PRE-SEASON RUN SIZE FORECASTS FOR FRASER RIVER SOCKEYE SALMON (*ONCORHYNCHUS NERKA*) AND PINK SALMON (*ONCORHYNCHUS GORBUSCHA*) IN 2023

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2024

Canadian Technical Report of
Fisheries and Aquatic Sciences 3634

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Canadian Technical Report of Fisheries and Aquatic Sciences

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Pre-season run size forecasts for Fraser River Sockeye Salmon (*Oncorhynchus nerka*) and Pink Salmon (*Oncorhynchus gorbuscha*) in 2023

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Cat. No. Fs97-6/3634E-PDF ISBN 978-0-660-73299-2 ISSN 1488-5379

Correct citation for this publication:

Dionne, K. and Liu, Q. 2024. Pre-season run size forecasts for Fraser River Sockeye Salmon (*Oncorhynchus nerka*) and Pink Salmon (*Oncorhynchus gorbuscha*) in 2023. Can. Tech. Rep. Fish. Aquat. Sci. 3634: iv + 120 p.

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ABSTRACT

Dionne, K. and Liu, Q. 2024. Pre-season run size forecasts for Fraser River Sockeye Salmon (*Oncorhynchus nerka*) and Pink Salmon (*Oncorhynchus gorbuscha*) in 2023. Can. Tech. Rep. Fish. Aquat. Sci. 3634: iv + 120 p.

Forecasts for the 2023 Fraser River Sockeye and Pink salmon returns were prepared with Bayesian statistical models and presented as cumulative probability distributions. The total Fraser River Sockeye return for 2023 has a median estimate of 1,564,000 (80% PI: 453,000 to 4,405,000) mainly from the Chilko and Quesnel Rivers in the Summer run timing group. Forecasts for 10 stocks included environmental covariates while sibling models were used to calculate the age-5 forecast for 12 stocks. Sibling models were used to incorporate the relatively strong returns of age-4 Sockeye in 2022 to forecast age-5 Sockeye in 2023 and the age composition of Fraser Sockeye for 2023 is expected to have an unprecedented 49% return of age-5 Sockeye. The 2023 forecast for Fraser River Pink salmon is 6,135,000 (3,247,000 to 11,591,000) . Forecasting Fraser River Pink salmon is uncertain due to the shifting enumeration methodologies through time, but the 2023 forecast has additional uncertainty due to the flooding that occurred in the Lower Fraser River in November 2021 resulting in a more conservative model selection for the forecast than the top ranked model in the retrospective analysis.

RÉSUMÉ

Dionne, K. and Liu, Q. 2024. Pre-season run size forecasts for Fraser River Sockeye Salmon (*Oncorhynchus nerka*) and Pink Salmon (*Oncorhynchus gorbuscha*) in 2023. Can. Tech. Rep. Fish. Aquat. Sci. 3634: iv + 120 p.

Les Les prévisions concernant les remontes de saumon rouge et de saumon rose en 2023 ont été préparées à l’aide de modèles statistiques bayésiens et présentées sous forme de distributions de probabilités cumulées. L’estimation médiane des remontes totales de saumons rouges du fleuve Fraser pour 2023 est de 1 564 000 individus (intervalle de précision à 80 % : de 453 000 à 4 405 000 individus) , provenant principalement des rivières Chilko et Quesnel dans le groupe de remonte estivale. Les prévisions pour 10 stocks comprenaient des covariables environnementales, et on a utilisé des modèles de classes d’âge jumelles pour calculer les prévisions pour les poissons d’âge 5 de 12 stocks. On a utilisé des modèles de classes d’âge jumelles pour incorporer les remontes relativement importantes des saumons d’âge 4 en 2022 afin de prédire la quantité de saumons rouges d’âge 5 en 2023; on prévoit également une remonte sans précédent de 49 % de saumons rouges d’âge 5 en ce qui concerne la composition selon l’âge des saumons rouges du fleuve Fraser en 2023. Les prévisions pour 2023 concernant le saumon rose du fleuve Fraser sont de 6 135 000 individus (de 3 247 000 à 11 591 000 individus) . Les prévisions concernant le saumon rose du fleuve Fraser sont incertaines en raison de l’évolution des méthodes de dénombrement au fil du temps, mais les prévisions pour 2023 présentent une incertitude supplémentaire en raison des inondations qui ont eu lieu dans le bas Fraser en novembre 2021, ce qui a entraîné une sélection de modèle plus conservatrice pour les prévisions que le modèle le mieux classé dans l’analyse rétrospective.

1. BACKGROUND

1.1 FRASER SOCKEYE SALMON

The Fraser River is the largest watershed in British Columbia and home to all species of Pacific Salmon found in the Eastern Pacific Ocean. Fraser River Sockeye salmon (*Oncorhynchus nerka)* typically demonstrate a lake-type life history, and a four year life cycle where juveniles rear in lakes for one full year prior to migrating to the marine environment where they spend two or three years at sea before returning to spawn in their natal streams. The exception to this life history strategy are the river-type Harrison Sockeye that migrate to the Strait of Georgia shortly after emergence from gravel and return as 3- and 4-year-old adults. Several stocks display cyclic dominance with one return year being more abundant than the remaining three cycle lines.

Fraser River Sockeye salmon have historically supported large commercial, recreational, and First Nations harvests (Gilhousen 1992). However, recent productivity trends for Fraser Sockeye stocks have become more variable, resulting in both the largest (2010) and lowest (2020) returns in recorded history (Figure 1; Pacific Salmon Commission 2021). In 2017, a Wild Salmon Policy (WSP) status evaluation, and a Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status report both identified persistent patterns of decline in many of the Conservation Units (CUs) or Designatable Units (DUs), which are the discrete and evolutionary distinct constituent stocks of the Fraser River Sockeye aggregate. The WSP process identified seven of the 19 forecast CUs as being in a state of significant conservation concern, while the COSEWIC status report recommends that seven of these stocks be listed as endangered (Grant et al. 2020, COSEWIC 2017).

The increased variability of returns of Fraser River Sockeye beginning in the 1990s has resulted in reduced predictability by forecast models and returns are generally lower on average than predicted based on long-term average survival (with the exception of several years of larger than expected returns). Several studies have linked ocean warming and environmental volatility associated with climate change to low survival of Fraser Sockeye salmon (Mueter et al. 2002; Connors et al. 2020; MacDonald et al. 2020). Environmental covariates are included in the forecasting process and show mixed signals for the 2023 return. Nearshore sea surface temperature (SST) measured at Departure Bay (used as a proxy for Entrance Island due to unavailability of data) and Pine Island in 2021 (the year of marine entry for the 2023 return) show above average conditions (Figure 3). However, the Pacific Decadal Oscillation (PDO) was cooler than average in 2021 (Figure 3) indicating that temperatures off shore have been more favourable for salmon production. Additionally, a summary of ocean ecosystem indicators used to characterize juvenile marine salmon survival in the Northern California Current ranks 2021 as the second best conditions on record (1998-2021) only after 2008 (Figure 9).

Escapement data are enumerated by DFO staff using a variety of methods. In general, a higher precision method (sonar or mark-recapture) is used to enumerate the larger stocks, while visual surveys or other methods with lower precision (peak count via aerial or ground-based surveys or carcass recovery surveys) are used to enumerate the smaller stocks (Scott Decker, DFO, Fraser River Stock Assessment Program Head Sockeye, pers. comm.). The specifics of the escapement programs as well as the escapement estimates are provided annually for the

forecasting process by the stock assessment program and are the primary driver of the forecasts (Macdonald and Grant 2012).

The 2023 Fraser River Sockeye salmon forecast of 1,564,000 (453,000 – 5,952,000) is lower than the long term and cycle line average return. However, both freshwater and marine survival have been trending up in the last several cycle lines and environmental conditions in the marine environment have been more favourable for salmon production than in recent years (Figure 9).

1.2 FRASER RIVER PINK SALMON

Fraser River Pink salmon (*Oncorhynchus gorbuscha)* are the largest run of pink salmon in British Columbia and exhibit a two-year life cycle. Adults spawn in the fall, fry emerge in the spring, and migrate immediately to sea. Adults return a year later to spawn at age 2.. Fraser River Pink salmon have a strong bi-annual pattern with significant returns of adult pink salmon occurring only on odd years. The last three returns (2017, 2019, and 2021) have been below the long-term average of 12.4 million fish. Fry (or sub-yearling smolts) are enumerated during their downstream migration in the spring on even years and these values are used to forecast the return for the fall of the next odd year (with the exception of 2020 where the program was unable to run due to the COVID 19 pandemic). These values are favoured for forecasting Fraser Pink salmon returns as the data have been consistently collected and are a better index of abundance than the adult escapement estimates where methodologies have varied through time. The methods, time series, and the history of data collection for Fraser River Pink salmon are detailed in Grant et al. (2014).

There are few studies on Fraser River Pink salmon and how environmental conditions at sea affect returns and productivity. Although evaluation of the inclusion of environmental covariates for the purposes of forecasting Fraser River Pink salmon has been limited, sea surface salinity (SSS) has been determined to be an appropriate covariate. Sea surface salinity values for the 2023 cohort suggest reduced upwelling and therefore less favourable conditions for Fraser River Pink salmon.

The 2023 Pink salmon forecast of 6.1 million is lower than the long-term average (12.4 million), and the 2022 fry outmigration of 225.9 million is the third lowest observed since the method for enumerating outmigrating fry was standardized in 1968, and less than half of the long-term average of 427.0 million.

1.3 SPECIAL CONSIDERATIONS: BIG BAR LANDSLIDE AND FRASER VALLEY FLOODING

Two significant environmental events occurred that likely negatively affected 2023 returns for Fraser Sockeye and Pink. In 2019, the Big Bar landslide resulted in a persistent migratory barrier throughout the adult migration season and caused the blockage and delay of several stocks attempting to reach their spawning grounds. This landslide resulted in heavy en-route losses for Middle and Upper Fraser Sockeye and led to the lowest escapement estimates on record for several stocks. Stocks that were particularly affected were Early Stuart and Bowron, while Chilko, Nadina, Late Stuart, Stellako, and Quesnel were impacted to a lesser extent. For further information on the Big Bar landslide and its perceived impacts on Fraser salmon stocks see the Big Bar Landslide Hydroacoustic Technical Report (Hanson-Wright et al., DRAFT).

In November 2021, an atmospheric river resulted in heavy precipitation and widespread flooding throughout the Lower Fraser River, below Hope, that may have caused a substantial reduction of survival for pink salmon eggs in this region. Evidence of the potential impact of this event on pink salmon survival can be seen in the 10-12 day delay in outmigration timing from the Mission Downstream Juvenile Project (Figure 7). There are two potential hypotheses for the delay in the downstream migration of juveniles. The first is that fry emerged from the gravel late due to below-seasonal temperatures in the winter and spring in the Lower Fraser River. Although daily temperatures did fall below average on several days in the winter of 2022, they did stay within one standard deviation of average suggesting that they were cool but not abnormal (Figure 8). An alternate hypothesis is that the delay in outmigration timing is due to the majority of encountered fry being from upstream of Hope, where overwinter temperatures are generally lower, so fry emerge later and have a greater distance to travel to Mission. Given the severity of the flooding that occurred and that deviations from the average temperature in the Lower Fraser River were not outside of expected variability, the evidence is more supportive of the hypothesis that the delay in the timing is due to a lack of pink fry originating from the Lower Fraser River in the spring of 2022, caused by egg loss due to flooding.

1.4 FORECASTING

Forecasting salmon returns has been an area of study for generations of fisheries scientists (see Haeseker et al. (2008) for an overview of salmon forecasting methods). Although forecast methods have not changed dramatically over time, there have been innovations both in the modeling frameworks applied and the sophistication of computation (e.g., Cass et al 2006, MacDonald and Grant 2012; Akenhead et al. 2016). The recent low, yet highly variable productivity for most Fraser Sockeye stocks has added additional challenges to forecasting returns, with many years falling at the low end of the forecast distributions. Significant efforts were devoted to update the retrospective analysis for Sockeye salmon in 2022 to evaluate the existing and new candidate models using a one-step-ahead approach, rather than the jackknife (or leave-one-out) approach of the retrospective analysis conducted a decade ago (MacDonald and Grant 2012; Liu and Xu, 2024). A one-step-ahead approach is more commonly used in fisheries science to assess forecast model performance as it only uses data that would have been available leading up to a forecast year to produce that year's forecast whereas a jack-knife approach is more generally used to assess overall model fit to a dataset (Haeseker et al. 2005, 2007, 2008; Ward et al. 2014; Brooks and Legault 2015; Thorson 2018; DFO 2021).

The Fraser River Sockeye and Pink Salmon preseason forecast is required to inform pre-season planning of First Nations fisheries, recreational, and commercial fisheries, and stock assessment programs. It serves an additional purpose as informative priors for the in-season run-size assessment programs. The forecast also informs planning decisions of the bilateral Fraser River Panel and provides advice to DFO fisheries managers regarding in-season harvest management of Sockeye salmon (Pacific Salmon Treaty 1985). Changes in fisheries management and increased variability of productivities of Fraser Sockeye stocks has resulted in reduced fishing opportunities for all sectors in recent years (Cohen 2013). The difficulty of in-season management of mixed stock fisheries has resulted in grouping and managing Fraser River sockeye as four stock aggregates based upon shared return timing to the Fraser River (Early Stuart, Early Summer, Summer, Late). Escapement and harvest plans are made at the stock management unit (SMU) level, and as such, aggregate forecasts at the management

group level and for the Fraser River as a whole are presented in addition to stock-specific return forecasts.

2. DATA AND METHODS

2.1. DATA

2.1.1. Sockeye Data

Fraser Sockeye data used in the forecast process includes the following:

Spawners

- Effective Female Spawners (EFS) data are included up to the 2019 brood year for all stocks except Harrison (2020 brood year) following previous forecasts (DFO 2020; 2021; Appendix D).
- Brood year EFS among most of major stocks are below the historic cycle-year average for the primary age cohorts returning in 2023 (Table 1B).

Juveniles

- Fry data for the 2019 brood year are available for Nadina and Weaver. Each stock typically has a large proportion of fry originating from a spawning channel with a monitoring program in place, along with a smaller proportion of fry originating from the adjacent natural spawning grounds. Fry data were available for the channels and the natural rivers/creeks historically, but limited to the channels in 2019 and 2020 brood years. Fry data gaps in the historic time series were infilled using the average historical fry/EFS production by stream multiplied by the relevant brood year EFS. This infilling approach is consistent with the previous model settings (Grant et al. 2010; MacDonald and Grant 2012). Gates channel fry survey has stopped since 2019 brood year (1968-2018) due to the termination of the spawning channel usage.
- Juvenile smolt data from the 2019 brood year are available for Cultus and Chilko.

Recruitment

- The most recent brood year for which full recruitment data are available (2019 brood year; 2020 for Harrison) is included in the dataset although values are considered preliminary.
- There were changes in recruitment data between current and previous forecasts due to the run-size adjustment process (return year: 2020 and 2021) and recalculation of age composition (return year 2018-2019).
- Recruitment estimates from 2022 were flagged among several stocks as being particularly uncertain. Poor genetic stock identification (GSI) resolution between the Stellako and Late Stuart stocks indicates high uncertainty associated with the 2022 return estimates. The use of 2022 preliminary data for both stocks was adopted by the Fraser Panel for fitting sibling models since the estimates were either comparable or higher than the preliminary escapement surveys. However, the 2022 escapement estimate for Nadina was higher than the return estimate (328,935 vs. 269,498) and estimated using high precision methods which led to adopting the escapement value over the return for the purpose of fitting sibling models.

- The time series (by brood year) of EFS, juveniles, and recruitment data used to run the models are from 1948-2019 for all stocks except for Nadina (1973-2019), Gates (1968-2019), Scotch (1980-2019), Fennell (1967-2019), Weaver (1966-2019) and Portage (1953-2019).

2.1.2 Pink Data

Adult returns are estimated by the Pacific Salmon Commission's (PSC) hydroacoustic program in the lower Fraser (aggregated with catch estimates), while outmigrating juvenile abundance (smolt) data are collected by Fisheries and Oceans Canada (DFO) by manual sampling. Fry abundance is used exclusively as the predictor variable in the relevant non-parametric and biological models for Fraser Pink salmon forecasts. Escapement is not used as a predictor variable for Pink salmon forecast given the considerable changes in escapement methods used over the historic time-span and lack of calibration work to account for differences between methodologies (Figure 5; Grant et al. 2014). In addition, catch estimation methods have varied over time, owing to differences in run-reconstruction methods between 1959-1977 and 1979-1985, differences in genetic stock identification methods between 1987-2005 and 2007-present (Grant et al. 2014; DFO 2015; 2021).

2.1.3 Environmental Data

The following environmental data were collected and incorporated in several biological models (used in 2006-2022; See Cass et al. 2006 and MacDonald and Grant 2012 for further details; DFO 2021):

- Pacific Decadal Oscillation (PDO) in the winter preceding outmigration (November to March), with a negative (colder ocean) condition for 2021 (Zhang et al. 1997, Mantua et al. 1997; data available online; Figure 3).
- Average of monthly sea surface temperature (SST) from Entrance Island (Departure Bay was used for the 2023 forecast due to missing data) lighthouse (Ei; Strait of Georgia, near Nanaimo, B.C.) from April to June, and Pine Island (Pi; Northeast corner of Vancouver Island) from April to July (data available online; Stebastien Donnet, DFO, Sidney, BC, pers. comm.; Figure 3) of the year of outmigration. Both SST variables show warmer than average conditions in 2021, especially the Pine Island location.
- Peak Fraser Discharge (FrD-peak) and average Fraser Discharge (FrD-average) from April to June of the outmigration year measured at Hope, BC, with higher discharge in both variables in 2021 compared with the time series average (David Patterson, DFO, Vancouver, BC, pers. comm.; Figure 4).
- For the Pink forecast, average sea surface salinity (SSS) from Amphitrite Point and Race Rocks (July-September) during the summer of the outmigration year (2022 for 2021 brood year) was used, with a level slightly below historic average (Sebastien Donnet, DFO, Sidney, BC, pers. comm.; Figure 3).

2.2. METHODS

The 2023 Fraser Sockeye forecasts followed recent forecasting methods using an MCMC (Markov Chain Monte Carlo) Bayesian statistical approach to estimate parameters from biological models and assess the uncertainties (Cass et al. 2006; MacDonald and Grant 2012; DFO 2013; DFO 2014; DFO 2015; DFO 2016; DFO 2017; DFO 2018; Hawkshaw et al. 2020a; Hawkshaw et al. 2020b; DFO 2021). Visualization tools including Taylor diagrams and an R

markdown HTML Viewer that were developed in the 2022 forecast season were also implemented for the 2023 forecast. The Taylor diagrams were implemented as a means to evaluate model performance in the retrospective analysis relative to one another in graphic space and to initiate discussion regarding top model selection from the retrospective ranking tables.

Model selection for the 19 major stocks is completed through consensus by expert opinion where a shortlist of top-ranked models from the retrospective analysis are considered. Model performance and ranking for Fraser Sockeye salmon are presented on the Taylor diagrams and ranking tables based on the one-step-ahead retrospective analyses conducted for the 2022 forecast season (Liu and Xi, 2024). The updated analysis retrospectively forecasts the run size for last three generations between 2009 and 2020 for all 27 stocks and is more reflective of recent population dynamics, current productivities, and environmental conditions. The total and age-specific forecasts from the top-ranked models and their corresponding implied productivities are presented and compared to the historical time-series of observed productivity. Preference was given to models that can capture the dynamics of recent productivity. Detailed descriptions of all the models are listed in Table 4. For miscellaneous stocks with no recruitment data available, forecasts are based on brood-year escapements and 'recent' observed productivity rates for proxy stocks (See Appendix A). Fraser Pink forecasts were prepared following the same methods as DFO (2017; 2019) and three models (Power, Power-SSS, and MRJ) were presented for model selection.

