

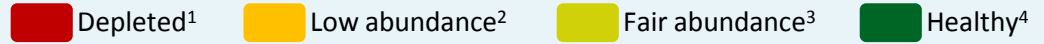


Appendix 2

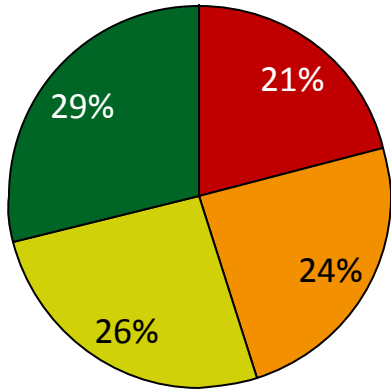
Global State of Stocks

Different weighting systems portray substantially different pictures of stock health

Assessed stocks

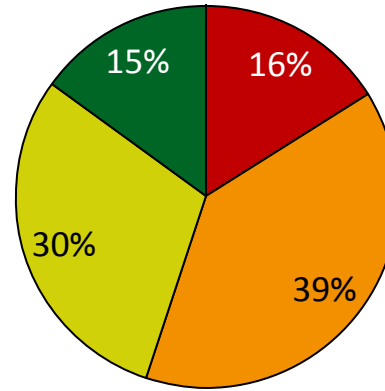


By number of stocks (most common system)



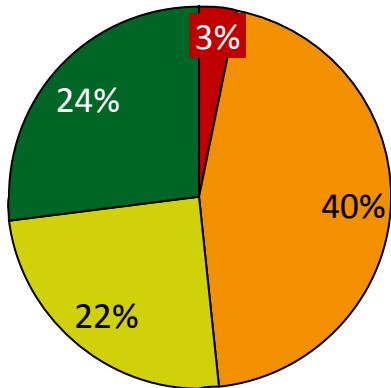
- Appropriate if we assume that all stocks should be treated equally – perhaps the right frame from a biodiversity perspective?
- This weighting system is best used to evaluate impact on biodiversity

By B_{MSY}



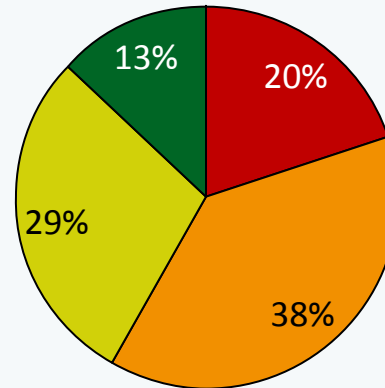
- Weighting stocks by B_{MSY} gives a sense of the state of the world, relative to its more natural conditions:
 - A substantially higher fraction of landings are at low abundance
 - An appropriate lens if food security is the objective function, as it gives perspective on “potential loss” in catch as a result of overfishing

By current catch weight



- Weighting by current catch weight gives a predictable result: we don't catch much fish from depleted stocks: However we do catch a lot of fish from populations at low abundance, which is a troubling sign

By maximum catch weight



- Since B_{msy} data is unavailable for most species, weighting each stock by their max. catch is a useful proxy for that can be applied to all stocks
 - The landings picture is very similar to the B_{MSY} approach; and much worse than treating each stock equally

1) $B/B_{MSY} < 0.4$ 2) B/B_{MSY} between 0.4 and 0.8 3) B/B_{MSY} between 0.8 and 1.2 4) $B/B_{MSY} > 1.2$

In assessing global stock status, we face a trade-off between good data and the amount of data

| Source | Methodology | % of world fisheries (tons) | Inherent representativeness | Quality of assessment | Problems |
|-----------------------------|---|-----------------------------|-----------------------------|-----------------------|--|
| FAO | <ul style="list-style-type: none"> Available quantitative data, supplemented by local knowledge | 70% | Fair to good | Fair to good | <ul style="list-style-type: none"> Qualitative assessments make comparability difficult Assessment rules are not transparent Impossible to replicate; current report is dated |
| Scientific stock assessment | <ul style="list-style-type: none"> Rigorous yield per recruit calculations based on age-structured models | 20-30% | poor | excellent | <ul style="list-style-type: none"> Greatly biased towards stocks with good management Available assessments limited to a handful of developed world countries |
| Historic landings | <ul style="list-style-type: none"> Current landings with respect to historical maximum catches | 100% | excellent | poor | <ul style="list-style-type: none"> References to maximum historical catches have little indicative power for current state of stocks Difficult to extrapolate for fisheries undergoing collapse, or being rebuilt for management reasons |
| CEA/UCSB | <ul style="list-style-type: none"> Stock assessments plus multivariate modeling for unassessed stocks with catch history being only one of the variables | 5-10% | good | good | <ul style="list-style-type: none"> Modeling based on assessed stocks might falsify results of un-assessed stocks if these two groups have different inherent characteristics that have a significant impact on the state of the stocks |

