Assessing the Impacts of Environmental and Ecological variables on the Performance of Fraser Sockeye Salmon Forecast

Supplementary materials

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Supplementary materials

Figure S1. Area (red polygon) where tagged Sockeye salmon were captured. Numbers are months when captured Sockeye salmon were tagged. Sea surface temperature was averaged over the polygon and used as a predictor for Sockeye salmon dynamics.

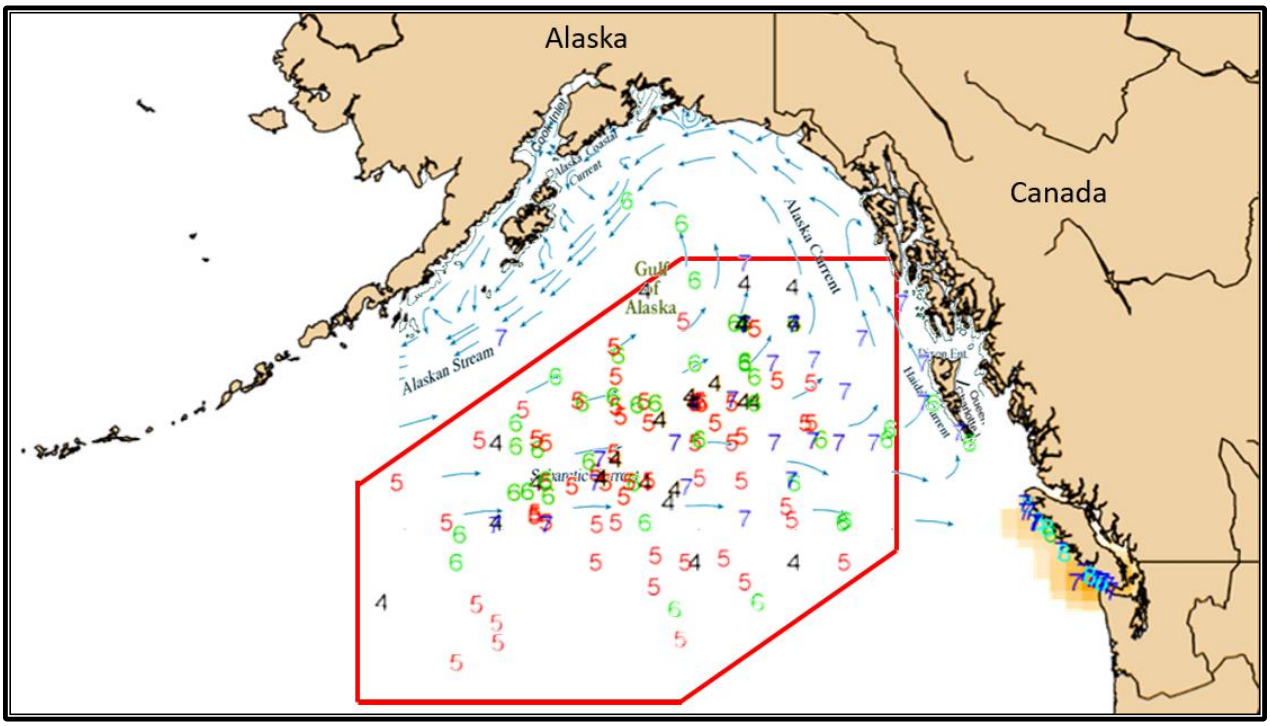


Figure S2. Observed and previously forecast Fraser sockeye adult returns for the 18 major stocks from 2009 to 2020.

