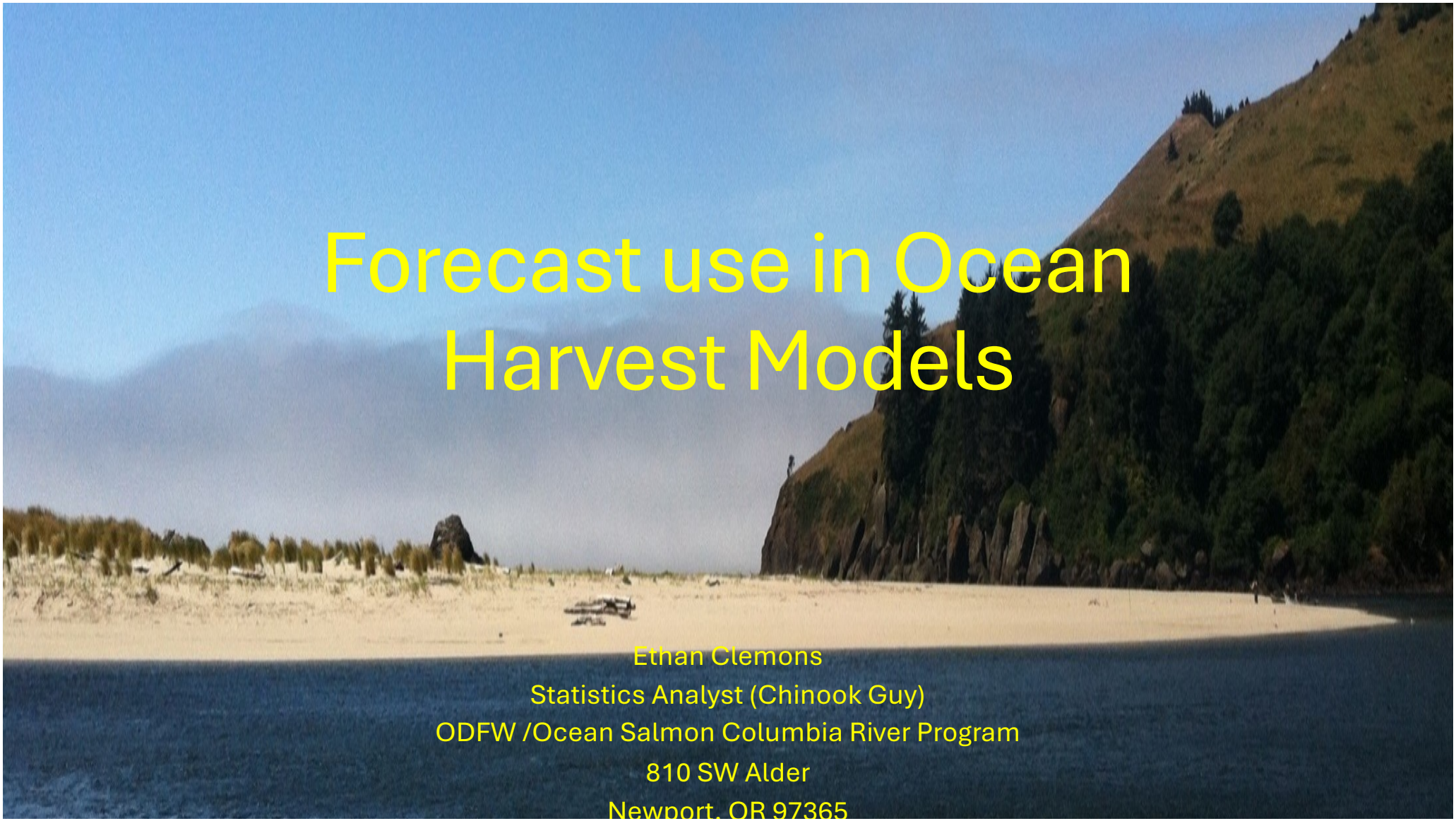

# Forecast use in Ocean Harvest Models

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ODFW /Ocean Salmon Columbia River Program
810 SW Alder
Newport, OR 97365

# Use of forecasts “how many fish are in the sea” …and how many can I catch.

- Conservation planning/management
- Domestic (country) planning/management
- Domestic (state) planning/management
- Basin-specific planning/management
  - Sometimes even tributary-based management (Umpqua/S. Umpqua)
- International treaty planning/management

# Chinook forecasting and use for Pacific Salmon Treaty Management

- “The Chinook Model”
  - Used for PST Chinook management
    - Also other output used by terminal management agencies
    - Output used for PFMC management for Chinook FRAM input
- Maintained by the CTC
- Run by CTC-AWG
- Inputs provided for by CTC-AWG and individual terminal management agencies

# Inputs to the Chinook Model

- Typically due second or third week in March
  - Hard deadline, needed to foster US domestic ocean salmon management (FRAM-PFMC management)
  - Exploitation rate analysis (ERA) conducted in February part of the information flow feeding into the PSC Chinook model.
- Inputs into Chinook Model
  - Base productivity-stocks
  - Fisheries impacts (both pre-terminal and terminal)
  - Maturation rates
  - Estimates of spawning or terminal abundance from 1979-present
  - Forecasts of abundance for the coming year's return
    - AK opts to allow Chinook model to predict coming year's abundance
    - All other terminal management agencies S. of AK borders provide for forecast of Chinook
      - History behind treaty struggles and forecasting review

# More model tidbits…

- Current model is deterministic
- Run annually
  - Pre-season assessment due by April 1st
  - Post-season assessment made have next year's model run is concluded
- Single-pool
- Everything is compared back to the "base years" 1979-1982
  - Per negotiated agreement
- Currently in the R&D phase to produce something "different"

