Iteration #2 Results

Fish Passage Modeling – EbF Anadromous Fish Sub Group

COMPASS Modeling Results

SRT Meeting – February 28, 2013
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NOAA Fisheries

Anadromous Fish Evaluation Results using COMPASS

- Results of the current condition, iteration 2 alternatives and E1, E2, E3, and E5
- Analysis of two Upper Columbia River species will be presented
- Spring Chinook and Steelhead
- Model will not be used to assess summer juvenile migrants

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- Important considerations
  - E1 and E2 are bookends to identify and better understand potential improvements
  - Only upriver spring Chinook and steelhead modeled
  - No resident species, fall Chinook, or sockeye
  - Model addresses effects of flow, temperature, and spill on travel time and survival
  - Other factors that could potentially influence performance metrics were not included, including total dissolved gas

Outline

- Metrics/evaluation criteria
- Overview of the model and methods
- Modeling results
- Summary

Metrics/Evaluation Criteria

- COMPASS model was used to assess potential effects of discharge scenarios on migrating Chinook and steelhead.
- Metrics evaluated:
  - In-river survival
  - Smolt-to-adult return (includes in-river survival)
  - Travel time
- Applies to river segments from Wells Pool through the Columbia to Bonneville tailrace. Adult returns to Priest Rapids

Modeling Methods

- Comprehensive Passage Model (COMPASS)
  - Models juvenile fish passage through dams and reservoirs on seaward migration
  - Developed in collaboration with multiple State, Federal, and Tribal agencies and University of Washington
  - Compilation of modules describing physical and biological processes
  - Model formulations are based on theory and model parameters are estimated from data
  - Provides a set of predicted outcomes given a set of measured or simulated inputs

Modeling Methods

- COMPASS – Physical Models
  - Geographic and physical representation of Snake and Columbia Rivers and major tributaries
  - Flow – taken as input at dams, or generated given headwater inputs and elevations
  - Velocity – calculated from flow and river geometry
  - Temperature – taken as input or predicted
  - Dam configurations (elevations, passage routes, flow capacities, etc)
  - Dam operations (spill, powerhouse flow, transportation)

Modeling Methods

- COMPASS – Biological Models
  - Migration rate and spread
  - Reservoir survival
  - Dam passage behavior
  - Dam route-specific survival
  - Post-Bonneville survival

Modeling Methods

- Modeling approach
  - Calibrate COMPASS model parameters to data
  - Apply COMPASS model to scenarios for prediction
- Model Calibration
  - PIT tag data (1998-2011) used for fitting survival, travel time, and SAR models
  - SAR models fit external to COMPASS
  - Dam passage routing and survival based on active tag studies

Modeling Methods

- Key attributes of the model/analysis
  - Upriver spring Chinook and steelhead only
  - Input daily flow and spill from HYDSIM model
  - Input predicted daily temperature
  - Input parameters for survival, dam passage, and travel time models
  - Release fish following population distribution at head of Wells Pool
  - Outputs used to calculate key metrics, including survival and travel time to Bonneville, and arrival timing for SAR

Modeling Results

Chinook

Alternative	In-River Survival	Travel Time	SAR
RC-CC	0.412	53.5	0.0034
2A-TC	0.412	53.6	0.0034
2A-TT	0.417	52.4	0.0035
2B-TC	0.412	53.6	0.0034

Steelhead

Alternative	In-River Survival	Travel Time	SAR
RC-CC	0.271	38.2	0.0069
2A-TC	0.270	38.3	0.0068
2A-TT	0.294	36.8	0.0075
2B-TC	0.268	38.5	0.0068

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Chinook

Alternative	In-River Survival	Travel Time	SAR
RC-CC	0.412	53.5	0.0034
E1	0.457	46.4	0.0040
E2	0.445	48.4	0.0038
E3	0.412	53.6	0.0034
E5	0.415	52.8	0.0035

Steelhead

Alternative	In-River Survival	Travel Time	SAR
RC-CC	0.271	38.2	0.0069
E1	0.410	32.8	0.0106
E2	0.360	34.8	0.0092
E3	0.268	38.4	0.0068
E5	0.281	37.4	0.0072

Modeling Results – Dry Years Only

Chinook

Alternative	In-River Survival	Travel Time	SAR
RC-CC	0.390	60.9	0.0031
2A-TC	0.390	60.8	0.0031
2A-TT	0.395	59.9	0.0031
2B-TC	0.390	60.8	0.0031

Steelhead

Alternative	In-River Survival	Travel Time	SAR
RC-CC	0.184	45.2	0.0046
2A-TC	0.184	45.2	0.0046
2A-TT	0.202	43.6	0.0051
2B-TC	0.185	45.2	0.0046

