



## Methods of Analysis: April 2018

### Ecological Indicators: **Stock Status – Biomass and Fishing Mortality**

#### **Has the status of fish stocks changed?**

This indicator shows the abundance of fish stocks in the fishery management area.

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Fishery catch and biomass time series data were compiled for all available stocks in the Northeast Multispecies and West Coast groundfish trawl fisheries. To determine changes in stock status after the implementation of the Northeast Multispecies Sector Program and the West Coast Shorebased Individual Fishing Quota (IFQ) Program, we evaluated biomass and fishing mortality of allocated groundfish stocks.

Stock assessment reports provided annual biomass data for individual stocks (see Information Sources). The West Coast stock data spanned the project baseline (2002-2010) and recent Shorebased IFQ Program years (2011-2013). The Northeast stock data included an extended baseline (1980-2002), as well as the project baseline (2002-2009) and Northeast Multispecies Sector Program years (2010-2013). Spawning stock biomass (SSB) was used where available, when not found, total stock biomass was used. The current estimated biomass reference points,  $SSB_{MSY}$  or  $B_{MSY}$ , were obtained from stock assessment and used in analyses for ratios of annual biomass to biomass reference point as an estimate of average biomass ratio to determine stocks that were above/below the  $B_{MSY}$  threshold. Ratios for biomass ( $B/B_{MSY}$ ) were calculated by dividing estimates of  $B$  for each year by the current estimate  $MSY$  value.

Stock reference points are updated over time; calculations of biomass ratios ( $B/B_{MSY}$ ) relied on yearly estimated biomass compared to the current  $B_{MSY}$  estimate. In order to track trends among groups of species, stocks that have required rebuilding plans are separated to observe trends in biomass ratios among that group. These analyses are not intended as a measure of the appropriateness of management decisions at any point in time but rather an indicator of change. In the case of Gulf of Maine winter flounder the reference point recommendation was used as a proxy for biomass target.

Focusing on average biomass ratio on a stock-by-stock basis allows equal weighting of the different stocks, regardless of their overall biomass. Furthermore, we used the geometric mean of

the biomass ratios rather than an arithmetic mean to ensure a proper comparison of species that were above or below the  $B_{MSY}$  threshold.

Similar metrics were calculated for fishing mortality using the ratio of fishing mortality ( $F$ ; removal of fish from fishing) to the fishing mortality reference point ( $F_{MSY}$ ).  $F$  and fishing mortality reference points were obtained from the most recent stock assessment documents. Analyses using annual fishing mortality against the current reference point provided yearly geometric means of these ratios across stocks to characterize the fishery-wide trends, proportion of stocks experiencing overfishing ( $F > F_{MSY}$ ) and the proportion of stocks with high fishing mortality ( $F > 1.5F_{MSY}$ ). Stocks that have required rebuilding plan (biomass less than  $B_{MSY}$  in 2002) were grouped in parallel analyses to observe the trends in the three metrics among rebuilding stocks.

For the Northeast, 14 of the 16 stocks allocated in the Northeast Multispecies Sector Program were included in this analysis. Eastern GB cod and Eastern GB haddock are not included because assessment documents did not include estimates of  $B_{MSY}$ . The West Coast analysis consisted of 22 stocks, excluding certain species to control for species continuity across analyses. Excluded rockfish species are managed as regional complexes (e.g. minor slope rockfish north), however often these species are often treated as one coastwide stock in assessments. In the cases where years have not been assessed, stock biomass from the most recently assessed year is used.