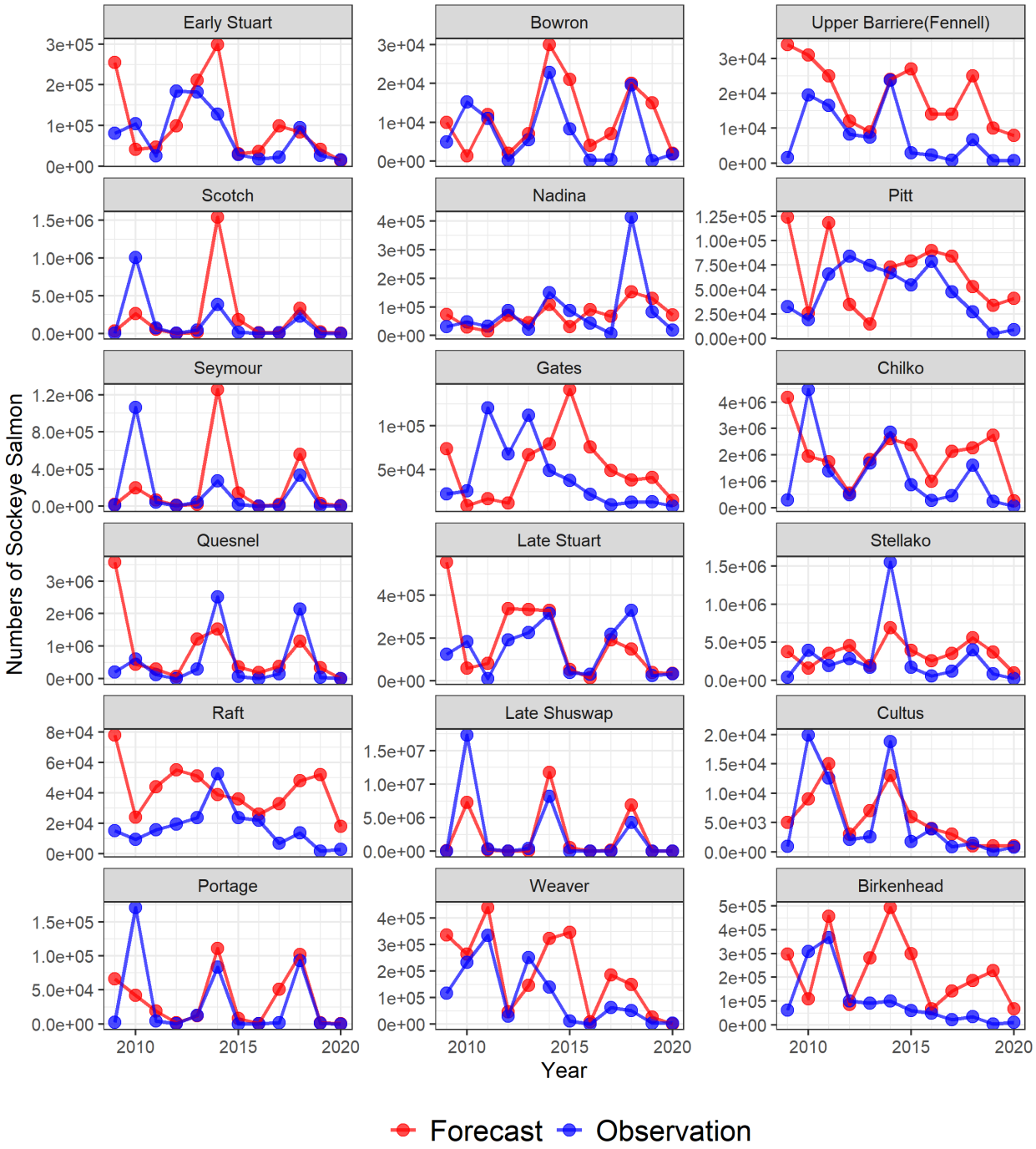
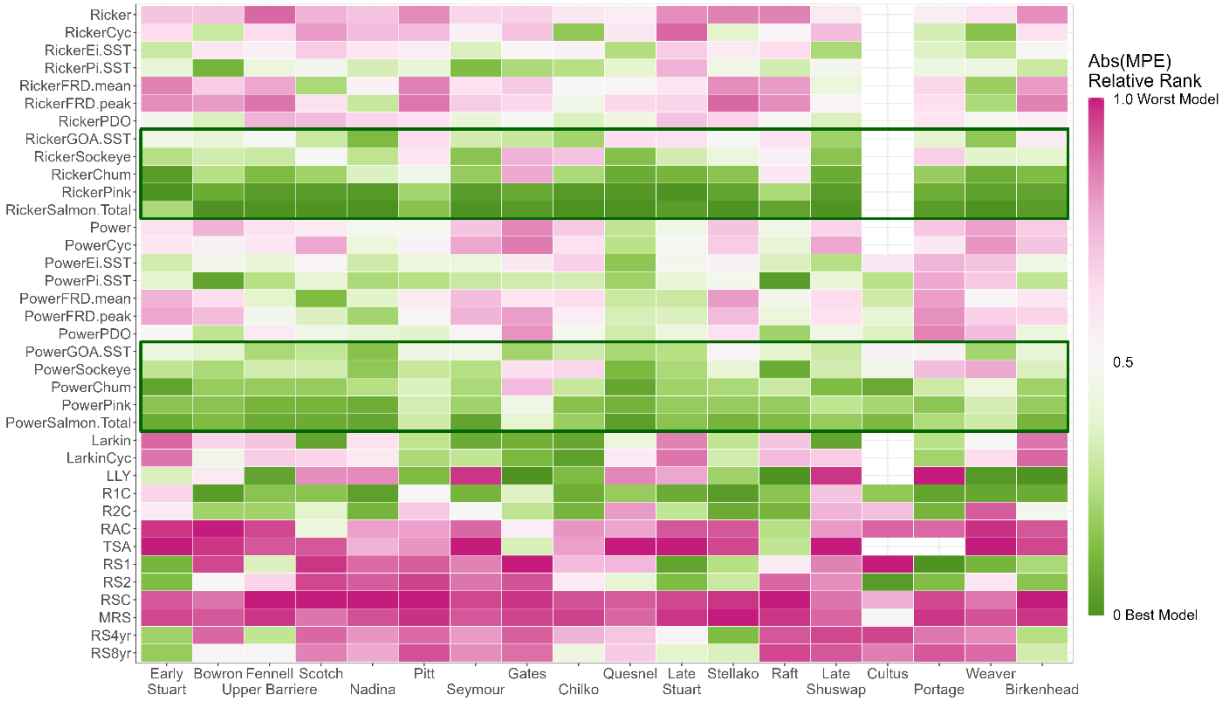


Figure S3. Relative ranking for all 37 models and all 18 Fraser Sockeye stocks of a) absolute value of mean raw error Abs(MRE) b) mean absolute error (MAE) c) absolute value of mean percent error Abs(MPE), d) root-mean-square error (RMSE), and e) normalized forecast metric (NFM) that measures bias with small biases between -2.0 and 2.0 shown numerically.