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Chinook – Dry Years

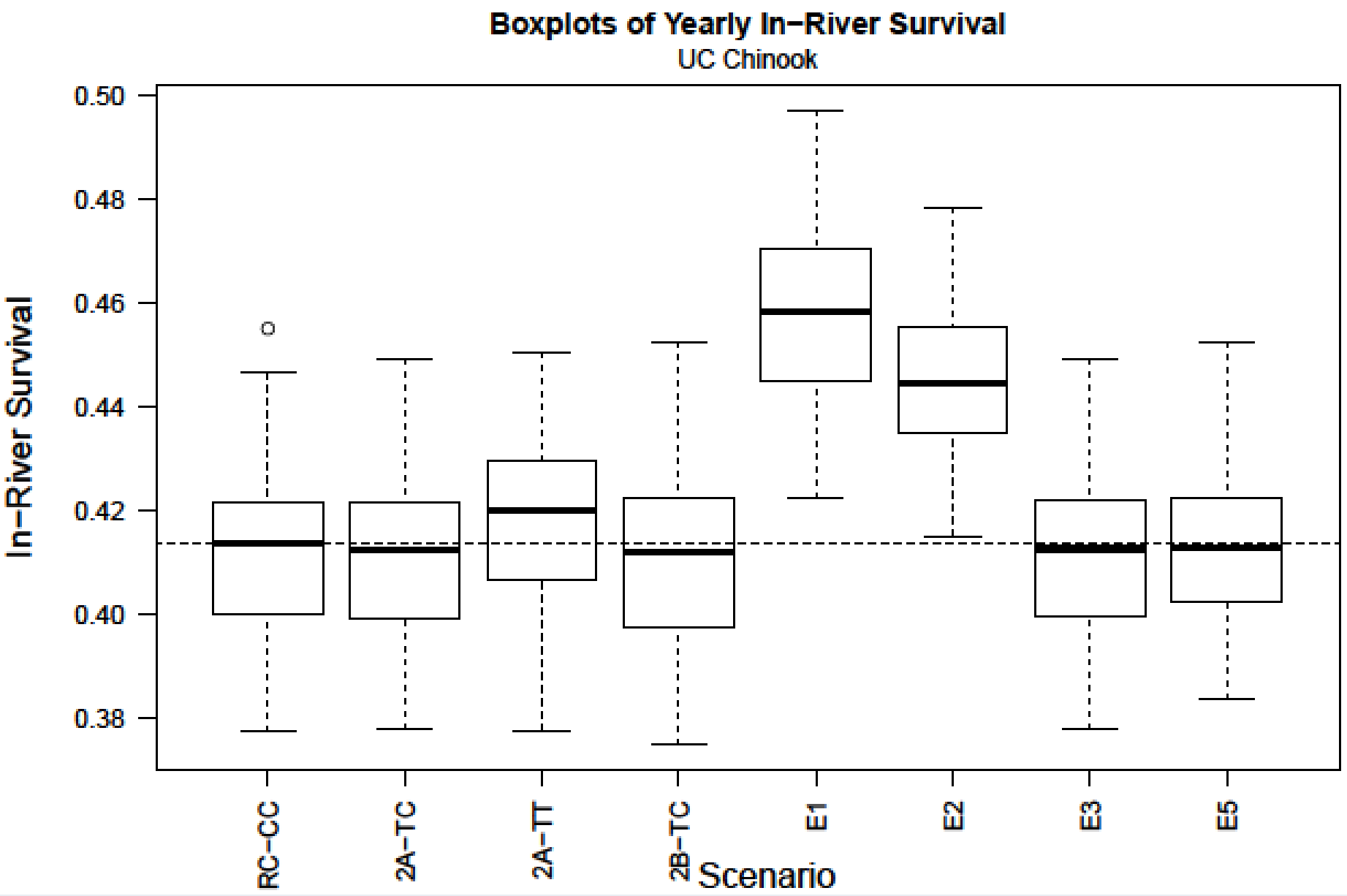
Alternative	In-River Survival	Travel Time	SAR
RC-CC	0.390	60.9	0.0031
E1	0.440	50.5	0.0037
E2	0.430	53.3	0.0036
E3	0.390	60.7	0.0031
E5	0.404	56.8	0.0033

