Appendix 9L

Junction Entrainment Analysis Documentation

This appendix provides information about the junction entrainment analysis methods and assumptions used for the Remanded Biological Opinions on the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) Environmental Impact Statement (EIS) analysis. This appendix is organized in two main sections:

- Section 9L.1: Methodology and Assumptions
  - The junction entrainment analysis uses the statistical relationship published in Cavallo et al. (2015) to predict the fish routing based on the proportion of flow moving through channel junctions in the Delta. This section briefly describes the approach and assumptions of the junction entrainment analysis.
- Section 9L.2: Results
  - This section presents the junction entrainment analysis results. Results are presented in a series of figures showing the probability of fish entrainment at various junctions in the Delta.

9L.1 Methodology and Assumptions

9L.1.1 Methodology

In this analysis, predicted entrainment into a distributary was based on 15-minute flow output from DSM2 over the 82-year simulation period following the statistical relationship reported in Cavallo et al. (2015). In that analysis, the proportion of acoustically tagged juvenile Chinook Salmon entrained in a distributary at seven junctions in the Delta was regressed against the proportion of flow into the distributary. The releases of tagged juvenile Chinook Salmon included fall- and late-fall-run fish.

The probability of fish entrainment was predicted at five Delta junctions: Georgiana Slough, Head of Old River, Turner Cut, Columbia Cut, and Middle River. Using the proportion of flow entering the distributary for every 15-minute observation in the 82-year simulation period, the mean daily proportion of flow into the distributary was calculated. The mean daily flow proportion was then used to calculate the predicted daily probability of fish entrainment.

9L.1.2 Scenario Assumptions

The junction entrainment analysis includes the following assumptions.

- The entrainment analysis is applicable to spring- and winter-run Chinook Salmon even though only fall- and late-fall-run Chinook Salmon were used to construct the statistical model.
- Hatchery fish used in the tagging studies behave similarly to natural-origin fish when migrating through channel junctions.
- The proportion of flow into a distributary could not exceed one.
- When flow was entering a junction from the distributary, the proportion of flow into the distributary was set to zero.

9L.2 Results

The following scenario comparisons are presented in Figures 9L.1 through 9L.30, comparing the probability of fish entrainment at various junctions:

- No Action Alternative compared to the Second Basis of Comparison
- Alternative 3 compared to the No Action Alternative
- Alternative 3 compared to the Second Basis of Comparison
- Alternative 5 compared to the No Action Alternative
- Alternative 5 compared to the Second Basis of Comparison

9L.3 Reference

Cavallo, B., P. Gaskill, J. Melgo, and S.C. Zeug. 2015. "Predicting juvenile Chinook Salmon routing in riverine and tidal channels of a freshwater estuary" 98:1571-1582.

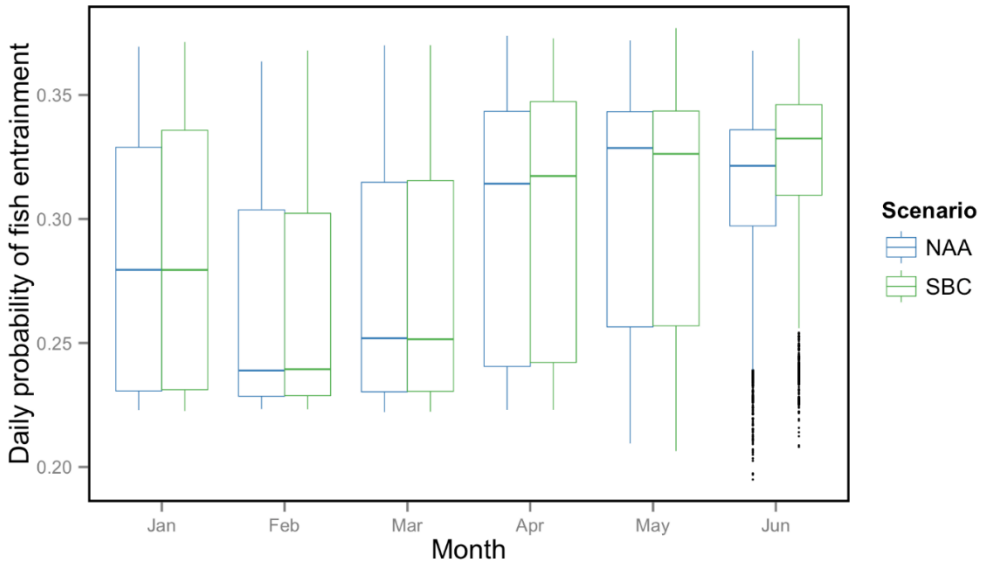

Figure 9L.1 Probability of Fish Entrainment into Georgiana Slough under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

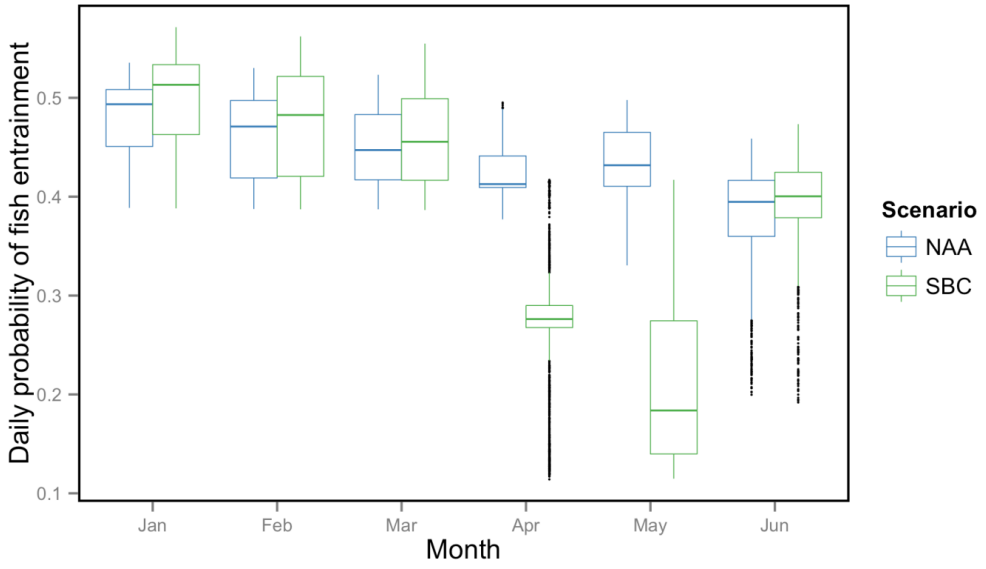

Figure 9L.2 Probability of Fish Entrainment into Head of Old River under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

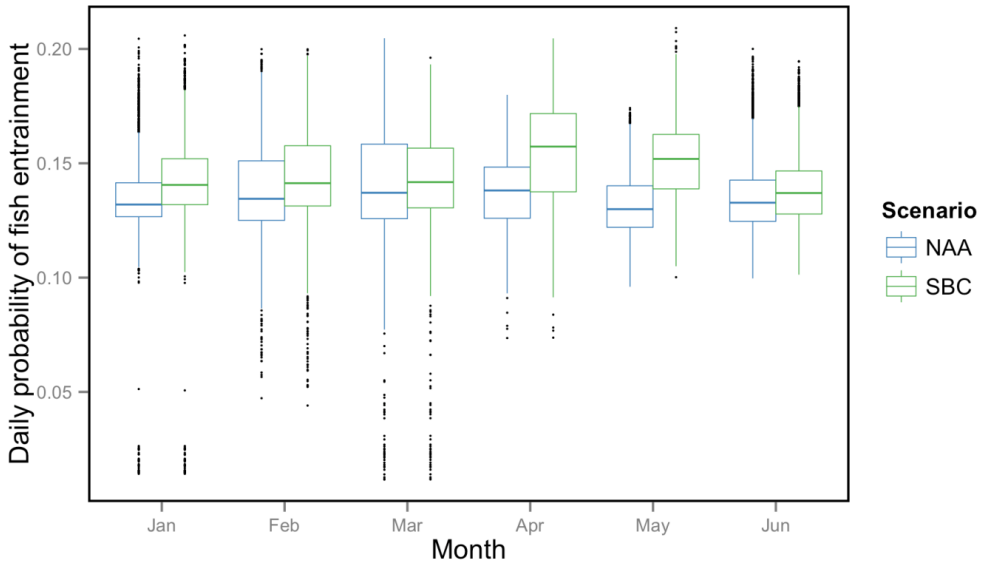

Figure 9L.3 Probability of Fish Entrainment into Turner Cut under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