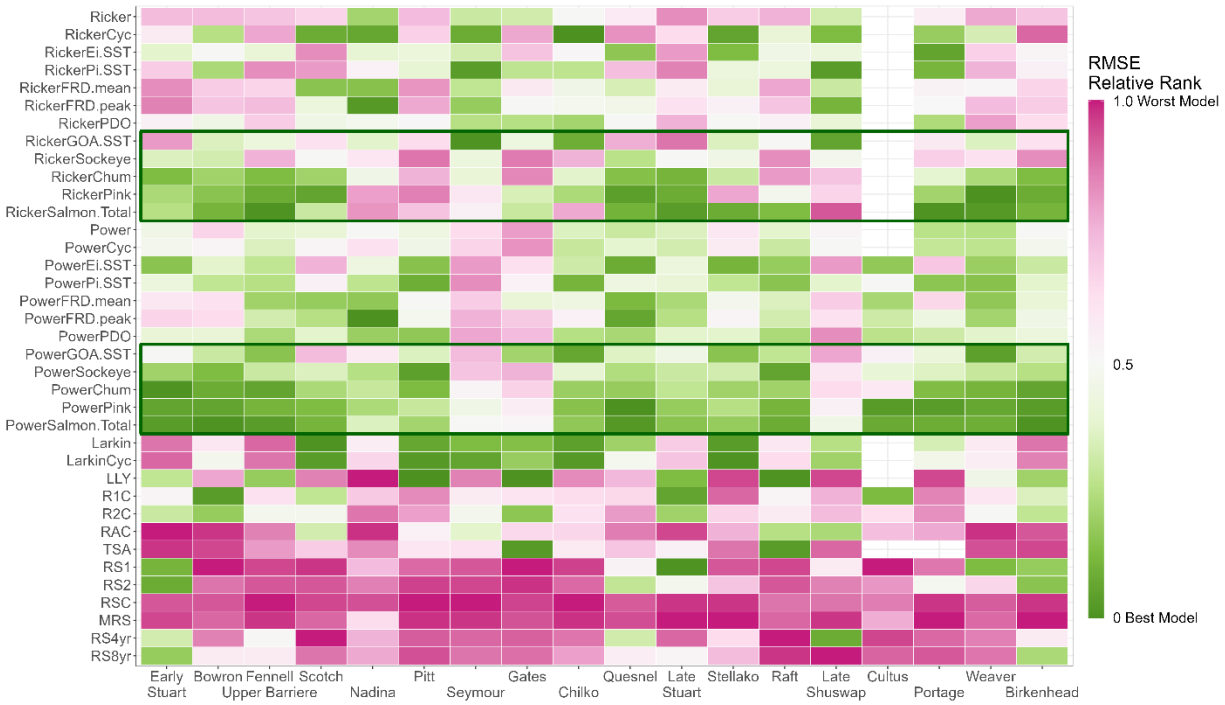
a.

b.

c.


Ricker
RickerCyc
RickerEi.SST
RickerPi.SST
RickerFRD.mean
RickerFRD.peak
RickerPDO
RickerGOA.SST
RickerSockeye
RickerChum
RickerPink
RickerSalmon.Total
Power
PowerCyc
PowerEi.SST
PowerPi.SST
PowerFRD.mean
PowerFRD.peak
PowerPDO
PowerGOA.SST
PowerSockeye
PowerChum
PowerPink
PowerSalmon.Total
Larkin
LarkinCyc
LLY
R1C
R2C
RAC
TSA
RS1
RS2
RSC
MRS
RS4yr
RS8yr
Early Stuart
Bowron
Fennell
Scotch
Upper Barriere
Nadina
Pitt
Seymour
Gates
Chilko
Quesnel
Late Stuart
Stellako
Raft
Late Shuswap
Cultus
Portage
Weaver
Birkenhead
Abs(MPE) Relative Rank
1.0 Worst Model
0.5
0 Best Model

d.


Ricker
RickerCyc
RickerEi.SST
RickerPi.SST
RickerFRD.mean
RickerFRD.peak
RickerPDO
RickerGOA.SST
RickerSockeye
RickerChum
RickerPink
RickerSalmon.Total
Power
PowerCyc
PowerEi.SST
PowerPi.SST
PowerFRD.mean
PowerFRD.peak
PowerPDO
PowerGOA.SST
PowerSockeye
PowerChum
PowerPink
PowerSalmon.Total
Larkin
LarkinCyc
LLY
R1C
R2C
RAC
TSA
RS1
RS2
RSC
MRS
RS4yr
RS8yr
Early Stuart
Bowron
Fennell
Scotch
Upper Barriere
Nadina
Pitt
Seymour
Gates
Chilko
Quesnel
Late Stuart
Stellako
Raft
Late Shuswap
Cultus
Portage
Weaver
Birkenhead
RMSE Relative Rank
1.0 Worst Model
0.5
0 Best Model

e.