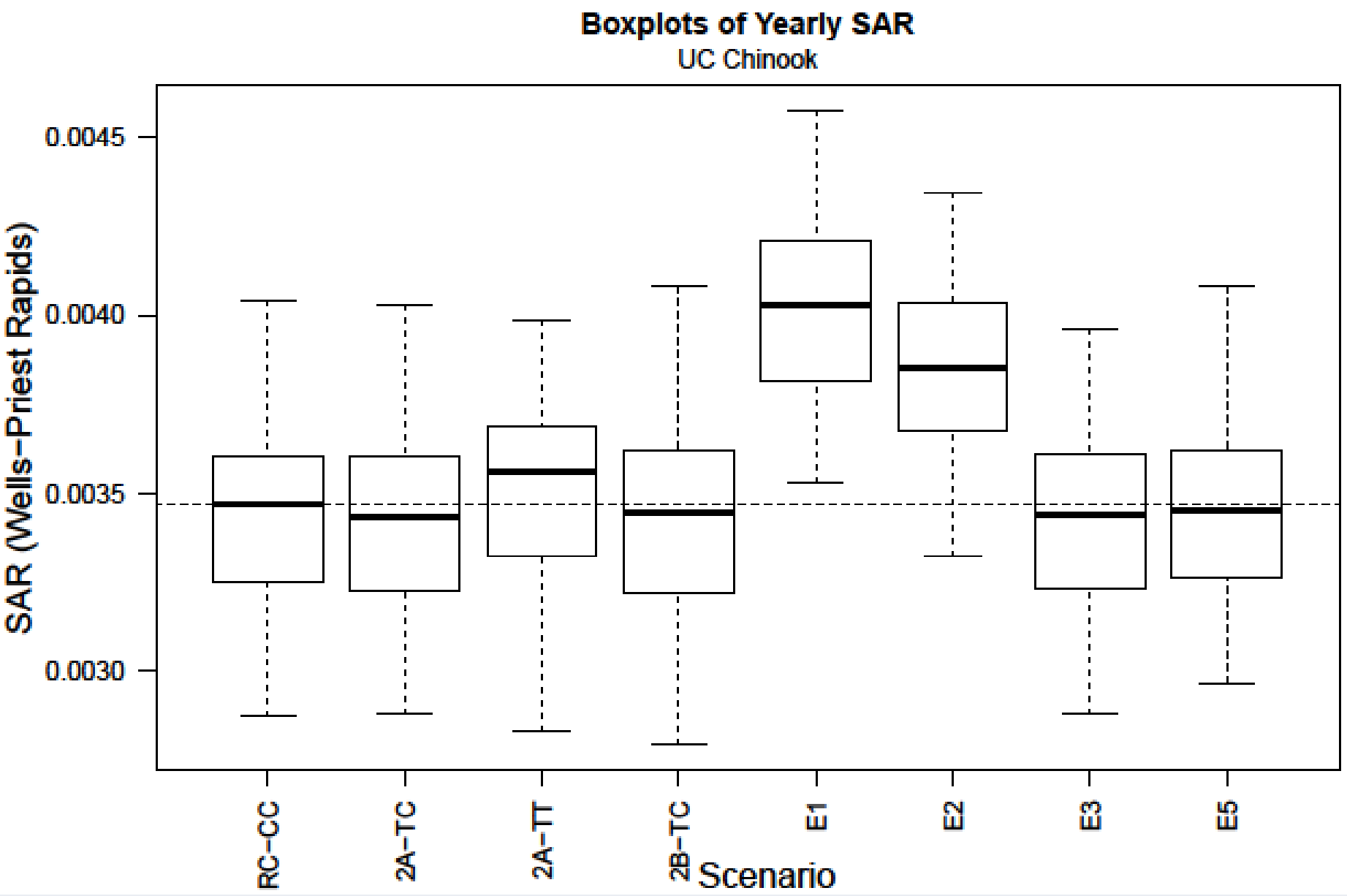
Steelhead – Dry Years

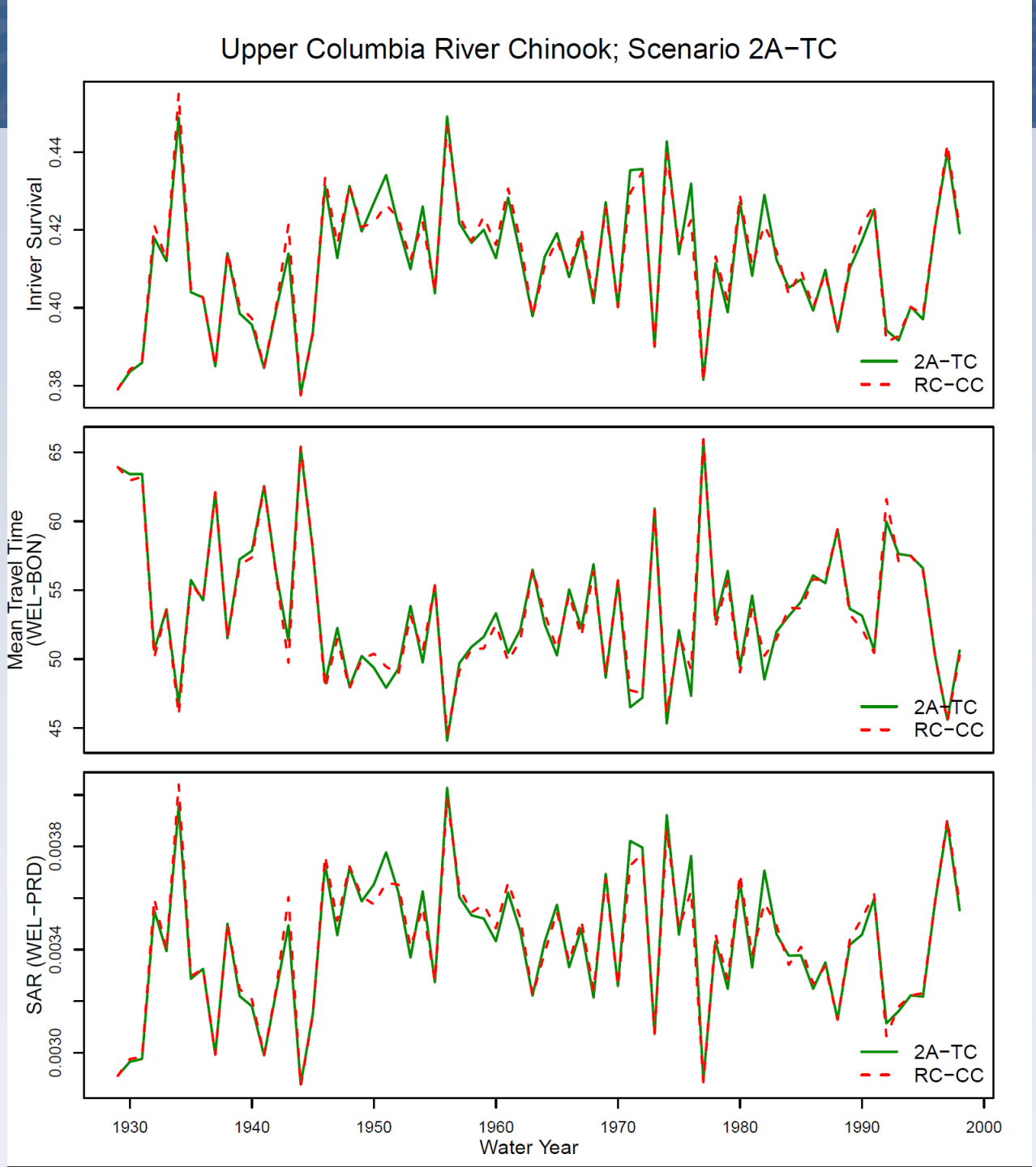
Alternative	In-River Survival	Travel Time	SAR
RC-CC	0.184	45.2	0.0046
E1	0.345	36.7	0.0091
E2	0.288	40.2	0.0073
E3	0.184	45.2	0.0046
E5	0.251	39.9	0.0066

