential biological reference points, such as F_{AMSY} , **SBR** ($SSB_{x\%}$), critical weight producing maximum **Y/R**, etc., as outputs of its stock assessments. These BRPs are used by the staff in communicating advice on status of the stocks.

The **WCPFC** has recently (2004) been established and has not yet addressed this matter of BRPs. Nonetheless, the Scientific Committee of the WCPFC provides estimates of several potential biological reference points for each of the key stocks that are monitored. This Committee has largely used **MSY**-based BRPs in its evaluation of stock condition.

The **ISC** has not formally adopted specific BRPs to use for management purposes. As of December 2005, its **ALBWG** has explored using a number of potential reference points, including SSB_{min} as a limit reference point. However, the Working Group called for further research on the topic and requested input from the fishery managers on desired outcomes with respect to the management of the fisheries before an appropriate BRP can be selected.

What are some questions that need addressing when considering appropriate BRPs for the ISC stocks?

The process for considering appropriate BRPs for the ISC stocks requires involvement of both scientists and fishery managers. Each group will have a specific role (as explained in the **ALBWG** report, November 28-December 2, 2005), but will need to work collaboratively in the process. The following are example questions that provide a picture of the different roles of the two groups.

What technical considerations should the scientists address in estimating potential BRPs?

- What BRPs can be estimated from the available data and assessment methods?
- Are the candidate BRPs robust enough for use over the assessment time period, and under changing environmental or anthropogenic conditions?

What objectives do the managers wish to achieve?

- To maintain stock levels at some level above a minimum historic catch or biomass level? And if so, with what probability?
- To maintain fishing pressure at or below some historic or current level?
- To maintain abundance at or above some fraction of the virgin abundance level (i.e. use a $B_{x\%}$ reference point)?