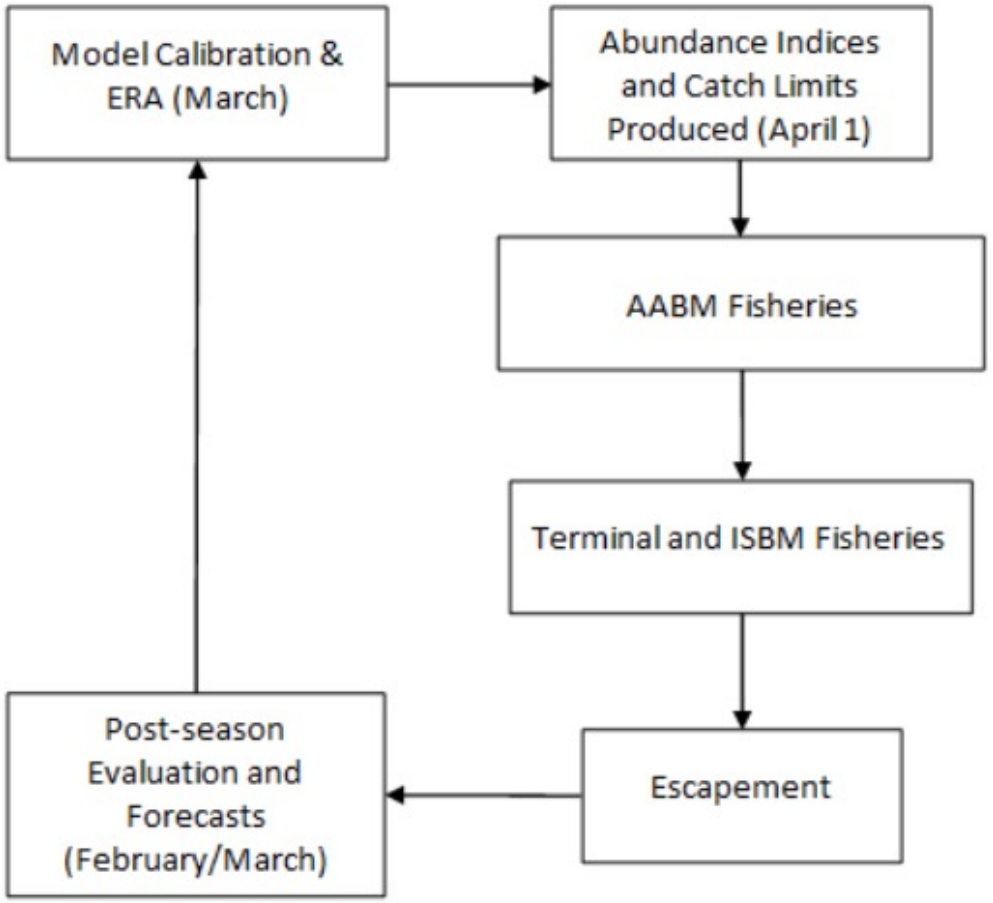



*Figure 1.1.—Pacific Salmon Treaty (PST) Chinook management and fishery process.*

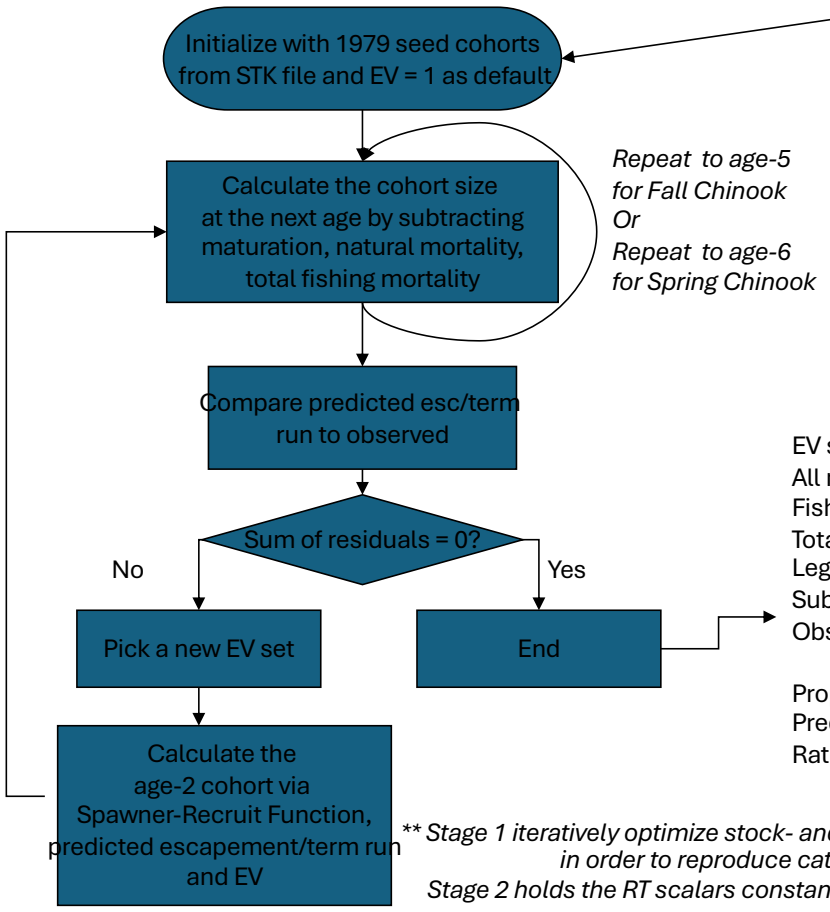
# Forecasts impact on the PSC Chinook model

- The ability of the PSC Chinook Model to accurately predict Chinook salmon ocean abundance in AABM fisheries depends on the ability of the model to predict the returns of Chinook salmon (in terms of ocean escapement or spawning escapement) in the forecast year.
- For each year's model calibration, all available agency-produced forecasts for model stocks are inputs to the model. Thus, for model stocks with agency-produced forecasts, the variation between model forecasts and actual returns can be broken into two parts: the ability of the model to fit the agency-produced forecasts used as inputs, and the ability of the agency-produced forecasts to accurately predict the actual return of Chinook salmon in the upcoming year.

# CTC Chinook Model Calibration

**Calibration Objective:** Estimate the set of stock and brood specific EVs that produce an identical set of Escapement/terminal runs compared to the observed escapement/terminal runs for 30 CTC stocks.