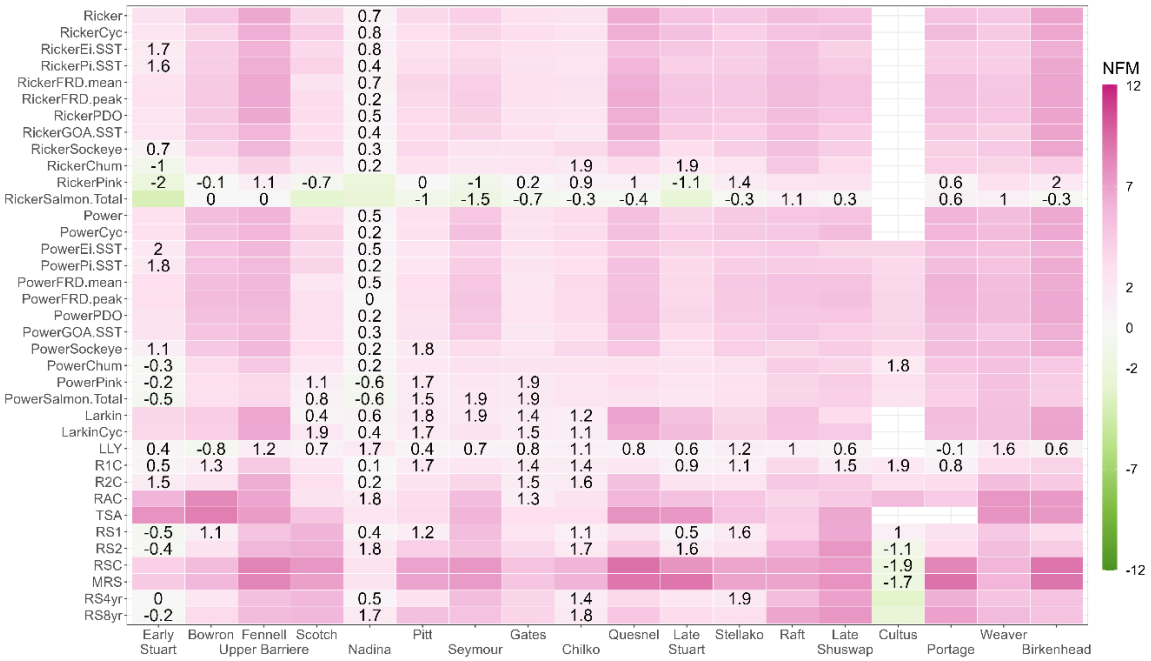


Figure S4. Normalized standard deviation of forecasts from all 37 models along with that from the historically selected model (named Forecast for simplicity) for all 18 Fraser Sockeye stocks during the period of 2009 to 2020.