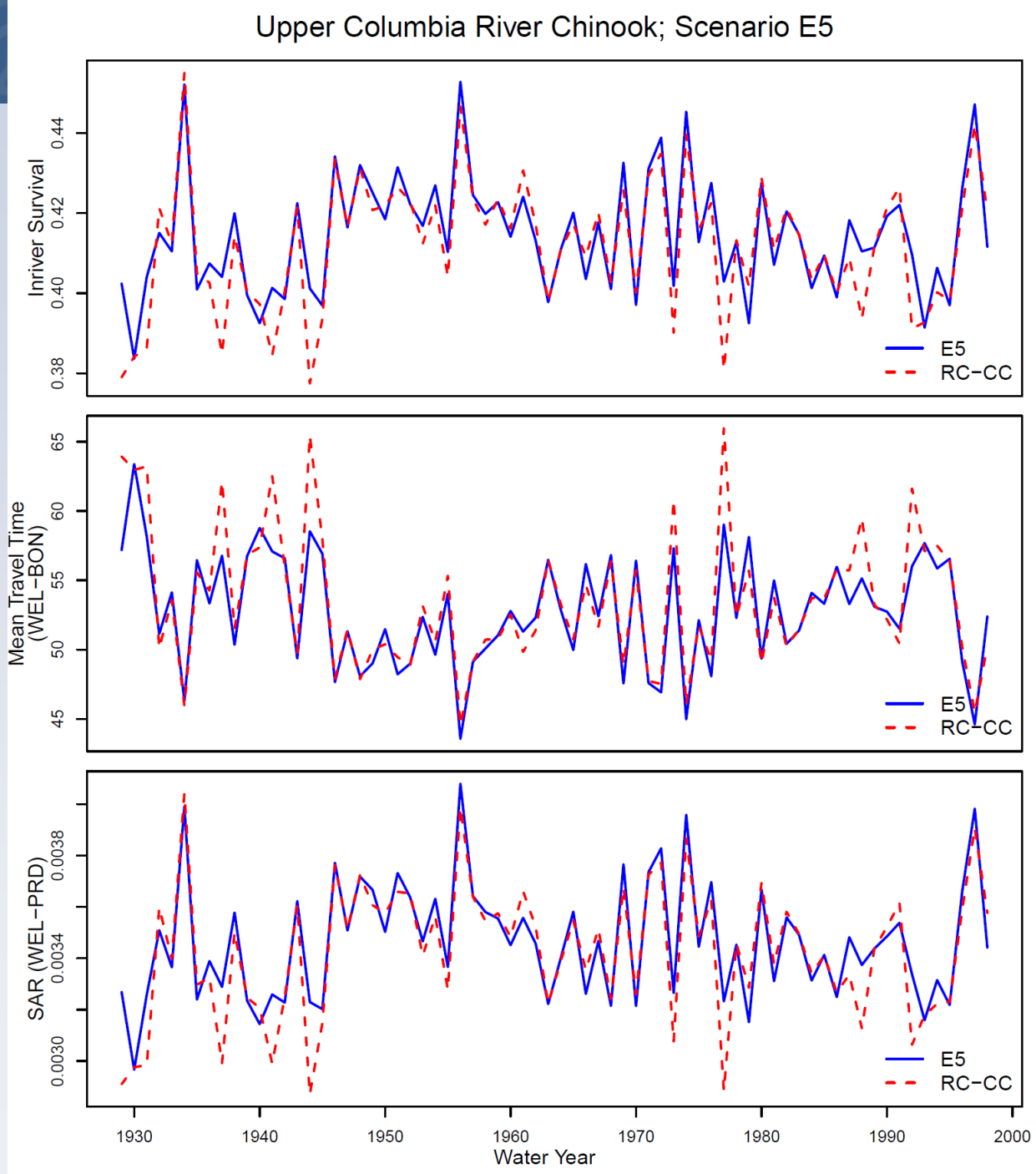
Modeling Results

Chinook


Boxplots of Yearly In−River Survival
UC Chinook
In−River Survival
0.50
0.48
0.46
0.44
0.42
0.40
0.38
RC−CC
2A−TC
2A−TT
2B−TC
E1