Calibration Process** Diagram




Key Calibration Inputs

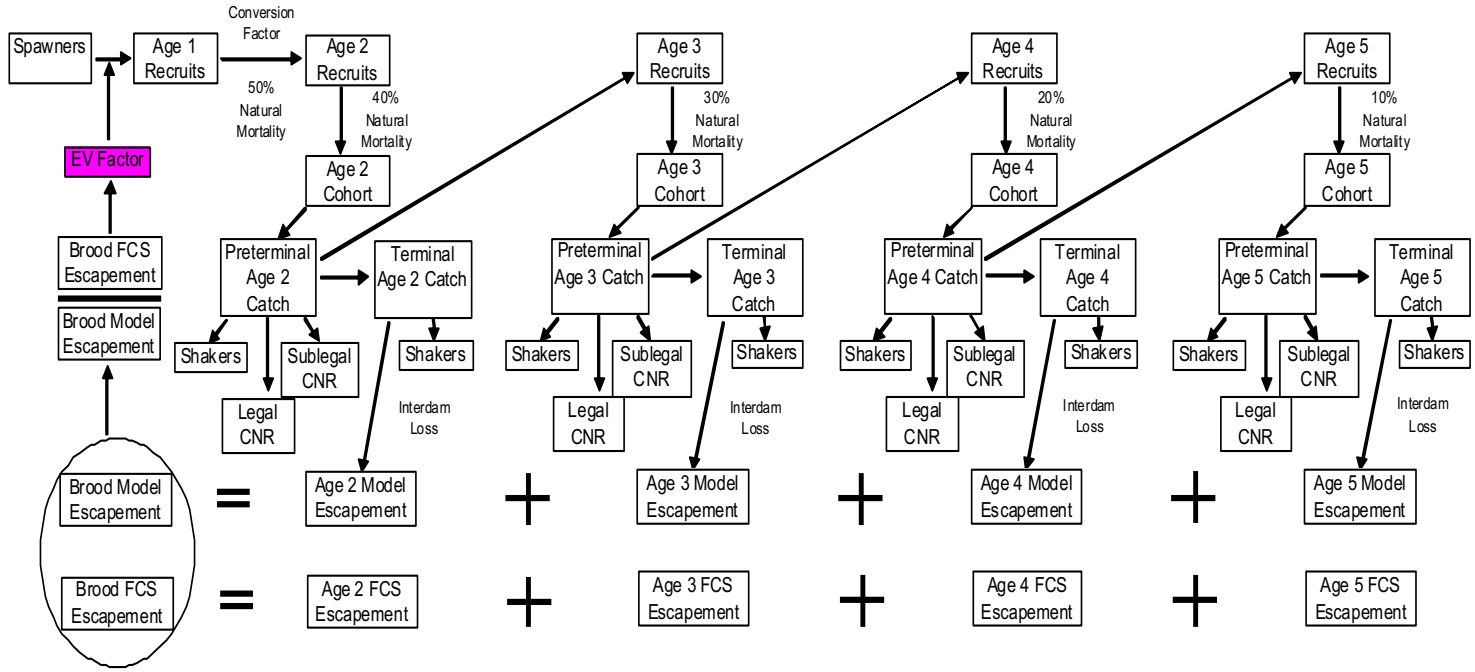
**Observed Catch by fishery (*.CEI)**
**Escapement/Terminal Run (*.FCS)**
**Spawner-Recruit Function (*.BSE)**
**Scalar for stock & age in the catch (*.FP) – from ERA**
**Base Period Exploitation Rates (*.STK)**
Non-retention rates (*.CNR)
Hatchery releases *.ENH
Incidental mortality rates *.IM
Maturation *MAT.DAT
Proportion vulnerable to gear *.PNV
Dam Passage Survival rates *.IDL

Calibration Outputs

EV set (*.EVO)
All model output but EV set (*.CCC)
Fishery catch by stock (*CAT.PRN)
Total incidental mort (*TIM.PRN)
Legal incidental mort by fishery (*LIM.PRN)
Sublegal incidental mort by fishery (*SIM.PRN)
Observed (from *.CEI) divided by modeled ceiling catch by fishery (*RT.PRN)
Proportion of stock encountered in each fishery (*PRP.PRN)
Predicted escapement by stock (*ESC.PRN)
Ratio of projected to actual catch (stock and age distribution in the fishery) by stock and age (*.FP)

*** Stage 1 iteratively optimize stock- and age-specific EV scalars and fishery-specific RT scalars in order to reproduce catches*
*Stage 2 holds the RT scalars constant to fine tune the EV scalars to reproduce escapements/term runs*

# Chinook Model Calibration Procedure



# Calculation Sequence

(1) Update Cohort (age, survival, growth)

(2) Pre-Terminal Catches

(3) Pre-Terminal Incidental Mortality

(4) Maturation

(5) Terminal Catches

(6) Terminal Incidental Mortality

# CTC Model Inputs

## Projection Runs

- .OP? – identified the input files and outputs to be generated
- .STK – Base period data for individual stocks (cohort size, maturation rates, AEQs, exploitation rates)
- .BSE – stocks, fisheries, terminal fishery specifications, survival rates
- .ENH – enhancement changes
- .IDL – post-fishery, pre-spawning mortality
- .MAT – annual maturation rate estimates from ERA
- .PNV – proportion non-vulnerable for individual fisheries (size limits)
- .CNR – chinook non-retention
- .CEI – catch levels for fisheries
- .FP – fishery policy factors