For the last several years, sibling models have been used to attempt to inform older age-class productivity, using return data from their brood-year mates that returned the year before. A description of the sibling model can be found in the 2019 forecast document (Hawkshaw et al. 2020a), and a description of the recently updated sibling model selection criteria can be found in the 2020 forecast document (Hawkshaw et al. 2020b). In the context of 2023, the goal of using sibling models is to forecast older age class fish by using data from the 2022 return to try and capture the higher-than-recent productivity observed for many stocks in 2022. This approach is different from past forecasts where sibling models were used to reduce the forecast of age-5 fish to more closely align with recent productivity trends. Additionally, the component of the forecast attributed to age-5 fish comes from a dominant cycle line (2018) while the age-4 fish will be produced from the cycle line that showed the lowest productivity and second-lowest return on record (2019).

3. RESULTS

3.1 SOCKEYE

The total Fraser River Sockeye return in 2023 is estimated to be 1,564,000 (80% PI 453,000 – 5,952,000). This return is forecasted to be below the cycle line average return (4.5 million) and substantially lower than the all-year average return (7.4 million; Table 1B). The below-average forecasted returns are largely driven by the extremely low escapement in 2019 which were further exacerbated by the Big Bar Landslide for several populations. The 2023 forecast is unusual in that nearly half of the forecasted return is expected to be age-5 fish (49%; Table 3). The atypical age proportion of the total return is driven by the large escapement on the dominant cycle line in 2018 followed by the second lowest escapement on record in 2019

leading to an anticipated very low proportion of age-4 fish (on average, Fraser Sockeye returns are 91% age 4). The Summer run-timing group is expected to dominate the return in 2023 contributing 74% of the total forecasted abundance (Table 6). Chilko, Quesnel, and Stellako are forecasted to be the primary contributing stocks at the P50 level to the 2023 return comprising 39%, 21%, and 10% of the return, respectively (Table 6).

The 2023 forecast for Early Stuart sockeye is 23,000 (6,000 to 86,000) and is generated using a Ricker model with sea surface temperature at Entrance Island as a covariate (Ricker(Ei)) and sibling model for forecasting the age-5 component. This combination of models resulted in a forecast comprised of 99% 5-year-old Sockeye for this stock (Table 3). A sibling model was selected for the age-5 component of the forecast as it ranked highly on the Taylor diagrams and in the age-specific retrospective ranking table. The adoption of the sibling model slightly increased the forecast relative to the Ricker with Entrance Island temperature covariate model by incorporating information from the large Early Stuart return in 2022. The age-4 component of the forecast is only anticipated to be 206 fish due to the extremely poor escapement in 2019 (46 effective female spawners, EFS) caused largely by the migratory impediment of the Big Bar landslide.

The total forecasted return for the Early Summer aggregate, including miscellaneous stocks, is 186,000 (47,000 to 665,000) and 141,000 (40,000 to 552,000) excluding miscellaneous stocks. The main contributors to this return are Nadina (76,000) and the Early Shuswap miscellaneous stock (41,000). Nadina was forecasted using a cycle-line Ricker model for age-4 and sibling model for age-5 and is expected to be nearly equally comprised of age 4 and 5 returns. Sibling models were selected for the age 5 component for all stocks with the exception of Bowron, Seymour, and the miscellaneous stocks as they ranked highly on both the Taylor Diagrams and in the age-specific retrospective tables. The lower-than-average forecast for this run-timing group is largely due to the extremely low escapements in 2019 due to the Big Bar landslide, and warm conditions in the nearshore marine environment, as temperature covariates were included in the selected models for Bowron, Upper Barriere, and Seymour.

The Summer run-timing group is expected to dominate the 2023 forecast with a predicted return of 1,167,000 (349,000 to 4,405,000). This aggregate is composed of six major stocks and three miscellaneous stocks. Chilko is predicted to contribute the most to the 2023 returns with a forecast of 591,000 (210,000 to 1,651,000) generated by a Larkin model for the 4-year-old return and a sibling model for the 5-year-old return. Median forecasts varied greatly for Chilko among top-ranked models (medians ranged from 400,000 to 1,100,000) but the Power-juvenile models frequently selected in previous forecasts had implied productivities that greatly exceeded recent observations in productivity. As such, the Larkin model was selected for the age-4 forecast as the implied productivity more closely aligned with recent observations. The sibling model performed well for the ag- 5 component of the Chilko forecasts in both the Taylor diagrams and is the top ranked model in the age-specific retrospective ranking table. Quesnel is expected to contribute the second most sockeye to the 2023 forecast and is estimated to be 319,000 (63,000 to 1,836,000). This forecast was generated using a Ricker(Ei) model. Sibling models do not perform well for this stock, therefore a total forecast from a single model was selected. Several Ricker models perform well for Quesnel on the Taylor diagrams but Ricker(Ei) was the top ranked in the retrospective ranking table. Additionally, the Ricker(Ei) model often has been selected in recent years and has performed well. The third largest contributor to the 2023 forecast is anticipated to be Stellako with a forecast of 157,000 (51,000 to 476,000) which

is generated by a Ricker(Ei) and sibling model. The sibling model performs very well for age-5 forecasts for Stellako as is evident in the Taylor diagram as well as in the age specific ranking table. For the age-4 component, Larkin Basic, Larkin Basic with a Cycle Age covariate, Ricker Cycle, and Ricker(Ei) were respectively ranked the highest in the retrospective analysis. However, the age-4 and total productivity values for Stellako have consistently been less than five recruits/EFS in the last two generations and the Larkin models showed implied productivities closer to nine. The Ricker(Ei) model was selected for the age 4 component as it had estimated productivity of 4.5, which aligns with recent observations of productivity for Stellako and was ranked highly in the retrospective analysis. Model selection for the remaining stocks in the Summer run timing aggregate can be found in Table 1A.

The aggregate forecast for the Late run timing group is 188,000 (50,000 to 796,000). Most of the forecasted return for Late run sockeye is expected to be 92,000 Birkenhead sockeye (31,000 to 269,000) forecasted using the combined Ricker model with a SST environmental covariate from Pine Island (Ricker(Pi)) and sibling models followed by 64,000 Weaver sockeye (15,000 to 306,000) forecasted using the combined cycle-line Ricker and sibling models. Late Shuswap is forecasted to return at 25,000 (3,000 to 162,000) estimated using a Ricker(Pi) and sibling model while Portage is forecasted to be 7,000 (900 to 56,000) by a Ricker(Ei) model. The Harrison and Lillooet miscellaneous stock are forecasted to return at 300 fish (70 to 3,000) while Cultus is forecasted to only have a return of 20 fish (0 to 100) estimated by a Power Juvenile model with a SST covariate from the Pine Island SST model. The forecasted return for Cultus is extremely low due to the poor escapement in 2019 of only 11 EFS. Additionally, hatchery supplementation of the 2019 brood year had only 8 males and 2 females available for broodstock, leading to the lowest smolt outmigration on record in 2021 (408 smolts).

3.2 PINK

The total forecast for Fraser River pink salmon is 6.14M (3.25M to 11.59M) and was forecasted using the mean recruits-per-juvenile (MRJ) model. Although the power model fit to juvenile data model and Power Juvenile model with a sea surface salinity (SSS) covariate were ranked higher in the retrospective analysis, the forecasts generated by these models were considered to be optimistic when considering recent return and productivity observations in addition to the uncertain impact of the flooding in the Lower Fraser Valley in November 2021. Additionally, the Power SSS model was the top-ranked model but SSTs for 2020 were near the average which we suggest means there would be a minimal effect of using the covariate on the forecast (Figure 3) and this was evident by the similar forecasts produced by the Power SSS model and Power models. Shifting enumeration methods through time for returning adult pink salmon and a lack of calibration between methodologies generates uncertainty for Fraser Pink forecasts in all years and additional caution is required for the 2023 forecast due to the flooding in the Lower Fraser Valley. Although the uncertainty range captured in the 80% probability interval is already quite large, the uncertainty in the escapement and juvenile fry data that inform the forecast models is not able to be accounted for and as such, it is likely that this probability interval does not capture the full range of potential outcomes for the 2023 Fraser Pink return.

4. DISCUSSION

The 2022 Fraser River Sockeye forecast was the first year that the updated retrospective analysis was used for model selection. From 2015 to 2020, forecast performance was

exceptionally poor with returns performing around the p10 value or lower for all years except 2018. Returns in 2021 were better than forecasted (p75) despite not having an updated retrospective analysis available. Forecast performance improved in 2022 relative to the last 10 years with the returns coming in between the p25 and p50. Many stocks came in near the median forecast value (i.e., Chilko and Quesnel) and some stocks returned well above forecast (i.e., Early Stuart) but the poor returns of Late Shuswap sockeye on the dominant cycle line led to a decreased forecast performance when considering the aggregate. The updated retrospective analysis uses a one-step-ahead approach and assesses model performance over the most recent time period (up to and including 2020) which ensures that forecasting models are capturing recent relationships between abundance and covariates and are not based on historical correlations.

Model performance was variable in 2022 when considering returns by stock for Fraser River Sockeye salmon. Early Stuart saw strong returns (~p90), many Early Summer stocks returned between the p50 and p75 estimates, and the larger Chilko and Quesnel stocks returned quite close to the p50 forecast. However, Early Thompson and Late Shuswap both returned closer to p10 despite being on a dominant cycle line when they typically make up the bulk of the return. The strong returns of most other Fraser River sockeye populations suggests that marine conditions were likely favourable for Sockeye production in 2020 and 2021, but the Early Thompson and Late Shuswap stocks share a freshwater rearing environment in Shuswap Lake and the Thompson River which may be an indicaor that conditions in freshwater impacted early survival from the last dominant cycle line return in 2018. This result may signify that the incorporation of additional freshwater environmental covariates that represent conditions in rearing lakes into forecasting models may be beneficial for some populations and will drive a greater understanding of Fraser Sockeye population dynamics in general.

The 2023 Fraser River Sockeye forecast is unusual in that the expected age composition for the return is anticipated to be close to 50/50 age-4 and 5-year-old Sockeye, with some stocks having an expected age-5 contribution of over 90% (i.e., Early Stuart and Bowron). In general, the current suite of forecast models is best adapted for an average 4-year life cycle for Fraser Sockeye salmon, which generates some additional uncertainty in the expected performance of forecast models in 2023. Although sibling models have been historically used in the Fraser Sockeye pre-season forecast to reduce the forecast of age-5 fish to better align with poor productivity observed in the last return, in 2023, sibling models were used for many populations to increase the forecast of age-5 fish to align with the strong returns observed in 2022. Additionally, it is important to recall that the 2019 brood year (brood for age 4_2 Sockeye) was the second worst escapement of Fraser sockeye on record, after 2020, and that 2018 (brood year for age 5_2 sockeye) was a dominant cycle line with strong returns. Furthermore, the Big Bar landslide further exacerbated the situation by generating severe delays in migration that led to high en-route losses in 2019 for many populations.

Fraser River Pink salmon are forecasted to return at less than half of the long term average of 12.4 million in 2023. Although environmental indicators for Fraser River Sockeye salmon suggest that environmental conditions are more favourable, environmental covariates used for forecasting Pink salmon are indicative of less favourable conditions. Additionally, a more conservative forecast was selected due to concerns about the flooding in November of 2021 that may not be captured by the juvenile data used in the forecasting models. However, returns in 2021 and 2019 were both underestimated and highlights the uncertainty in Pink population

dynamics not captured in our current model infrastructure. The 2023 Fraser Pink salmon forecast should be considered highly uncertain.

5. CONCLUSIONS

The last generation of Fraser Sockeye has seen the two lowest returns on record with 2019 and 2020 consecutively breaking records (Figure 1). Forecast performance over the past decade has been generally poor and unable to capture the pattern of low productivity that was observed until 2021 where forecast performance improved. Updates to the retrospective analysis are likely doing a better job capturing current productivity and population dynamics than in previous forecasts which were using rankings that were several years out of date. In 2023, the expected proportion of age-4 fish is only 51% as total brood in 2018 was much higher than in 2019 (Table 1B). Environmental indicators are mixed for the 2019 brood year with nearshore temperatures being above average, but the PDO signifying cooler conditions, better for salmon production, offshore (Figure 3). A stoplight chart of ocean indicators generated by NOAA shows that overall marine conditions in 2021 were favourable for salmon production and were the second-best ranked in the time series, exceeded only by 2008 (Figure 9). It is important to note that while marine conditions offshore suggest the potential for high productivity and marine survival, the brood year EFS values for 2019 are very low. The low brood year adds some uncertainty to the forecast in that there is potential for high productivity (in the absence of density-dependence in freshwater) but it is also possible for populations to remain at this low level of productivity for the 2023 returns.

Forecasting returns of Fraser River Pink salmon is always uncertain due to shifting enumeration methodologies through time. Although we were able to utilize the juvenile downstream migration data in the 2023 forecast, the migration was the third lowest on record and was delayed by approximately two weeks (Figure 7). As such, a precautionary approach was applied in selecting the MRJ model even though the power and power SSS models were ranked higher in the retrospective analysis. Testing of additional model forms, incorporation of more environmental covariates, and a formalized retrospective analysis of models for forecasting the returns of Fraser River Pink salmon should be pursued in the future to improve the reliability of the forecast and to better capture the uncertainty around the forecast.

6. TABLES

Table 1A. The 2023 Fraser River Sockeye forecasts. Forecasts are presented from their 10% to 90% probability levels (probability that returns will be at or below the specified run size). At the mid-point (median value) of the forecast distribution (50% probability level), there is a one in two chance the return will fall above or below the specified forecast value for each stock, based on the historical data. Results above 1,000 have been rounded to the nearest 1,000; between 100 and 1,000 to the nearest 100; and between 10 and 100 to the nearest 10.

Run timing group Stocks	**Forecast Model**	**Probability that Return will be at/or Below Specified Run Size**				
		10%	**25%**	**50%**	**75%**	**90%**
Early Stuart	*Ricker (Ei)4/Sibling5*	6,000	11,000	23,000	46,000	86,000
Early Summer Total		47,000	81,000	186,000	354,000	665,000
Total excluding misc. stocks		40,000	71,000	141,000	284,000	552,000
Bowron	*Ricker (Pi)*	100	400	2,000	6,000	15,000
Upper Barriere (Fennell)	*Ricker (Pi)4/Sibling5*	700	1,000	2,000	5,000	9,000
Gates	*LLY4/Sibling5*	3,000	6,000	12,000	25,000	48,000
Nadina	*RickerCyc4/Sibling5*	19,000	37,000	76,000	157,000	315,000
Pitt	*Larkin4/Sibling5*	12,000	19,000	31,000	49,000	77,000
Scotch	*Larkin4/Sibling5*	3,000	5,000	11,000	23,000	42,000
Seymour	*Ricker(Pi)*	2,000	3,000	7,000	19,000	46,000
Misc (EShu)	*R/S*	7,000	9,000	41,000	64,000	100,000
Misc (Taseko)	*R/S*	0	0	10	10	10
Misc (Chilliwack)	*R/S*	300	400	2,000	3,000	6,000
Misc (Nahatlatch)	*R/S*	300	500	2,000	3,000	7,000
Summer Total		349,000	614,000	1,167,000	2,398,000	4,405,000
Total excluding misc. stocks		349,000	614,000	1,166,000	2,396,000	4,401,000
Chilko	*Larkin4/Sibling5*	210,000	343,000	591,000	1,013,000	1,651,000
Late Stuart	*R1C4/Sibling5*	10,000	19,000	39,000	85,000	180,000
Quesnel	*Ricker(Ei)*	63,000	137,000	319,000	882,000	1,836,000
Stellako	*Ricker(Ei)4/Sibling5*	51,000	87,000	157,000	288,000	476,000
Harrison	*TSA3/LLY4*	12,000	23,000	51,000	111,000	228,000
Raft	*LLY4/Sibling5*	3,000	5,000	9,000	17,000	30,000
Misc (N. Thomp. Tribs)	*R/S*	20	40	100	200	300
Misc (N. Thomp River)	*R/S*	200	300	800	2,000	3,000
Misc (Widgeon)	*R/S*	20	60	80	200	700
Late Total		50,000	93,000	188,000	387,000	796,000
Total excluding misc. stocks		50,000	93,000	188,000	386,000	793,000
Cultus	*PowerJuvPi*	0	10	20	60	100
Late Shuswap	*Ricker(Pi)4/Sibling5*	3,000	9,000	25,000	65,000	162,000
Portage	*Ricker(Ei)*	900	2,000	7,000	20,000	56,000
Weaver	*RickerCyc4/Sibling5*	15,000	30,000	64,000	140,000	306,000
Birkenhead	*Ricker(Pi)4/Sibling5*	31,000	52,000	92,000	161,000	269,000
Misc Harrison/Lillooet	*R/S*	70	200	300	900	3,000
TOTAL SOCKEYE SALMON		453,000	800,000	1,564,000	3,185,000	5,952,000
Total Sockeye excluding misc. stocks		445,000	789,000	1,518,000	3,112,000	5,832,000
TOTAL PINK SALMON	*MRJ*	3,247,000	4,389,000	6,135,000	8,575,000	11,591,000

Table 1B. Fraser Sockeye brood year effective female spawners (EFS, except smolts for Cultus) for the four- and five-year-old recruits returning in 2023 (2019 and 2018 brood years). Brood year effective female spawners (EFS) are colour-coded by comparing to the cycle-line average from the historical time series (start years vary; "Mean EFS, Cyc. Years" column). Fraser Sockeye average run sizes are presented across all years and for the 2023 cycle-line for each stock. Median 2023 forecast returns for non-miscellaneous stocks are compared to cycle averages for colour-coding ("Mean Run Size, Cyc. Years" column). Red, yellow, and green shading represents below, near, and above average, respectively. With the near-average range defined as average +/- 0.5 standard deviation of historical time series. For Harrison, 2020 EFS are presented in the 2018 EFS column.

Run Timing Group Stocks	2019 EFS	2018 EFS	Mean EFS		2023 FC Return	Mean Run Size	
			All Years	Cyc. Years		All Years	Cyc. Years
Early Stuart	50	21,000	39,000	23,000	23000	258,200	154,800
Early Summer (excl.	17,000	164,000	62,000	56,000	141,000	494,200	411,700
Bowron	10	5,000	4,000	7,000	2,000	30,000	62,200
Upper Barriere	300	1,000	3,000	3,000	2,000	20,200	25,600
Gates	5,000	2,000	4,000	4,000	12,000	48,700	27,800
Nadina	8,000	58,000	9,000	8,000	76,000	86,700	69,400
Pitt	2,000	7,000	14,000	13,000	31,000	64,900	74,700
Scotch	1,000	29,000	9,000	2,000	11,000	104,700	17,900
Seymour	700	62,000	19,000	17,000	7,000	139,000	134,100
Misc(EShu)	1,300	128,000	9,000	2,000	41,000	NA	NA
Misc(Taseko)	0	40	1,000	3,000	10	NA	NA
Misc(Chilliwack)	600	1,000	3,000	1,000	2,000	NA	NA
Misc(Nahatlatch)	600	1,000	1,000	2,000	2,000	NA	NA
Summer (excl. misc.)	170,000	888,000	523,000	366,000	1,166,000	3,733,000	2,209,400
Chilko	75,000	389,000	221,000	233,000	591,000	1,377,900	1,443,200
Late Stuart	3,000	67,000	66,000	9,000	39,000	476,500	76,200
Quesnel	14,000	333,000	148,000	28,000	319,000	1,292,700	108,000
Stellako	27,000	96,000	54,000	51,000	157,000	434,000	503,400
Harrison	51,000	1,000	30,000	43,000	51,000	124,400	64,900
Raft	400	2,000	4,000	3,000	9,000	27,500	13,700
Misc(N. Thomp. Tribs)	70	50	300	200	100	NA	NA
Misc(N. Thomp. River)	100	2,000	2,000	3,000	800	NA	NA
Misc (Widgeon)	90	70	300	300	80	NA	NA
Late (excl. misc.)	7,000	839,000	392,000	215,000	188,000	2,865,600	1,735,600
Cultus	11	153	800	2,000	20	28,300	52,000
Late Shuswap	3,000	801,000	331,000	153,000	25,000	2,189,900	1,220,000
Portage	300	22,000	3,000	2,000	7,000	40,000	21,200
Weaver	1,000	9,000	17,000	14,000	64,000	299,800	160,800
Birkenhead	2,000	7,000	40,000	43,000	92,000	307,600	281,600
Misc(Non-Shuswap)	40	700	2,000	2,000	300	NA	NA
Total Sockeye	194,000	1,913,000	1,016,000	660000	1,518,000	7,351,000	4,511,500

Table 2. Geometric average four-year-old recruits-per-EFS for each of the forecast Fraser Sockeye stocks presented for the following: the entire time series of brood years: 1948-2018, peak generational (4-year) geometric average, the most recent three generations (2009-2020). Cultus is presented as four-year-old recruits-per-smolt. Forecast four-year-old recruits-per-EFS associated with the various probability levels of the 2023 forecast are presented for comparison. Red (< average), yellow (average) and green (>average), with the average range defined as average +/- 0.5 standard deviation of historical time series.