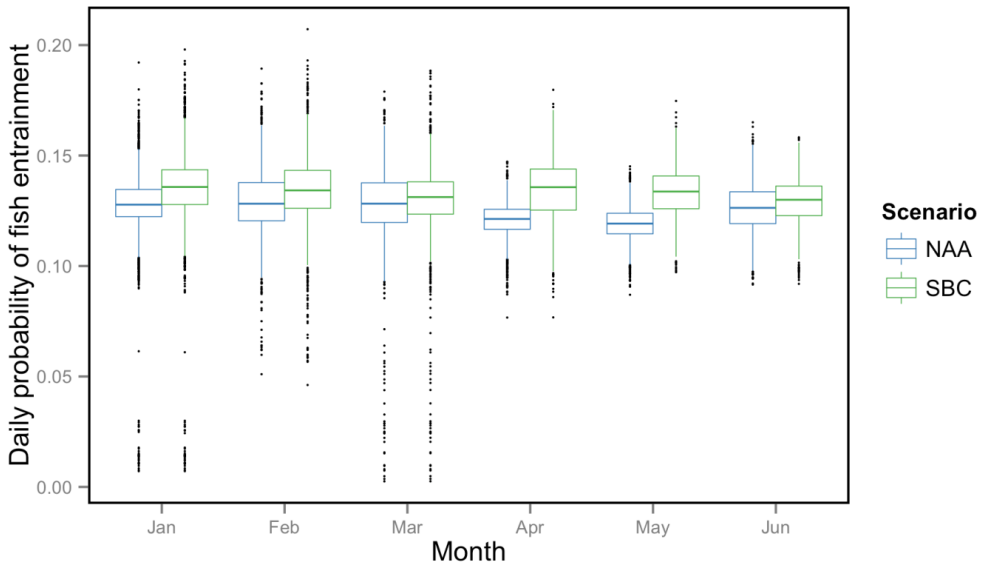

Figure 9L.4 Probability of Fish Entrainment into Columbia Cut under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

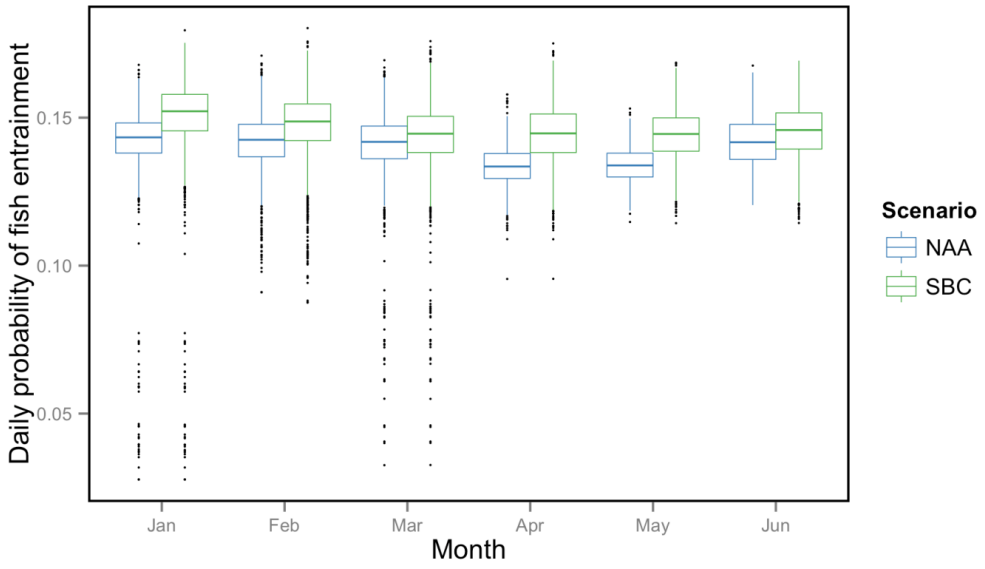

Figure 9L.5 Probability of Fish Entrainment into Middle River under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

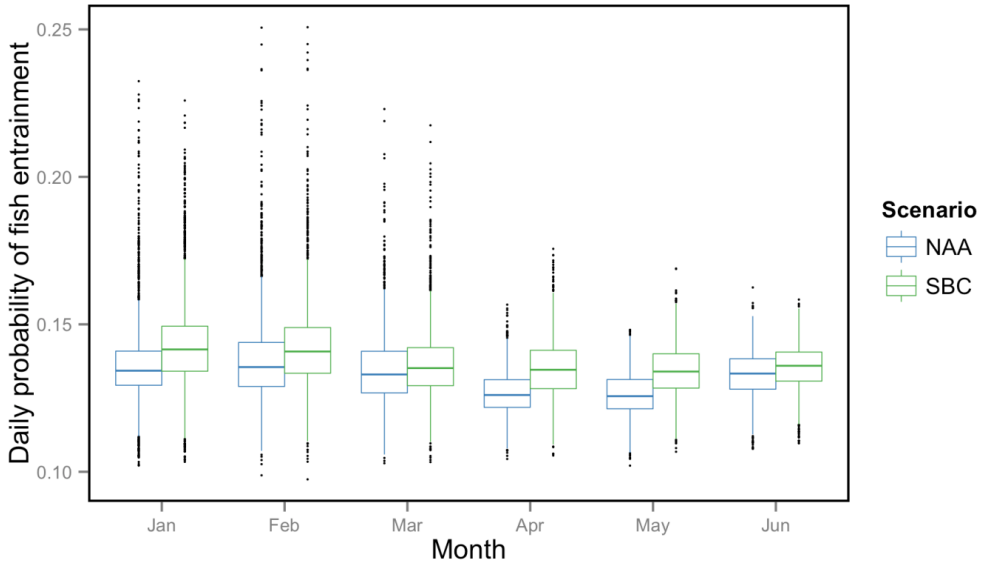

Figure 9L.6 Probability of Fish Entrainment into Old River under the No Action Alternative (NAA) compared to the Second Basis of Comparison (SBC)

