

# **Appendix B: Pacific Mackerel Stock Assessment**

# **PACIFIC MACKEREL BIOMASS PROJECTION ESTIMATE FOR USA MANAGEMENT (2014-15)**

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## **Introduction**

Beginning in 2015, the Pacific Fishery Management Council (Council) will begin an assessment/management schedule for Pacific mackerel (*Scomber japonicus*) based on: 1) conducting *full* assessments every four years starting in 2015; 2) conducting catch-only projection estimates every four years starting in 2017; and setting harvest and management guidelines as biennial specifications that serve for two consecutive (fishing) years, starting in 2015. In 2015, a full assessment should be conducted for purposes of providing management advice that serves for two (fishing) years, 2015-16 and 2016-17. In 2017, a catch-only projection estimate should be conducted for informing management for fishing years 2017-18 and 2018-19.

Based on recommendations from the Scientific and Statistical Committee (SSC) and following methods used in last year's Pacific mackerel projection assessment, here we present an extended forecast analysis for providing management advice for the upcoming Pacific mackerel fishing year from July 1, 2014 to June 30, 2015. Sensitivity analysis conducted here was discussed informally with members of the SSC's CPS-Subcommittee prior to preparation of this document.

## **Methods**

Details regarding the assessment model XA, which served as the baseline model for developing all annual management guidelines since 2011, are presented in the stock assessment report (Crone et al. 2011; June 2011 Briefing Book, Agenda Item G.2.b, Attachment 1). The projection model used here was parameterized similarly as last year's projection model that provided biomass estimates for management in 2013-14 (Crone 2013, June 2013 Briefing Book, Agenda Item I.2.b, Attachment 2), and assumes a Tier 2 sigma value of 0.72. Important model information follows, including data, parameterizations, and sensitivity analysis:

- Recent Pacific mackerel landings (catch) are presented in Table 1. In the current projection model, forecast catch estimates were included for fishing years 2011-13 (updated catch estimates in 2013).

- No other data or parameterization changes.
- Sensitivity analysis
  - Estimated biomass and derived management quantities were robust to a wide range of alternative catch time series. For example, substantial increases in total landings assumed in the model had little to no effect on estimates of abundance and stock status, given that present catches have remained at very low levels over an extended timeframe.
  - Results were sensitive to alternative assumptions (model scenarios) regarding recent recruitment success and potential impacts on estimates of overall stock (age 1+ fish) biomass used for advising management (Table 2).
    - ✓ In addition to the default projection (forecast recruitment estimates were based on stock-recruitment relationship), three recent recruitment scenarios were evaluated, i.e., assuming forecast recruitment is equal to: 1) the recent average estimated recruitment (2008-10); the historical 3-year (running) low estimated recruitment (1997-00); and the lower bound of the 95% CI associated with the estimated recruitment in the terminal year (2010) of the main period of the default projection model.
    - ✓ Recruitment (age 0-1 yr-old fish) adjustments and subsequent biomass estimation were performed external to the model based on straightforward re-calculations of estimated numbers-at-age from the default projection model, according to the assumed recruitment level and accounting for losses due to natural mortality. That is, recruitment uncertainty was not evaluated internally within the projection model, given inherent constraints in Stock Synthesis regarding changes to recruitment deviations for the forecast vs main periods of the model and subsequently, structural changes to baseline files (catch time series) that would be needed to similarly address the three recruitment scenarios above. Finally, both external and internal recruitment-related adjustments are based on generally similar approaches and expected to produce comparable results.
    - ✓ Estimates of stock (age 1+ fish) biomass generated from the four model scenarios are presented in Figure 1.
- Expectedly, assumptions of depressed recruitment over the last few years resulted in substantial decreases in model estimates of absolute abundance of Pacific mackerel and associated yields to the fisheries. In general, the alternative recruitment success assumptions reflected reductions of roughly one-half to two-thirds of that indicated from the default projection model, depending on the model scenario of interest (Table 2).

Table 1. Pacific mackerel landings (mt) for fishing years 2009 to 2013 (i.e., through June 2014). Recent catch estimates for Ensenada (ENS) in calendar year 2013 are unconfirmed at this time, but not likely to change significantly when final statistics become available. Total commercial and recreational landings were used in the projection model.

Fishing year (July-June)	USA Com.	ENS Com.	Total Com.	Rec.
2009	3,009.7	0.2	3,009.9	268.7
2010	2,085.7	1,604.7	3,690.4	216.6
2011	1,855.4	1,150.8	3,006.1	127.0
2012	4,752.6	116.7	4,869.2	100.2
2013	8,494.7	957.4	9,452.1	109.7

Table 2. Pacific mackerel harvest control rules (HCR) for the 2014-15 fishing year based on alternative assumptions (model scenarios) of recent recruitment success. Default S-R = stock-recruitment (Beverton-Holt) relationship; Avg = average recruitment (2008-10 and 1997-00); and 95% CI = lower 95% CI for 2010 recruitment estimate.