Unassessed stocks

Unassessed stocks

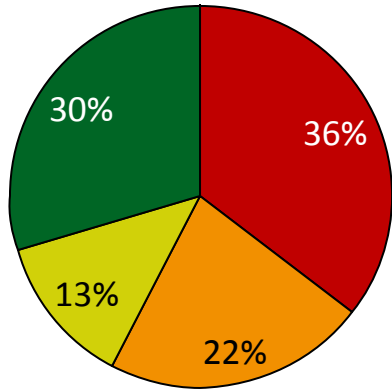
Depleted¹

Low abundance²

Fair abundance³

Healthy⁴

By number of stocks (most common system)



- A higher percentage of unassessed stocks than assessed stocks are either depleted or have low abundance

By B_{MSY}

B_{MSY} estimates are not available for unassessed stocks

Estimates by current catch weight are not currently available

Estimates by maximum catch weight are not currently available

By current catch weight

By maximum catch weight

1) $B/B_{MSY} < 0.4$

2) B/B_{MSY} between 0.4 and 0.8

3) B/B_{MSY} between 0.8 and 1.2

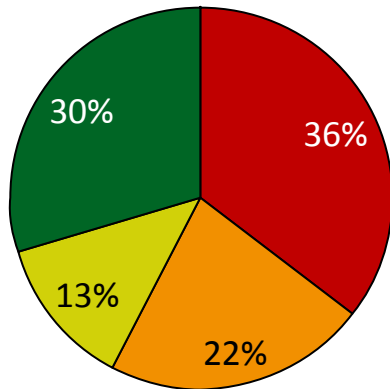
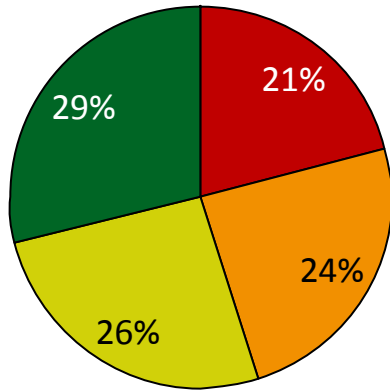
4) $B/B_{MSY} > 1.2$

Global unassessed stocks appear to be in worse shape than assessed stocks

Global stocks

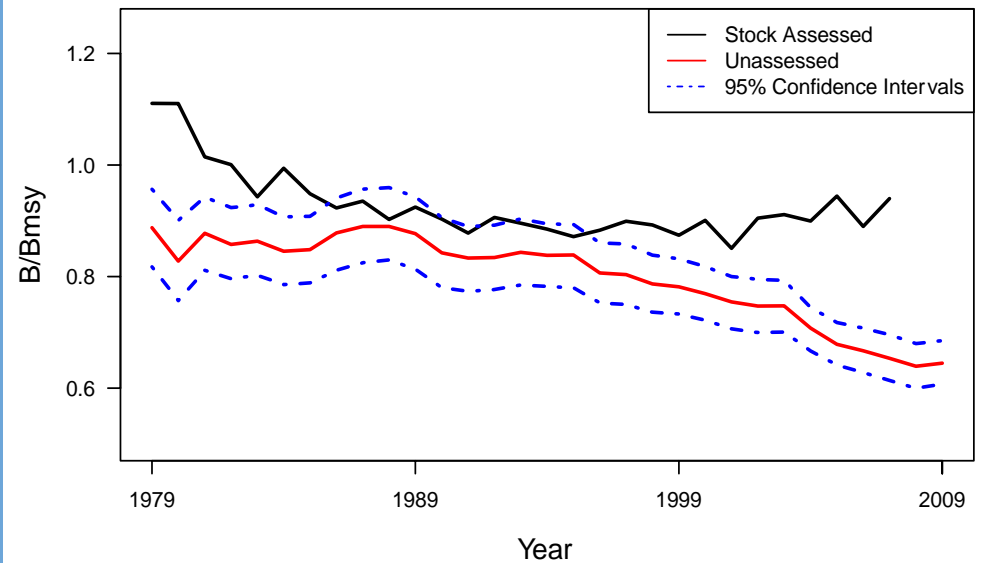
■ Depleted¹
■ Low abundance²
■ Fair abundance³
■ Healthy⁴

Assessed Stocks – By number of stocks²



Unassessed Stocks – By number of stocks²

Time trend of median B/B_{MSY} for stock assessed and unassessed fisheries¹



1. C. Costello et al., Status, trends, and solutions for the world's unassessed fisheries. *Science*, (in review).
2. C. Costello et al., Status, trends, and solutions for the world's unassessed fisheries. *Science*, (in review). And CEA analysis.

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