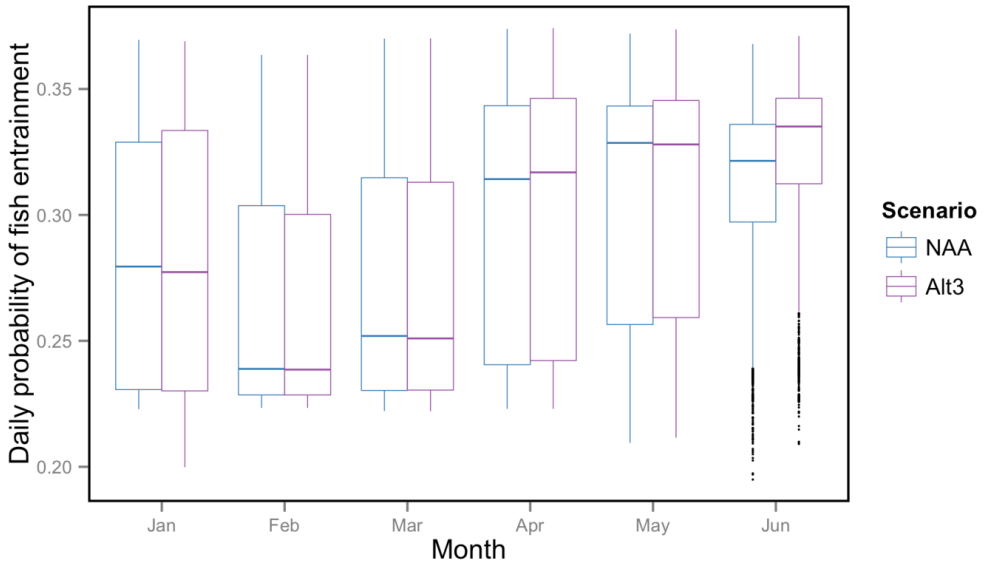

Figure 9L.7 Probability of Fish Entrainment into Georgiana Slough under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

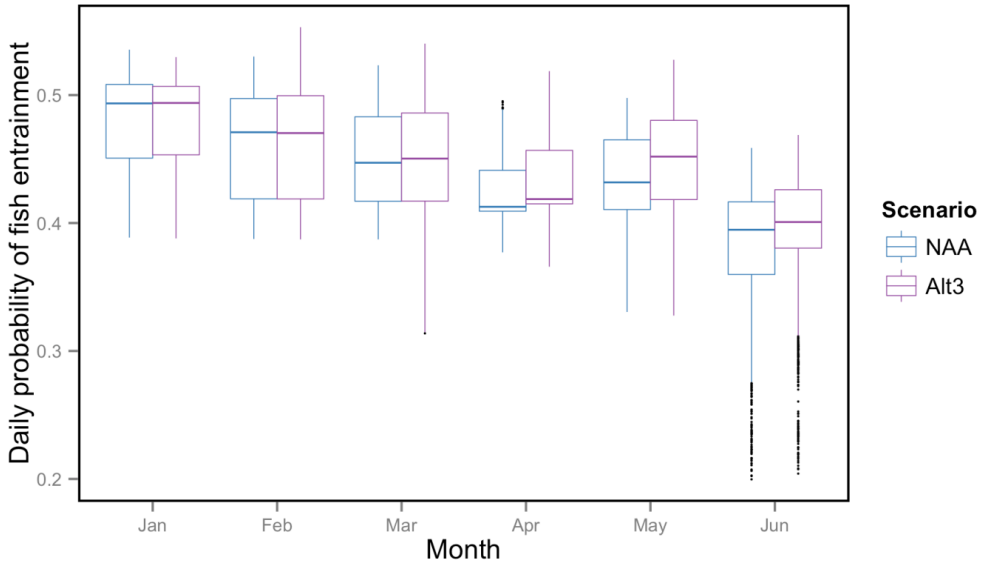

Figure 9L.8 Probability of Fish Entrainment into Head of Old River under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

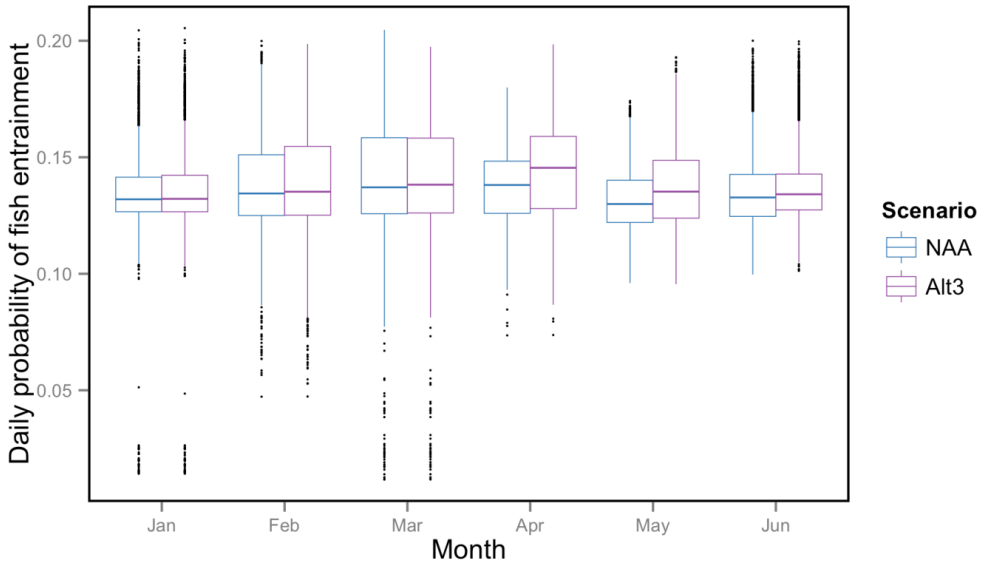

Figure 9L.9 Probability of Fish Entrainment into Turner Cut under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

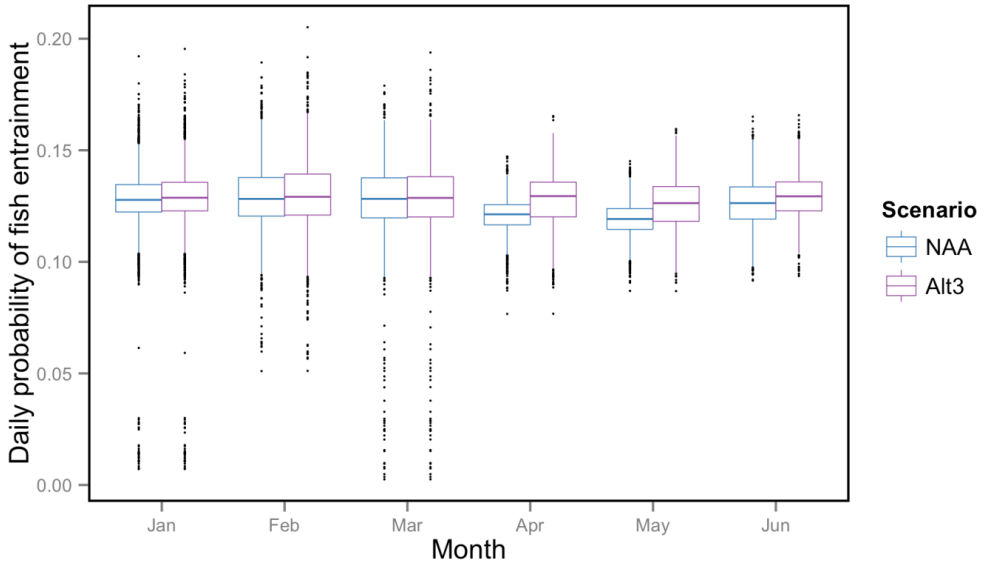

Figure 9L.10 Probability of Fish Entrainment into Columbia Cut under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