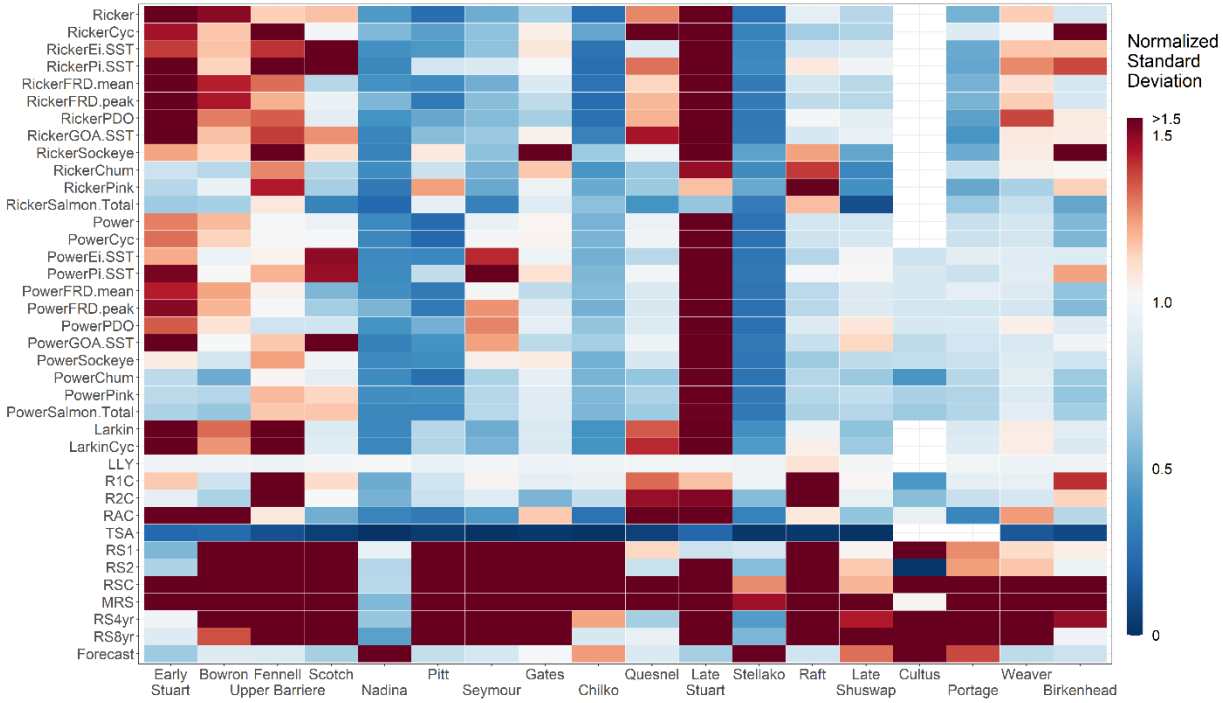
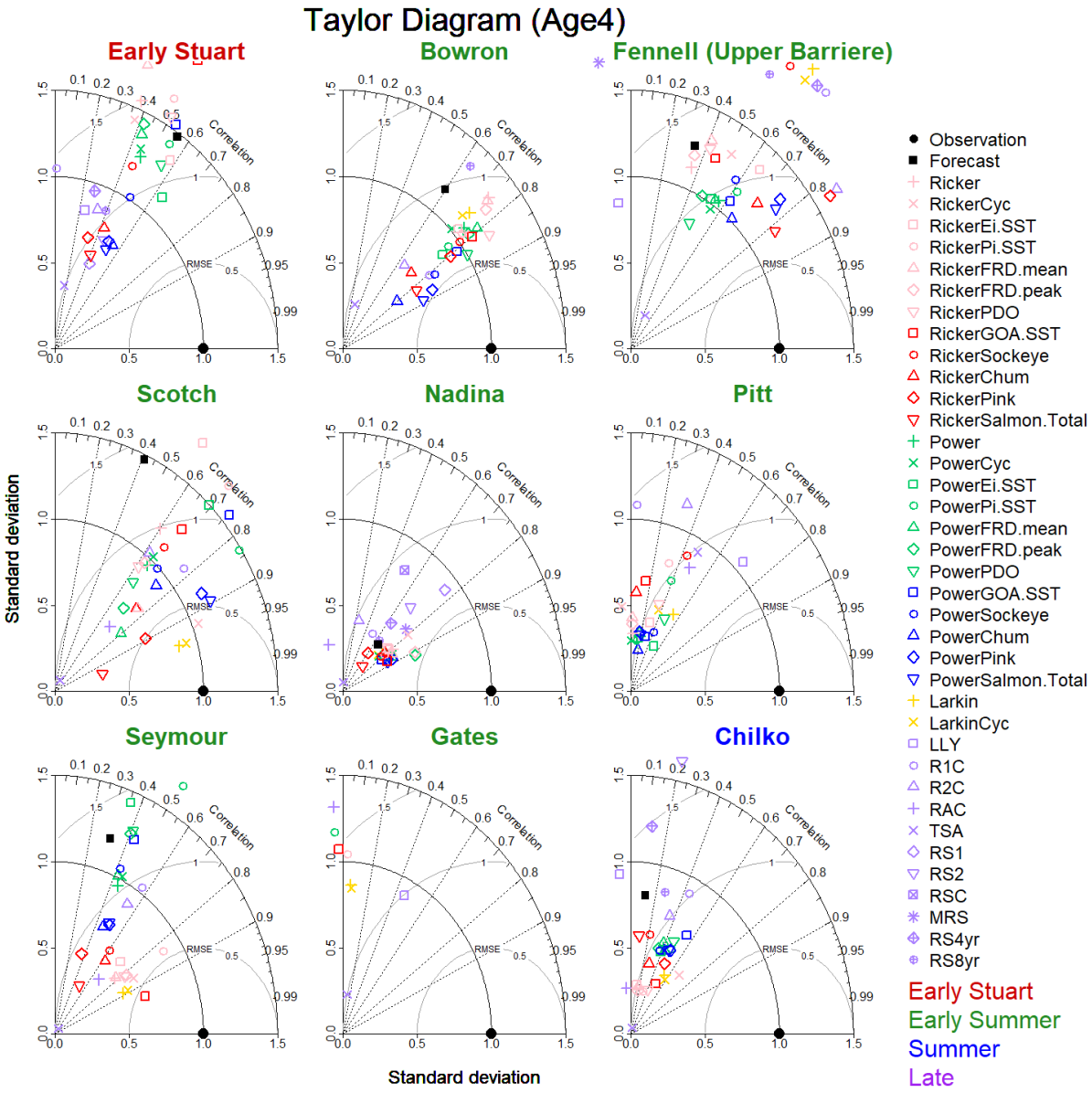


