ASSESSMENT OF THE PACIFIC SARDINE RESOURCE IN 2012 FOR U.S. MANAGEMENT IN 2013

Fisheries Resources Division
Southwest Fisheries Science Center
NOAA National Marine Fisheries Service
**Update Data & Model Change**

**Fishery data:**
- Landings for 2010 and 2011 updated with final data; 2012 landings were based on information-to-date, forecast to year-end. ENS data not available for 2012, so assumed identical to 2011 landings;
- Length compositions from CA, OR, WA, and BC were updated (2011-1) and appended (2011-2 & 2012-1). New ENS length data not available since 2009;
- Conditional age-at-length (CA, OR, & WA) appended for model year 2011.

**Survey data:**
- DEPM estimate of SSB from the spring 2012 survey off California;
- Acoustic-trawl method (ATM) estimates of biomass from the spring 2012 survey (California) and summer 2012 survey (San Diego to Vancouver Island);
- NWSS aerial survey estimate from summer 2012.

**Model change:**
- Last year for estimated recruitment deviations changed from end-year -2 back to end-year -1; reviewed by SSC CPS Subcommittee in early October.
Landings by Fishing Area and Calendar

![Graph showing landings by fishing area and calendar year over time. The x-axis represents calendar years from 1981 to 2011, and the y-axis represents metric tons ranging from 0 to 180,000. Different areas are represented by different colors: BC, WA, OR, CCA, SCA_Dir, SCA_Inc, and ENS. The graph shows fluctuations in landings over the years.]
Spring 2012 DEPM Estimate

- Survey transects ranged from Ft. Bragg to San Diego;
- Eggs only observed within the core DEPM area (line 60 and south);
- 21 trawls were positive for sardine, 16 collections contained mature females for adult repro. parameters;
- Lower SSB primarily due to lower egg density ($P_0$) and smaller area ($A$) in the low density stratum (Region 2).

- $SSB_{total} = 255,391 \text{ mt}$
- $SSB_{female} = 113,178 \text{ mt}$
- Female SSB 48% lower than 2011, but higher than the 2008-2010 survey estimates;
Spring 2012 ATM Estimate

- 21 positive trawls grouped as 14 clusters
- Trawl compositions used to apportion total CPS backscatter densities by species;
- ATM biomass = 469,480 mt;
- Time series modeled with $q=1$;
- Length composition series fit with asymptotic selectivity.
SWFSC Summer 2012 ATM Survey

- 31 trawl clusters;
- Majority of sardine observed between S.F. and central Oregon;
- ATM biomass = 340,831 mt
- Time series modeled with $q=1$;
- Length composition series fit with asymptotic selectivity.
Summer 2012 - NWSS Aerial Survey

- Set ‘B’ photo transects conducted from 7/31 to 8/22;
- 14 acceptable point set samples conducted from 8/23 to 9/13;
- No temporal overlap between aerial transects and point sets;
- Point sets were limited in spatial coverage;
- Biomass (696,251 mt) used in update was based on point sets pooled across years.
- Length composition based on the 14 acceptable point sets;
Survey Time Series

![Survey Time Series Graph]

- DEPM
- TEP
- Aerial
- ATM

Indexed biomass (mmt) vs. model year from 1993 to 2013.
Recruitment Time Series
Estimated Stock Biomass Series from Model X6e

Stock biomass (ages 1+, mmt)

Model year, start of S1 (July)

659,539 mt
Exploitation Rate

Calendar year

Exploitation rate

Total

U.S.
**HG, ABC, & OFL for 2013**

<table>
<thead>
<tr>
<th>Harvest Formula Parameters</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOMASS (ages 1+, mt)</td>
<td>659,539</td>
</tr>
<tr>
<td>$P^*$ (probability of overfishing)</td>
<td></td>
</tr>
<tr>
<td>0.45</td>
<td>0.40</td>
</tr>
<tr>
<td>0.30</td>
<td>0.20</td>
</tr>
<tr>
<td>BUFFER$_P^*$ (Sigma=0.36)</td>
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</tr>
<tr>
<td>0.95577</td>
<td>0.91283</td>
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<tr>
<td>0.82797</td>
<td>0.73861</td>
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<tr>
<td>$F_{MSY}$ (stochastic, SST-independent)</td>
<td>0.18</td>
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<tr>
<td>FRACTION</td>
<td>0.15</td>
</tr>
<tr>
<td>CUTOFF (mt)</td>
<td>150,000</td>
</tr>
<tr>
<td>DISTRIBUTION (U.S.)</td>
<td>0.87</td>
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</tbody>
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**Amendment 13 Harvest Formulas**

<table>
<thead>
<tr>
<th></th>
<th>MT</th>
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<tbody>
<tr>
<td>OFL = BIOMASS * $F_{MSY}$ * DISTRIBUTION</td>
<td>103,284</td>
</tr>
<tr>
<td>$ABC_{0.45}$ = BIOMASS * BUFFER$<em>{0.45}$ * $F</em>{MSY}$ * DISTRIBUTION</td>
<td>98,716</td>
</tr>
<tr>
<td>$ABC_{0.40}$ = BIOMASS * BUFFER$<em>{0.40}$ * $F</em>{MSY}$ * DISTRIBUTION</td>
<td>94,281</td>
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<tr>
<td>$ABC_{0.30}$ = BIOMASS * BUFFER$<em>{0.30}$ * $F</em>{MSY}$ * DISTRIBUTION</td>
<td>85,515</td>
</tr>
<tr>
<td>$ABC_{0.20}$ = BIOMASS * BUFFER$<em>{0.20}$ * $F</em>{MSY}$ * DISTRIBUTION</td>
<td>76,287</td>
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<tr>
<td>HG = (BIOMASS - CUTOFF) * FRACTION * DISTRIBUTION</td>
<td>66,495</td>
</tr>
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