New England Fishery Management Council

RISK POLICY

Appendix III

RISK POLICY MECHANICS

Date/Version

Available for Risk Policy Working Group Meeting

June 3, 2026

Each factor within the Council's Risk Policy receives a weight and a score, which is used to calculate a Z-score that is translated through a logistic function to derive a recommended probability of management success. The mechanics for each step are described in detail below.

1. Normalize Council weightings

Voting Council members (Members) will complete a weighting form that identifies their individual judgement on the importance of each of the factors to the Council's decision-making. Members will assign a weight to each factor ranging from 0 to 4, where "0" signals that a factor is not important to decision-making and "4" signals that a factor is very important to decision-making.

Once each member has submitted their weightings, the average weight for each factor, $\overline{w_f}$, is calculated given the following:

$$\overline{w_f} = \frac{1}{n}\sum_{i=1}^{n} w_{i,f} \qquad \textit{Equation 1}$$

where $w_{f,i}$ is the weight of an individual Council member, i, for a given factor, f, and n is the total number of Council members that submitted weights. The average weight for a given factor is then normalized, $\widetilde{W}_f$, so that the data can be assumed as normally distributed and is given by:

$$\widetilde{W}_f = \frac{\overline{w_f}}{\sum_{f=1}^{5} \overline{w_f}} \qquad \textit{Equation 2}$$

where $\sum_{f=1}^{5} \overline{w_f}$ is the sum of averages across the five factors. The total of the normalized weight across the five factors should equal 1.

2. Standardize stock-level factor scores

Plan Development Teams will use the best available information and the Scoring Guidance document to assign a numerical score to each factor for a particular species, stock, or stock complex. The score aims to reflect the condition of the resource and fishery with values ranging from -4 to 4 for the Spawning Stock Biomass (SSB) / Stock Status and Recruitment factors, -4 to 0 for the Climate Vulnerability factor, or 0 to 4 for the Commercial and Recreational Fishery Characterization factors.

After scores are submitted by the PDT, the scores are scaled to a range from 0 to 1 to allow for equal comparison between factors. A scaled factor score, $S'_{j,f}$, is calculated by:

$$S'_{j,f} = \frac{s_{j,f}}{4} \qquad \textit{Equation 3}$$

where $s_{j,f}$, is the score for a given species, stock, or stock complex, j, and factor, f.

3. Calculate the stock-level Z-Score

The z-score (z_j) represents the Council's measure of risk aversion for a given species, stock or stock complex (j). It is the sum product of the normalized weights ($\widetilde{W}_f$) and standardized scores ($S'_{j,f}$), and is given by:

$$z_j = \sum_{f=1}^{5} \widetilde{W}_f \times S'_{j,f} \qquad \textit{Equation 4}$$

4. Plot the stock-level Z-Score

To find the recommended probability of management success, $p(Z_j)$, for a given species, stock, or stock complex (j), input the calculated z-score into the logistic function given by:

$$p(Z_j) = \frac{0.5}{1+e^{z_j}} + 0.5 \qquad \textit{Equation 5}$$

To illustrate the level of risk aversion qualitatively, the z-score value and recommended probability value should be plotted along the logistic curve generated by Equation 5 and shown in Figure 1.