Figure S5. (a) Age 4 Taylor diagrams for Early Stuart sockeye stock, 7 Early Summer run stocks (Bowron, Fennel (Upper Barriere), Scotch, Nadina, Pitt, Seymour, and Gates), and 1 Summer run stock (Chilko). (b) Age 4 Taylor diagrams for 4 Summer run stocks (Quesnel, Late Stuart, Stellako, Raft) and 5 Late run stocks (Late Shuswap, Cultus, Portage, Weaver, and Birkenhead). Each Taylor diagram compares 37 model forecasts and the historical Forecast (black solid square) against the Observation (black solid circle on the x-axis). The distance from the origin is the normalized standard deviation with the normalized value for observations being 1. The angle describes the correlation between model forecasts and observations. The dashed arcs around the Observation illustrate the root-mean-square error (RMSE). Models with negative correlations are not shown. The closer the model is to the Observation, the better predictive power the model has.

a.



b.

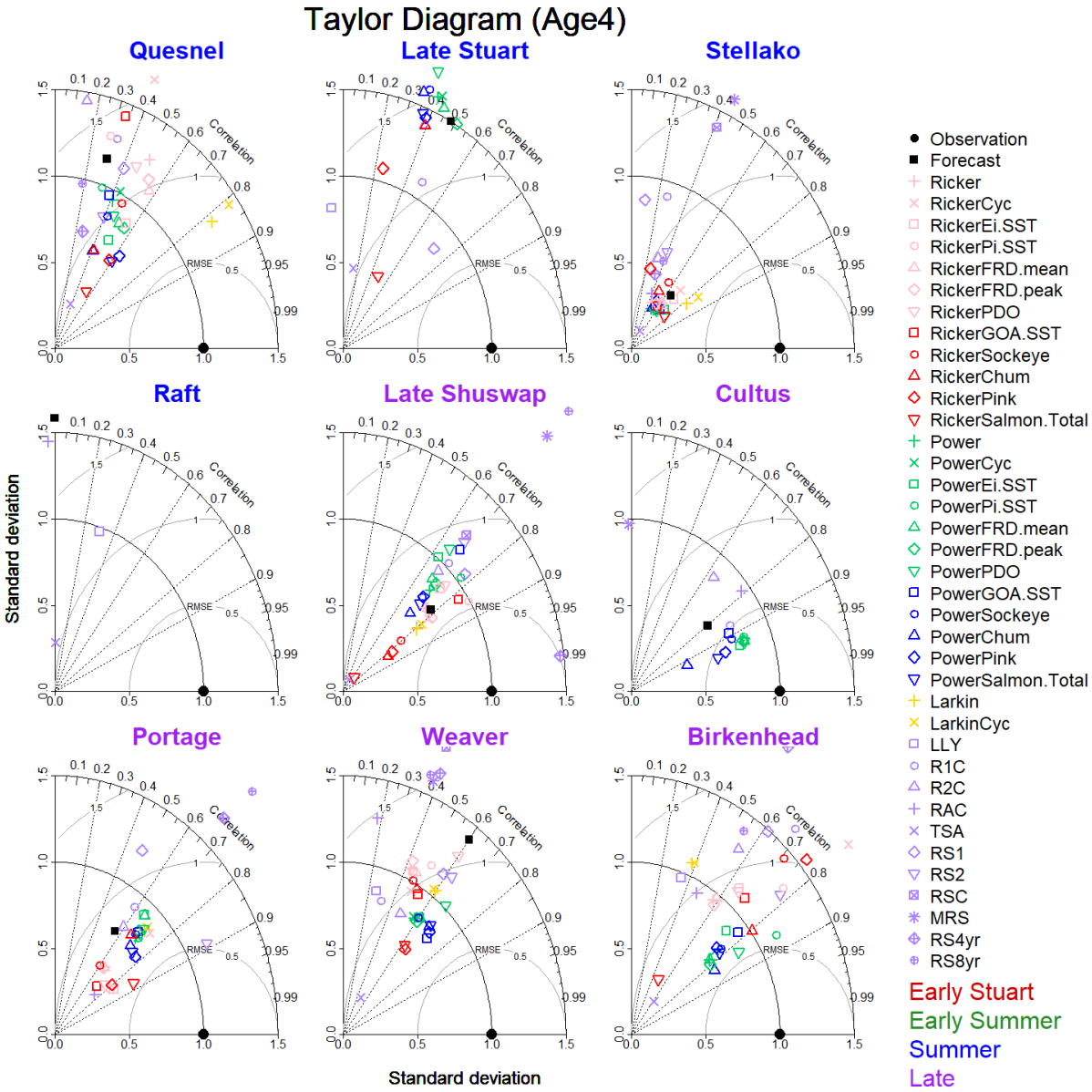
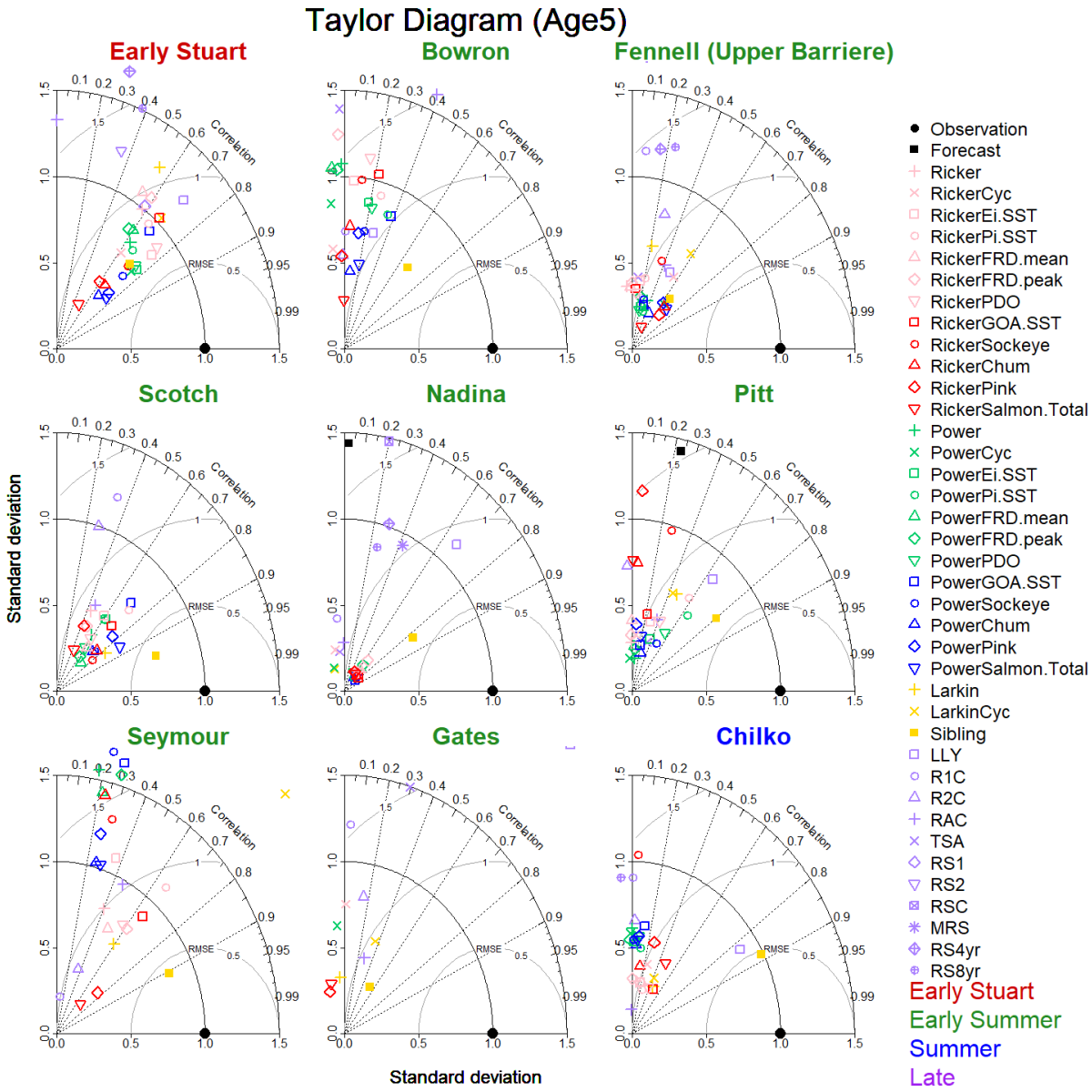
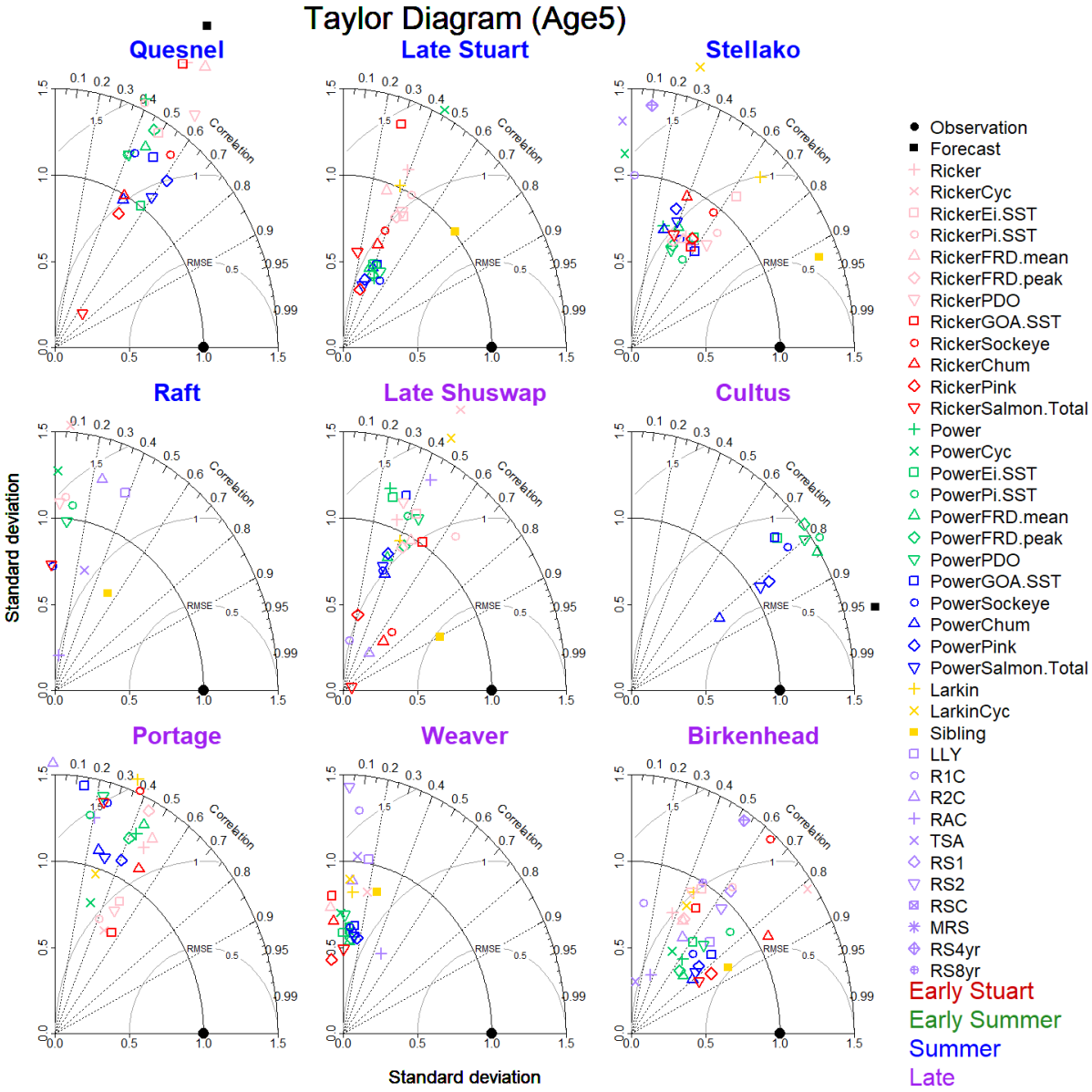