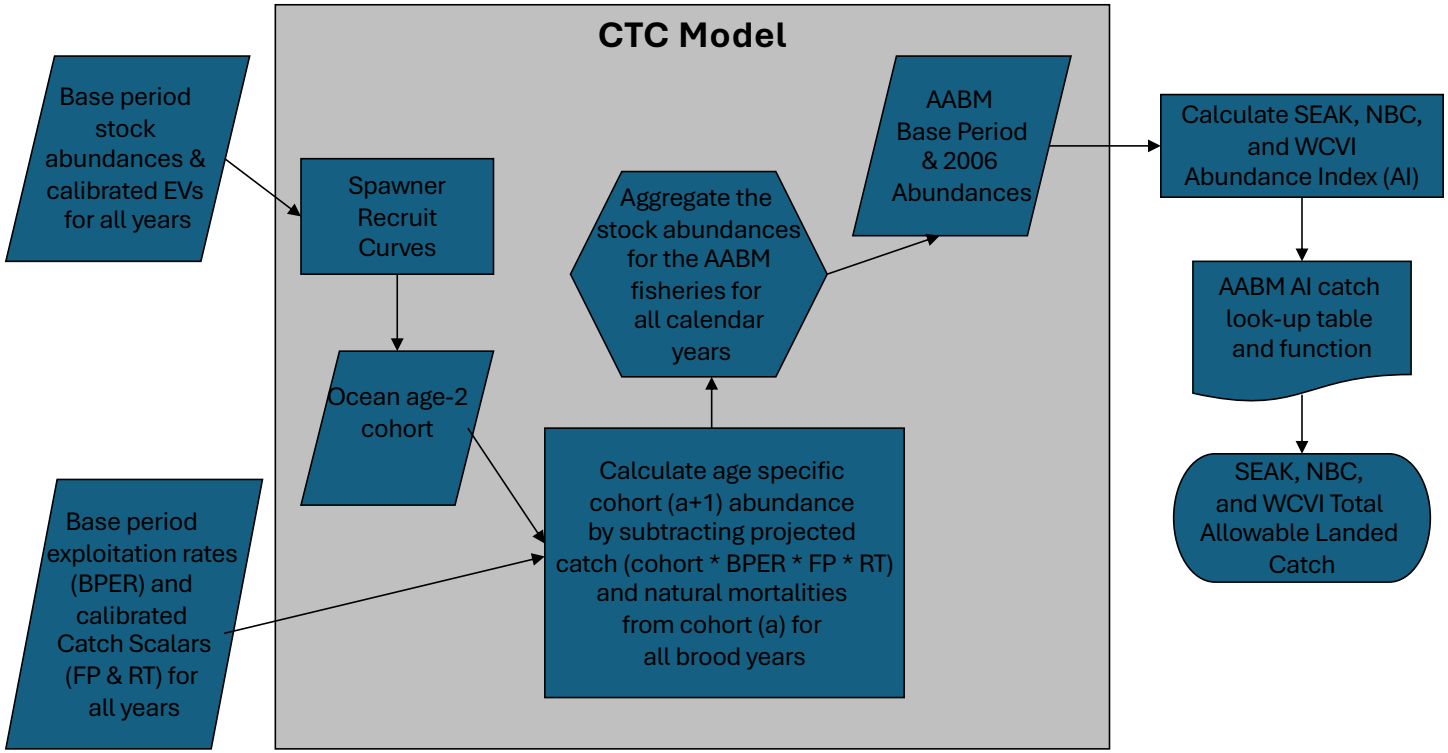
Etc.

## Calibration

.FCS – historical data and forecasts

# CTC Chinook Model Projection

**Projection Objective:** Project the pre-season total allowable landed catch for the SEAK, NBC, and WCVI AABM fisheries



# FCS file –input to PSC Chinook model

- Stock specific
  - Age/no age specific information
  - Mix of both
- Contains both forecasts and observations of escapement or terminal run
- Escapement or terminal run based metrics specific to the stock
  - This is/has been determined how the stock was accounted for during the base period calibration

```
FS3,Fraser Early Sp 1-3
1,Adjustment to maturation rate
2,Escapement + Fraser River net sport and FN
3,First age of data
1,Minimum number of ages per brood
79,0,1,32107
80,0,1,20865
81,0,1,17230
82,0,1,19210
83,0,1,31685
84,0,1,35554
85,0,1,49551
86,0,1,57563
87,0,1,57853
88,0,1,47601
89,0,1,39182
90,0,1,47689
91,0,1,37080
92,0,1,37544
93,0,1,44153
94,0,1,64217
95,0,1,51240
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98,0,1,36667
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104,0,1,41424
105,0,1,28465
106,0,1,27585
107,0,1,14928
108,0,1,19921
109,0,1,33505
110,0,1,19693
111,0,1,14586
112.0.1.14082
```

```
FSO,Fraser Early Sum 0-3
2,read in maturation rate
1,Escapement
3,First age of data
1,Minimum number of ages per brood
79,1,4137.98529878384,19790.3644724444,989.518223622222
80,1,1092.70866561498,5273.50703840275,3895.74393827951
81,0,1,16057.1027320246
82,1,594.87534676014,6713.59319915015,424.910961971529
83,1,610.297002226793,8001.67180697351,610.297002226793
84,1,1270.69224333843,11506.8242035646,2682.57251371446
85,1,4736.19993614729,14265.662458275,1141.252996662
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113,1,49551.0557682873,66408.2585112284,4032.68572048429
114.1.13447.8414853186.66878.2337012278.4373.92481345365
```

```
URB,Columbia River UpRiver Brights only NO MCBs
2,read in maturity schedule
2,Terminal Run Adults
3,First Age
1,Minimum number of ages AGE 5 = AGE 5+6
79,1,9400,64500,15300
80,1,11913,29236,35657
81,1,7684,45572,13347
82,1,35218,29083,14678
83,1,28428,47795,9828
84,1,35931,76839,18599
85,1,64873,80357,51134
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89,1,30657,66114,164531
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92,1,17591,37652,25773
93,1,13394,62267,27248
94,1,12980,63134,56725
95,1,22950,19372,64137
96,1,53400,71000,18717
97,1,22193,108090,31452
98,1,43319,22162,76094
99,1,25204,119389,21296
100,1,18378,63268,74949
101,1,76054,111089,45224
102,1,59073,168108,52366
103,1,45469,216453,112231
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105,1,58437,154181,64622
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107,1,27296,52159,34546
108,1,102655,56491,38150
109,1,45378,137583,29142
110,1,148092,112131,64685
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113,1,427626,329676,20952
114.1.113947.518630.51662
```

# Model error

- With the PSC Chinook model
  - Most impact from errors in
    - Forecasts
    - Maturation…getting the mat rate right is almost important as getting the escapement estimate correct.