Run-timing Group, Stock	Geo. Average R_4/EFS	Peak Geo. Ave. R_4/EFS	Min. Geo. Ave. R_4/EFS	Recent Gen. R_4/EFS (2009-2020)	2023 Forecast R_4/EFS by Probability Level				
					10%	25%	50%	75%	90%
Early Stuart	5.9	24.5	1.4	4.1	1.73	2.74	4.48	7.74	12.13
Early Summer									
Bowron	5.7	20.4	0.4	3.3	0.69	1.52	3.36	6.89	12.39
Upper Barriere	5.1	53.5	0.5	2.3	0.66	1.44	3.16	7.27	16.85
Gates	8.0	41.0	1.1	9.4	0.54	1.06	2.21	4.61	8.96
Nadina	5.4	13.5	1.4	4.8	0.82	1.71	3.88	8.85	19.08
Pitt[a]	2.9	10.4	0.5	1.8	0.21	0.43	0.92	1.77	3.11
Scotch	5.6	21.5	1.2	5.3	1.37	2.79	6.05	13.38	24.3
Seymour	6.4	29.2	1.0	3.7	0.84	1.5	2.78	5.1	9.41
Misc (Early Shuswap) [b]	-	-	-	-	0.5	0.6	2.8	4.4	6.8
Misc (Taseko) [b]	-	-	-	-	NA	NA	NA	NA	NA
Misc (Chilliwack) [b]	-	-	-	-	0.3	0.4	1.5	2.6	6.5
Misc (Nahatlatch) [b]	-	-	-	-	0.3	0.4	1.5	2.6	6.5
Summer									
Chilko	5.8	25.3	0.7	3.7	2.36	3.82	6.51	11	17.66
Late Stuart	7.8	57.2	2.1	3.2	0.96	2.28	5.99	15.71	37.46
Quesnel	7.2	31.4	0.6	2.1	1.09	2.27	5.07	10.87	24.8
Stellako	5.9	16.3	0.7	2.8	1.4	2.43	4.49	8.44	14.09
Harrison[c]	5.9	33.8	0.5	4.9	2.96	5.35	10.35	20.03	36.27
Raft	4.9	14.3	0.5	2.6	4.83	8.36	15.38	28.3	49
Misc (N. Thomp.Tribs) [b]	-	-		-	0.3	0.4	1.1	2.3	3.5
Misc (N. Thomp River) [b]	-	-		-	0.3	0.4	1.1	2.3	3.5
Misc (Widgeon) [b]	-	-		-	0.1	0.4	0.6	1.8	5.5
Late									
Cultus [d]	0.03	0.06	0.005	0.02	0.0016	0.0038	0.0091	0.023	0.058
Late Shuswap	4.8	21.2	0.2	0.9	0.13	0.61	1.81	4.41	8.92
Portage	9.9	69.1	1.4	2.7	1.2	2.74	7	18.07	41.89
Weaver	9.5	41.8	0.8	6.1	0.4	1.32	5.86	22.27	71.74
Birkenhead	4.3	21.5	0.2	1.4	0.59	1.2	2.79	6.02	12.03
Misc Lillooet-Harrison [b]	-	-		-	1.8	5.7	7.6	23.8	71.8

a. Pitt displayed as Five-Year-Old survival, therefore recent generation is 2008-2019.
b. Naïve (non-biological) models do not have recruitment time series; so averages could not be compiled
c. Harrison is presented as total survival;.
d. Cultus survivals are presented as marine survival; recruits-per-juvenile.

Table 3. Four- and five-year-old and total 2023 Fraser Sockeye median (50% probability) forecasts for each stock. The four- and five-year-old proportions of the total median forecast are presented in the final two columns. Values below 1,000 were rounded to the nearest 100, and values below 100 were rounded to the nearest 10, rather than the nearest 1,000, in order to demonstrate age distributions. Harrison three-year-old returns are presented in the five-year-old column.

Sockeye stock/timing group	2023 Fraser Sockeye Forecasts				
	Four-year-old return 50%	Five-year-old Return 50%	Total Return 50%	Four-Year-Old Proportion	Five-Year-Old Proportion
Early Stuart	200	22,800	23,000	1%	99%
Early Summer					
Bowron	30	1,970	2,000	2%	98%
Upper Barriere (Fennell)	800	1,200	2,000	40%	60%
Gates	11,200	800	12,000	93%	7%
Nadina	32,000	44,000	76,000	42%	58%
Pitt	2,000	29,000	31,000	6%	94%
Scotch	6,000	5,000	11,000	55%	45%
Seymour	2,000	5,000	7,000	29%	71%
Misc (EShu)	4,000	37,000	41,000	10%	90%
Misc (Taseko)	0	10	10	0%	100%
Misc (Chilliwack)	1,400	600	2,000	70%	30%
Misc (Nahatlatch)	1,400	600	2,000	70%	30%
Summer					
Chilko	486,000	105,000	591,000	82%	18%
Late Stuart	18,000	21,000	39,000	46%	54%
Quesnel	73,000	246,000	319,000	23%	77%
Stellako	120,000	37,000	157,000	76%	24%
Harrison	14,000	37,000	51,000	27%	73%
Raft	6,000	3,000	9,000	67%	33%
Misc (N. Thomp. Tribs)	80	20	100	80%	20%
Misc (N. Thomp River)	100	700	800	13%	87%
Misc (Widgeon)	50	30	80	62%	38%
Late					
Cultus	0	20	20	0%	100%
Late Shuswap	6,000	19,000	25,000	24%	76%
Portage	2,000	5,000	7,000	29%	71%
Weaver	6,000	58,000	64,000	9%	91%
Birkenhead	6,000	86,000	92,000	7%	93%
Misc(Non-Shuswap)	20	280	300	7%	93%
Total	798,000	766,000	1,564,000	51%	49%

Table 4. List of candidate models organized by their two broad categories (non-parametric/naïve and biological) with descriptions. Models are described in detail in Appendices 1 to 3 of Grant et al. (2010). Where applicable, models use effective female spawner data (EFS) as a predictor variable unless otherwise indicated by '(juv)' or '(smolt)' next to the model (Tables 1A), where fry or smolt data are used instead.

MODEL CATEGORY	DESCRIPTION
A. Non-Parametric (Naïve) Models	
LLY	Return from the previous year
R1C	Return from 4 years before to forecast year
R2C	Average return from 4 and 8 years before the forecast year
RAC	Average return on the forecast cycle line for all years
TSA	Average return across all years
RS1 (or RJ1)	Product of average survival from 4 years before the forecast year and the forecast brood year EFS (or juv/smolt)
RS2 (or RJ2)	Product of average survival from 4 and 8 years before the forecast year and the forecast brood year EFS (or juv/smolt)
RS4yr (or RJ4yr)	Product of average survival from the last 4 consecutive years and the forecast brood year EFS (or juv/smolt)
RS8yr (or RJ8yr)	Product of average survival from the last consecutive 8 years and the forecast brood year EFS (or juv/smolt)
MRS (or MRJ)	Product of average survival for all years and the forecast brood year EFS (or juv/smolt)
RSC (or RJC)	Product of average cycle-line survival (entire time series) and the forecast brood year EFS (or juv/smolt)
R/S (used for miscellaneous stocks)	Product of average survival on time series for specified stocks and the forecast brood year EFS
B. Biological Models	
Power	Bayesian power model, see Appendix 2 of Grant et al. 2010
Power-cyc	Same as above, using cycle line data only
Ricker	Bayesian Ricker model, see Appendix 2 of Grant et al. 2010
Ricker-cyc	Same as above, using cycle line data only
Larkin	Bayesian Larkin model, see Appendix 2 of Grant et al. 2010
Sibling	Bayesian sibling model, see 2.2.1 of Hawkshaw et al. 2020a
C. Biological Models Covariates	(e.g. Power (FrD-mean))
FrD-mean, AprFrD, MayFrD, JunFrD	Mean Fraser discharge (April - June), Mean April flow, May flow, June flow
FrD-peak	Peak Fraser Discharge
Ei, AprEi, MayEi, JunEi, JulEi	Mean Entrance Island spring-summer sea-surface temperature (SST) (April-July). Departure Bay was substituted for Entrance Island this year due to a lack of data.
Pi, MayPi, JunPi, JulPi	Mean Pine Island spring-summer SST (May-July)
PDO	Pacific Decadal Oscillation

Table 5.Total Fraser Sockeye forecasts for 1998 to 2022 from the 10% to 90% p-levels, where available. The forecast value (or values) that corresponded most closely to the actual return is highlighted. For returns that fell above the 50% p-level, the cells are highlighted green. For returns that fell at the 50% p-level, cells are highlighted yellow. Returns falling below the 50% p-level are highlighted orange, and below the 25% p-level are highlighted red. Returns for 2022 are preliminary based on in-season estimates only at the time of this publication.

Return Year	Forecast Probability Level						Actual Returns
	<10%	10%	25%	50%	75%	90%	
1998	NA	4,391,000	6,040,000	6,822,000	11,218,000	18,801,000	**10,870,000**
1999	NA	3,067,000	4,267,000	4,843,000	8,248,000	14,587,000	**3,640,000**
2000	NA	1,487,000	2,449,000	4,304,000	7,752,000	NA	**5,200,000**
2001	NA	3,869,000	6,797,000	12,864,000	24,660,000	NA	**7,190,000**
2002	NA	4,859,000	7,694,400	12,915,900	22,308,500	NA	**15,130,000**
2003	NA	1,908,000	2,742,000	3,141,000	5,502,000	9,744,000	**4,890,000**
2004	NA	1,858,000	2,615,000	2,980,000	5,139,000	9,107,000	**4,180,000**
2005	NA	5,149,000	8,734,000	16,160,000	30,085,000	53,191,000	**7,020,000**
2006	NA	5,683,000	9,530,000	17,357,000	31,902,000	56,546,000	**12,980,000**
2007	NA	2,242,500	3,602,000	6,247,000	11,257,000	19,706,000	**1,510,000**
2008	NA	1,258,000	1,854,000	2,899,000	4,480,000	7,057,000	**1,740,000**
2009	NA	3,556,000	6,039,000	10,578,000	19,451,000	37,617,000	**1,590,000**
2010	NA	5,360,000	8,351,000	13,989,000	23,541,000	40,924,000	**28,250,000**
2011	NA	1,700,000	2,693,000	4,627,000	9,074,000	15,086,000	**5,110,000**
2012	NA	743,000	1,203,000	2,119,000	3,763,000	6,634,000	**2,050,000**
2013	NA	1,554,000	2,655,000	4,765,000	8,595,000	15,608,000	**4,130,000**
2014	NA	7,237,000	12,788,000	22,854,000	41,121,000	72,014,000	**20,000,000**
2015	NA	2,364,000	3,824,000	6,778,000	12,635,000	23,580,000	**2,120,000**
2016	NA	814,000	1,296,000	2,271,000	4,227,000	8,181,000	**853,000**
2017	NA	1,315,000[R]	2,338,000	4,432,000	8,873,000	17,633,000	**1,641,000**
2018	NA	5,265,000	8,423,000	13,981,000	22,937,000	36,893,000	**10,675,000**
2019	NA	1,832,000	2,979,000	5,056,000	9,133,000	15,313,000	**564,000**
2020	NA	275,000	486,000	924,000	1,834,000	3,573,000	**288,000**
2021	NA	313,000	624,000	1,330,000	2,775,000	5,496,000	**2,549,000**
2022	NA	2,374,000	4,662,000	9,775,000	20,395,000	41,707,000	6,886,000

Table 6. Stock composition of 2017-2019 Brood Years and 2023 median forecast (excluding misc. stocks). The five largest stocks in each column are highlighted in bold font, and the largest stock marked in red.

Stock	2017 EFS	2018 EFS	2019 EFS	2023 Median Forecast Return
Early Stuart	1.4%	1.1%	0%	1.5%
Early Summer				
Bowron	0.0%	0.2%	0%	0.1%
Upper Barriere (Fennell)	0.1%	0.1%	0.2%	0.2%
Gates	0.6%	0.1%	**3.4%**	0.8%
Nadina	0.5%	3.0%	**5.8%**	**5.0%**
Pitt	3.8%	0.4%	1.4%	2.0%
Scotch	0.5%	1.5%	0.7%	0.7%
Seymour	0.3%	3.2%	0.5%	0.5%
Summer				
Chilko	**42.3%**	**20.2%**	**51.7%**	**38.9%**
Late Stuart	**15.9%**	**3.5%**	2.1%	2.6%
Quesnel	**11.9%**	**17.3%**	**9.9%**	**21.0%**
Stellako	**9.8%**	**5.0%**	**18.5%**	**10.3%**
Harrison	**5.8%**	0.4%	0.9%	0.33%
Raft	0.5%	0.1%	0.3%	0.6%
Late				
Cultus	NA	NA	NA	NA
Late Shuswap	1.7%	**41.7%**	2.4%	1.6%
Portage	0.1%	1.2%	0.2%	0.5%
Weaver	2.9%	0.4%	0.7%	4.2%
Birkenhead	2.0%	0.4%	1.4%	**6%**
Total Number	503,000	1,920,000	144,000	1,518,000

Table 7. Overview of model selections for 2019, 2022 and 2023 forecast. Models that changed from 2022 to 2023 are highlighted. See Appendix 3 for stock-specific model choice rationales. The Ricker model is highlighted in red for 2019 to show that a stock-recruit model does exist for this stock but is currently only being applied on the dominant cycle line for Chilliwack due to a shortened time series.

Year/Model	2019	2022	2023
Early Stuart	*Ricker(Ei)*	*Ricker(Ei)*	***Ricker (Ei)4/Sibling5***
Early Summer			
Bowron	*Ricker(Pi)*	*Ricker(Ei)*	***Ricker (Pi)***
Upper Barriere	*Power4/Sibling5*	*Ricker (Pi)4/Sibling5*	*Ricker (Pi)4/Sibling5*
Gates	*Larkin*	*LLY4/Sibling5*	*LLY4/Sibling5*
Nadina	*MRJ*	*PowerJuvFrD-peak4/Sibling5*	***RickerCyc4/Sibling5***
Pitt	*Larkin4/Sibling5*	*LLY4/Sibling5*	***Larkin4/Sibling5***
Scotch	*Larkin4/Sibling5*	*Larkin4/Sibling5*	*Larkin4/Sibling5*
Seymour	*Larkin4/Sibling5*	*Ricker(Ei)4/Sibling5*	***Ricker(Pi)***
Misc (EShu)	*R/S*	*R/S*	*R/S*
Misc (Taseko)	*R/S*	*R/S*	*R/S*
Misc (Chilliwack)	*Ricker*	*R/S*	*R/S*
Misc (Nahatlatch)	*R/S*	*R/S*	*R/S*
Summer			
Chilko	*PowerJuv(Pi)*	*Ricker(Ei)4/Sibling5*	***Larkin4/Sibling5***
Late Stuart	*R1C*	*Ricker(FrDMn)4/Sibling5*	***R1C4/Sibling5***
Quesnel	*Ricker(Ei)4/Sibling5*	*Ricker(Ei)*	*Ricker(Ei)*
Stellako	*Larkin*	*Larkin4/Sibling5*	***Ricker(Ei)4/Sibling5***
Harrison	*RickerEiOdd*	*Ricker(Ei)Even3/Sibling4*	***TSA3/LLY4***
Raft	*Ricker (PDO)*	*LLY4/Sibling5*	*LLY4/Sibling5*
Misc (N. Thomp. Tribs)	*R/S*	*R/S*	*R/S*
Misc (N. Thomp River)	*R/S*	*R/S*	*R/S*
Misc (Widgeon)	*R/S*	*R/S*	*R/S*
Late			
Cultus	*PowerJuv(Pi)*	*PowerJuvPi*	*PowerJuvPi*
Late Shuswap	*RickerCyc4/Sibling5*	*Ricker(Ei)*	***Ricker(Pi)4/Sibling5***
Portage	*Larkin*	*RickerCyc*	***Ricker(Ei)***
Weaver	*Ricker(PDO)4/Sibling5*	*PowerJuvPi4/Sibling5*	***RickerCyc4/Sibling5***
Birkenhead	*Ricker (Ei)*	*Ricker(Ei)4/Sibling5*	***Ricker(Pi)4/Sibling5***
Misc(Non-Shuswap)	*R/S*	*R/S*	*R/S*

7. FIGURES

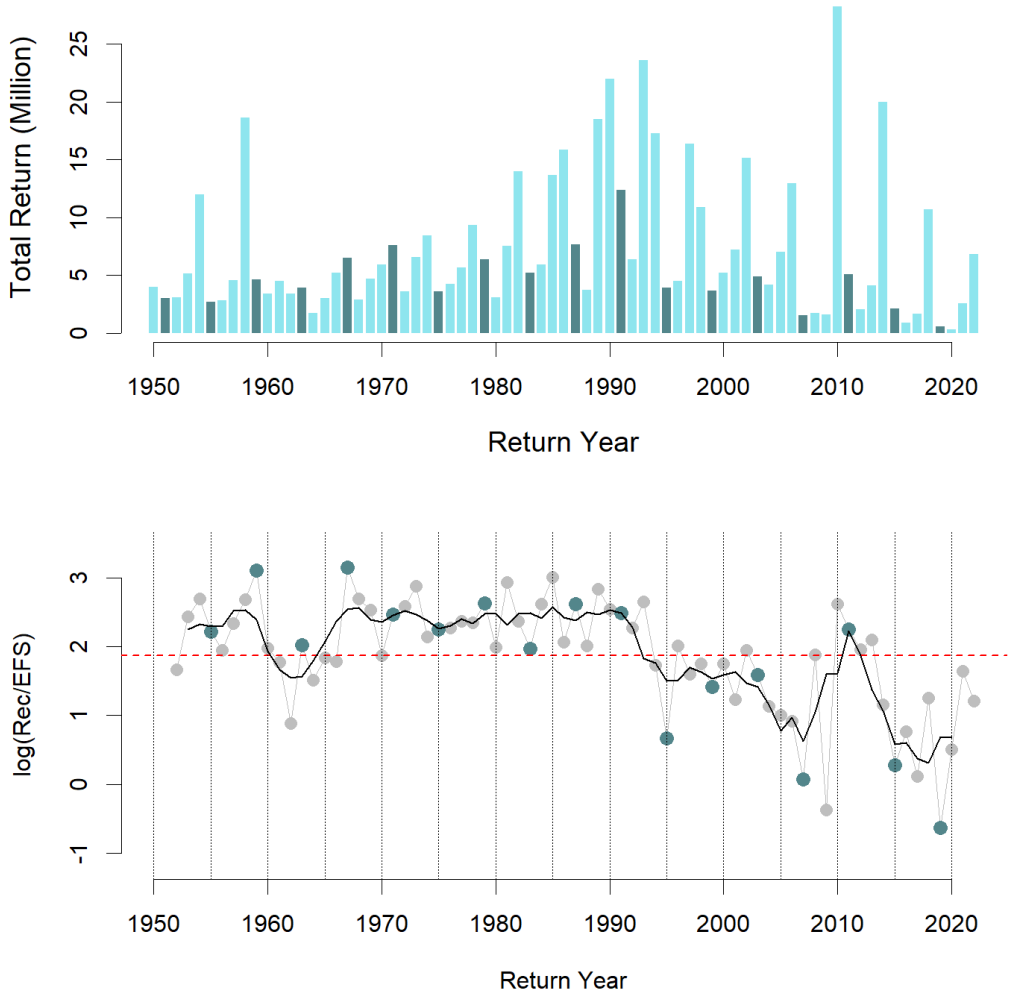

Figure 1. Total returns and overall productivity of Fraser Sockeye: Top panel shows total adult annual returns (note that adult returns in 2022 are preliminary); Bottom panel shows overall Fraser Sockeye productivity (log(recruits / effective female spawners) up to the 2022 return year for the 19 stocks with long time series of spawner and recruit estimates. Points represent annual productivity and the black line represents the smoothed four year running average. The dashed horizontal red line is the time-series average. In both panels, dark blue represents the 2023 cycle line.