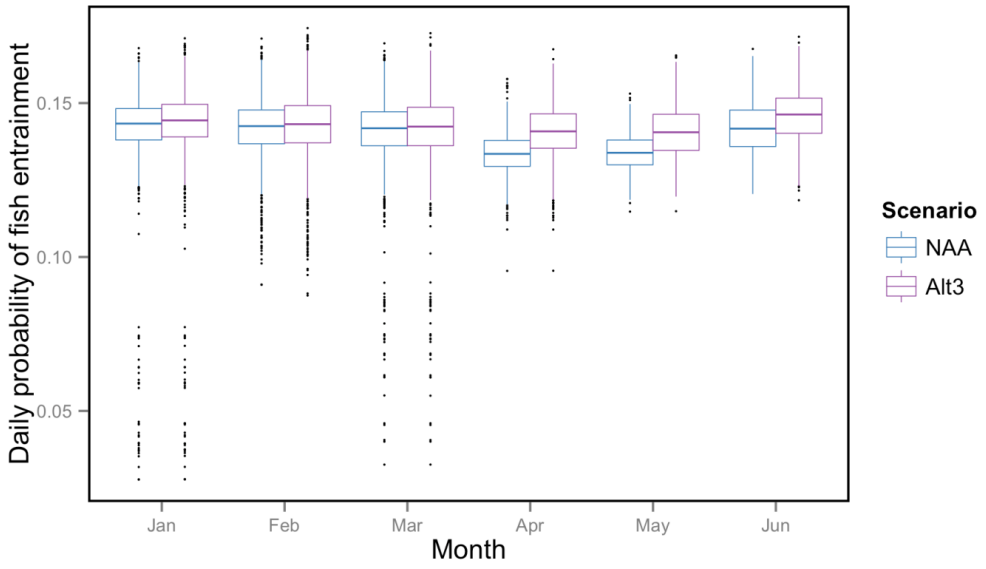

Figure 9L.11 Probability of Fish Entrainment into Middle River under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

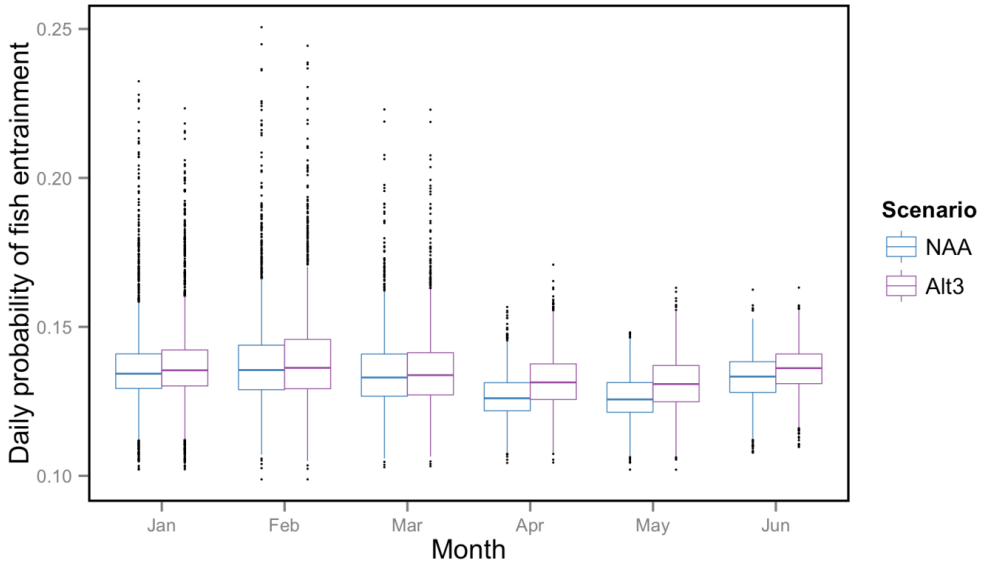

Figure 9L.12 Probability of Fish Entrainment into Old River under Alternative 3 (Alt 3) as compared to the No Action Alternative (NAA)

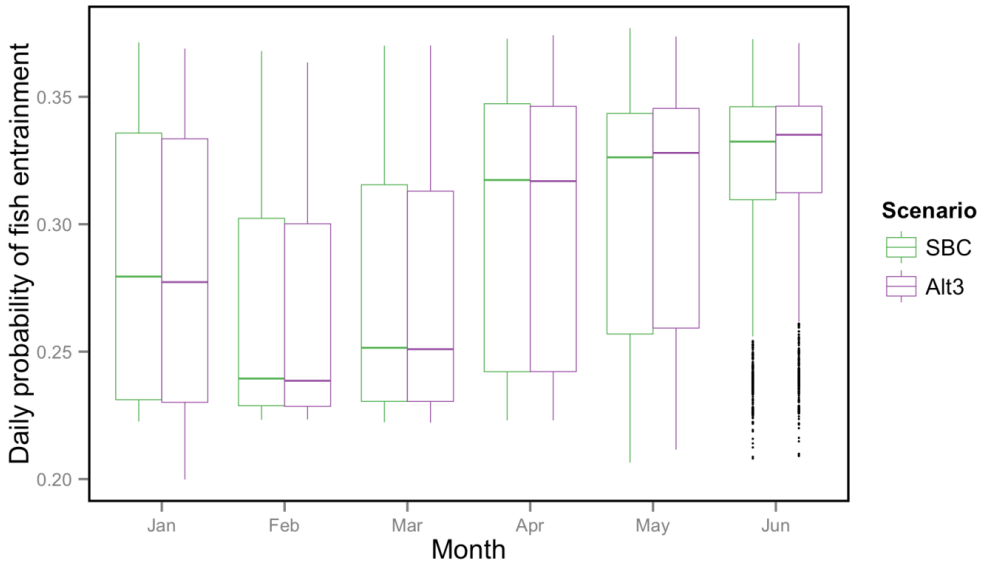

Figure 9L.13 Probability of Fish Entrainment into Georgiana Slough under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)

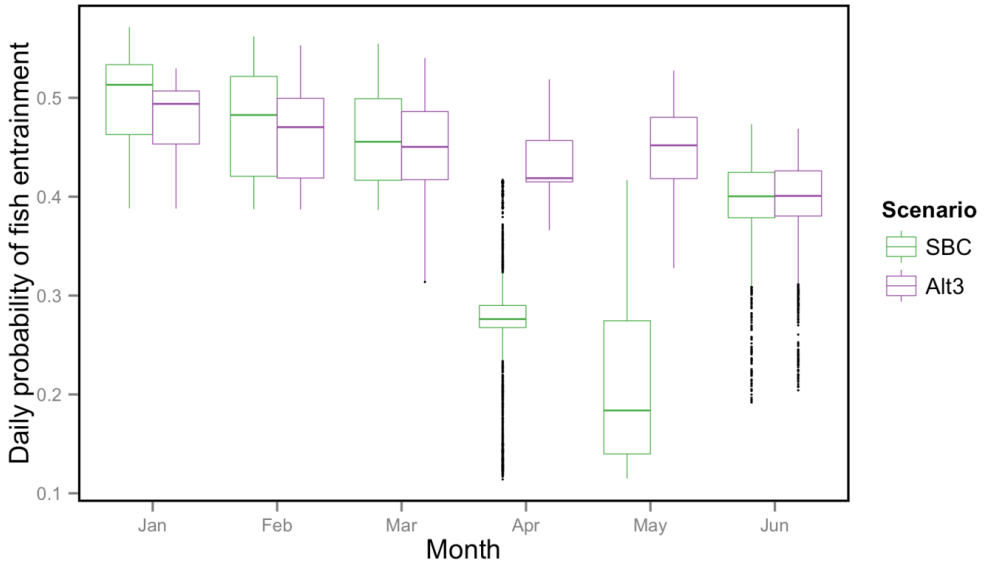

Figure 9L.14 Probability of Fish Entrainment into Head of Old River under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)