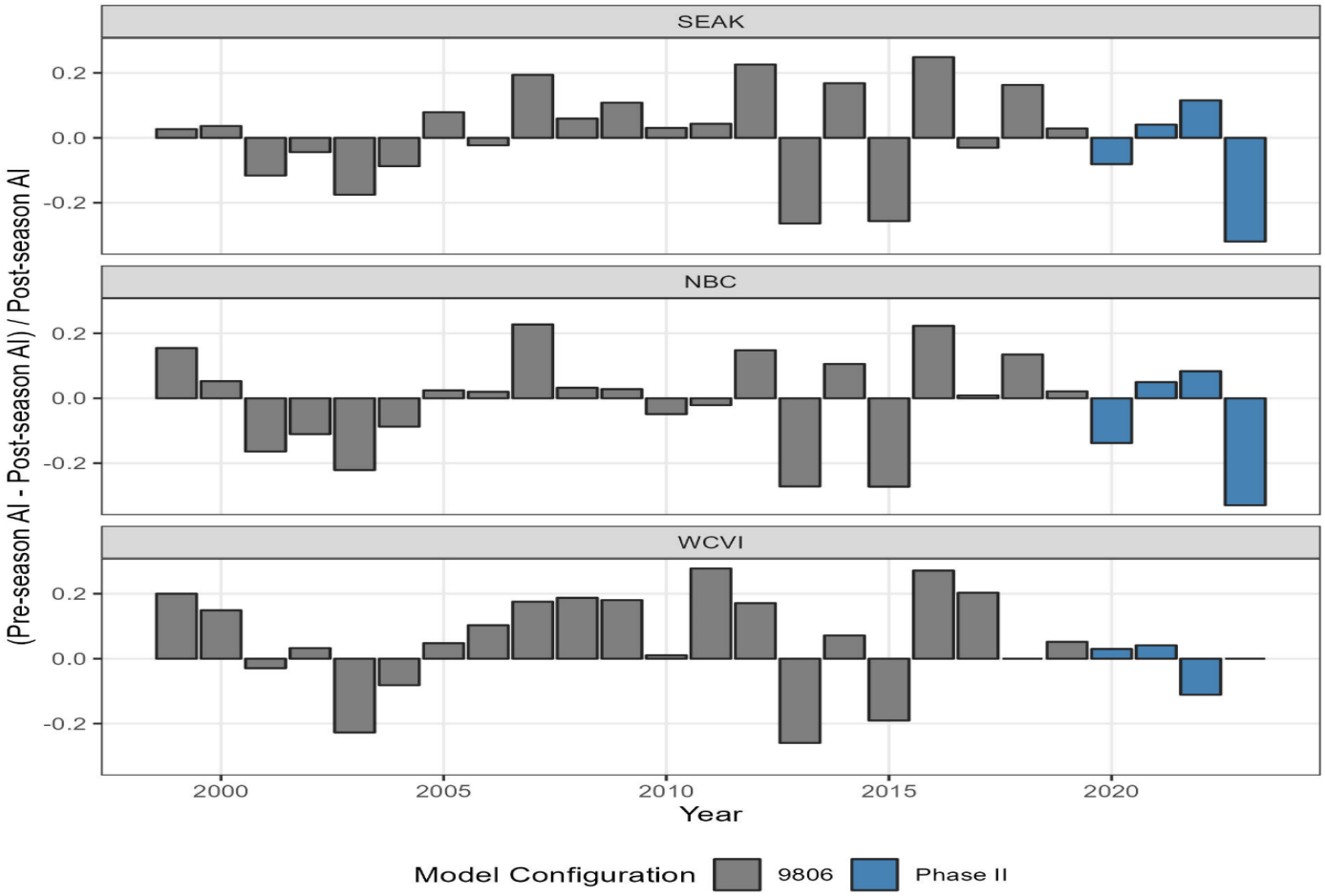
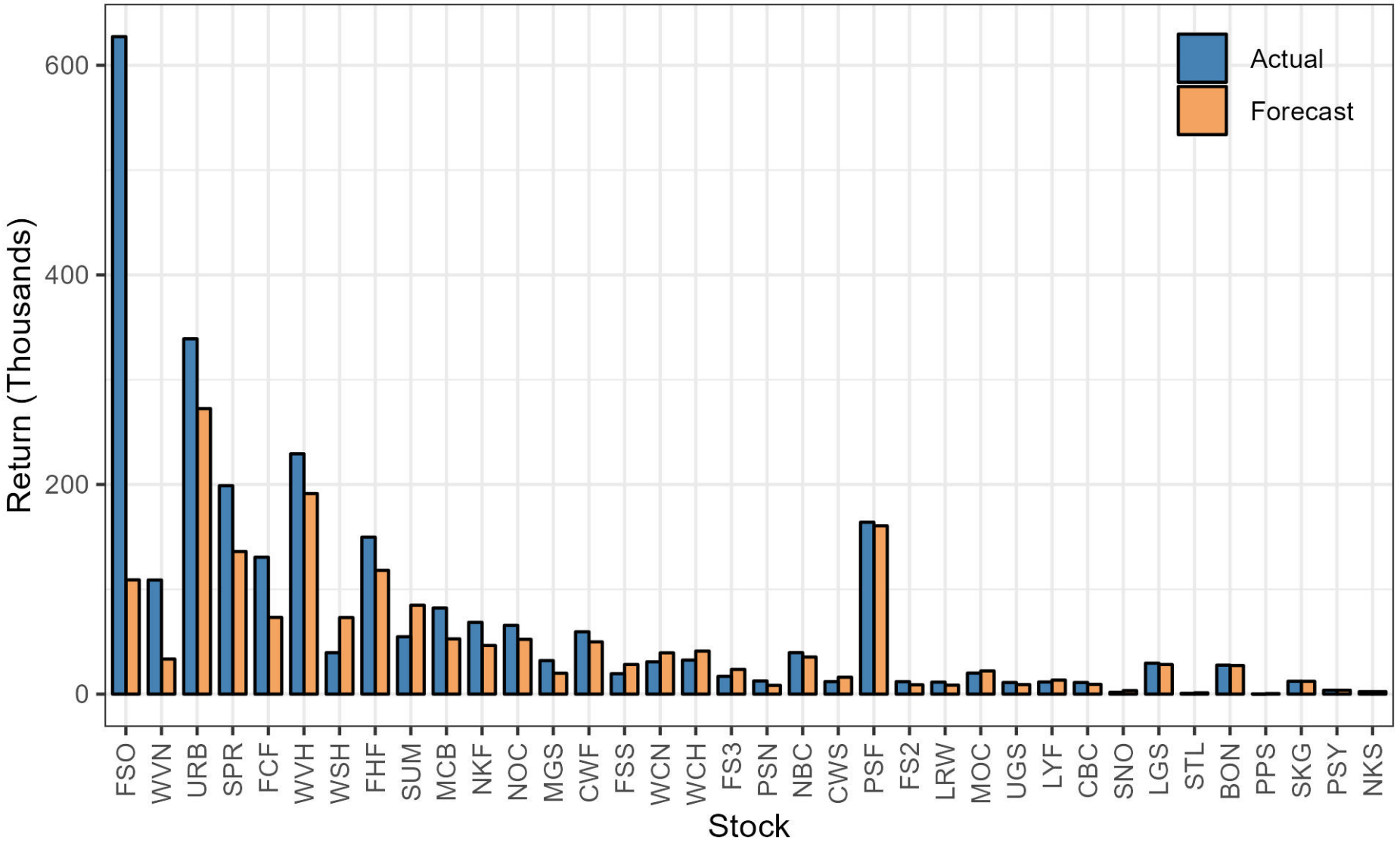