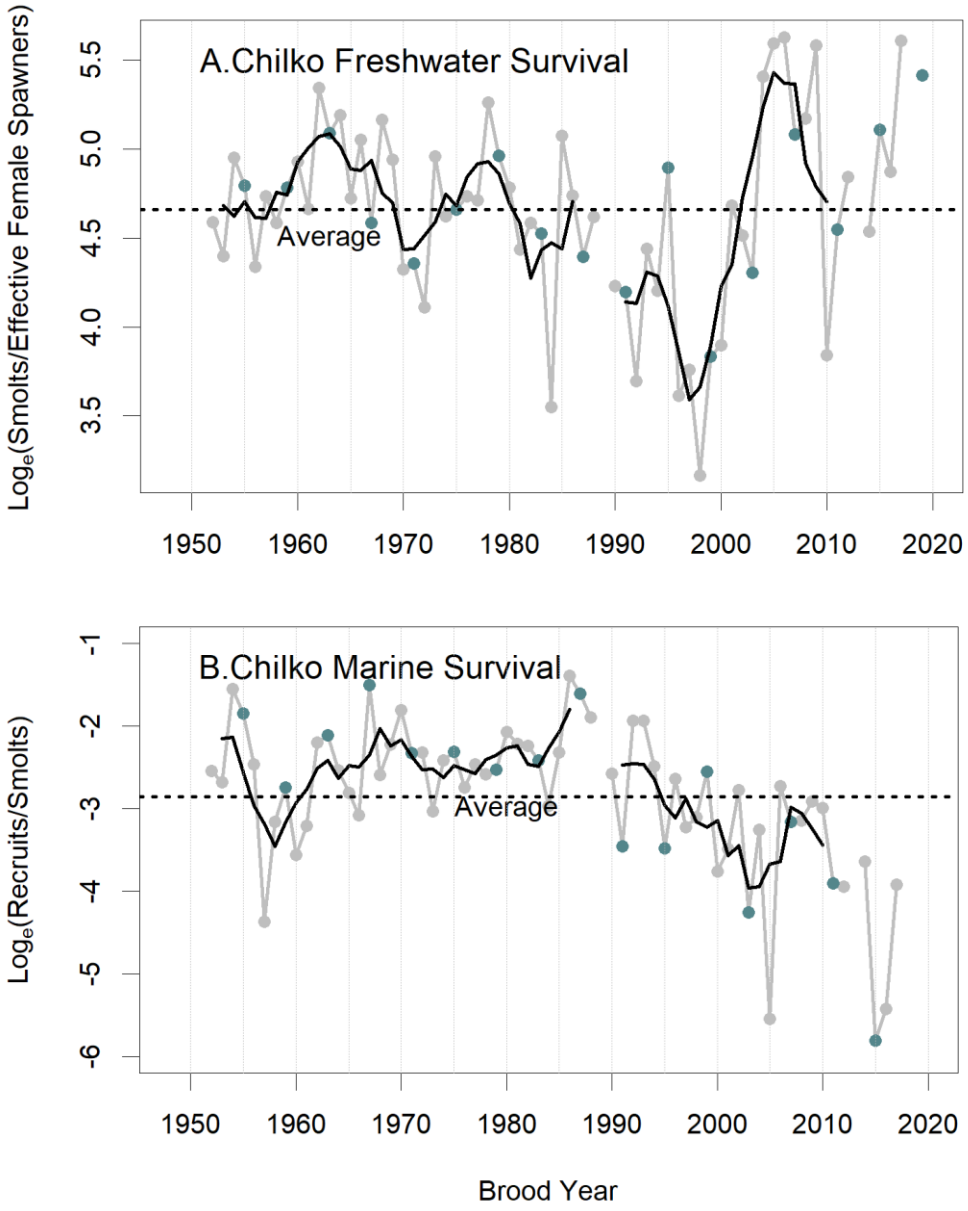

Figure 2. A. Annual freshwater survival (log smolts/effective female spawners; filled grey dots and lines); dark blue circle represents the 2023 cycle line. The black line represents the smoothed four-year running average survival and the black dashed lines indicate average survival. Note that no smolt assessment was conducted in the 2013 and 2018 brood year representing a gap. B. Annual 'marine' (loge recruits/smolt) survival (filled grey circles and lines). 'Marine survival' includes the period of time smolts spend migrating from the outlet of Chilko Lake (where they are enumerated) to when they return as adults and includes their downstream migration in the Fraser River as smolts.

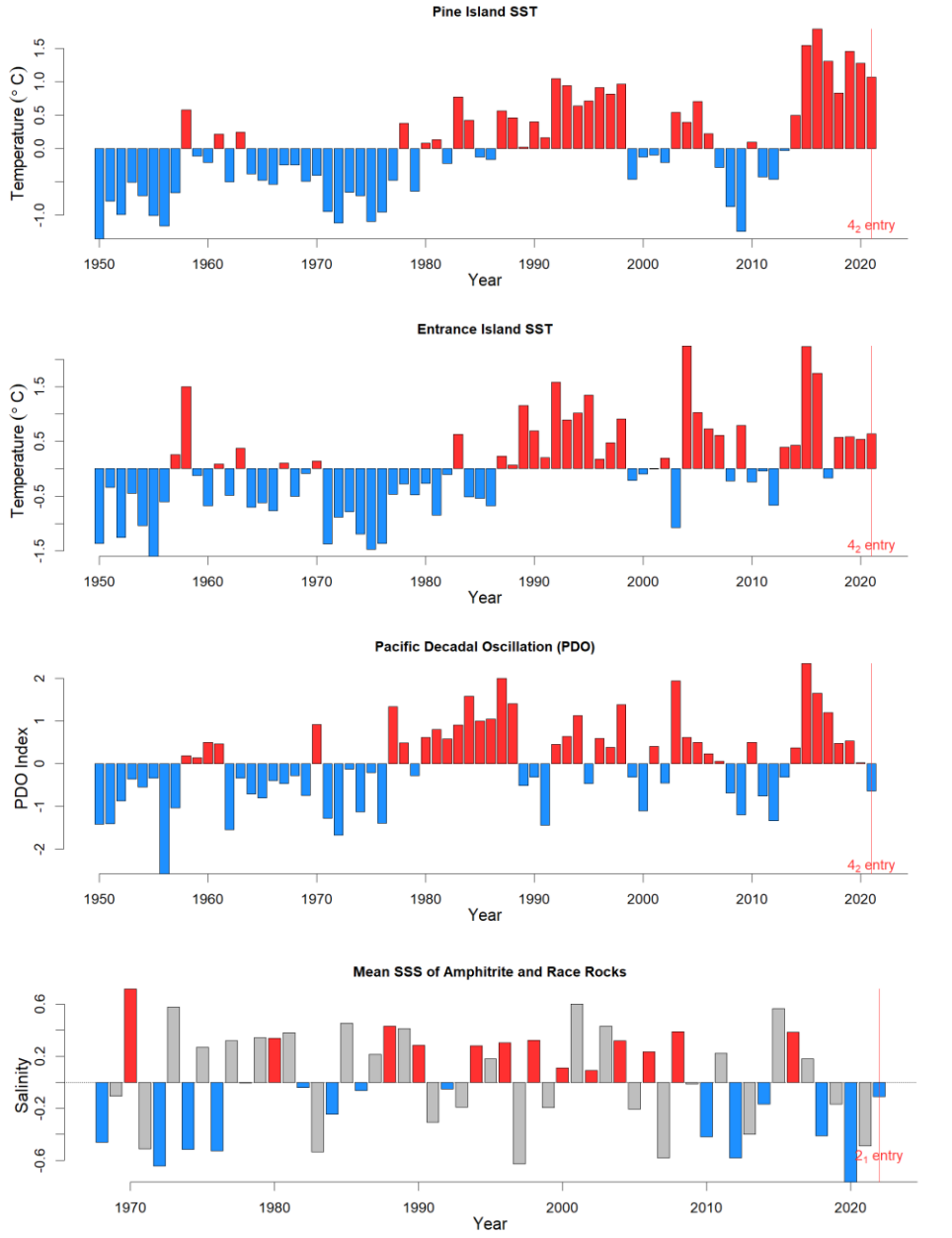

Figure 3. Sea surface temperatures (SST) measured at Entrance Island (Strait of Georgia) (April-June average) (Departure Bay was substituted for Entrance Island for 2021 entry), Pine Island (Queen Charlotte Strait) (April-July average),standardized winter PDO index (Nov-March), and averaged sea surface salinity (SSS) of Amphitrite and Race Rocks (July-September). Temperatures are presented as raw deviations from time-series averages (1950-2021). The 2021 ocean entry year, highlighted with a red vertical line, marks the temperature anomalies that most Fraser Sockeye from the 2019 brood year entered into upon outmigration as smolts (i.e. a 4_2 life cycle). Red bars (positive values) indicate warm temperature anomalies (above average) and blue bars (negative values) indicate cool temperature anomalies (below average). The grey bars of mean SSS were even year data which wasn't used in the model.

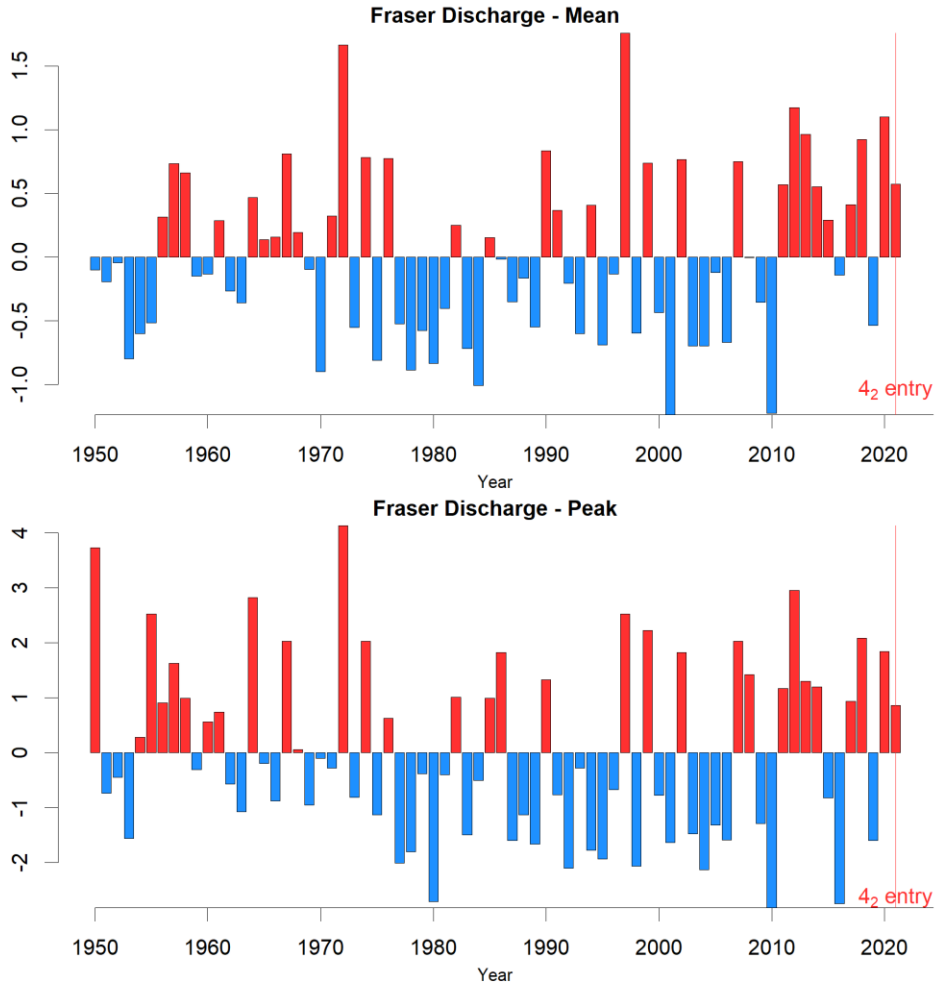

Figure 4. Fraser River discharge shown as mean conditions over April-June and peak discharge. Values are presented as raw deviations from time-series averages (1950-2021). The 2021 ocean entry year, highlighted with a red vertical line, marks the temperature anomalies that most Fraser Sockeye from the 2019 brood year entered into upon outmigration as smolts (i.e. a 4_2 life cycle). Red bars (positive values) indicate increased discharge anomalies (above average) and blue bars (negative values) indicate decreased discharge anomalies (below average).

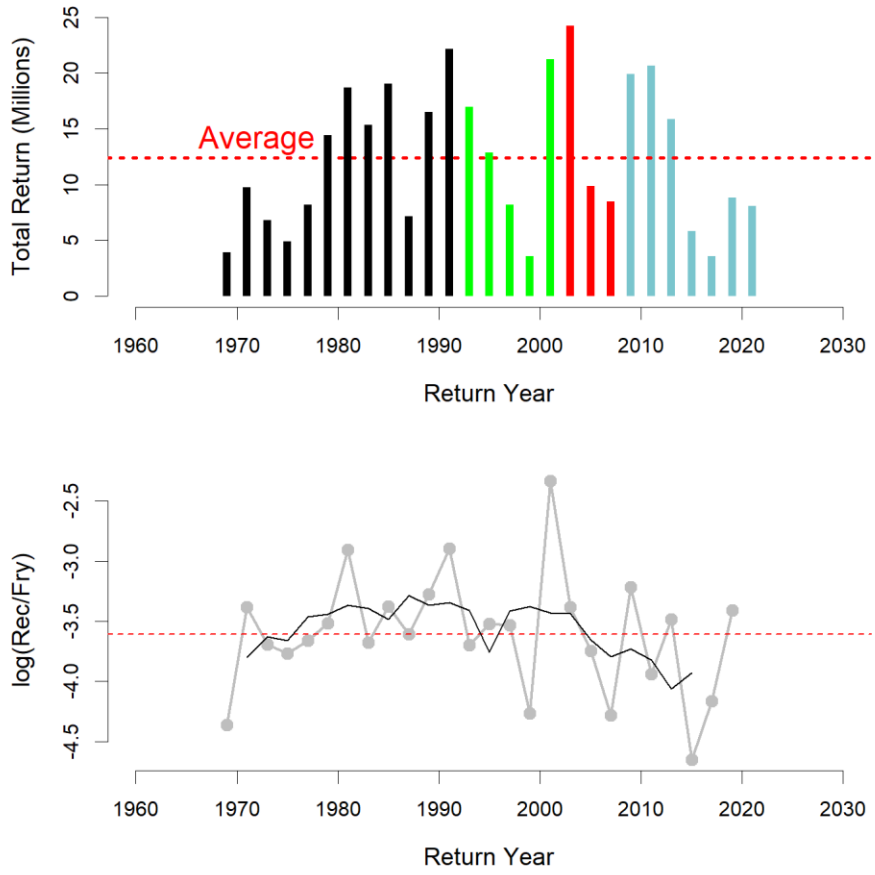

Figure 5. Upper Panel: Fraser River Pink Salmon returns (black or colored bars) estimates. Escapement estimates were generated from system-specific programs from 1957 to 1991 (black bars), system-wide single mark recaptures from 1993 to 2001 (green bars), indirect system-wide marine test fisheries estimates from 2003 to 2007 (red bars), and system-wide hydroacoustic estimate from 2009 to 2021 (blue bars). Given the lack of calibration work between methods, escapement estimates between years are not entirely comparable. The red dashed line is the average pink return (12.4 M); Bottom Panel: Fraser Pink marine survival (recruits-per-fry) from the 1967 to 2019 brood years; these estimates are uncertain and not entirely comparable inter-annually due to differences in return (catch and escapement) estimation methods over time. The red dashed line is the average survival (3.2%).

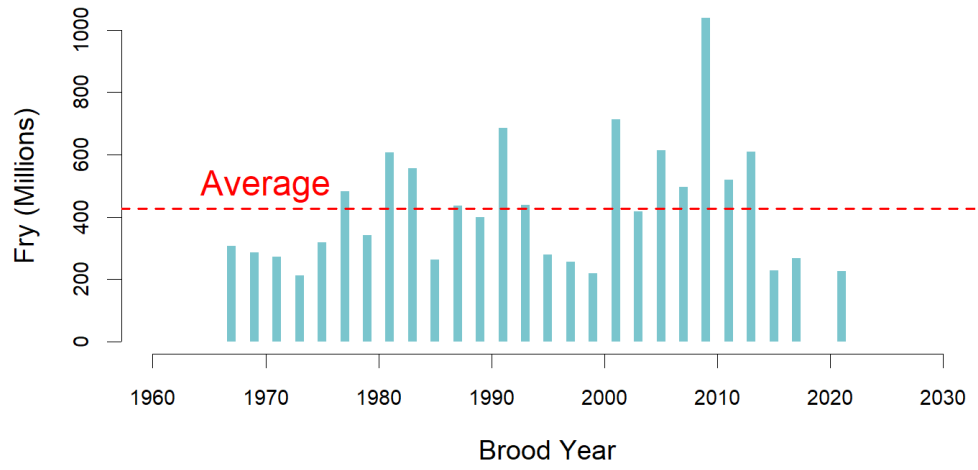

Figure 6. Fraser River Pink Salmon fry abundance. The average fry abundance over the time series is 427 million (dashed red line).

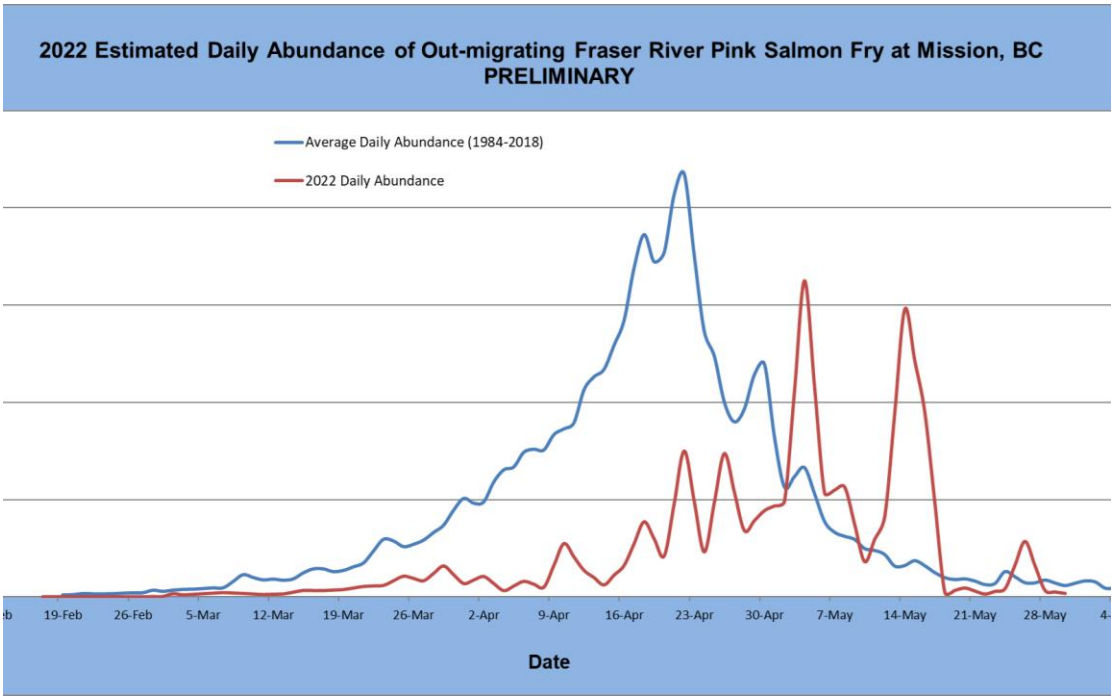

Figure 7. Estimated Daily Abundance of Out-migrating Fraser River Pink Salmon Fry at Mission, BC in 2022.