Harvest Control Rule Formulas	
OFL	$\text{BIOMASS} * E_{\text{MSY}} * \text{DISTRIBUTION}$
$\text{ABC}_{\text{P-star}}$	$\text{BIOMASS} * \text{BUFFER}_{\text{P-star}} * E_{\text{MSY}} * \text{DISTRIBUTION}$
HG	$(\text{BIOMASS} - \text{CUTOFF}) * \text{FRACTION} * \text{DISTRIBUTION}$

HCR Parameters	Default S-R Rec	Avg Rec 2008-10	Avg Rec 1997-00	Lower 95% CI Rec
P-star	0.45	0.45	0.45	0.45
ABC Buffer for Tier 2 $\text{Pstar}_{0.45}$	0.9135	0.9135	0.9135	0.9135
FRACTION	0.3	0.3	0.3	0.3
CUTOFF (mt)	18,200	18,200	18,200	18,200
DISTRIBUTION (U.S.)	0.7	0.7	0.7	0.7
BIOMASS (ages 1+, mt)	304,184	157,106	122,489	120,625

HCR Values (MT)	Default S-R Rec	Avg Rec 2008-2010	Avg Rec 1997-2000	Lower 95% CI Rec
OFL =	63,879	32,992	25,723	25,331
ABC =	58,353	30,138	23,498	23,140
HG =	60,057	29,170	21,901	21,509

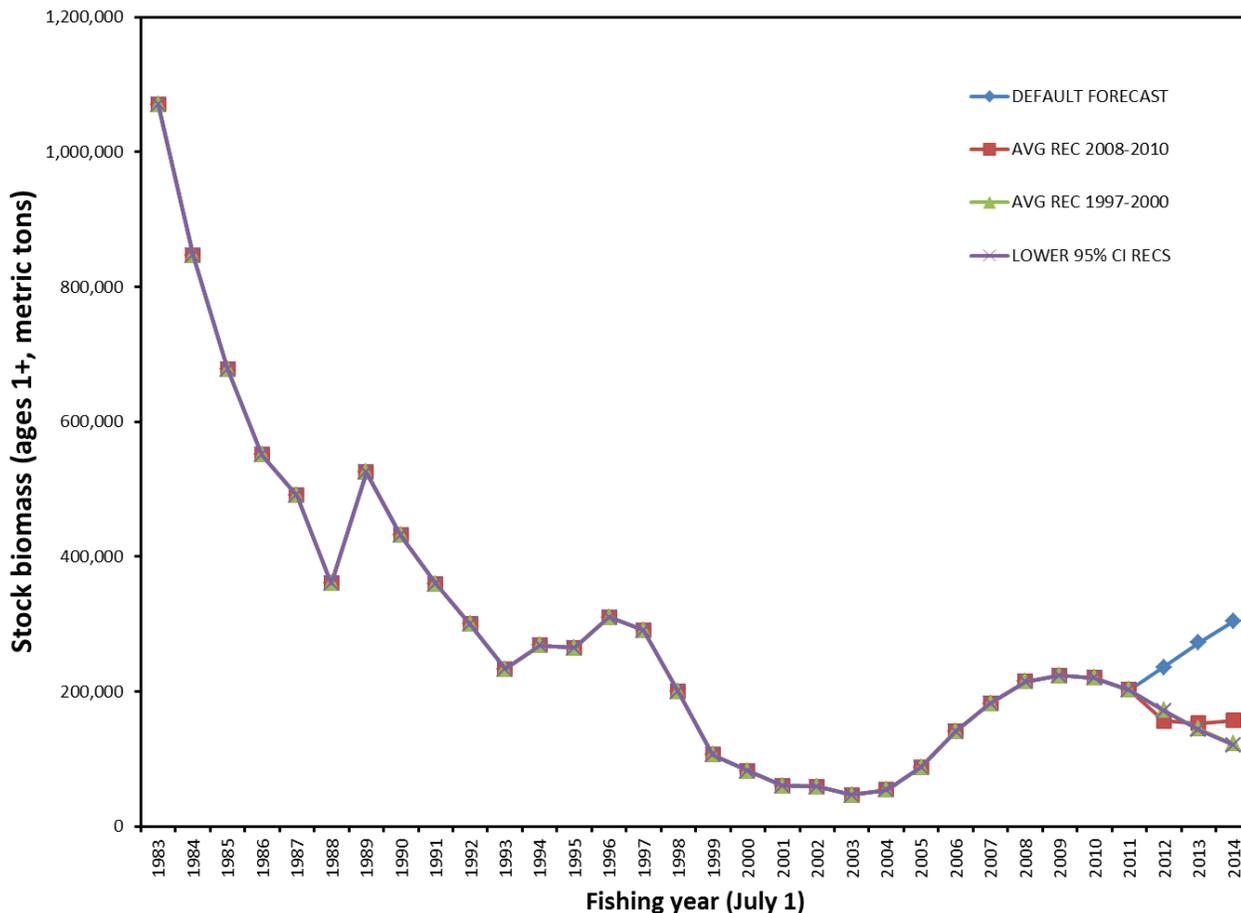


Figure 1. Pacific mackerel stock biomass time series for alternative assumptions (model scenarios) regarding recent recruitment success.