*Figure 4.9.—Deviation between pre- and post-season abundance indices (AIs) for the three aggregate abundance-based management (AABM) fisheries, 1999–2023.*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Forecast
Return (Thousands)
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400
200
0
FSO
WVN
URB
SPR
FCF
WVH
WSH
FHF
SUM
MCB
NKF
NOC
MGS
CWF
FSS
WCN
WCH
FS3
PSN
NBC
CWS
PSF
FS2
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MOC
UGS
LYF
CBC
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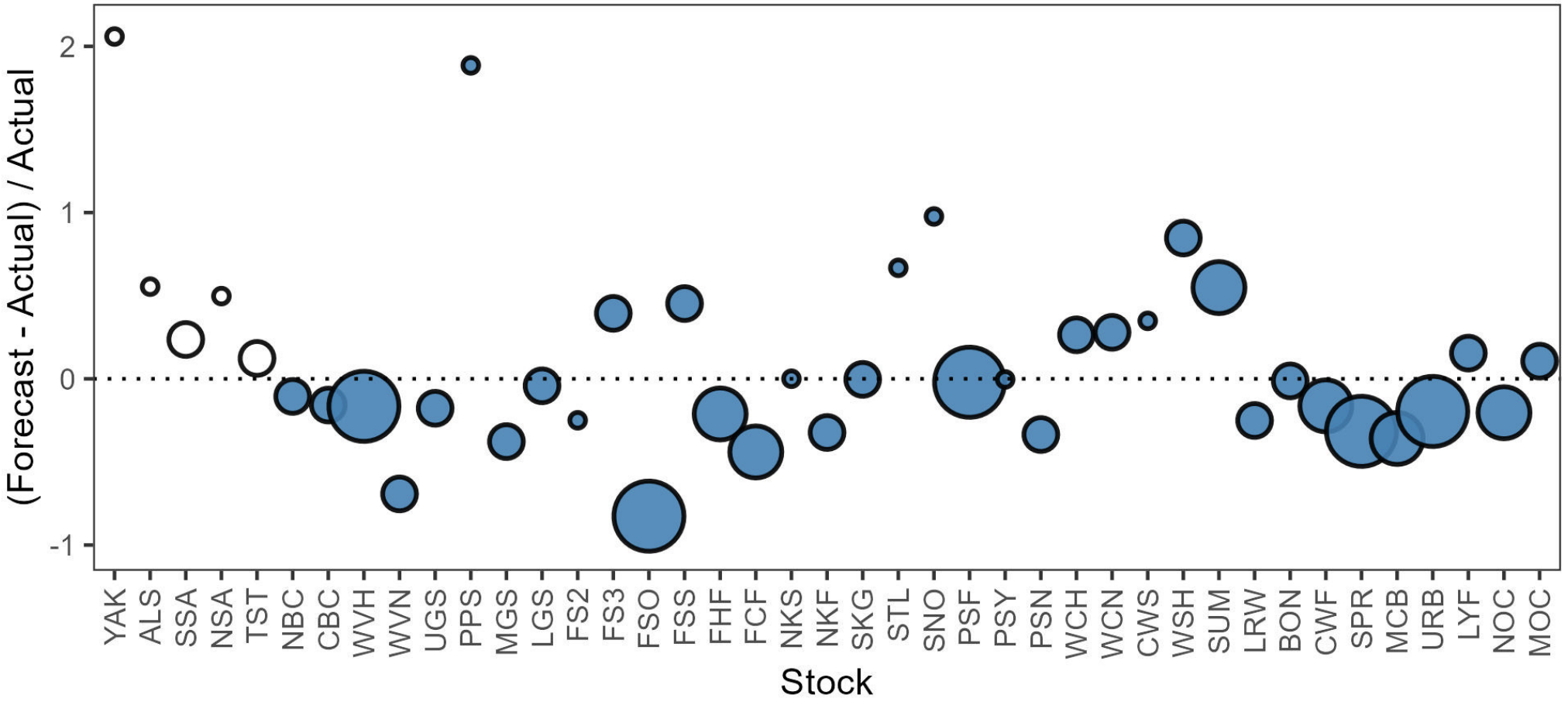
LGS
STL
BON
PPS
SKG
PSY
NKS
Stock


