

SOME EXAMPLES OF LIMIT REFERENCE POINTS¹

Reference Point	Description	Some Pros	Some Cons
$X\% B_{MSY}$ $X\% SSB_{MSY}$	A percentage (X) of the biomass (B) or spawning stock biomass (SSB) that is obtained on average from fishing at rates associated with maximum sustainable yield (MSY)	<p>Takes into account various components of productivity;</p> <p>Many proxies have developed over the years;</p> <p>DFO's PA Policy gives a provisional default LRP of 40% B_{MSY} (other jurisdictions have policy defaults ranging from 30-50% B_{MSY})</p>	<p>May be difficult to estimate;</p> <p>Sensitive to uncertainty in model assumptions concerning recruitment (e.g. steepness), natural mortality rate, selectivity, etc;</p> <p>Relationship between B_{MSY} and B_0 depends on model assumptions</p>
$X\% B_0$ (or K)	A percentage (X) of the biomass (B) or spawning stock biomass (SSB) under conditions of no fishing; sometimes 'carrying capacity' (K) is used	<p>May be more estimable than B_{MSY} for data-poorer stocks;</p> <p>Provisional policy defaults available in other countries (e.g., 20% B_0);</p> <p>40-50% B_0 are common generic proxies for B_{MSY} (although 30-60% can be used)</p>	<p>May be difficult to estimate;</p> <p>Sensitive to uncertainty in model assumptions (e.g. steepness, natural mortality rate)</p>
Y% Equilibrium B at $F_{X\%SPR}$	A percentage (Y) of the equilibrium biomass (B) at a level of fishing mortality (F) that allows the stock to maintain X% of its maximum spawning potential (i.e. X% spawning potential ratio) that would have been obtained with no fishing	<p>Used as a reference point for recruitment overfishing;</p> <p>Requires fewer assumptions or data (e.g., stock-recruitment relationship is not required);</p> <p>$F_{40\%SPR}$ is a common proxy for F_{MSY} (the equilibrium biomass is therefore a proxy for B_{MSY})</p>	<p>Sensitive to uncertainty in model assumptions (e.g., "assumed" resilience, natural mortality rate);</p> <p>Dynamic pool-type reference points like SPR may not be suitable for stocks with complex spatial structure (e.g., invertebrates)</p>

¹ Adapted from Pew Charitable Trusts (2016) Reference Points: Measuring Success in Fisheries Management. 8 pp.

Reference Point	Description	Some Pros	Some Cons
B at X% R_{\max}	Biomass (B) associated with a percentage (X) of virgin or maximum recruitment, either modelled or non-parametrically estimated	Used as a reference point for recruitment overfishing; R_{\max} estimated from a Ricker stock-recruitment relationship is sometimes used as a proxy for B_{MSY}	Dependent on stock-recruitment relationship (including data on recruitment at low stock sizes); May be dangerously low for stocks with high steepness
B_{loss} , B_{recover}	Lowest biomass (B) observed historically, and generally from which recovery has been observed	Useful for data-poorer stocks; Not influenced as strongly by model assumptions	Values may vary widely among stocks (they may not “scale” with stock biology); Assumption of possible recovery in future depends on prevailing conditions
Empirical LRPs	Expressed in something that can be measured directly (catch, CPUE, survey index or indices)	Useful for data-poorer stocks; Can be easier to understand, cheaper to use, and remain effective for management; Some historical proxies possible for B_0 , B_{MSY}	May be harder to link to desired management outcomes in some cases; Assumptions around quality of indicator in relation to stock attributes may be key