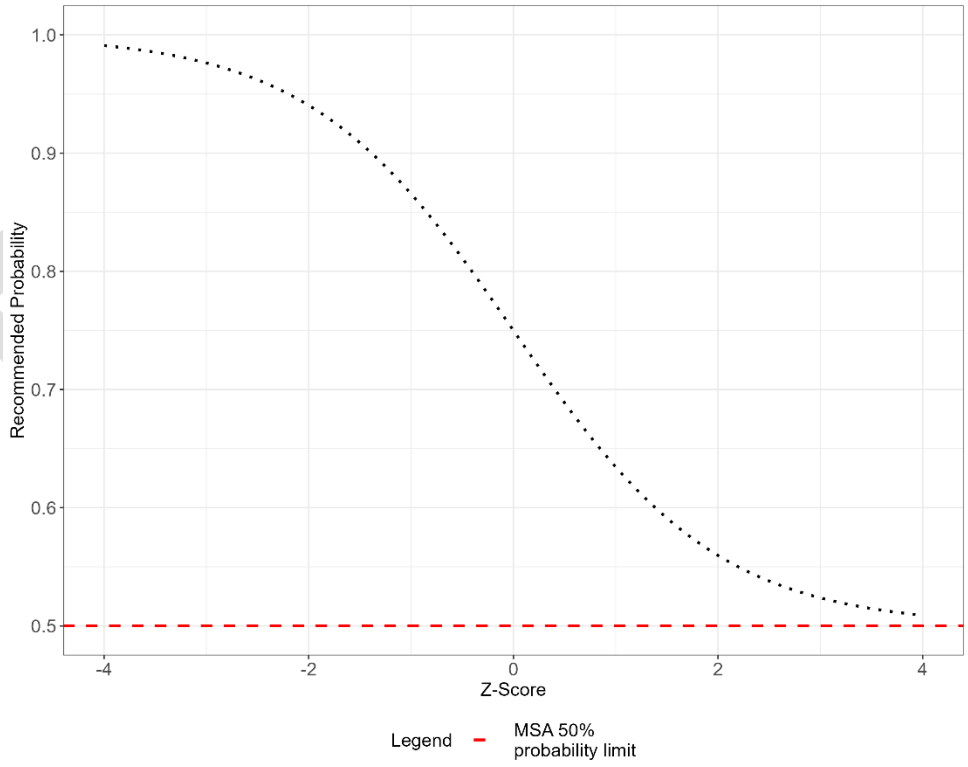

Figure 1. Inverted logistic function

5. Characterize the level of risk tolerance

The qualitative level of risk is based on the stock-level z-score and recommended probability of success, which are associated with defined risk zones along the inverted logistic curve. Risk zones were derived by finding the points along the logistic curve where the change in slope is at its steepest. In other words, where $p''(Z) = 0$, and where $p''(Z)$ is the second derivative of $p(Z_j)$ given by:

$$p''(Z) = \frac{0.5e^Z(e^Z-1)}{(1+e^Z)^3} \qquad \textit{Equation 6}$$

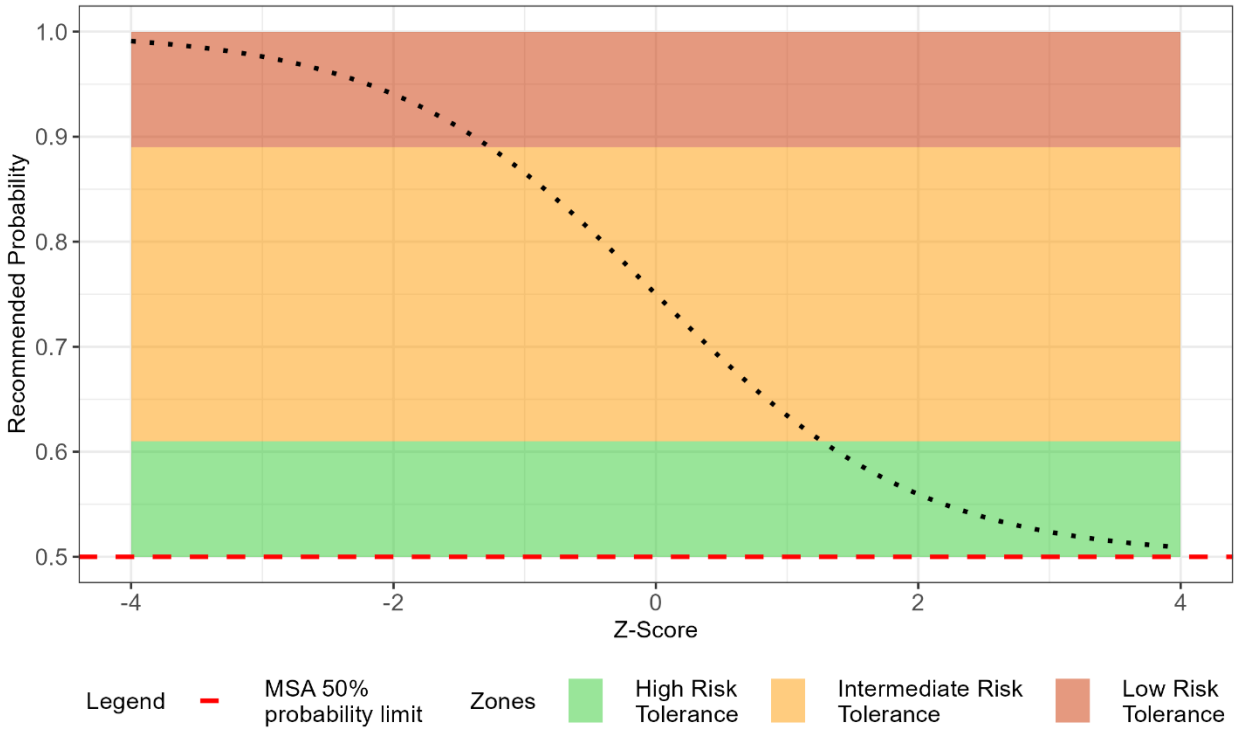

Figure 2. Risk tolerance zones based upon the inverted logistic function and the points on the curve where the change in its slope is at its steepest.