(Forecast - Actual) / Actual
2
1
0
-1
YAK
ALS
SSA
NSA
TST
NBC
CBC
WVH
WVN
UGS
PPS
MGS
LGS
FS2
FS3
FSO
FSS
FHF
FCF
NKS
NKF
SKG
STL
SNO
PSF
PSY
PSN
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SUM
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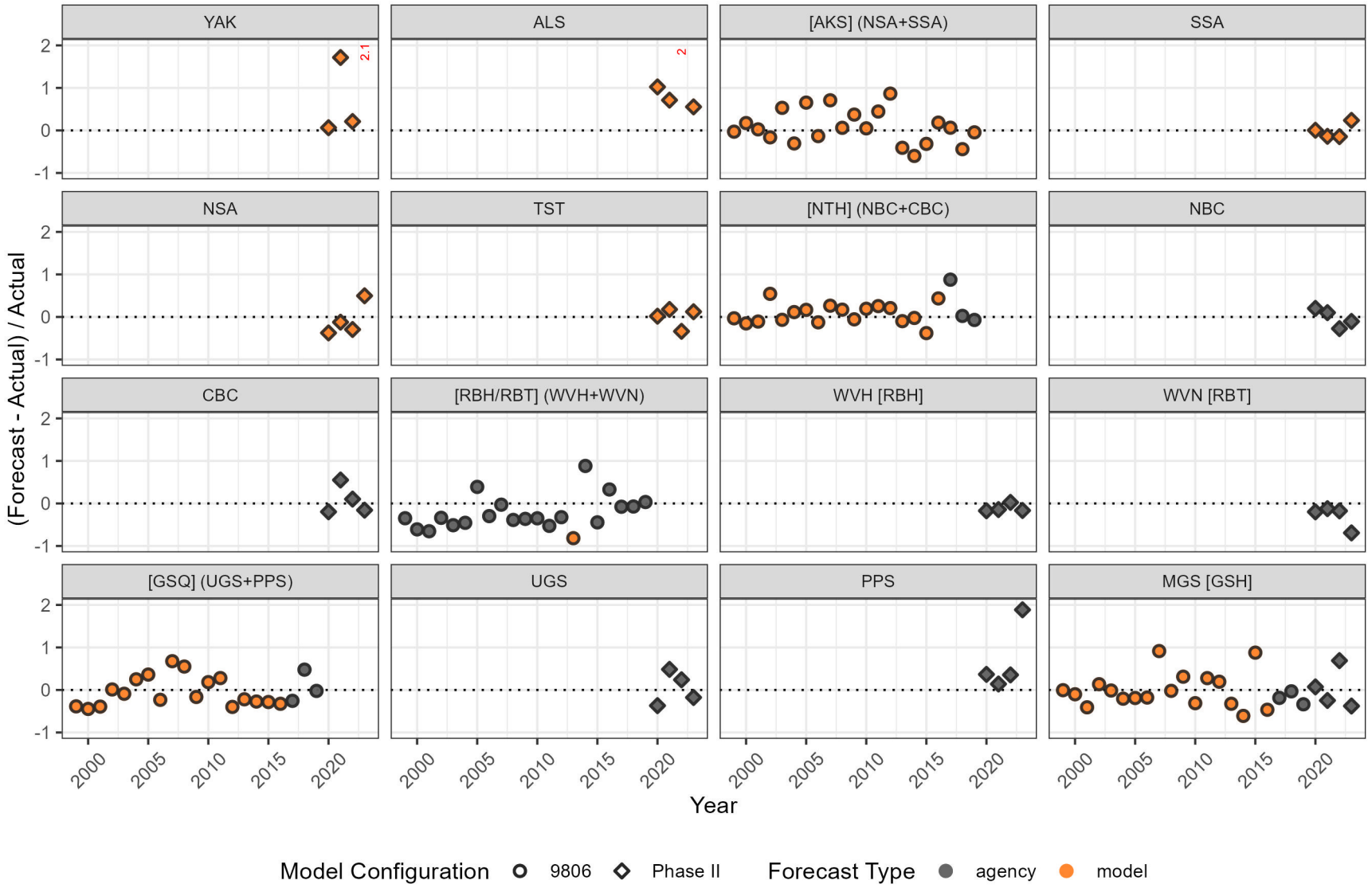
BON
CWF
SPR
MCB
URB
LYF
NOC
MOC
Stock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SSA
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WVH [RBH]
WVN [RBT]
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PPS
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(Forecast - Actual) / Actual
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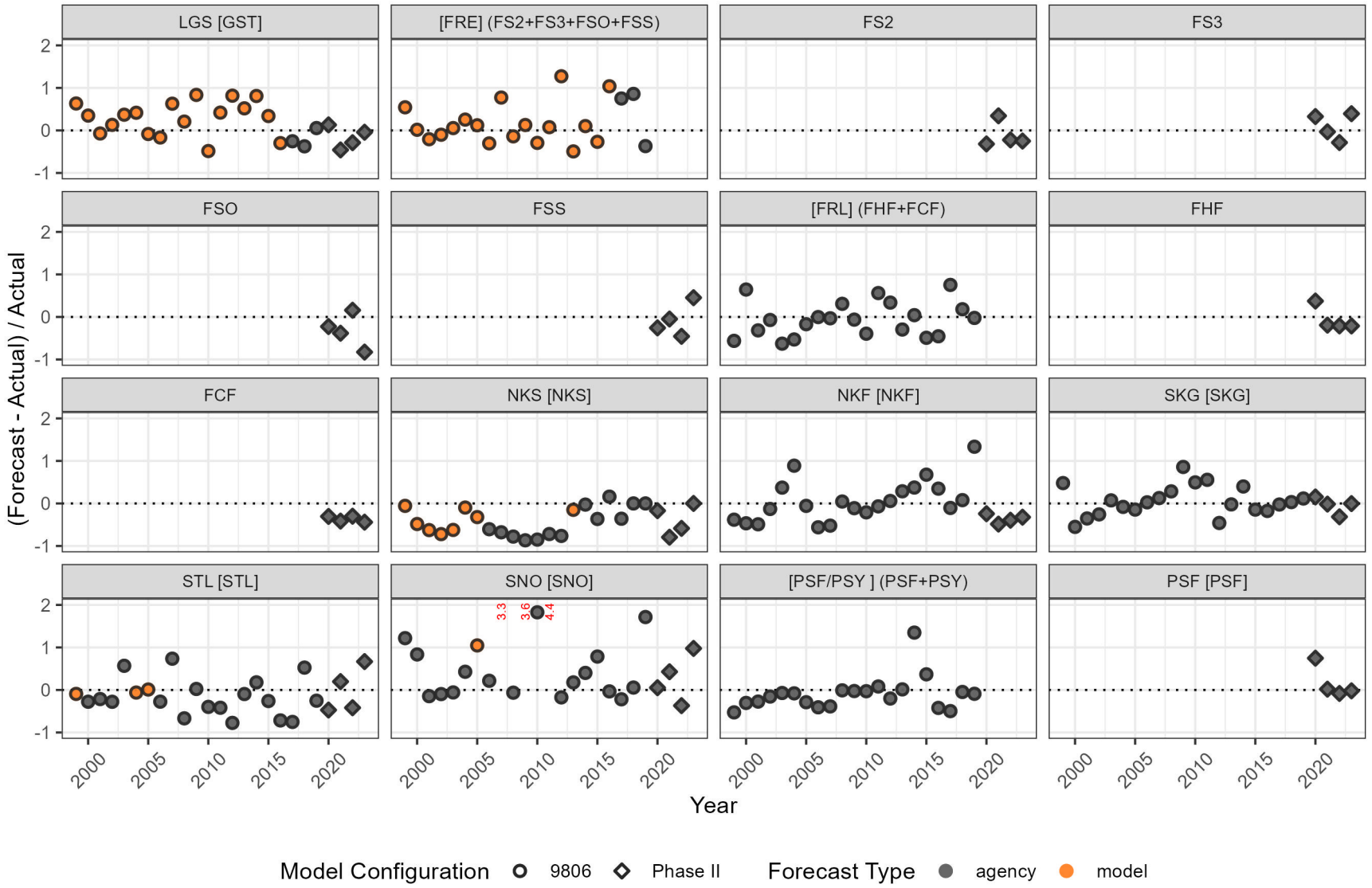