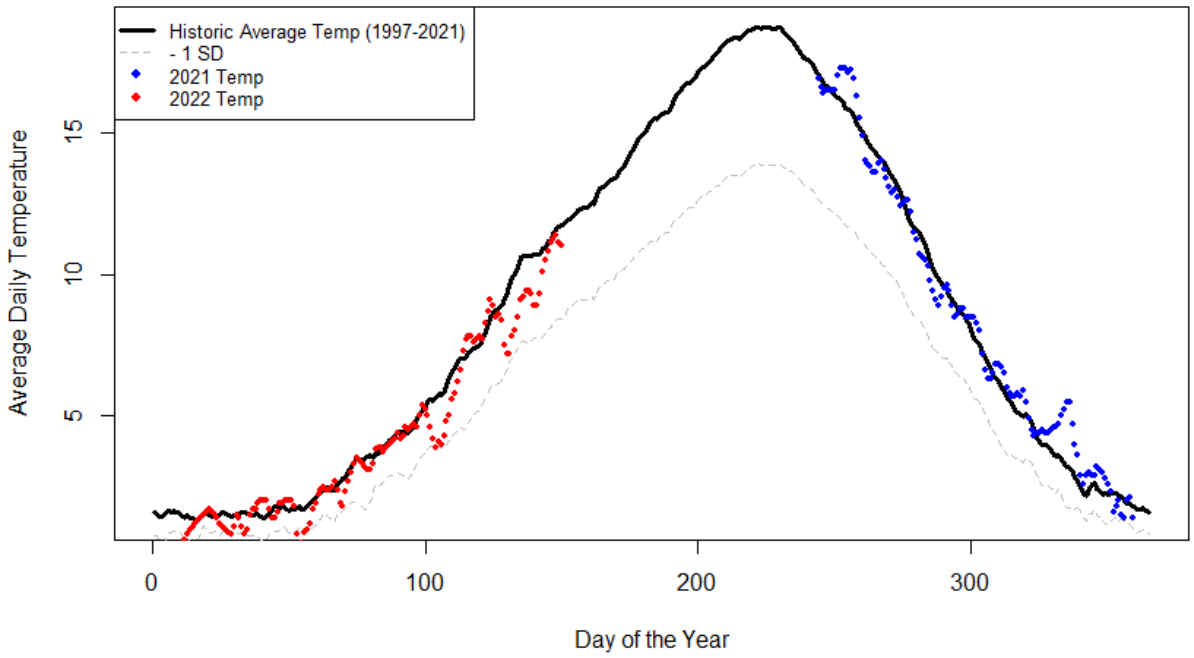

Figure 8. Approximate thermal exposure of Fraser River Pink salmon in 2021 and 2022 in the Fraser River at Qualark from egg deposition to fry emergence. Blue dots indicate temperatures experienced in the fall and winter of 2021 and red dots indicate temperatures experienced in the winter and early spring of 2022. Data are based on a combination of unpublished observed and modelled data for non-summer periods.

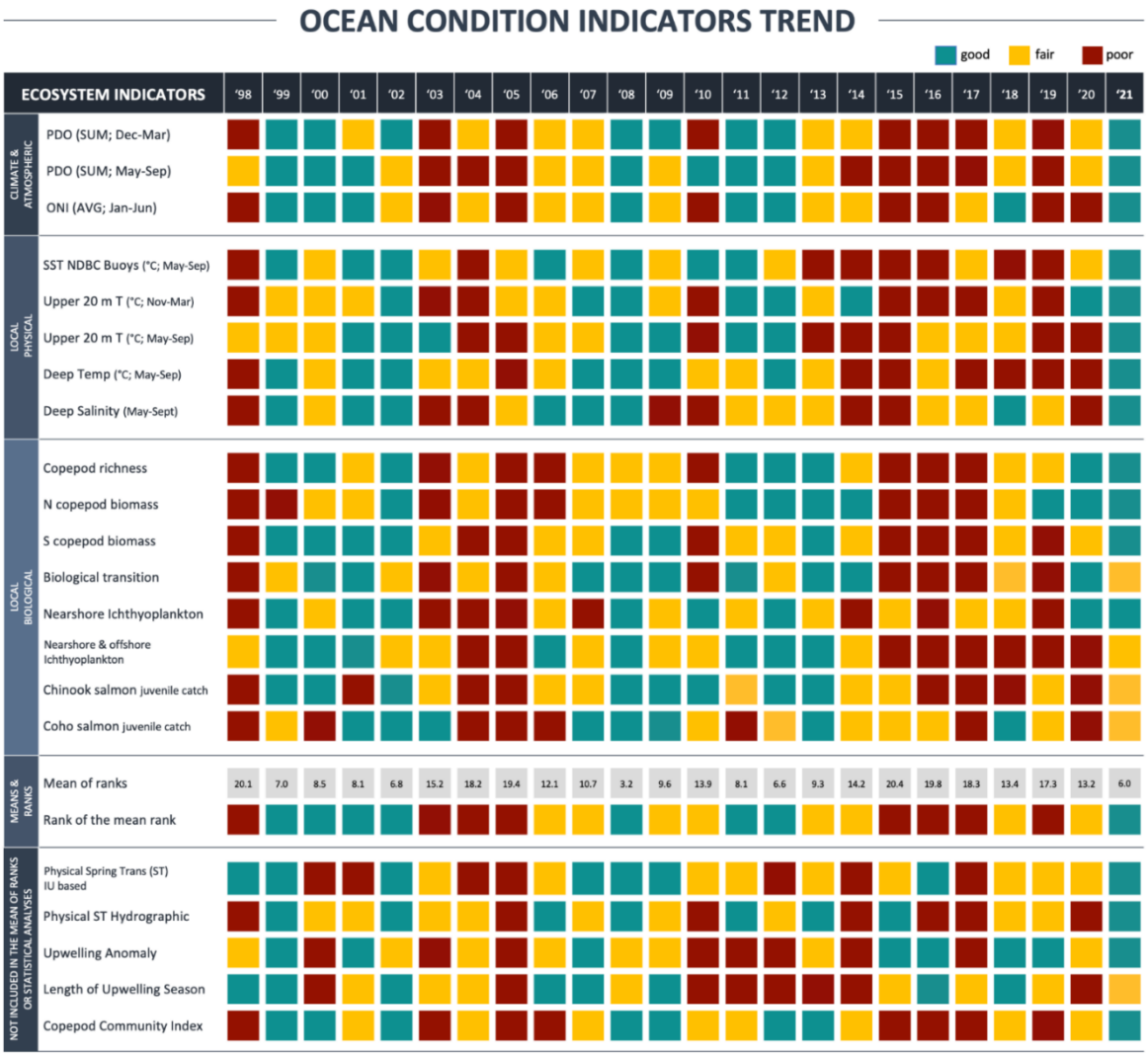

Figure 9. Stoplight chart of ocean indicators favourable for the production of juvenile salmon in the California Current. Source: NOAA 2021 (https://www.fisheries.noaa.gov/west-coast/science-data/ocean-conditions-indicators-trends

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9. CONTRIBUTORS

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APPENDIX A. STOCK GROUP DATA SUMMARIES

Early stuart (Takla-Trembleur-Early Stuart CU)

Run Timing Group	Escapement				2019Stock Contributions
Early Stuart	Avg.	Cyc. Avg	BY(2019)	BY Trend[a]	Early Stuart
All stocks[b]	38,500	22,200	50	DOWN	100%

a. Trend refers to change from previous brood year (2015)

b. Escapement and cycle year average 1952-2019

Early summer

Run Timing Group	Escapement				2019 Stock Contributions										
Early Summer	Avg.	Cyc. Avg.	BY(2019)	BY Trend[a]	Bowron	Seymour	Fennell	Scotch	Gates	Nadina	Pitt	South Thom	Tasekko	Chilliwack	Nahatlatch
Primary stocks[b]	62,600	56,600	17,300	DOWN	0%	4%	2%	6%	29%	48%	12%	NA	NA	NA	NA
Total (including misc.)[c]	146,400	56,900	19,900	DOWN	0%	2%	1%	3%	17%	28%	7%	26%	2%	10%	5%

a. Trend refers to change from previous brood year (2015)

b. Escapement and cycle year average 1952-2019

c. Escapement and cycle year average 2003-2019

Summer

Run Timing Group	Escapement				2019 Stock Contributions								
Summer	Avg.	Cyc. Avg.	BY (2019)	BY Trend[a]	Late Stuart	Stellako	Raft	Quesnel	Chilko	Harrison	North Thom. Trib	North Thom. Riv	Widgeon
Primary stocks[b]	562,000	371,800	120,400	DOWN	3%	22%	0%	12%	62%	1%	NA	NA	NA
Total (including misc.)[c]	663,900	473,100	120,700	DOWN	2%	20%	0%	11%	56%	1%	0%	9%	0%

a. Trend refers to change from previous brood year (2015)
b. Escapement and cycle year average 1952-2019
c. Escapement and cycle year average 2003-2019

Late

Run Timing Group	Escapement				2019 Stock Contributions					
Late	Avg.	Cyc. Avg.	BY (2019)	BY Trend[a]	Late Shuswap	Birkenhead	Portage	Weaver	NonShu Harrison	Cultus[d]
Primary stocks[b]	406,800	217,300	6,700	DOWN	51%	30%	4%	15%	NA	--
Total (including misc.)[c]	451,200	79,700	6,700	UP	28%	17%	2%	8%	44%	--

a. Trend refers to change from previous brood year (2015)
b. Escapement and cycle year average 1952-2019
c. Escapement and cycle year average 2003-2019
d. Cultus Is not included because only juvenile data are used for this stock

Miscellaneous Stocks – All Management Units

Forecast Unit	Populations*
Early Summer	
EShu	Adams Channel, Adams River (upper and lower), Anstey River, Blueberry Creek, Burton Creek, Cayenne Creek, Celista Creek, Craigellachie Creek, Crazy Creek, Eagle River, Four Mile Creek, Hiuhill Creek, Hunakwa Creek, Loftus Creek, Momoch River(upper and lower), Nikwikwaia Creek, Onyx Creek, Perry River, Ross Creek, Salmon River, Sinmax Creek, Yard Creek
Taseko	Taseko Lake, Taseko River(upper), Yoheta (upper and lower), Lastman Creek
Chilliwack	Chilliwack Lake, Chilliwack River, Chilliwack River(upper)
Nahatlatch	Nahatlatch River, Nahatlatch Lake
Summer	
North Thompson Tributaries	Barriere River, Clearwater River, Dunn Creek, Finn Creek, Grouse Creek, Hemp Creek, Lemieux Creek, Lion Creek, Mann Creek
North Thompson River	North Thompson River
Widgeon	Widgeon Creek, Widgeon Slough
Late	
Non-Shuswap	Big Silver Creek, Cogburn Creek, Crazy Creek, Douglas Creek, Green River, Joffre Creek, Miller Creek, North Creek, Pemberton Creek, Railroad Creek, Sampson Creek, Sloquet Creek, Tipella Creek, Ure Creek

Forecast total return of miscellaneous stocks and the proxy used for long term productivity

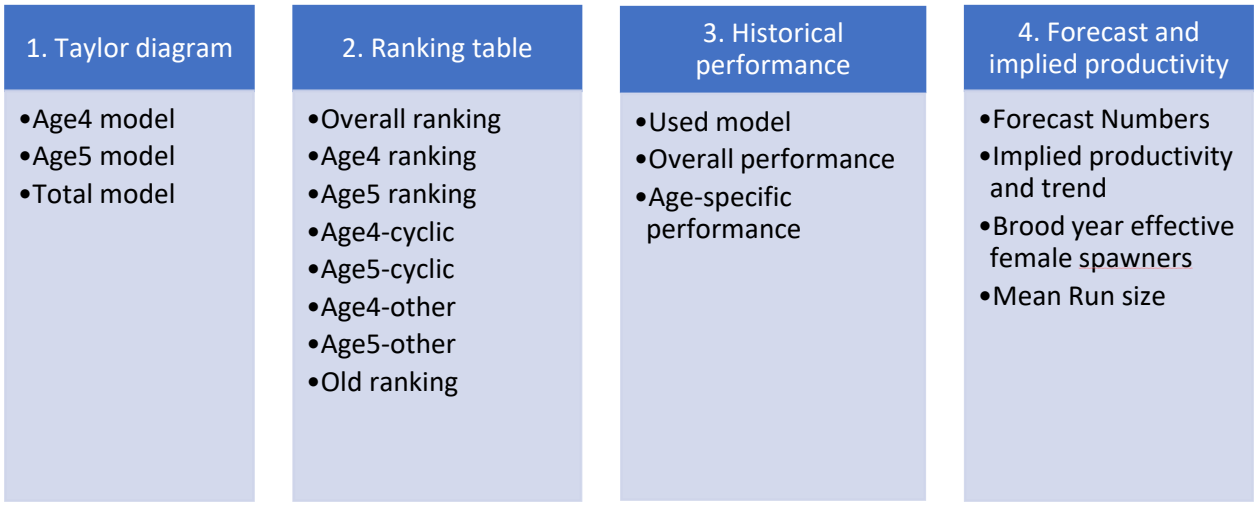
	Effective Females		Proxy for long-term Prod.	Forecast total Return				
	2018	2019		10%	25%	50%	75%	90%
Early Summer								
Misc(EShu)	128,313	1,306	Scotch/Seymour	6,685	8,549	40,902	64,193	99,524
Misc(Taseko)	35	0	Chilko	2	2	6	8	11
Misc(Chilliwack)	975	619	All ES Stocks	264	441	1,518	2,544	6,337
Misc(Nahatlatch)	987	644	All ES Stocks	272	454	1,564	2,621	6,527
Summer								
Misc(N. Thomp. Tribs)	50	73	Raft/Fennell	24	35	97	213	319
Misc (N. Thomp. River)	1,710	133	Raft/Fennell	205	298	820	1,806	2,699
Misc (Widgeon)	68	88	Birkenhead	18	58	78	242	730
Late								
Misc (Non-Shuswap)	724	36	Birkenhead	68	221	296	924	2,783

Age-4 return and productivity.

	Forecast Age-4 Return					Forecast Age-4 Productivity				
	10%	25%	50%	75%	90%	10%	25%	50%	75%	90%
Early Summer										
Misc(EShu)	600	768	3,673	5,764	8,936	0.5	0.6	2.8	4.4	6.8
Misc(Taseko)	0	0	0	0	0	NA	NA	NA	NA	NA
Misc(Chilliwack)	264	441	1,518	2,544	6,337	0.3	0.4	1.5	2.6	6.5
Misc(Nahatlatch)	173	290	997	1,671	4,161	0.3	0.4	1.5	2.6	6.5
Summer										
Misc(N. Thomp. Tribs)	19	28	77	170	253	0.3	0.4	1.1	2.3	3.5
Misc (N. Thomp. River)	35	51	140	309	462	0.3	0.4	1.1	2.3	3.5
Misc (Widgeon)	12	39	52	162	488	0.1	0.4	0.6	1.8	5.5
Late										
Misc(Non-Shuswap)	5	16	21	66	199	1.8	5.7	7.6	23.8	71.8

APPENDIX B. MODEL SELECTION CRITERIA AND RATIONALE

The Fraser River Sockeye forecast model selection process is an expert-driven process, which took place over a two day meeting in December 2022. Previously, forecast model selection was based on methods and results (model ranking from retrospective analysis) summarized in MacDonald and Grant (2012) in conjunction with the recent productivity trend. Recognition of relatively inaccurate forecast results from recent years (2015-2020) led to the update and revision of the retrospective analysis used for the model selection process and the addition of a new tool: Taylor Diagrams. Additionally, a set of new environmental covariates were incorporated into the existing biological models for assessment. Generally the model selection process follows the steps outlined below but deviations at the stock level can occur and are outlined in the text below.



1. **Step 1: Taylor diagram**: Candidate models for the total population and age-specific forecasts are presented on a Taylor diagram and demonstrate relative model performance graphically. The Taylor diagram comparatively demonstrates the differences between model and observation and among models in regard to three statistics: the Pearson correlation coefficient, the root-mean-square error (RMSE), and the standard deviation (SD). Generally, a model is desired and considered for further selection process when it shows relatively high correlation coefficient, low RMSE, and SD similar to the observation.

2. **Step 2: Ranking table**: Models are then ranked according to their relative performance on each of four performance measures: mean raw error (RME), mean absolute error (MAE), mean percent error (MPE) and RMSE (see Cass et al. 2006 for details). Ranks across the four performance measures are then averaged to generate an overall score and rank for each model evaluated. The previous retrospective analysis for the Fraser Sockeye forecast ranked model performance on returns from 1997-2004 (see Table 5 in MacDonald and Grant 2012) which means that the retrospective analysis was not considering model performance in more recent years when environmental conditions have changed. The updated retrospective analysis produces new model ranking tables based on the returns from the past three generations (2009-2020). The ranking tables are divided into all-year, cyclical year and other (non-cyclical year) categories in an age-specific manner. For cyclical stocks, rankings based on the cycle-line years are preferred.

3. **Step 3: Historical performance:** Performance of previously used forecast models in 2009-2020 is presented for each stock by comparing the estimates with actual returns in number and percentage for both age classes (age 4 & 5) and total population. The yearly deviation and overall correlation between the past forecast number and observation are reviewed. Performance of the historically top-ranked models is considered in addition to the tendency to over or under estimate returns in recent years which may result in the selection of alternate models.

4. **Step 4: Forecast and implied productivity**: The total and age-specific forecasts resulted from top-ranked models and their corresponding implied productivities are presented; they are compared with historical time-series of observed productivity (both raw and log scale). Since many stocks have shown lower-than-average productivities in recent generations, efforts are made to choose models that might capture the dynamics of these recent declines in productivity (i.e. using environmental covariates). In addition, models with new covariates are proposed but they are mainly used as reference for comparison.

Model choice rationales for individual stock

Early Stuart: RickerEi(4)Sibling(5)

Ricker models with environmental covariates performed strongly on the Taylor Diagram and the RickerEi model was the top ranked in the retrospective ranking table. However, the age-5 Taylor Diagram showed strong support for the performance of a sibling model for Early Stuart. The selection of a sibling model for forecasting age-5 Early Stuart sockeye was recommended due to the very strong return of age-4 Early Stuart sockeye in 2022 as a sibling model uses the productivity of the age-4 return in the previous year to predict age-5 returns.

Bowron: RickerPi

The forecast for Bowron is expected to be predominantly 5-year-old fish as the 2019 return to Bowron was significantly affected by the Big Bar landslide. Although the sibling model performed well on the Taylor diagram for Bowron, the RickerPi model was ranked higher on the retrospective ranking table for forecasting age-5 fish. Additionally, the difference in the forecast was only 500 fish and RickerPi has been a regularly selected model for this stock.