Taylor Diagram (Age4)
Quesnel
Late Stuart
Stellako
Raft
Late Shuswap
Cultus
Portage
Weaver
Birkenhead
Standard deviation
Standard deviation
Correlation
RMSE
Observation
Forecast
Ricker
RickerCyc
RickerEi.SST
RickerPi.SST
RickerFRD.mean
RickerFRD.peak
RickerPDO
RickerGOA.SST
RickerSockeye
RickerChum
RickerPink
RickerSalmon.Total
Power
PowerCyc
PowerEi.SST
PowerPi.SST
PowerFRD.mean
PowerFRD.peak
PowerPDO
PowerGOA.SST
PowerSockeye
PowerChum
PowerPink
PowerSalmon.Total
Larkin
LarkinCyc
LLY
R1C
R2C
RAC
TSA
RS1
RS2
RSC
MRS
RS4yr
RS8yr
Early Stuart
Early Summer
Summer
Late

Figure S6. (a) Age 5 Taylor diagrams for Early Stuart Sockeye stock, 7 Early Summer run stocks (Bowron, Fennel (Upper Barriere), Scotch, Nadina, Pitt, Seymour, and Gates), and 1 Summer run stock (Chilko). (b) Age 5 Taylor diagrams for 4 Summer run stocks (Quesnel, Late Stuart, Stellako, Raft) and 5 Late run stocks (Late Shuswap, Cultus, Portage, Weaver, and Birkenhead). Each Taylor diagram compares 38 model forecasts and the historical Forecast (black solid square) against the Observation (black solid circle on the x-axis). The distance from the origin is the normalized standard deviation with the normalized value for observations being 1. The angle describes the correlation between model forecasts and observations. The dashed arcs around the Observation illustrate the root-mean-square error (RMSE). Models with negative correlations are not shown. The closer the model is to the Observation, the better predictive power the model has.

a.



b.


Taylor Diagram (Age5)
Quesnel
Late Stuart
Stellako
Raft
Late Shuswap
Cultus
Portage
Weaver
Birkenhead
Standard deviation
Standard deviation
Correlation
RMSE
Observation
Forecast
Ricker
RickerCyc
RickerEi.SST
RickerPi.SST
RickerFRD.mean
RickerFRD.peak
RickerPDO
RickerGOA.SST
RickerSockeye
RickerChum
RickerPink
RickerSalmon.Total
Power
PowerCyc
PowerEi.SST
PowerPi.SST
PowerFRD.mean
PowerFRD.peak
PowerPDO
PowerGOA.SST
PowerSockeye
PowerChum
PowerPink
PowerSalmon.Total
Larkin
LarkinCyc
Sibling
LLY
R1C
R2C
RAC
TSA
RS1
RS2
RSC
MRS
RS4yr
RS8yr
Early Stuart
Early Summer
Summer
Late