E2
E3
E5
Scenario

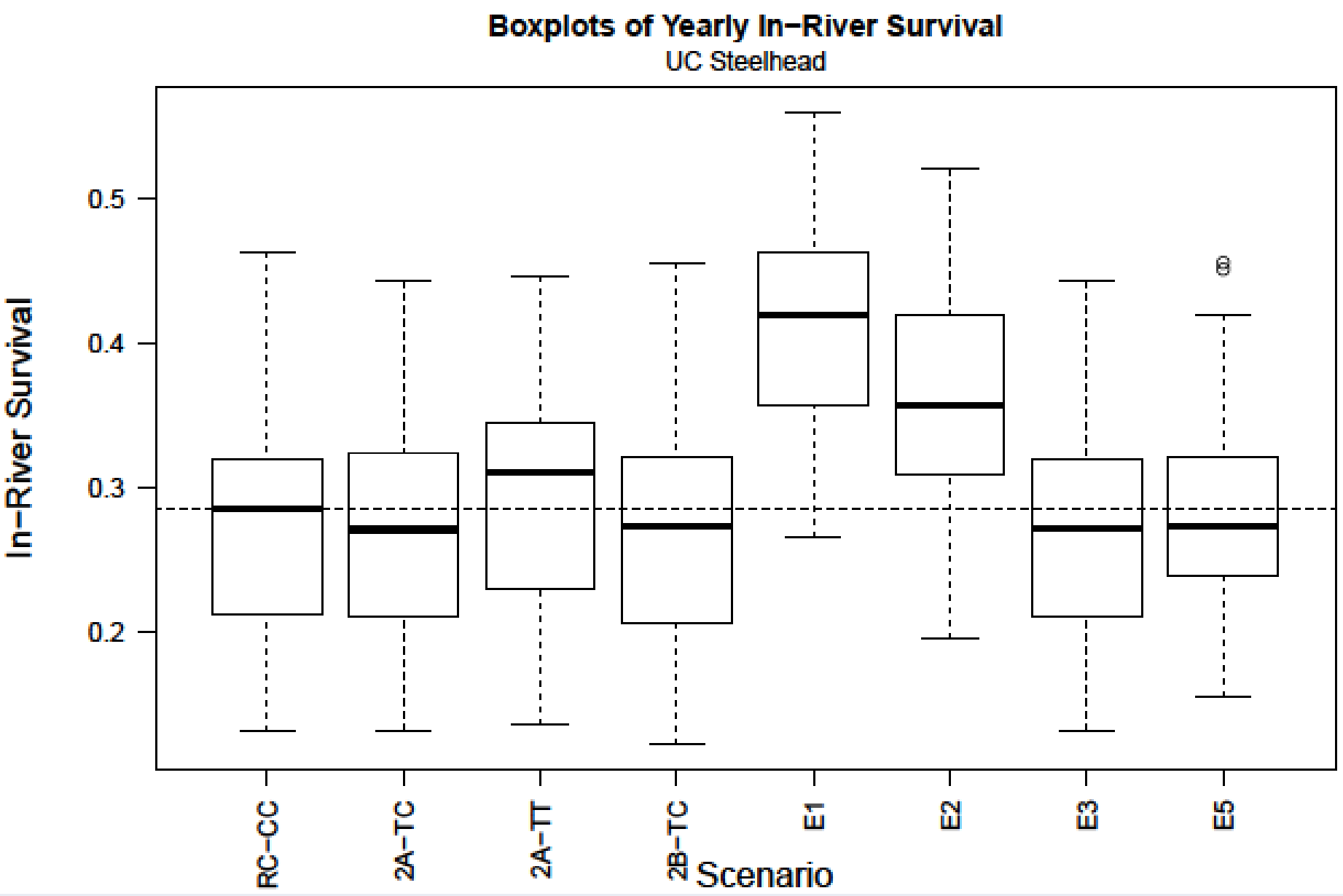

Boxplots of Yearly SAR
UC Chinook
SAR (Wells−Priest Rapids)
0.0045
0.0040
0.0035
0.0030
RC−CC
2A−TC
2A−TT
2B−TC
E1
E2
E3
E5
Scenario