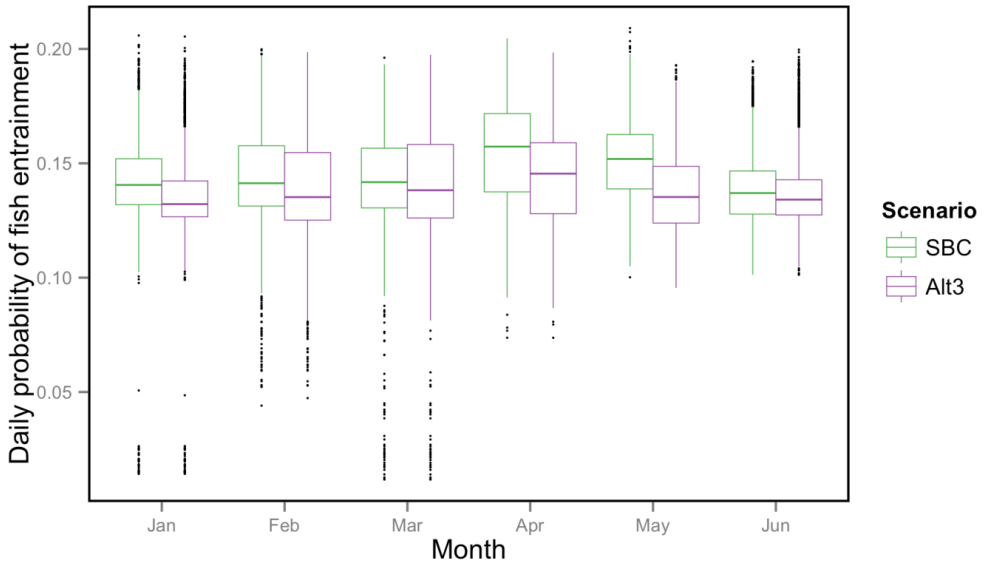

Figure 9L.15 Probability of Fish Entrainment into Turner Cut under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)

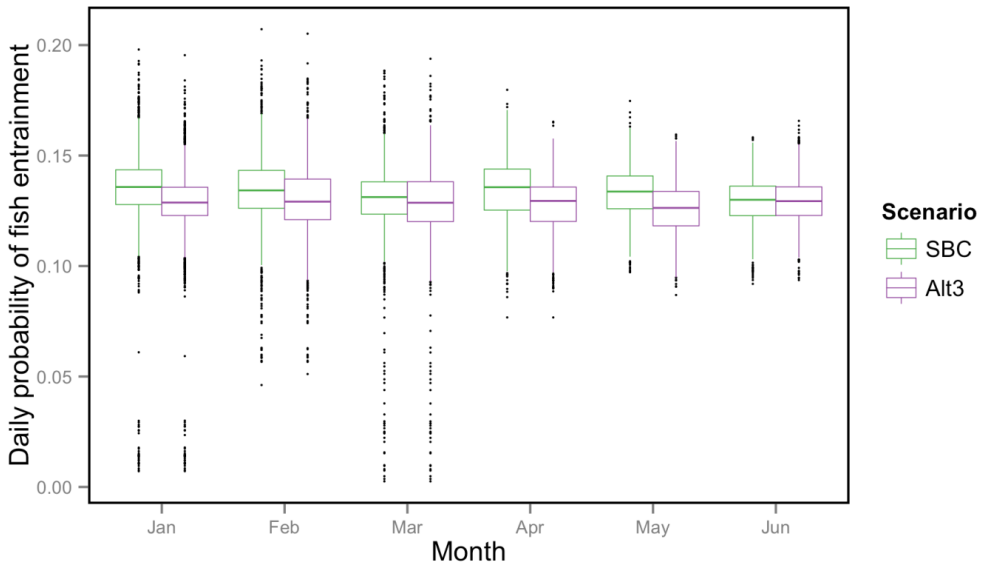

Figure 9L.16 Probability of Fish Entrainment into Columbia Cut under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)

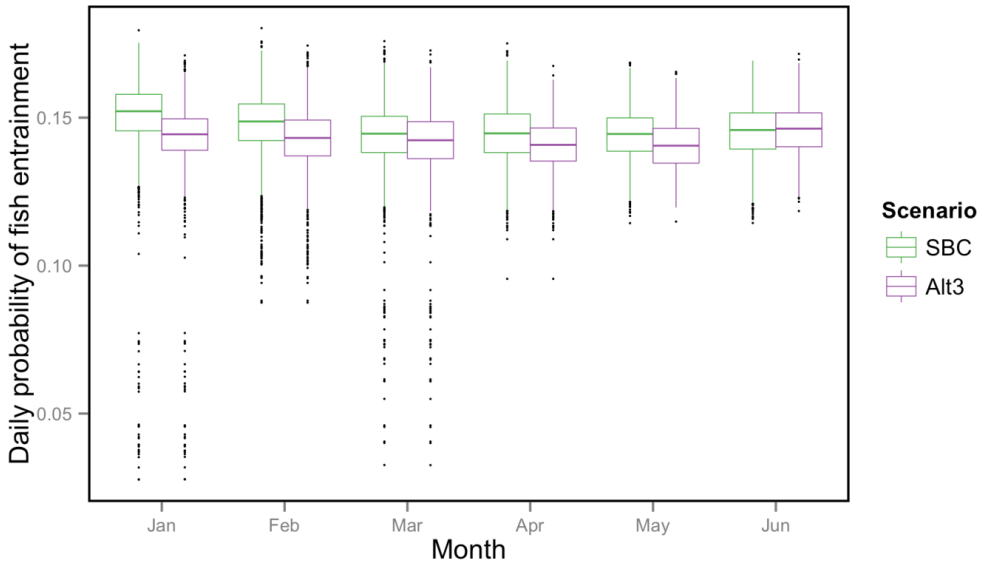

Figure 9L.17 Probability of Fish Entrainment into Middle River under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)

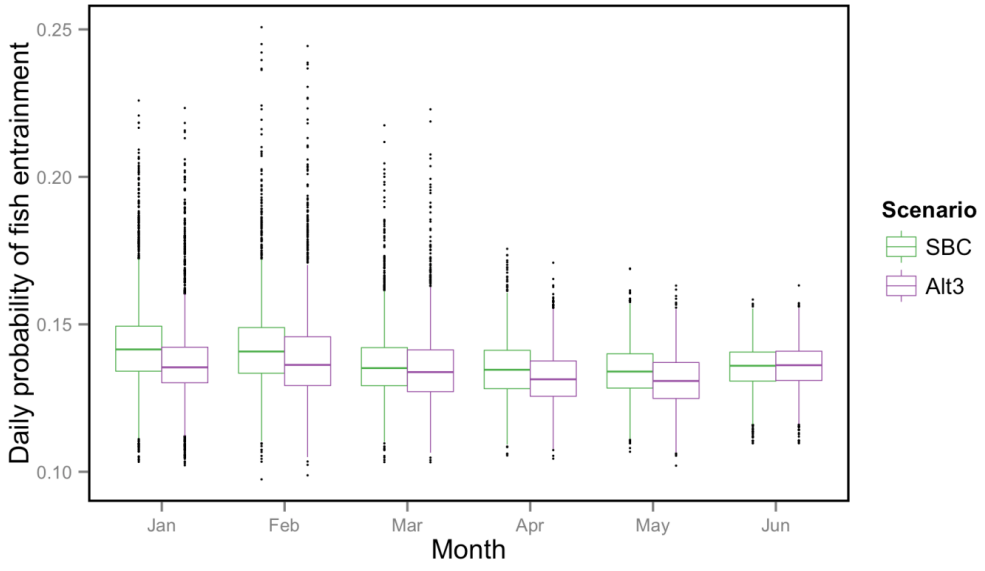

Figure 9L.18 Probability of Fish Entrainment into Old River under Alternative 3 (Alt 3) as compared to the Second Basis of Comparison (SBC)