Upper Barriere/Fennell: RickerPi(4)/Sibling(5)

The sibling model performed reasonably well for age-5 fish based on the Taylor diagram but was ranked the highest in the retrospective ranking table and was therefore selected. Historically power models have been used to forecast but Upper Barriere/Fennell has consistently been overforecasted. In 2021, the Ricker model with the Pine Island sea surface temperature covariate was selected and was selected again for consistency.

Gates: LLY(4)/Sibling(5)

The sibling model performed reasonably well for Gates based on the Taylor diagram for age-5 fish and was ranked in the top three in the retrospective table. Recently, models have been overestimating returns for this population. The top performing model for forecasting the age-4 component of the Gates population was a like last year (LLY) and it was the top ranked in the retrospective ranking table. Although a LLY model had never been selected in the past, the

implied productivities for both ages were consistent with recent observations providing further support for the model.

Nadina: RickerCyc(4)/Sibling(5)

The sibling model demonstrated a high performance on the Taylor diagram for forecasting age-5 fish and it was the top ranked model in the retrospective ranking table for age 5. The Taylor diagram showed several similarly ranked models for forecasting age 4 fish so the retrospective ranking table was consulted. The highest ranked model in the retrospective ranking table for forecasting age-4 fish was a RickerCyc model and was therefore selected for this population. Many of the models for forecasting age 4 Nadina fish produced similar forecasts.

Upper Pitt: Larkin(4)/Sibling(5)

The sibling model demonstrated high performance on the Taylor diagram for forecasting age-5 fish and it was the top ranked model in the retrospective ranking table. However, the implied productivity for age-5 fish produced by the sibling model was quite high relative to other models. High productivity for age-5 fish has been observed in the last 3 generations however and a sibling model was selected. A basic Larkin model and a like last year (LLY) were both highly ranked in the Taylor diagram for forecasting age-4 fish. However, Larkin models had been used in previous years although they tended to overestimate returns slightly. The Larkin model was selected as the forecast generated by the LLY was overoptimistic.

Scotch: Larkin(4)/Sibling(5)

Based on the Taylor diagram, the sibling model performed well for forecasting age-5 returns and was selected. It was also highly ranked in the retrospective ranking table. Two Larkin models performed well for forecasting the age-4 component and produced similar forecasts. However, a basic Larkin model has been selected in the past and performed fairly well and was therefore selected again.

Seymour: RickerPi

The sibling model performed well for the age-5 forecast for Seymour sockeye but had a very high mean raw error and mean percent error leading to a lower than expected rank in the retrospective ranking table. The RickerPi model was the highest ranked for the total forecast in the retrospective ranking table and demonstrated reasonable implied productivity values for this stock.

Chilko: Larkin(4)/Sibling(5)

The sibling model performed well in both the Taylor Diagram and in the retrospective ranking table and was selected for forecasting the age-5 component for Chilko. The RickerCyc model was most highly ranked in the Taylor diagrams and in the retrospective ranking table for age-4 but the implied productivity was higher than had been seen in the last decade. The Larkin model was selected for forecasting the age4 component of the stock as the model is based on cycle line dynamics which would allow us to account for the effect of Big Bar and the implied productivity of the Larkin model is more aligned with recent observations for this stock.

Late Stuart: R1C(4)/Sibling(5)

Based on the Taylor diagram, sibling models performed well for forecasting age 5 returns and was selected for forecasting age-5 Late Stuart sockeye. Two naïve models were ranked highest for forecasting age-4 returns. The R1C and RS1 were both highly ranked on the Taylor Diagram and in the retrospective ranking tables. Although the RS1 performance was marginally better than the R1C, the R1C model had been chosen in the past to forecast Late Stuart sockey and was therefore preferred. The productivity for both models were below 10 which aligned with recent trends and the difference in the forecast for 4-year-olds was 6,000 fish.

Quesnel: RickerEi

Sibling models do not perform well for the age-5 component of Quesnel sockeye so we assessed the best performing model for the total forecast. New models that include Pacific salmon abundance covariates were the highest ranked available models in the retrospective ranking table, however they have yet to undergo review and be formally adopted into the forecast. The RickerEi model was ranked just below all of the top performing salmon abundance models and produced a similar forecast to the other highly ranked models. RickerEi has been commonly selected for Quesnel for several years and was selected again for consistency and due to its high ranking. However, the implied productivity of the forecast was quite high

Stellako: RickerEi(4)/Sibling(5)

The sibling model was selected for forecasting the age-5 component of Stellako as it was highly ranked in the Taylor Diagram and in the retrospective ranking table. Larkin models were highly ranked in both the Taylor Diagram and retrospective ranking table but have consistently overestimated this population. RickerEi and RickerCyc were also well ranked on the Taylor Diagram. Although the RickerCyc model performed slightly better in the retrospective ranking table, the productivity associated with an age 4 forecast from RickerEi aligned better with recent observations for this population.

Raft: LLY(4)/Sibling(5)

A sibling model was selected for forecasting age-5 fish due to its performance on the Taylor diagrams and highly ranked position in the retrospective ranking tables. The highest ranked model on the Taylor Diagram and in the retrospective ranking table for the age-4 component was a LLY (like last year) model and was therefore selected for the forecast.

Cultus: PowerJuvPi

A power juvenile model with a Pine Island SST covariate was selected as the top model for forecasting Cultus sockeye in 2023. It was the highest ranked of all of the peer reviewed models available and the forecast made sense given the issues for this particular brood year. Most models forecasted a median return of around 20-25 fish for the total population return. Although this population is enhanced, typical fry and smolt release strategies were not possible due to issues pertaining to the COVID-19 pandemic. The 2021 smolt year for the Cultus fence that enumerates smolts leaving the lake only counted approximately 450 smolts which was the lowest number on record. Additionally, EFS in 2019 was only 11 suggesting that the return would be quite low for 2023.

Late Shuswap: RickerPi(4)/Sibling(5)

The sibling model was ranked highly on both the Taylor Diagram and in the age specific retrospective ranking table for Late Shuswap. A RickerPi model was ranked highly for the total forecast as well as for the age-4-specific forecast. The total RickerPi was considered for the Late Shuswap complex due to its performance but the forecast was fairly optimistic. Given the lower than expected returns for Lower Shuswap in 2022, it was decided that the RickerPi for the age-4 and sibling for the age-5 components would best capture the unexpected low productivity observed in the 2018 brood year for the 4-year-old return in 2022.

Portage: RickerEi

The sibling model was not ranked well on the Taylor Diagram or in the retrospective ranking tables for age-5 so a total forecast model was selected. RickerEi and RickerPi were both highly ranked for Portage Sockeye but forecasts were quite similar between the two models. Historically, Larkin models have been selected and Portage sockeye have been consistently overestimated. Ultimately, a RickerEi model was selected as it was the best ranked model in the retrospective ranking table.

Weaver: RickerCyc(4)/Sibling(5)

Several Power models were most highly ranked for the total forecast of Weaver sockeye. However, the sibling model was the top ranked model in the age specific retrospective ranking table. The escapement of Weaver sockeye in 2022 was quite strong and therefore a sibling model was selected for forecasting the age 5 component to try and encompass the high productivity seen in the 2018 brood year in the 2023 forecast. Of the available peer reviewed models, a RickerCyc model was the most highly ranked for forecasting age-4 Weaver sockeye and was therefore selected.

Birkenhead: RickerPi(4)/Sibling(5)

The sibling model was ranked highly on both the Taylor Diagram and the age specific retrospective ranking table for the age-5 component of the Birkenhead sockeye forecast and was therefore selected. When considering the age-4 component of the forecast, several models were highly ranked. RickerPi was the most highly ranked model for the age-4 component and the implied productivity of the model was more aligned with recent observations than other models.

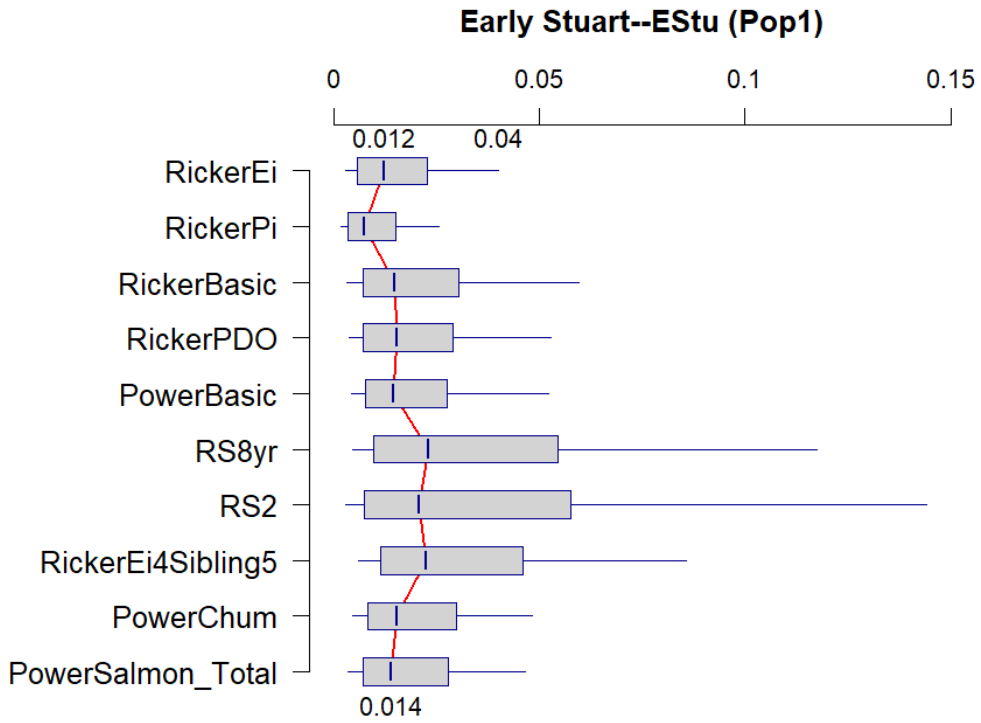
Harrison:TSA(3)/LLY(4)

Although substantial work has been done to develop biological models such as the Ricker odd and even models, when considering the data in the stock-recruit relationship it is clear that there is not a good basis to consider biological models for Harrison sockeye. Model options are limited for this population due to the inconsistent SR relationship and therefore we decided to rely on naïve models for this forecast. The time series average (TSA) model was selected for forecasting the age-3 component of Harrison sockeye as it was the most highly ranked in the age specific retrospective ranking table. The sibling model was most highly ranked in the age specific retrospective ranking table for age-4 but it ranked quite poorly for mean percent error. Therefore, a LLY model was selected for forecasting age-4 returns as it had the second highest rank.

APPENDIX C. INDIVIDUAL STOCK FORECAST SUMMARIES

Early Stuart

Forecast: All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
RickerEi	1	2,854	5,763	12,293	22,919	40,216
RickerPi	1	1,829	3,463	7,482	15,084	25,643
RickerBasic	3	3,276	7,101	14,813	30,460	59,553
RickerPDO	3	3,784	7,068	15,458	29,081	52,977
PowerBasic	7	4,370	7,795	14,593	27,750	52,254
RS8yr	16	4,551	9,832	23,138	54,448	117,621
RS2	19	3,029	7,562	20,895	57,736	144,119
RickerEiAge4.SiblingAge5	99	6,078	11,323	22,604	46,076	85,808
PowerChum	99	4,752	8,186	15,442	29,818	48,254
PowerSalmon_Total	99	3,568	7,058	13,858	27,949	46,654

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
RickerEi	1	80	126	206	356	558

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
RickerPi	1	57	89	157	258	410
RickerBasic	3	90	151	276	482	791
RickerPDO	3	115	190	319	553	842
PowerBasic	7	263	440	843	1,486	2,603
RS8yr	16	40	86	203	477	1,030
RS2	19	44	110	303	838	2,092
RickerEiAge4.SiblingAge5	99	80	126	206	356	558
PowerChum	99	320	519	831	1,326	1,949
PowerSalmon_Total	99	97	147	252	441	674

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
RickerEi	1	2,775	5,637	12,087	22,563	39,658
RickerPi	1	1,772	3,374	7,325	14,826	25,233
RickerBasic	3	3,186	6,950	14,537	29,978	58,762
RickerPDO	3	3,669	6,877	15,139	28,528	52,135
PowerBasic	7	4,107	7,355	13,750	26,264	49,651
RS8yr	16	4,512	9,746	22,935	53,971	116,591
RS2	19	2,985	7,452	20,592	56,898	142,027
RickerEiAge4.SiblingAge5	99	5,999	11,197	22,398	45,720	85,250
PowerChum	99	4,432	7,667	14,611	28,491	46,305
PowerSalmon_Total	99	3,471	6,911	13,606	27,508	45,980

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
RickerEi	1	1.85	3.00	5.05	8.79	14.00
RickerPi	1	1.32	2.09	3.75	6.31	10.08
RickerBasic	3	2.09	3.60	6.67	11.87	19.96
RickerPDO	3	2.65	4.44	7.63	13.36	20.76
PowerBasic	7	5.85	9.86	18.94	33.54	59.01
RS8yr	16	1.08	2.33	5.47	12.88	27.82
RS2	19	1.10	2.73	7.55	20.87	52.10
RickerEiAge4.SiblingAge5	99	2.01	3.26	5.53	9.87	16.11
PowerChum	99	7.12	11.62	18.74	30.18	44.60
PowerSalmon_Total	99	2.24	3.52	6.11	10.87	16.82

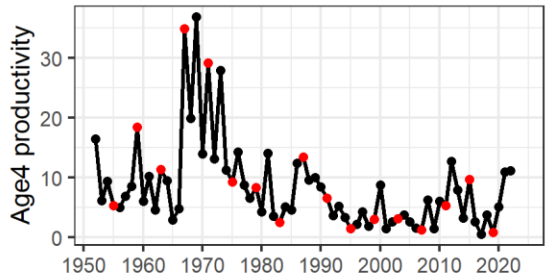
Age4Prod

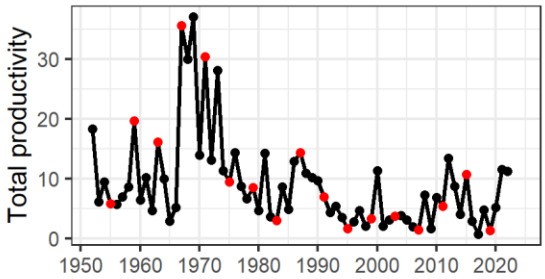
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
RickerEi	1	1.73	2.74	4.48	7.74	12.13
RickerPi	1	1.25	1.94	3.41	5.61	8.91
RickerBasic	3	1.96	3.28	6.00	10.48	17.20
RickerPDO	3	2.50	4.14	6.93	12.02	18.29
PowerBasic	7	5.71	9.56	18.32	32.30	56.60
RS8yr	16	0.87	1.87	4.40	10.36	22.39
RS2	19	0.96	2.39	6.59	18.22	45.48
RickerEiAge4.SiblingAge5	99	1.73	2.74	4.48	7.74	12.13
PowerChum	99	6.96	11.28	18.06	28.84	42.38
PowerSalmon_Total	99	2.10	3.20	5.48	9.58	14.66

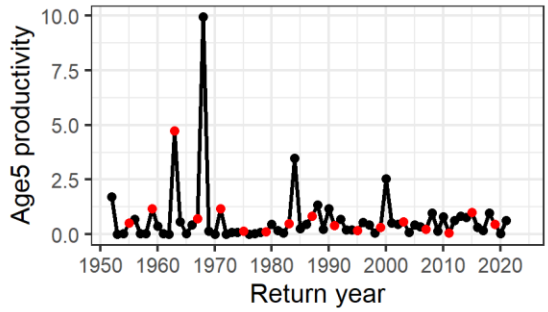
Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
RickerEi	1	0.12	0.26	0.56	1.05	1.87
RickerPi	1	0.07	0.15	0.34	0.70	1.17
RickerBasic	3	0.13	0.32	0.67	1.40	2.76
RickerPDO	3	0.15	0.30	0.70	1.33	2.46
PowerBasic	7	0.14	0.30	0.62	1.23	2.42
RS8yr	16	0.21	0.45	1.07	2.52	5.44
RS2	19	0.14	0.35	0.96	2.65	6.62
RickerEiAge4.SiblingAge5	99	0.28	0.52	1.04	2.13	3.97
PowerChum	99	0.16	0.34	0.68	1.34	2.22
PowerSalmon_Total	99	0.14	0.32	0.63	1.29	2.17

RawProd





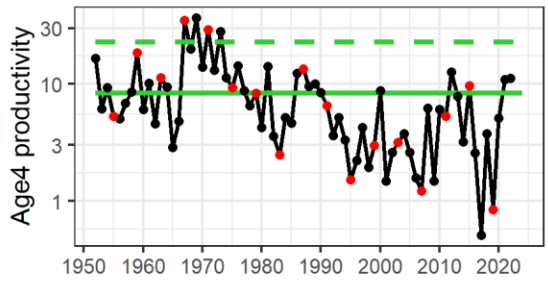


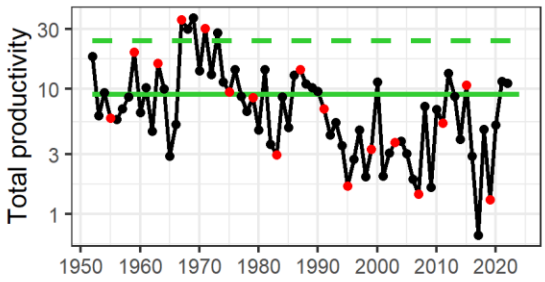
Early Stuart

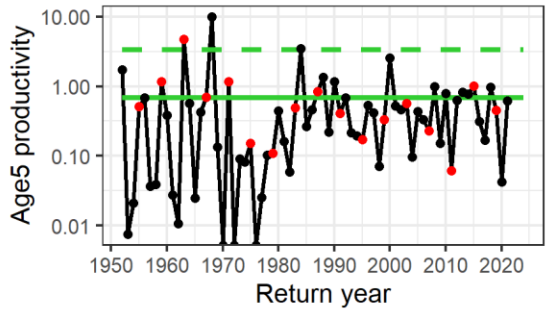
Brood_Year	Eff
2018	21450
2019	46

		Mean_run_size
1	All Years	268376
2	Cyc Years	148381

logProd







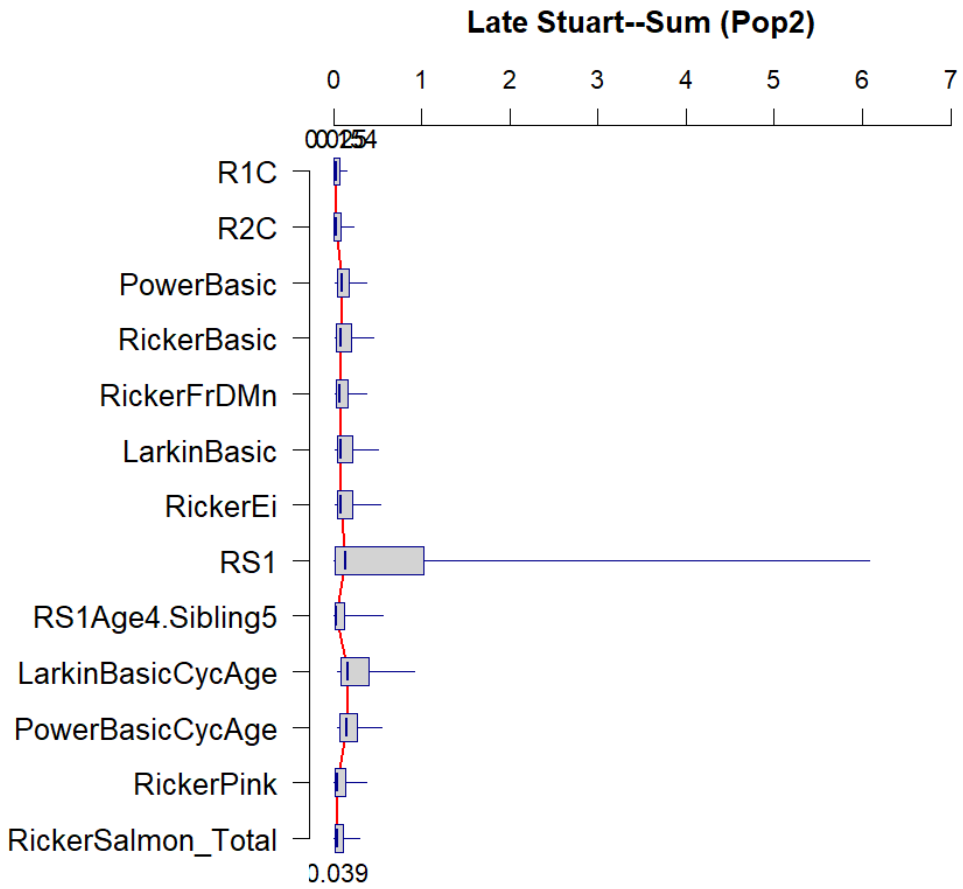
Early Stuart

Brood_Year	Eff
2018	21450
2019	46

		Mean_run_size
1	All Years	268376
2	Cyc Years	148381

Late Stuart

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
R1C	1	3,925	9,358	24,568	64,501	153,763
R2C	2	4,298	11,059	31,605	90,321	232,398
PowerBasic	3	22,143	42,680	90,678	178,384	369,211
RickerBasic	3	17,175	34,344	82,866	208,358	450,713
RickerFRDMean	5	13,755	29,949	75,499	158,353	376,395
LarkinBasic	8	17,548	39,590	88,271	209,726	505,570
RickerEi	12	15,443	38,561	87,530	215,083	530,042
RS1	18	3,203	19,147	139,593	1,017,713	6,083,268
RS1Age4.SiblingAge5	99	6,879	13,128	32,386	120,901	563,826
LarkinBasicCycAge	99	38,533	79,421	163,926	396,177	917,390
PowerBasicCycAge	99	40,236	73,586	144,438	275,449	552,767
RickerPink	99	6,882	14,444	44,208	142,264	371,952