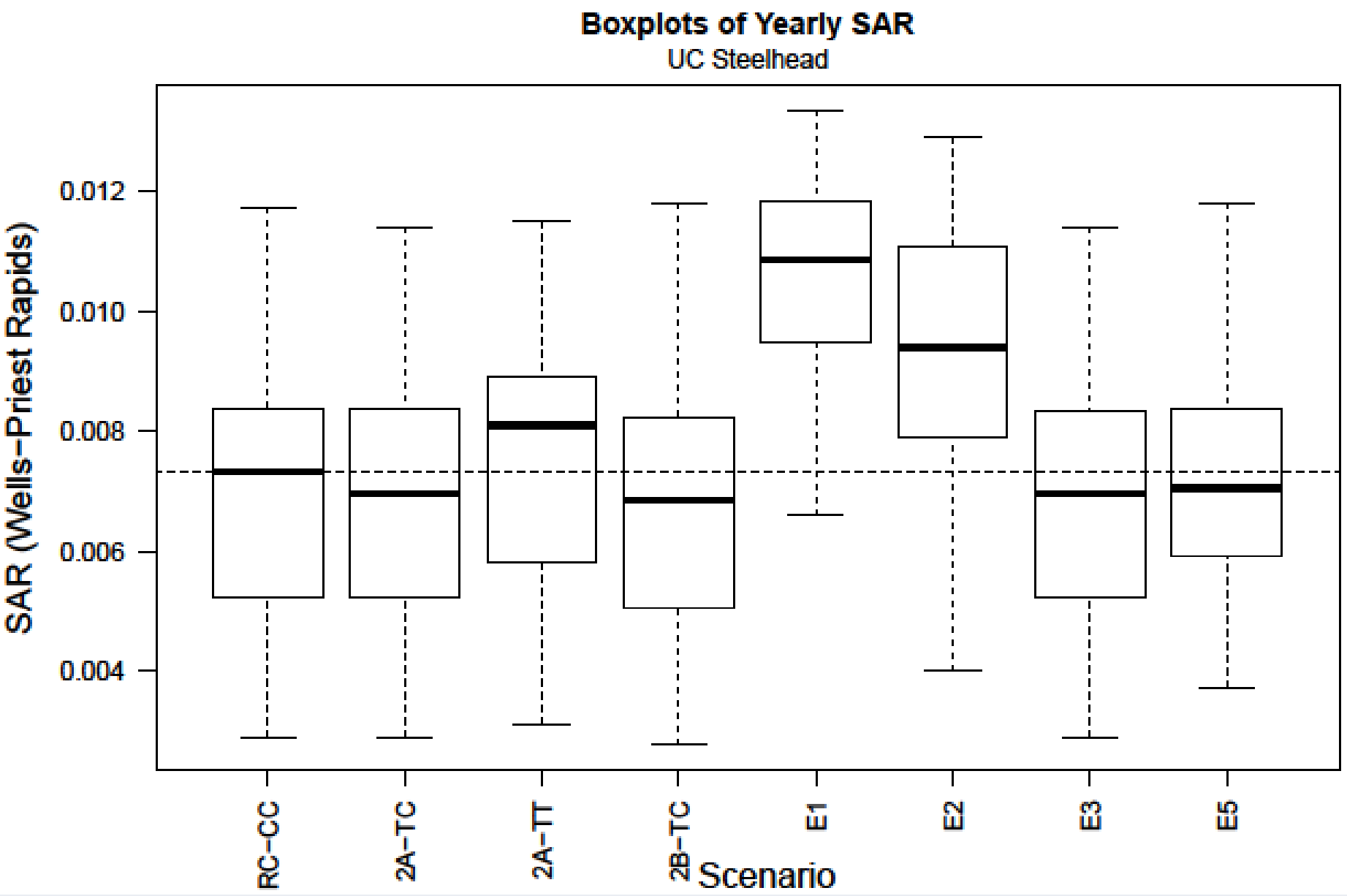

Upper Columbia River Chinook; Scenario 2A−TC
Inriver Survival
0.38
0.40
0.42
0.44
2A−TC
RC−CC
Mean Travel Time (WEL−BON)
45
50
55
60
65
2A−TC
RC−CC
SAR (WEL−PRD)
0.0030
0.0034
0.0038
2A−TC
RC−CC
1930
1940
1950
1960
1970
1980
1990
2000
Water Year