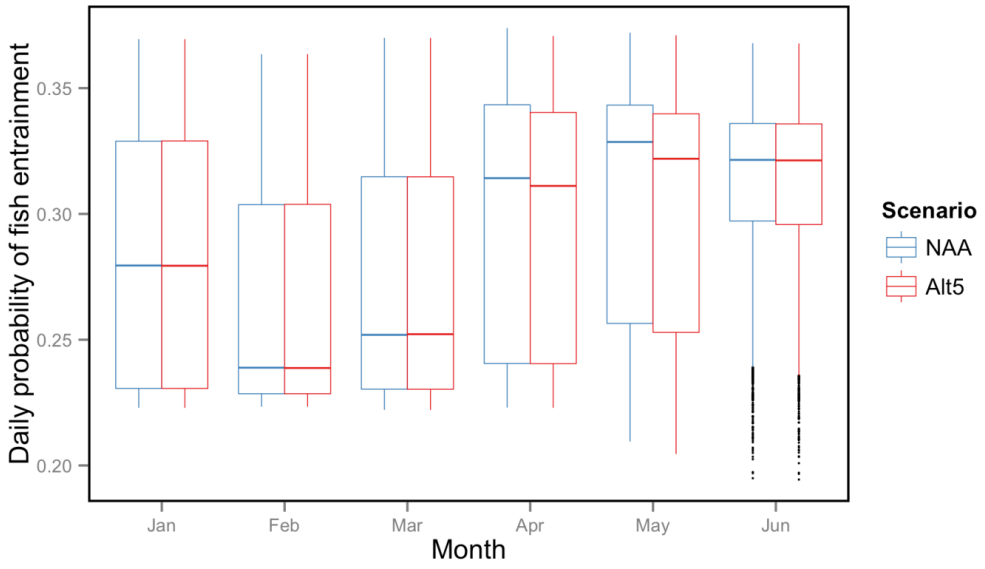

Figure 9L.19 Probability of Fish Entrainment into Georgiana Slough under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

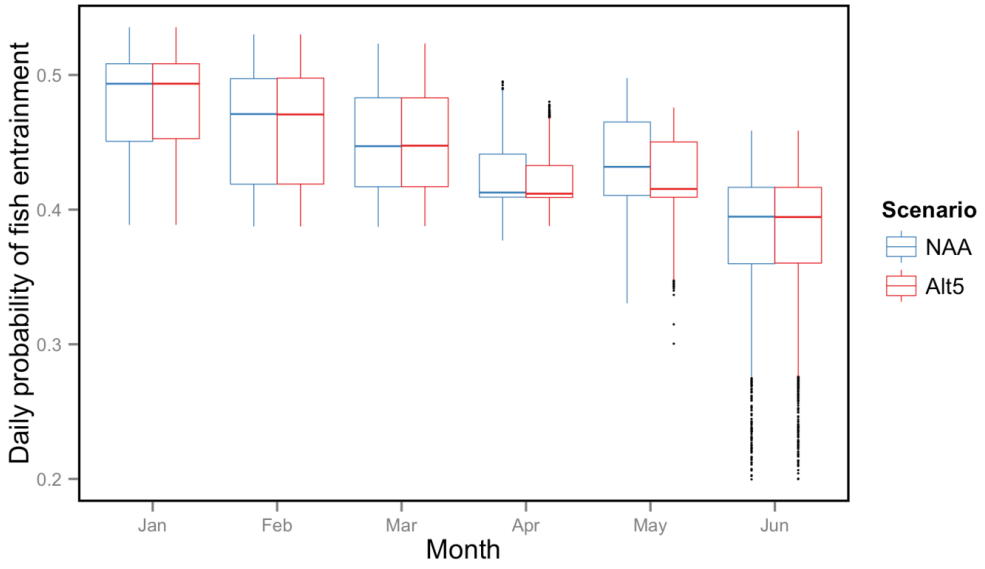

Figure 9L.20 Probability of Fish Entrainment into Head of Old River under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

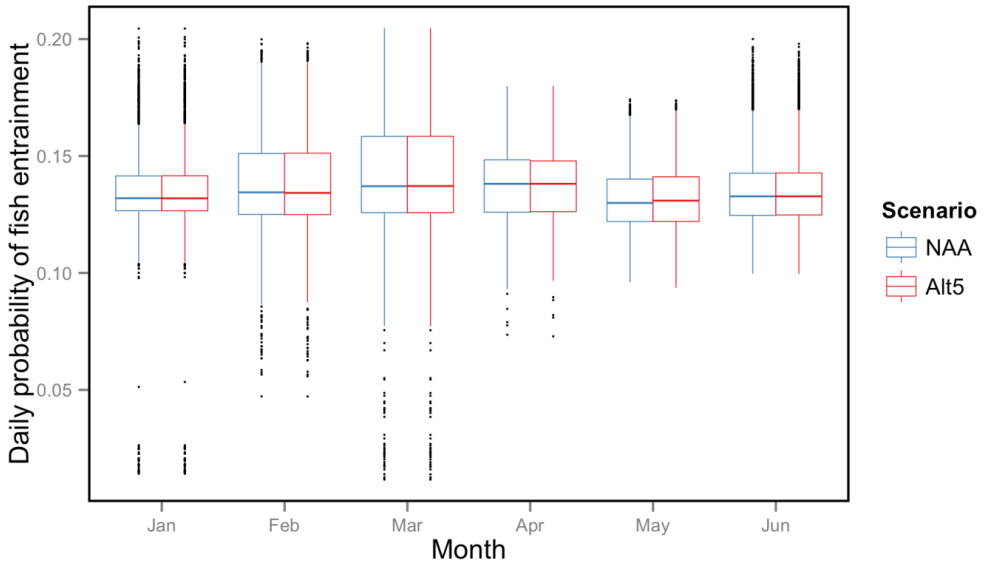

Figure 9L.21 Probability of Fish Entrainment into Turner Cut under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

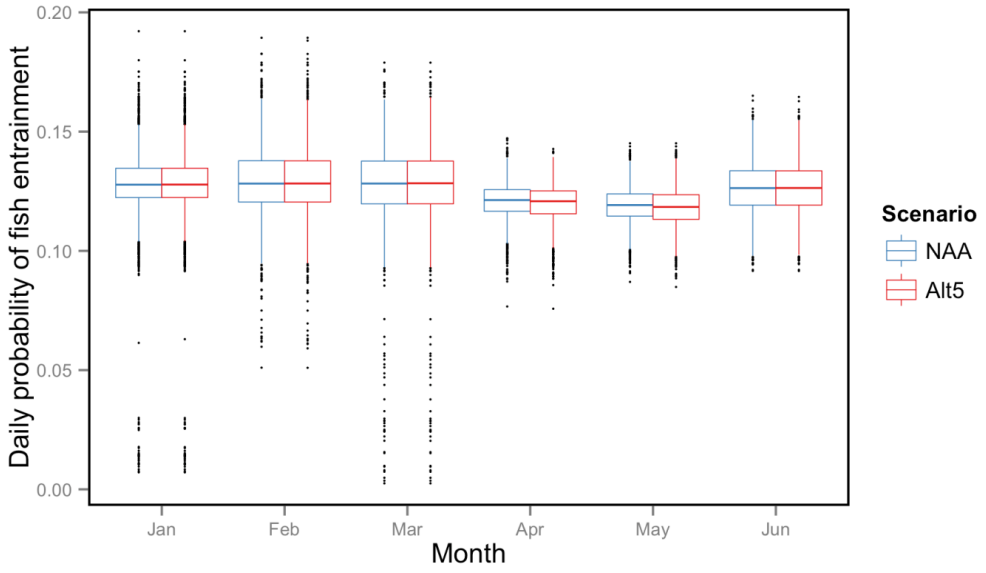

Figure 9L.22 Probability of Fish Entrainment into Columbia Cut under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

