2.3 SSC Communication of Uncertainty and Risk in Management Decision-Making
Sources of uncertainty (lifted from A. Punt)

• **Estimation error**: differences between the actual values of the parameters of the OM and those provided by the estimator when fitting a model to available data;

• **Implementation error**: differences between intended management actions and those actually achieved;

• **Observation error** (or measurement error): differences between the measured value of some resource index and the corresponding actual value in the OM;

• **Process error**: natural variations in resource dynamics.

• **Model error**: difference between the model on which the management strategy is based and that on which the OM is based.
Box plots

Figure 9.4  Box plot showing the results of the MSE for mean total abundance. Panels represent different limit reference points (% of unfished spawning stock biomass). Shading of the bars represents different probability thresholds ($P^*$). Individual bars with the same shading represent a range of $F_{	ext{target}}$ values, as indicated on the x-axis.
“Many LEPMAG members found the box plots difficult to interpret, and requested a simple summary of the results. They acknowledged that a depiction of the range of possible outcomes was important, but additionally wanted to have a very clear impression of the ‘central tendency’ for each HCR and performance measure.”
Experience, Needs, Ideas, Recommendations

• What means of communicating uncertainty and risk are best for you (as an SSC) in evaluating an MSE?

• What means of communicating uncertainty and risk are best for stakeholders and to decision-makers?

• What tools have you used to communicate uncertainty and risk that have been particularly effective?
Experience, Needs, Ideas, Recommendations

• What unsolved challenges have you had in communicating uncertainty and risk?

• What would be helpful to hear more about from others?
Experience, Needs, Ideas, Recommendations

• What can we do at each point of the MSE process to ensure not just covering the range of most consequentiaL uncertainties, but to communicate it well to stakeholders, analysts, reviewers, and decision-makers?

• Design
• Modeling
• Evaluation
• Communicating Results
  • Stakeholders
  • Scientific audience
  • Policy audience
Communicating Results...not always uncertainty
Kobe Phase Plots

Figure 17.2 Example of Kobe phase plots, quadrants identify where the stock is overfished (biomass or SSB is less than B_{MVT}) or overfishing is occurring (F \geq F_{MVT}) and a target region (where both SSB \geq SSB_{MVT} and F \leq F_{MVT}). IATTC graph is for the Eastern Pacific hake stock. Discussion continues.

Kell et al.
Strategy Matrix

<table>
<thead>
<tr>
<th>Objective</th>
<th>TAC 0K</th>
<th>TAC 6K</th>
<th>TAC 12K</th>
<th>TAC 18K</th>
<th>TAC 24K</th>
<th>TAC 30K</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_{2022} \leq F_{\text{MSY}}$</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>0.91</td>
<td>0.72</td>
</tr>
<tr>
<td>$SSB_{2022} \geq B_{\text{MSY}}$</td>
<td>1.0</td>
<td>0.99</td>
<td>0.96</td>
<td>0.89</td>
<td>0.74</td>
<td>0.59</td>
</tr>
<tr>
<td>Green quadrant</td>
<td>1.0</td>
<td>0.99</td>
<td>0.96</td>
<td>0.89</td>
<td>0.72</td>
<td>0.53</td>
</tr>
</tbody>
</table>

*Table 17.3* Strategy matrix in the IOTC format for setting management measures based on Eastern Atlantic bluefin.

Kell et al.
Box plots

Figure 9.4 Box plot showing the results of the MSE for mean total abundance. Panels represent different limit reference points (% of unfished spawning stock biomass). Shading of the bars represents different probability thresholds ($P^*$). Individual bars with the same shading represent a range of $F_{targ}$ values, as indicated on the x-axis.
Table 9.3 Tabular description of selected MSE results. For all the scenarios shown here, $p^* = 0.05$ and TAC constraint = 20%. Values in the table represent the median across simulations. "F" is the target $F$ (% of $F_{ref}$) and “B” is the limit reference point (% of 50).