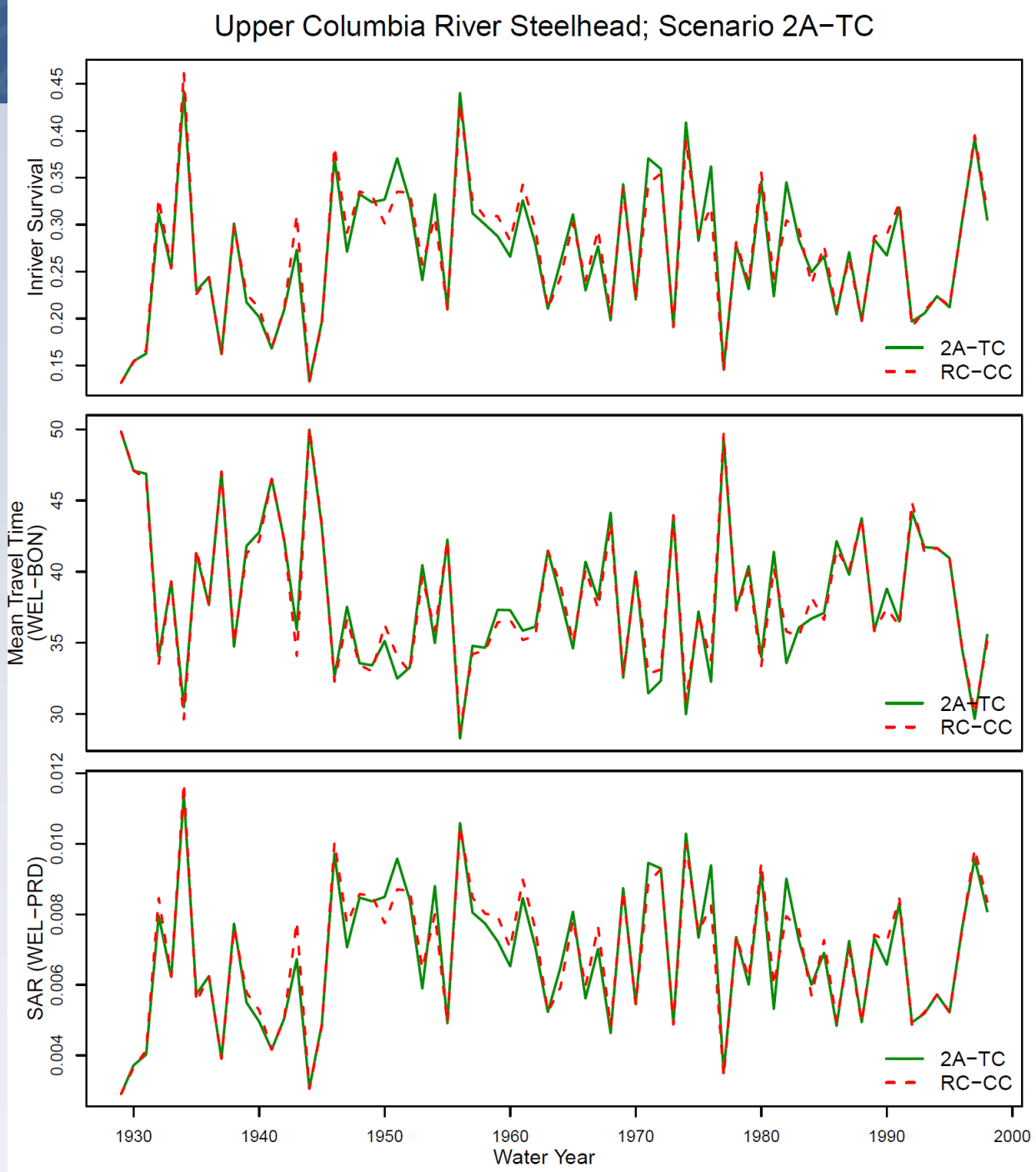

Upper Columbia River Chinook; Scenario E5
Inriver Survival
0.38
0.40
0.42
0.44
E5
RC−CC
Mean Travel Time (WEL−BON)
45
50
55
60
65
E5
RC−CC
SAR (WEL−PRD)
0.0030
0.0034
0.0038
E5
RC−CC
1930
1940
1950
1960
1970
1980
1990
2000
Water Year