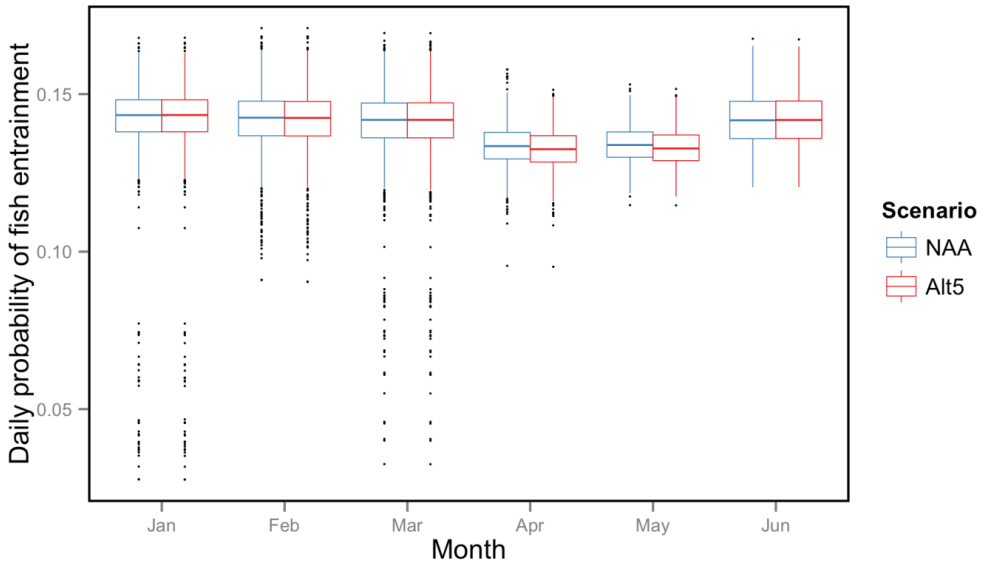

Figure 9L.23 Probability of Fish Entrainment into Middle River under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

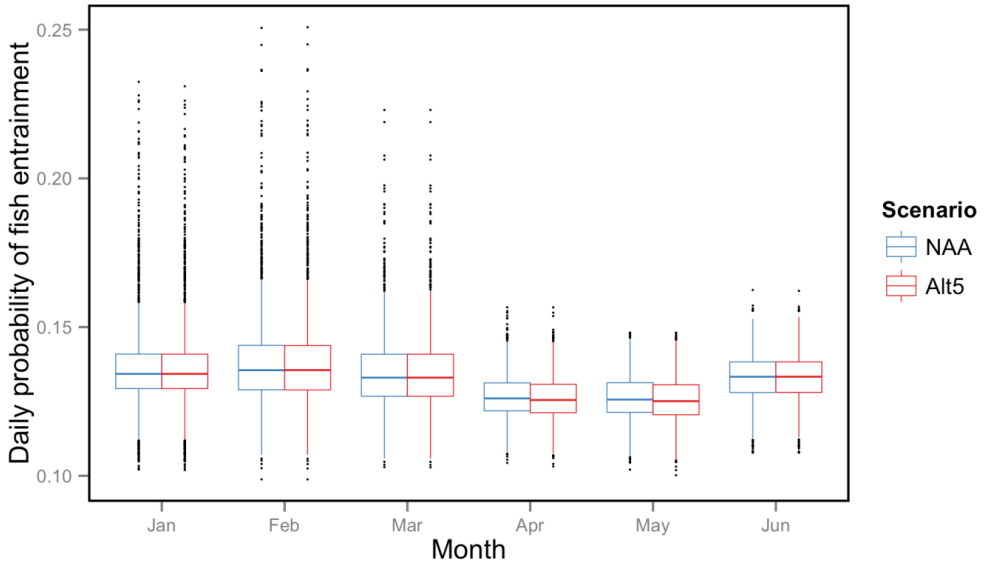

Figure 9L.24 Probability of Fish Entrainment into Old River under Alternative 5 (Alt 5) as compared to the No Action Alternative (NAA)

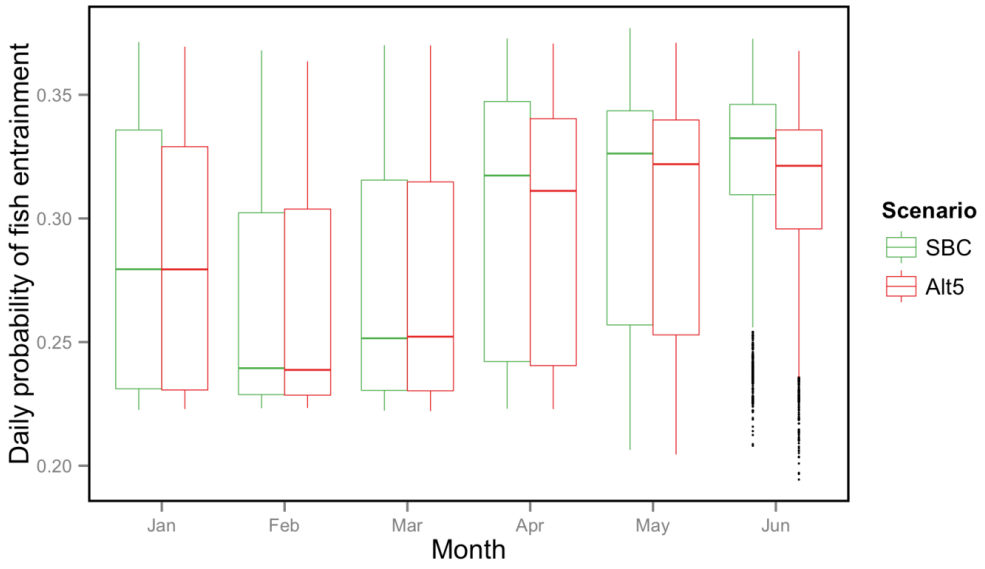

Figure 9L.25 Probability of Fish Entrainment into Georgiana Slough under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

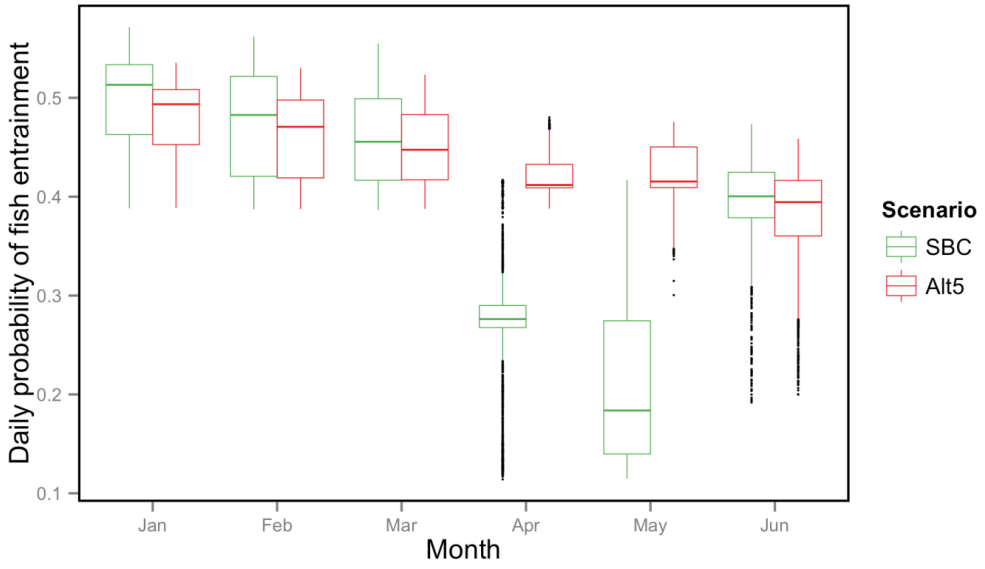

Figure 9L.26 Probability of Fish Entrainment into Head of Old River under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