<table>
<thead>
<tr>
<th></th>
<th>F = 40</th>
<th>F = 60</th>
<th>F = 80</th>
<th>F = 100</th>
<th>F = 40</th>
<th>F = 60</th>
<th>F = 80</th>
<th>F = 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spawner biomass (million kg)</td>
<td>30.1</td>
<td>27.9</td>
<td>26.1</td>
<td>24.6</td>
<td>30.1</td>
<td>28.3</td>
<td>26.7</td>
<td>25.3</td>
</tr>
<tr>
<td>Commercial yield (million lbs)</td>
<td>2.87</td>
<td>3.95</td>
<td>4.83</td>
<td>5.50</td>
<td>2.85</td>
<td>3.88</td>
<td>4.63</td>
<td>5.16</td>
</tr>
<tr>
<td>Recreational catch per hour</td>
<td>0.43</td>
<td>0.42</td>
<td>0.41</td>
<td>0.41</td>
<td>0.43</td>
<td>0.42</td>
<td>0.42</td>
<td>0.41</td>
</tr>
<tr>
<td>$P(\text{Com yield }&lt; 4 \text{ mil lbs.})$</td>
<td>0.88</td>
<td>0.6</td>
<td>0.36</td>
<td>0.22</td>
<td>0.88</td>
<td>0.6</td>
<td>0.4</td>
<td>0.36</td>
</tr>
<tr>
<td>— change from lowest scenario</td>
<td>300%</td>
<td>173%</td>
<td>64%</td>
<td>0%</td>
<td>300%</td>
<td>173%</td>
<td>82%</td>
<td>64%</td>
</tr>
<tr>
<td>$P(\text{Rec catch per hour }&lt; 0.4)$</td>
<td>0.44</td>
<td>0.48</td>
<td>0.52</td>
<td>0.52</td>
<td>0.44</td>
<td>0.48</td>
<td>0.48</td>
<td>0.52</td>
</tr>
<tr>
<td>— change from lowest scenario</td>
<td>0%</td>
<td>9%</td>
<td>18%</td>
<td>18%</td>
<td>0%</td>
<td>9%</td>
<td>9%</td>
<td>18%</td>
</tr>
</tbody>
</table>

Editor’s note: Two different mass units (kilogram and pounds) are used as they are more familiar to the walleye stakeholders and managers.
Trade-off analysis

Figure 9.5 Trade-off analysis of two risk-related performance measures: probability of recreational catch per hour falling below 0.4 (y-axis) and probability of commercial yield falling below 4 million pounds of walleye (x-axis). Each point represents a different $F_{\text{mean}}$, with the number representing the target as a percentage of $F_{\text{mean}}$. All HCR results presented here used a $P^*$ of 0.05 and an LRP of 20% B0.
Median with 95% of simulations range

Qualitative comparisons

Figure 5 Example of plots which qualitatively compare four management strategies across six general areas of mean performance for a large multisector, multispecies fishery in southeastern Australia (E. Fulton, CSIRO, personal communication). A better result for a performance statistic is indicated by a vertex which is further from the centre of each hexagon.
Biomass distributions (Wetzel and Punt 2017)
Sacramento Winter Chinook MSE

Figure 1. Performance measures evaluated for each of the nine control rules and four alternative scenarios. For the “spanner” and “reduced age - skip rate” rules, the circles represent mean values and the vertical lines denote the 50 percent intervals of the distribution. Circles for other performance measures denote point estimates. The “Age - 1 impact rate” performance measure denotes the allowable impact rate specified by the control rule.
At the April 2017 SSC meeting, the SSC recommended two changes to the analysis: adding scenarios to explore alternative assumptions regarding productivity, and reporting the proportion of years with allowable impact rates within ranges to illustrate both the frequency and magnitude of changes in allowable impact rates. The updated analysis incorporates both recommendations. In particular, the updated evaluation contains alternative scenarios that include longer droughts, more frequent droughts, and overall warmer river temperature, each of which affects egg-to-fry survival.

The analysis represents the best available science for differentiating between the effects of alternative control rules, and for evaluating the tradeoff between conservation benefits and harvest constraints if the harvest control rule is based on the median versus mode of the abundance forecast.
Salmon Advisory Subpanel Report to PFMC

SALMON ADVISORY SUBPANEL REPORT ON
THE SACRAMENTO RIVER WINTER CHINOOK (SRWC) CONTROL RULE, FINAL
RECOMMENDATIONS

On Tuesday, the Sacramento River Winter Chinook Workgroup (SRWCW) provided a presentation to the Salmon Advisory Subpanel (SAS) reviewing the analysis of the four control rules forwarded for public review. The SAS very much appreciates their analysis and the presentation made to us based on their report to the Council (Agenda Item D.3.a, SRWCW Report 1).

The SAS appreciates the opportunity to comment on the Sacramento winter run Chinook issue. The SAS recommends Control Rule (CR) 10. CR 10 is a hybrid between CR 5 and CR 7. CR 10 provides additional conservation values when compared to CR 5, and provides more fishing opportunity when compared to CR7. CR 10 is a good balance between the range of alternatives considered, and is the preferred choice of the SAS.