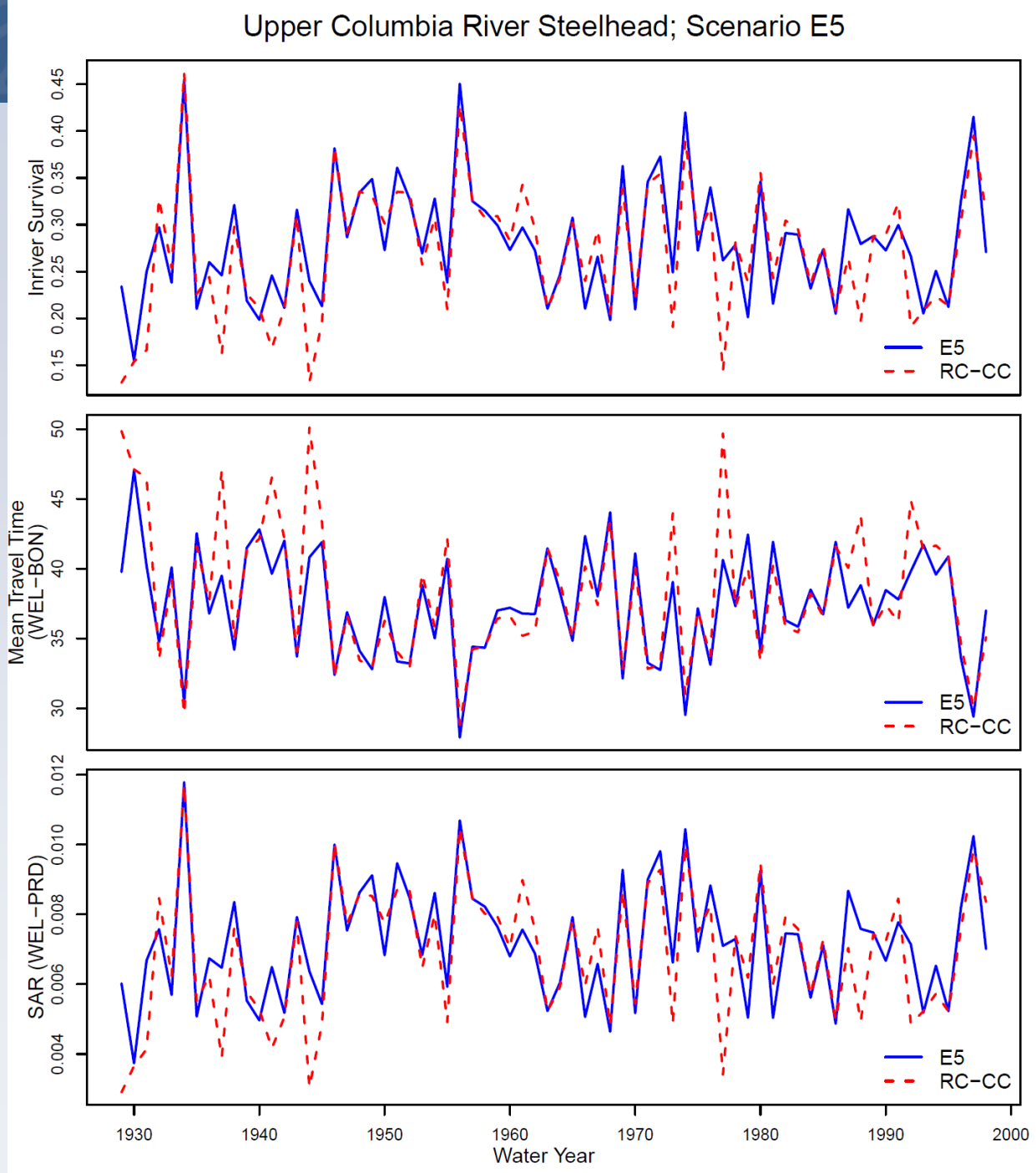
Modeling Results

Steelhead


Boxplots of Yearly In−River Survival
UC Steelhead
In−River Survival
0.2
0.3
0.4
0.5
RC−CC
2A−TC
2A−TT
2B−TC
E1
E2
E3
E5
Scenario


Boxplots of Yearly SAR
UC Steelhead
SAR (Wells–Priest Rapids)
0.012
0.010
0.008
0.006
0.004
RC–CC
2A–TC
2A–TT
2B–TC
E1
E2
E3
E5
Scenario


Upper Columbia River Steelhead; Scenario 2A−TC
Inriver Survival
0.15
0.20
0.25
0.30
0.35
0.40
0.45
2A−TC
RC−CC
Mean Travel Time (WEL−BON)
30
35
40
45
50
2A−TC
RC−CC
SAR (WEL−PRD)
0.004
0.006
0.008
0.010
0.012
2A−TC
RC−CC
1930
1940
1950
1960
1970
1980
1990
2000
Water Year


Upper Columbia River Steelhead; Scenario E5
Inriver Survival
0.15
0.20
0.25
0.30
0.35
0.40
0.45
E5
RC−CC
Mean Travel Time (WEL−BON)
30
35
40
45
50
E5
RC−CC
SAR (WEL−PRD)
0.004
0.006
0.008
0.010
0.012
E5
RC−CC
1930
1940
1950
1960
1970
1980
1990
2000
Water Year

Summary

- Main results summary
  - Little change across metrics for 2A and 2B scenarios
  - E1 and E2 show significantly increased survival and total return and reduced travel times
  - E3 show little improvements, but most of additional flow applied in summer, not during spring migration
  - E5 show significant improvements in dry years
  - Relative changes greater for steelhead than Chinook

Summary

- Important considerations
  - E1 and E2 are bookends to identify and better understand potential improvements
  - Only upriver spring Chinook and steelhead modeled
  - No resident species, fall Chinook, or sockeye
  - Model addresses effects of flow, temperature, and spill on travel time and survival
  - Other factors that could potentially influence performance metrics were not included, including total dissolved gas

Summary

- Important considerations
  - Variation in shape and timing of release distributions not modeled
  - Some scenarios (E1 and E2) produce conditions (forced spill)beyond where we have data, requiring caution in interpretation
  - COMPASS is useful as a comparative tool between scenarios

Summary

- Coming developments
  - Modeling of Snake River stocks in Lower Columbia
  - Application of prediction uncertainty
  - Investigation of timing of fish migration relative to timing of flow releases
  - Potential linkages with Life Cycle Modeling