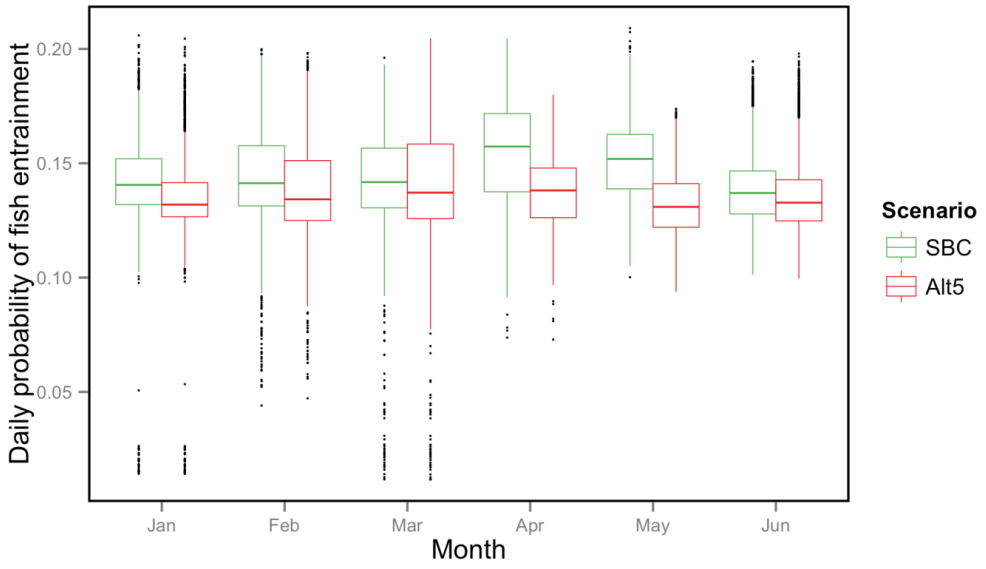

Figure 9L.27 Probability of Fish Entrainment into Turner Cut under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

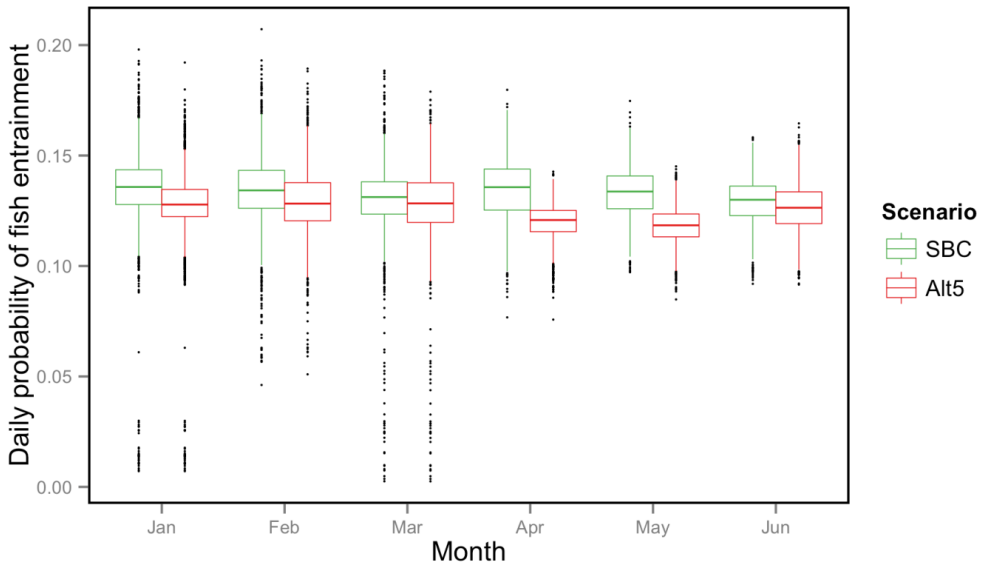

Figure 9L.28 Probability of Fish Entrainment into Columbia Cut under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

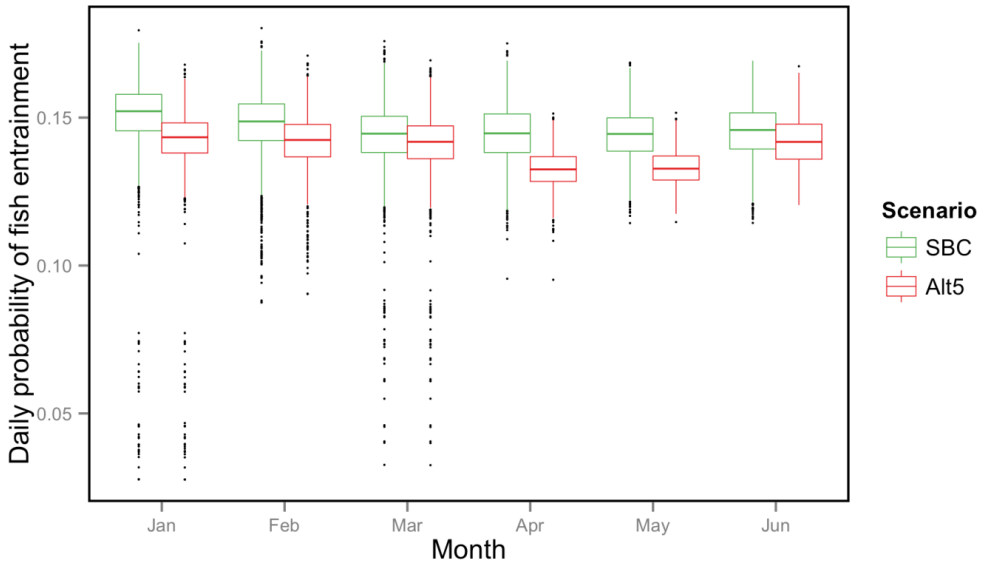

Figure 9L.29 Probability of Fish Entrainment into Middle River under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

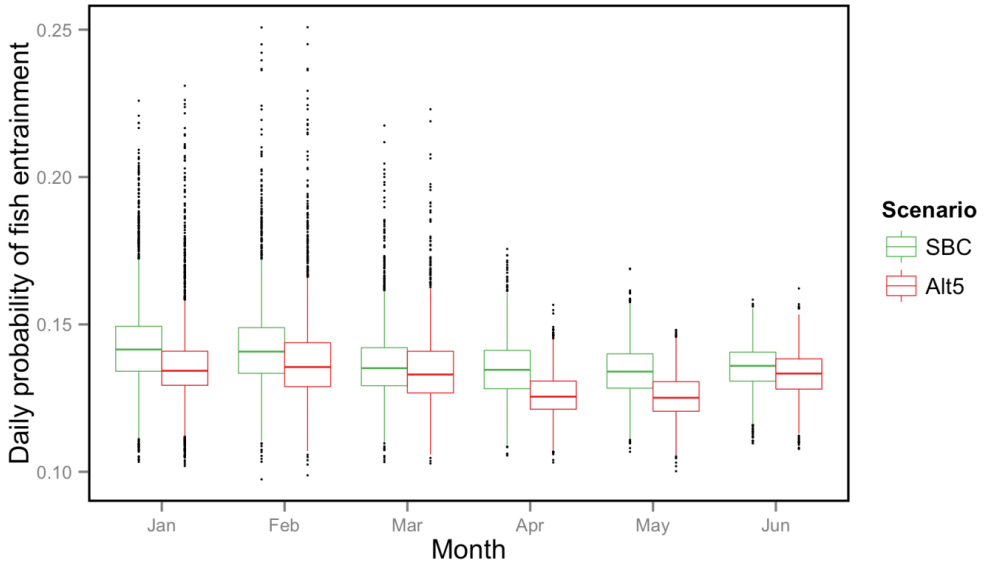

Figure 9L.30 Probability of Fish Entrainment into Old River under Alternative 5 (Alt 5) as compared to the Second Basis of Comparison (SBC)

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