Phase II
Forecast Type
agency
model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FS3
FSO
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NKF [NKF]
SKG [SKG]
STL [STL]
SNO [SNO]
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3.6
4.4
(Forecast - Actual) / Actual
Year
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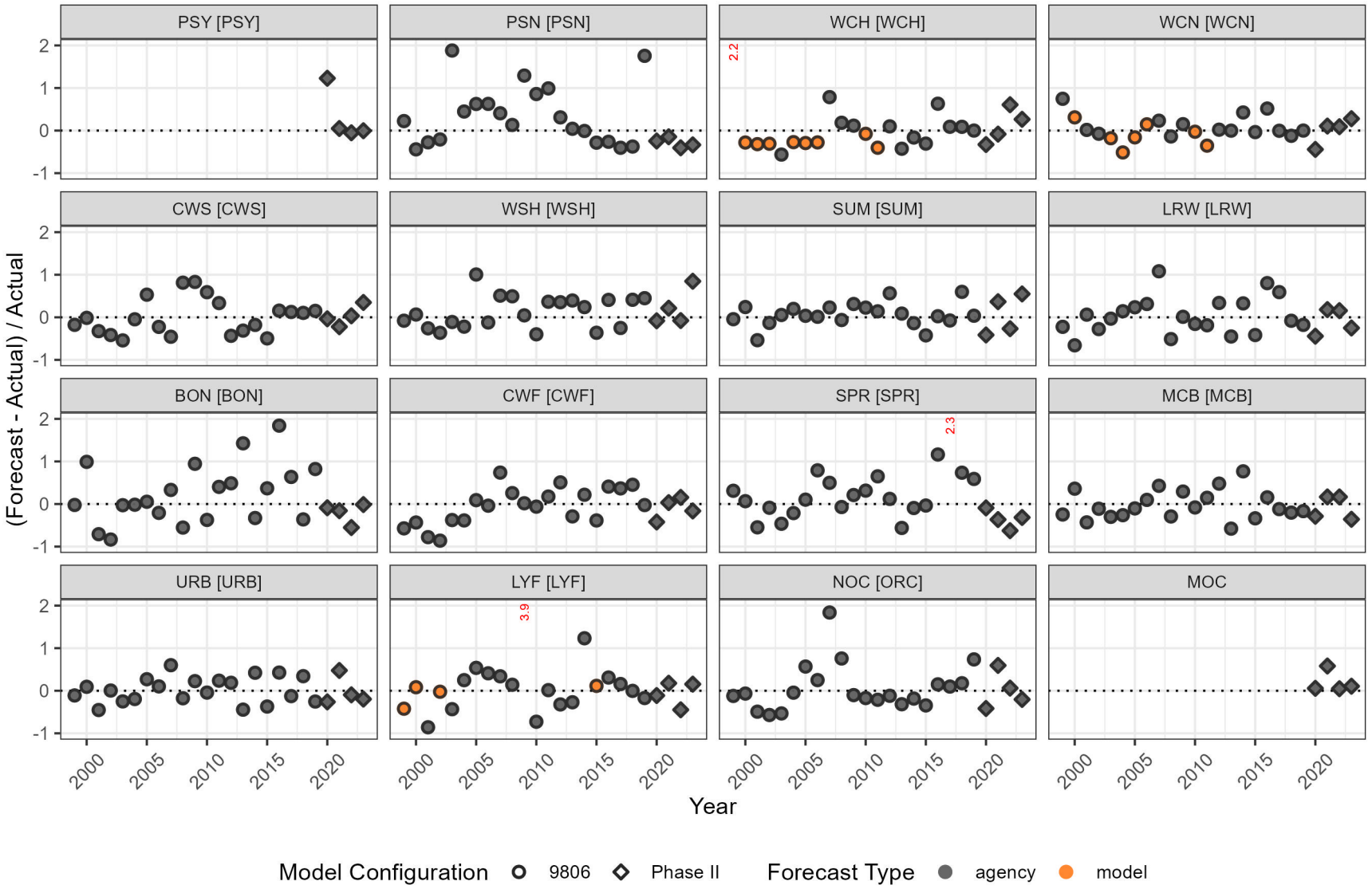
agency
model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CWF [CWF]
SPR [SPR]
MCB [MCB]
URB [URB]
LYF [LYF]
NOC [ORC]
MOC
2.2
2.3
3.9
(Forecast - Actual) / Actual
Year
Model Configuration
9806
Phase II
Forecast Type
agency
model

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