ASSESSMENT OF THE PACIFIC SARDINE RESOURCE IN 2011 FOR U.S. MANAGEMENT IN 2012


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Acknowledgments

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**ODFW:** Jill Smith, Keith Matteson, Sheryl Manley, Kelly Corbet, David Wolfe Wagman

**Northwest Sardine Survey, LLC:** Jerry Thon, Tom Jagielo, Ryan Howe, Meghan Mikesell

**CDFG:** Dianna Porzio, Mandy Lewis, Bill Miller, Paul Ton, Santi Luangpraseut, Briana Brady, Ed Dunn, Sonia Torres, Lou Zeidberg

**SWFSC:** Dave Griffith, Amy Hays, Dimitry Abramenko, Sue Manion, Bill Watson, Elaine Acuña, Andrew Thompson, Sherri Charter, Sarah Zao, Noelle Bowlin, David Demer, Juan Zwolinski, Randy Cutter, Kyle Byers, Josiah Renfree, Steve Sessions, John Field

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**STAR Panel:** Andre Punt, Ray Conser, Larry Jacobson, Chris Francis, Mike Okoniewski, and Lorna Wargo
Ongoing Sardine Modeling Issues

• Scaling population from low to high (CANSAR, ASAP) to lower levels again (SS);
• Sensitivity to new data (e.g. SS model 2008);
• Implausibly high $F$ estimates (SS models 2009-2010):
  — fixed ‘$q=1$’ for Aerial Survey;
• Recent models had many selectivity parameters and time-varying elements resulting in some model instability (i.e. over-parameterized).
Changes from Previous Assessments

NEW MODEL STRUCTURE:

Goal: build more parsimonious model; robust to data/scaling; plausible $F$ estimates;
• Regional fisheries aggregated to MexCal and PacNW ‘fleets’;
• Truncated time series (1993 start year);
• Fewer time-varying elements (selectivity and growth);
• Number of estimated parameters reduced from 132 to 61

NEW DATA SOURCES:
• SWFSC Acoustic survey time series
• Ensenada fishery lengths, 1989-2009
Length & Age Composition – MexCal_S1 Fleet
Survey Indices of Biomass

![Graph showing indices of biomass over model years from 1993 to 2011. The graph compares different methods: DEPM, TEP, Aerial, and Acoustic. The biomass data is rescaled by Q (mmmt).]
SSB and Recruitment Estimates

Graphs showing the trend of spawning stock biomass (mm) and year-class abundance (age-0, billions) over time.
Estimated Stock Biomass Series from Base Model

Stock biomass (ages 1+, mmt)

Model year, start of S1 (July)


988,385 mt
Estimated Stock Biomass Series from Base Model
Estimated Recruitment Series from Base Model

![Graph showing estimated recruitment series from base model with various years and models indicated.](image-url)
## OFL, ABC, and HG for 2012

<table>
<thead>
<tr>
<th>Harvest Formula Parameters</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOMASS (ages 1+, mt)</td>
<td>988,385</td>
</tr>
<tr>
<td>$P_{\text{star}}$ (probability of overfishing)</td>
<td>0.45 0.40 0.30 0.20</td>
</tr>
<tr>
<td>$\text{BUFFER}<em>{P</em>{\text{star}}}$ (Sigma=0.36)</td>
<td>0.95577 0.91283 0.82797 0.73861</td>
</tr>
<tr>
<td>$F_{\text{MSY}}$ (stochastic, SST-independent)</td>
<td>0.18</td>
</tr>
<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>
</tr>
</tbody>
</table>

### Amendment 13 Harvest Formulas

<table>
<thead>
<tr>
<th>Formula</th>
<th>MT</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFL = BIOMASS * $F_{\text{MSY}}$ * DISTRIBUTION</td>
<td>154,781</td>
</tr>
<tr>
<td>$ABC_{0.45} = BIOMASS * \text{BUFFER}<em>{0.45} * F</em>{\text{MSY}}$ * DISTRIBUTION</td>
<td>147,935</td>
</tr>
<tr>
<td>$ABC_{0.40} = BIOMASS * \text{BUFFER}<em>{0.40} * F</em>{\text{MSY}}$ * DISTRIBUTION</td>
<td>141,289</td>
</tr>
<tr>
<td>$ABC_{0.30} = BIOMASS * \text{BUFFER}<em>{0.30} * F</em>{\text{MSY}}$ * DISTRIBUTION</td>
<td>128,153</td>
</tr>
<tr>
<td>$ABC_{0.20} = BIOMASS * \text{BUFFER}<em>{0.20} * F</em>{\text{MSY}}$ * DISTRIBUTION</td>
<td>114,323</td>
</tr>
<tr>
<td>HG = (BIOMASS - CUTOFF) * FRACTION * DISTRIBUTION</td>
<td>109,409</td>
</tr>
</tbody>
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