Model	Old.Rank	p10	p25	p50	p75	p90
RickerSalmon_Total	99	5,291	13,938	38,768	111,938	296,401

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
R1C	1	2,912	6,942	18,225	47,847	114,062
R2C	2	3,188	8,204	23,445	67,000	172,393
PowerBasic	3	8,182	18,428	42,177	94,472	185,133
RickerBasic	3	4,903	10,164	24,629	59,271	127,815
RickerFRDMean	5	3,980	9,042	21,856	53,791	121,708
LarkinBasic	8	4,382	10,240	25,119	61,143	129,738
RickerEi	12	4,161	9,633	25,683	62,994	148,632
RS1	18	262	1,568	11,430	83,334	498,120
RS1Age4.SiblingAge5	99	262	1,568	11,430	83,334	498,120
LarkinBasicCycAge	99	3,618	8,859	21,359	51,277	106,111
PowerBasicCycAge	99	7,034	15,022	35,670	81,337	157,135
RickerPink	99	595	1,670	4,472	11,157	23,467
RickerSalmon_Total	99	689	1,838	4,810	12,365	30,811

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
R1C	1	1,014	2,416	6,343	16,654	39,701
R2C	2	1,110	2,855	8,160	23,321	60,005
PowerBasic	3	13,962	24,252	48,500	83,912	184,078
RickerBasic	3	12,272	24,180	58,237	149,087	322,898
RickerFRDMean	5	9,775	20,907	53,643	104,562	254,686
LarkinBasic	8	13,166	29,350	63,152	148,583	375,832
RickerEi	12	11,281	28,928	61,847	152,090	381,410
RS1	18	2,941	17,579	128,163	934,379	5,585,148
RS1Age4.SiblingAge5	99	6,616	11,560	20,955	37,567	65,707
LarkinBasicCycAge	99	34,916	70,562	142,567	344,900	811,279
PowerBasicCycAge	99	33,203	58,565	108,768	194,112	395,632
RickerPink	99	6,287	12,774	39,736	131,107	348,485
RickerSalmon_Total	99	4,602	12,099	33,958	99,573	265,590

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
R1C	1	0.97	2.32	6.08	15.96	38.05
R2C	2	1.06	2.74	7.82	22.35	57.50
PowerBasic	3	2.70	6.11	14.12	32.06	63.41
RickerBasic	3	1.63	3.44	8.54	21.26	46.89
RickerFRDMean	5	1.32	3.03	7.53	18.98	43.46
LarkinBasic	8	1.46	3.47	8.74	21.96	48.60
RickerEi	12	1.38	3.25	8.87	22.56	54.81
RS1	18	0.13	0.78	5.65	41.22	246.39
RS1Age4.SiblingAge5	99	1.05	2.45	6.30	16.27	38.43
LarkinBasicCycAge	99	1.42	3.56	8.75	21.59	47.55
PowerBasicCycAge	99	2.49	5.32	12.74	29.32	58.53
RickerPink	99	0.21	0.64	1.92	5.55	12.93
RickerSalmon_Total	99	0.24	0.68	1.95	5.51	14.15

Age4Prod

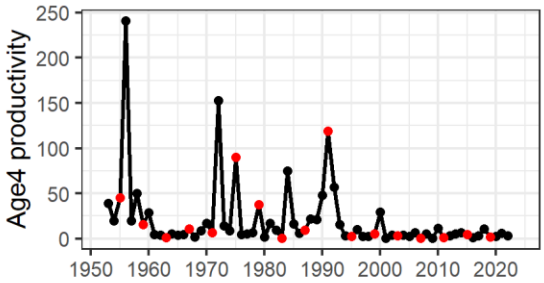
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
R1C	1	0.96	2.28	5.99	15.71	37.46
R2C	2	1.05	2.69	7.70	22.00	56.62
PowerBasic	3	2.69	6.05	13.85	31.03	60.80
RickerBasic	3	1.61	3.34	8.09	19.47	41.98
RickerFRDMean	5	1.31	2.97	7.18	17.67	39.97
LarkinBasic	8	1.44	3.36	8.25	20.08	42.61
RickerEi	12	1.37	3.16	8.43	20.69	48.81
RS1	18	0.09	0.51	3.75	27.37	163.59
RS1Age4.SiblingAge5	99	0.09	0.51	3.75	27.37	163.59
LarkinBasicCycAge	99	1.19	2.91	7.01	16.84	34.85

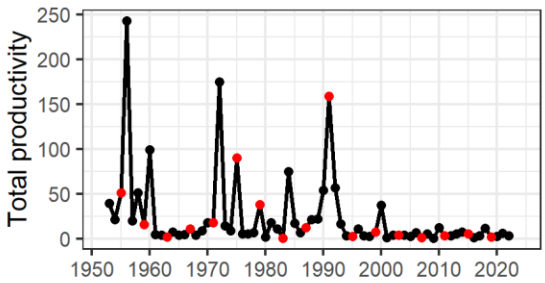
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
PowerBasicCycAge	99	2.31	4.93	11.71	26.71	51.60
RickerPink	99	0.20	0.55	1.47	3.66	7.71
RickerSalmon_Total	99	0.23	0.60	1.58	4.06	10.12

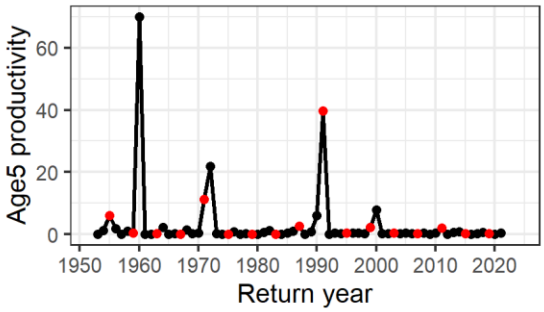
Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
R1C	1	0.02	0.04	0.09	0.25	0.59
R2C	2	0.02	0.04	0.12	0.35	0.89
PowerBasic	3	0.01	0.06	0.27	1.03	2.61
RickerBasic	3	0.02	0.10	0.45	1.79	4.91
RickerFRDMean	5	0.01	0.06	0.36	1.32	3.49
LarkinBasic	8	0.02	0.10	0.49	1.88	6.00
RickerEi	12	0.01	0.09	0.43	1.87	6.00
RS1	18	0.04	0.26	1.90	13.85	82.81
RS1Age4.SiblingAge5	99	0.10	0.17	0.31	0.56	0.97
LarkinBasicCycAge	99	0.23	0.65	1.74	4.75	12.70
PowerBasicCycAge	99	0.18	0.38	1.03	2.61	6.93
RickerPink	99	0.01	0.09	0.45	1.89	5.22
RickerSalmon_Total	99	0.01	0.08	0.37	1.45	4.03

RawProd





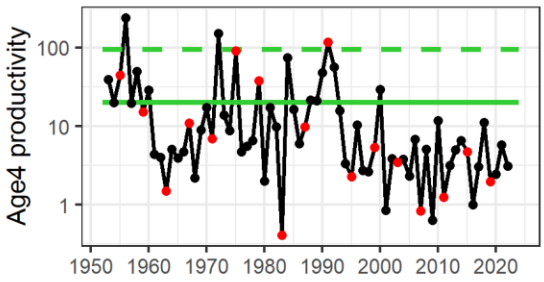


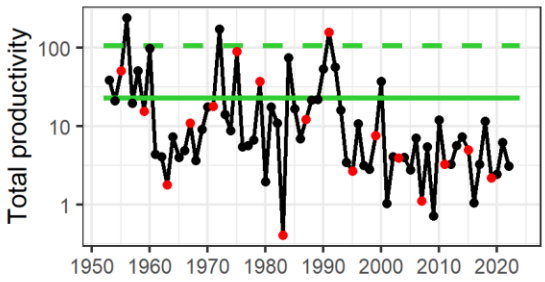
Late Stuart

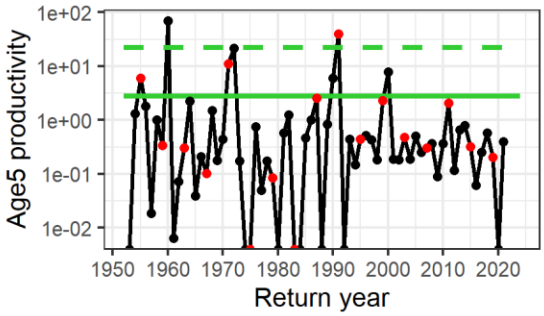
Brood_Year	Eff
2018	67449
2019	3045

		Mean_run_size
1	All Years	481075
2	Cyc Years	74030

logProd







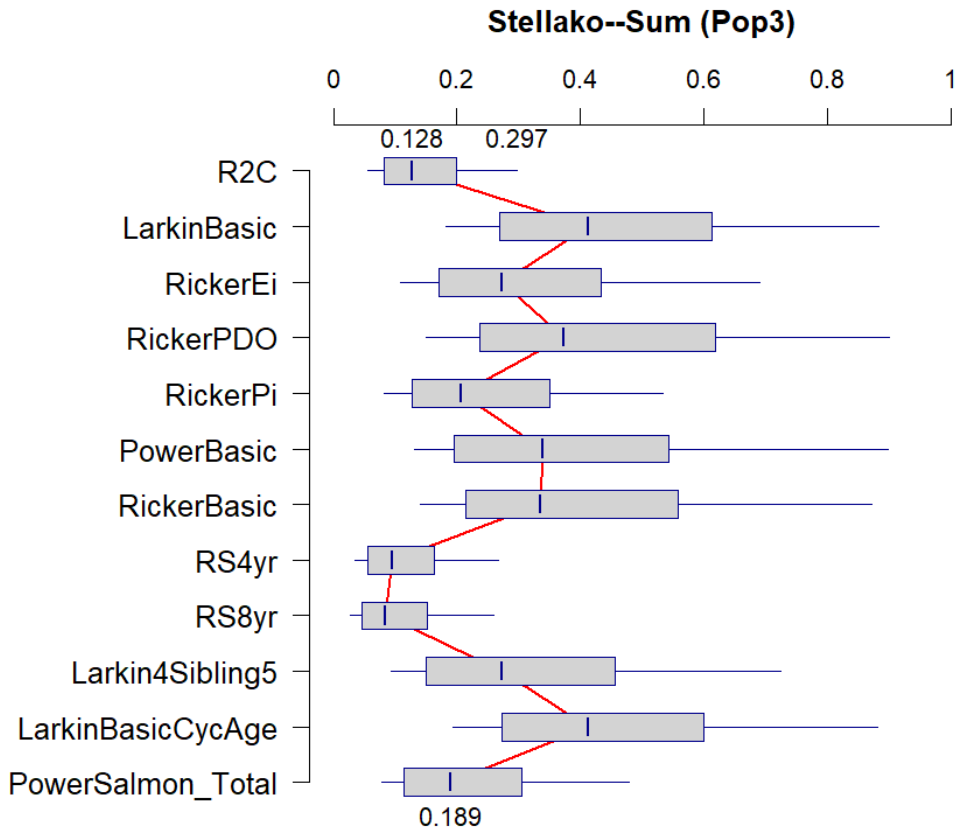
Late Stuart

Brood_Year	Eff
2018	67449
2019	3045

		Mean_run_size
1	All Years	481075
2	Cyc Years	74030

Stellako

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
R2C	1	55,359	82,386	128,144	199,318	296,629
LarkinBasic	2	181,420	268,834	413,005	612,314	883,338
RickerEi	3	107,622	170,851	273,021	433,539	690,248
RickerPDO	4	150,012	237,285	373,419	618,533	901,158
RickerPi	6	82,259	127,528	206,371	351,215	533,148
PowerBasic	8	130,691	196,238	338,783	544,024	899,592

Model	Old.Rank	p10	p25	p50	p75	p90
RickerBasic	8	140,749	215,199	335,500	557,642	872,679
RS4yr	15	33,772	55,078	94,841	163,310	266,340
RS8yr	17	27,190	46,421	84,106	152,384	260,166
LarkinBasicAge4.SiblingAge5	99	92,786	149,622	272,331	457,060	725,608
LarkinBasicCycAge	99	192,798	272,851	412,335	600,524	881,332
PowerSalmon_Total	99	77,727	114,633	188,834	304,495	479,852

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
R2C	1	43,152	64,220	99,889	155,369	231,224
LarkinBasic	2	79,284	127,836	235,794	394,452	626,581
RickerEi	3	37,322	64,803	120,093	225,519	376,485
RickerPDO	4	56,173	104,194	203,069	362,940	631,706
RickerPi	6	35,567	58,556	107,675	200,923	364,828
PowerBasic	8	56,804	97,043	176,888	346,839	622,546
RickerBasic	8	53,768	96,676	186,808	325,534	563,695
RS4yr	15	17,509	28,556	49,172	84,670	138,088
RS8yr	17	13,434	22,936	41,556	75,292	128,546
LarkinBasicAge4.SiblingAge5	99	79,284	127,836	235,794	394,452	626,581
LarkinBasicCycAge	99	78,876	133,259	235,701	406,187	645,730

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
PowerSalmon_Total	99	19,725	35,139	61,839	111,719	187,145

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
R2C	1	12,206	18,166	28,255	43,949	65,405
LarkinBasic	2	102,136	140,998	177,211	217,862	256,757
RickerEi	3	70,300	106,048	152,927	208,020	313,764
RickerPDO	4	93,839	133,091	170,350	255,593	269,452
RickerPi	6	46,692	68,972	98,696	150,293	168,320
PowerBasic	8	73,887	99,195	161,894	197,185	277,046
RickerBasic	8	86,981	118,523	148,693	232,108	308,984
RS4yr	15	16,262	26,522	45,669	78,640	128,252
RS8yr	17	13,755	23,485	42,550	77,092	131,620
LarkinBasicAge4.SiblingAge5	99	13,501	21,786	36,537	62,608	99,027
LarkinBasicCycAge	99	113,921	139,593	176,634	194,338	235,602
PowerSalmon_Total	99	58,002	79,494	126,995	192,776	292,707

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
R2C	1	1.74	2.59	4.03	6.27	9.33
LarkinBasic	2	3.26	5.34	9.97	17.19	27.77
RickerEi	3	1.63	2.90	5.51	10.51	18.14
RickerPDO	4	2.32	4.40	8.75	15.99	28.44
RickerPi	6	1.46	2.49	4.66	8.92	16.27
PowerBasic	8	2.31	4.03	7.52	14.93	27.17

Model	Old.Rank	p10	p25	p50	p75	p90
RickerBasic	8	2.23	4.08	8.03	14.27	25.32
RS4yr	15	0.82	1.34	2.32	3.99	6.50
RS8yr	17	0.65	1.10	2.00	3.62	6.18
LarkinBasicAge4.SiblingAge5	99	3.47	5.60	10.19	17.10	27.15
LarkinBasicCycAge	99	3.41	5.70	10.04	17.35	27.85
PowerSalmon_Total	99	0.94	1.78	3.31	6.24	10.89

Age4Prod

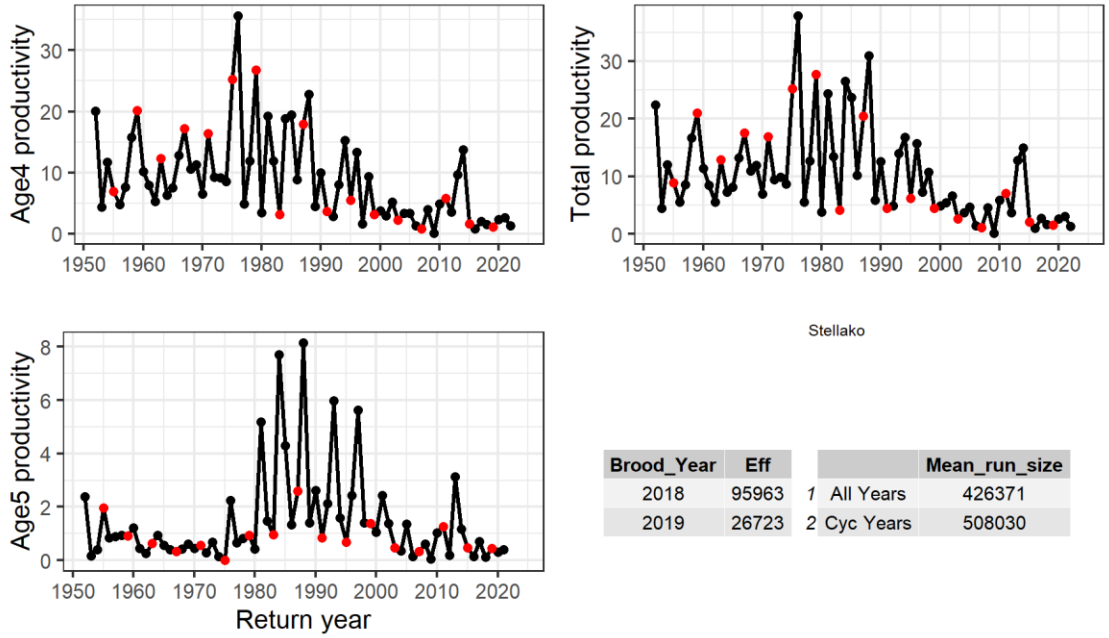
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
R2C	1	1.61	2.40	3.74	5.81	8.65
LarkinBasic	2	2.97	4.78	8.82	14.76	23.45
RickerEi	3	1.40	2.43	4.49	8.44	14.09
RickerPDO	4	2.10	3.90	7.60	13.58	23.64
RickerPi	6	1.33	2.19	4.03	7.52	13.65
PowerBasic	8	2.13	3.63	6.62	12.98	23.30
RickerBasic	8	2.01	3.62	6.99	12.18	21.09
RS4yr	15	0.66	1.07	1.84	3.17	5.17
RS8yr	17	0.50	0.86	1.56	2.82	4.81
LarkinBasicAge4.SiblingAge5	99	2.97	4.78	8.82	14.76	23.45
LarkinBasicCycAge	99	2.95	4.99	8.82	15.20	24.16
PowerSalmon_Total	99	0.74	1.31	2.31	4.18	7.00

Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
R2C	1	0.13	0.19	0.29	0.46	0.68
LarkinBasic	2	0.29	0.56	1.15	2.43	4.32
RickerEi	3	0.23	0.48	1.01	2.07	4.05
RickerPDO	4	0.22	0.50	1.15	2.40	4.81
RickerPi	6	0.13	0.30	0.63	1.40	2.62
PowerBasic	8	0.19	0.40	0.90	1.95	3.87
RickerBasic	8	0.22	0.46	1.04	2.08	4.23
RS4yr	15	0.17	0.28	0.48	0.82	1.34
RS8yr	17	0.14	0.24	0.44	0.80	1.37
LarkinBasicAge4.SiblingAge5	99	0.51	0.82	1.37	2.34	3.71

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasicCycAge	99	0.46	0.71	1.22	2.15	3.68
PowerSalmon_Total	99	0.20	0.46	1.00	2.06	3.89

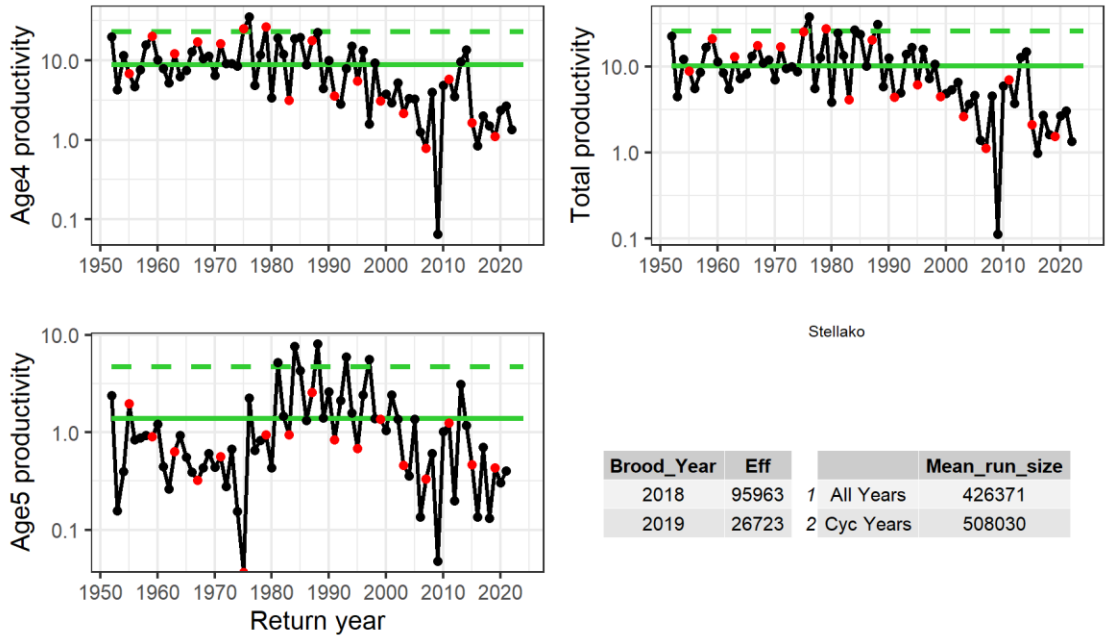
RawProd



Brood_Year	Eff
2018	95963
2019	26723

		Mean_run_size
1	All Years	426371
2	Cyc Years	508030

logProd

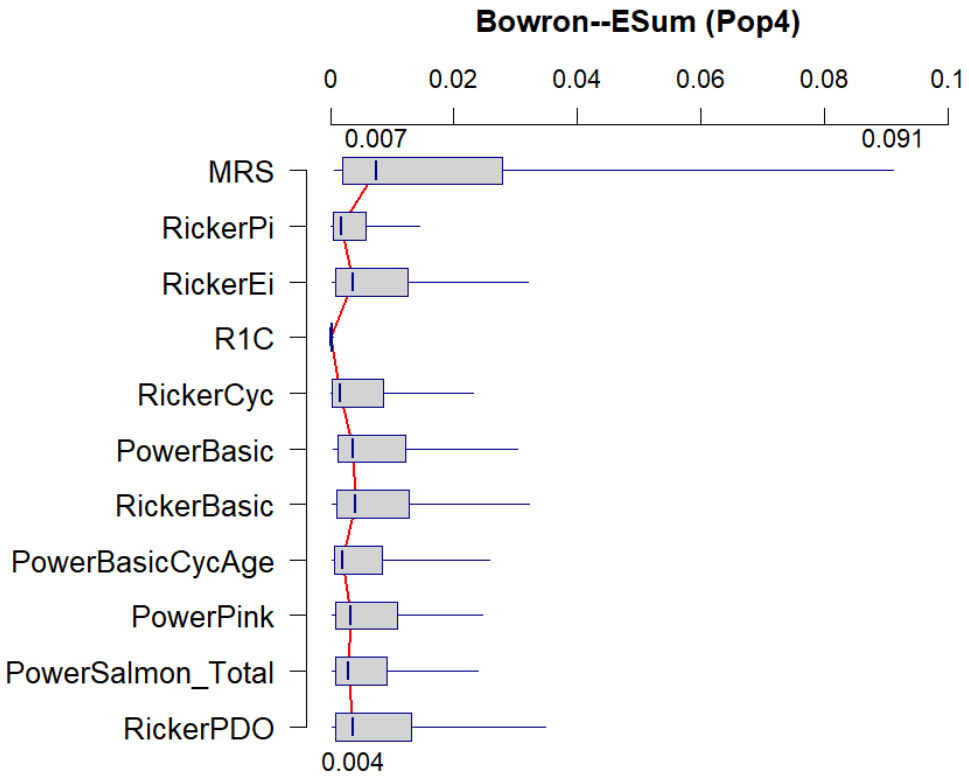


Brood_Year	Eff
2018	95963
2019	26723

		Mean_run_size
1	All Years	426371
2	Cyc Years	508030

Bowron

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
MRS	1	608	1,993	7,450	27,848	91,233
RickerPi	2	112	412	1,713	5,704	14,520
RickerEi	3	180	832	3,607	12,478	32,020
R1C	6	10	26	72	199	495
RickerCyc	7	62	321	1,607	8,489	23,079
PowerBasic	11	470	1,125	3,571	12,183	30,371
RickerBasic	11	245	949	3,950	12,727	32,234
PowerBasicCycAge	99	198	549	2,006	8,328	25,784
PowerPink	99	259	769	3,276	10,834	24,717
PowerSalmon_Total	99	294	836	2,913	9,122	23,812
RickerPDO	99	246	810	3,578	13,032	34,808

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
MRS	1	8	25	95	355	1,165
RickerPi	2	7	15	34	69	124
RickerEi	3	10	22	51	116	225
R1C	6	9	23	62	172	428
RickerCyc	7	5	13	39	105	295
PowerBasic	11	37	88	211	491	1,053
RickerBasic	11	11	22	52	118	237
PowerBasicCycAge	99	39	85	219	520	1,190
PowerPink	99	20	40	98	218	412
PowerSalmon_Total	99	27	62	135	311	560
RickerPDO	99	13	28	65	143	307

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
MRS	1	601	1,968	7,355	27,492	90,068
RickerPi	2	106	397	1,680	5,635	14,396
RickerEi	3	170	810	3,557	12,362	31,795
R1C	6	1	4	10	27	67
RickerCyc	7	58	309	1,569	8,384	22,784
PowerBasic	11	433	1,037	3,360	11,692	29,318
RickerBasic	11	234	927	3,898	12,608	31,996
PowerBasicCycAge	99	158	464	1,786	7,808	24,595
PowerPink	99	239	729	3,177	10,616	24,306
PowerSalmon_Total	99	266	774	2,778	8,811	23,253
RickerPDO	99	234	783	3,513	12,889	34,500

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
MRS	1	0.90	2.95	11.03	41.22	135.05
RickerPi	2	0.70	1.60	3.71	8.05	15.39
RickerEi	3	0.97	2.38	5.79	14.13	29.10
R1C	6	0.90	2.25	6.22	17.17	42.81
RickerCyc	7	0.45	1.31	4.17	12.24	34.17
PowerBasic	11	3.70	8.89	21.70	51.56	111.54
RickerBasic	11	1.12	2.39	6.02	14.45	30.39

Model	Old.Rank	p10	p25	p50	p75	p90
PowerBasicCycAge	99	3.94	8.49	22.19	53.64	124.26
PowerPink	99	1.97	4.06	10.46	24.03	46.19
PowerSalmon_Total	99	2.75	6.30	14.09	32.98	60.89
RickerPDO	99	1.31	2.90	7.24	17.00	37.92

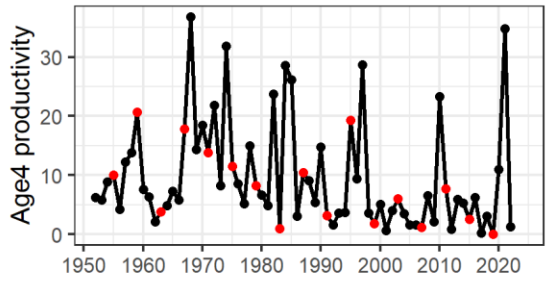
Age4Prod

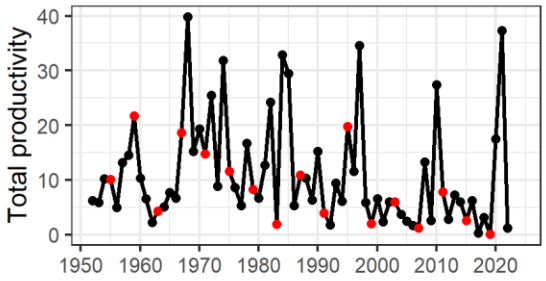
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
MRS	1	0.78	2.54	9.51	35.55	116.46
RickerPi	2	0.69	1.52	3.36	6.89	12.39
RickerEi	3	0.96	2.23	5.07	11.57	22.50
R1C	6	0.90	2.25	6.22	17.16	42.80
RickerCyc	7	0.45	1.29	3.88	10.52	29.50
PowerBasic	11	3.68	8.76	21.08	49.14	105.31
RickerBasic	11	1.10	2.22	5.23	11.84	23.74
PowerBasicCycAge	99	3.94	8.47	21.95	52.02	118.99
PowerPink	99	1.96	3.95	9.84	21.81	41.16
PowerSalmon_Total	99	2.73	6.19	13.53	31.14	55.98
RickerPDO	99	1.29	2.76	6.53	14.34	30.74

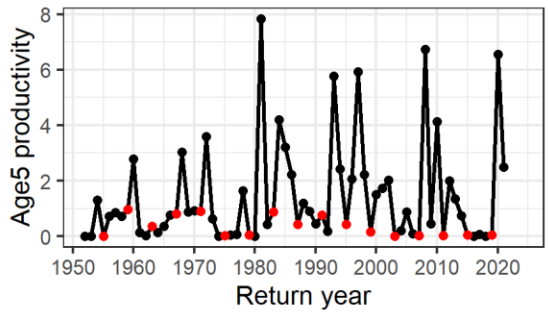
Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
MRS	1	0.12	0.41	1.52	5.67	18.59
RickerPi	2	0.01	0.07	0.34	1.16	2.99
RickerEi	3	0.01	0.14	0.72	2.56	6.60
R1C	6	0.00	0.00	0.00	0.01	0.01
RickerCyc	7	0.00	0.03	0.29	1.72	4.67
PowerBasic	11	0.02	0.13	0.62	2.41	6.24
RickerBasic	11	0.02	0.17	0.79	2.61	6.65
PowerBasicCycAge	99	0.00	0.02	0.24	1.62	5.27
PowerPink	99	0.02	0.11	0.62	2.22	5.03
PowerSalmon_Total	99	0.02	0.11	0.55	1.85	4.90
RickerPDO	99	0.02	0.14	0.71	2.66	7.18

RawProd





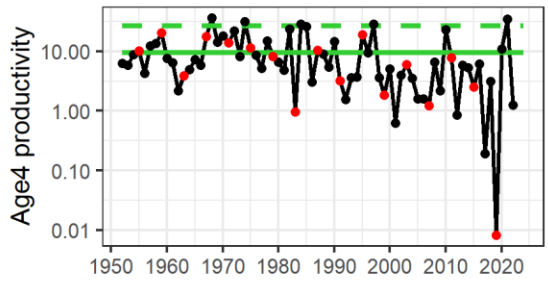


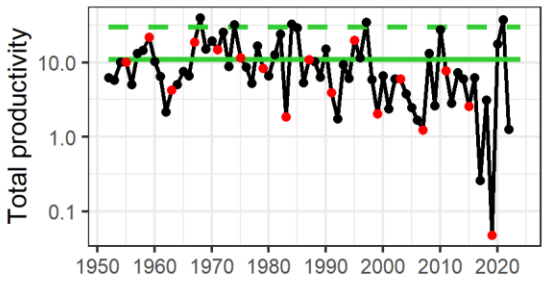
Bowron

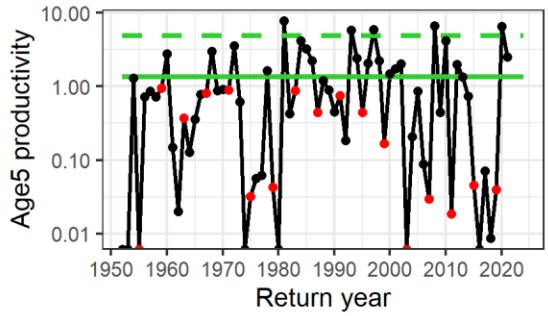
Brood_Year	Eff
2018	4846
2019	10

		Mean_run_size
1	All Years	33681
2	Cyc Years	66681

logProd







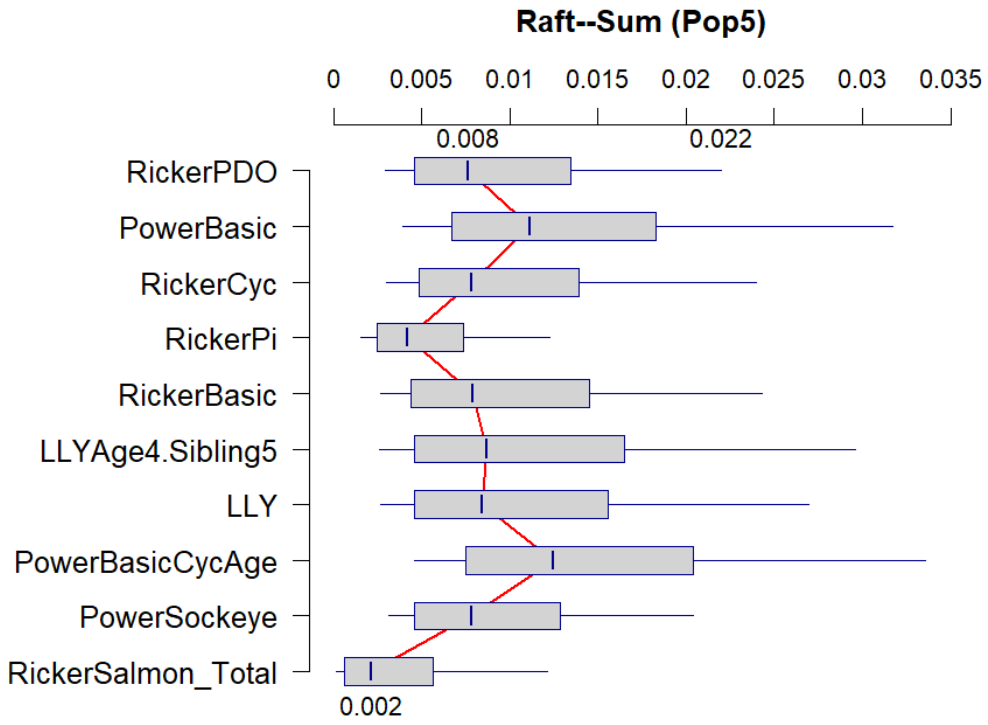
Bowron

Brood_Year	Eff
2018	4846
2019	10

		Mean_run_size
1	All Years	33681
2	Cyc Years	66681

Raft

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
RickerPDO	1	2,922	4,615	7,642	13,444	21,964
PowerBasic	2	3,928	6,681	11,157	18,256	31,744
RickerCyc	2	3,014	4,877	7,863	13,897	23,979
RickerPi	4	1,534	2,454	4,203	7,385	12,261
RickerBasic	7	2,660	4,401	7,906	14,489	24,316
LLYAge4.SiblingAge5	99	2,601	4,611	8,663	16,526	29,598
LLY	99	2,655	4,597	8,460	15,568	26,955
PowerBasicCycAge	99	4,607	7,485	12,439	20,427	33,578
PowerSockeye	99	3,135	4,595	7,827	12,881	20,434
RickerSalmon_Total	99	180	587	2,108	5,671	12,126

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
RickerPDO	1	625	1,182	2,383	4,635	8,454
PowerBasic	2	1,038	2,078	4,052	7,913	14,349
RickerCyc	2	244	543	1,381	3,241	7,913
RickerPi	4	314	620	1,174	2,366	4,243
RickerBasic	7	495	945	1,998	4,109	7,731
LLYAge4.SiblingAge5	99	1,747	3,025	5,567	10,244	17,737
LLY	99	1,747	3,025	5,567	10,244	17,737
PowerBasicCycAge	99	840	1,678	3,293	6,731	12,289
PowerSockeye	99	788	1,390	2,772	5,051	9,200
RickerSalmon_Total	99	11	44	192	689	2,042

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
RickerPDO	1	2,297	3,433	5,259	8,808	13,509
PowerBasic	2	2,890	4,603	7,105	10,343	17,396
RickerCyc	2	2,771	4,334	6,481	10,656	16,066
RickerPi	4	1,220	1,834	3,029	5,019	8,019
RickerBasic	7	2,165	3,456	5,908	10,379	16,585
LLYAge4.SiblingAge5	99	854	1,586	3,097	6,282	11,861
LLY	99	908	1,572	2,893	5,324	9,218
PowerBasicCycAge	99	3,767	5,807	9,145	13,697	21,289
PowerSockeye	99	2,347	3,205	5,055	7,829	11,235
RickerSalmon_Total	99	169	542	1,917	4,982	10,084

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
RickerPDO	1	2.14	4.23	8.84	17.46	32.61
PowerBasic	2	3.32	6.86	13.66	27.74	51.53
RickerCyc	2	1.48	3.01	6.74	14.53	31.59
RickerPi	4	1.10	2.30	4.56	9.41	16.95
RickerBasic	7	1.78	3.63	7.87	16.96	32.06
LLYAge4.SiblingAge5	99	5.31	9.26	17.14	31.88	55.75
LLY	99	5.34	9.25	17.03	31.33	54.25
PowerBasicCycAge	99	3.20	6.44	12.87	26.23	48.60

Model	Old.Rank	p10	p25	p50	p75	p90
PowerSockeye	99	2.58	4.70	9.71	18.18	33.94
RickerSalmon_Total	99	0.06	0.27	1.25	4.35	12.01

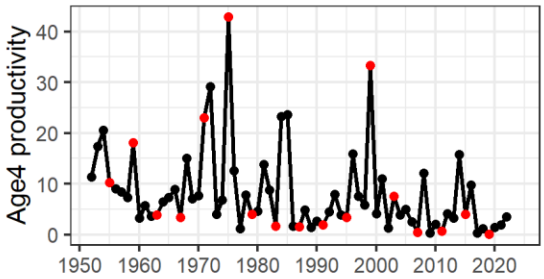
Age4Prod

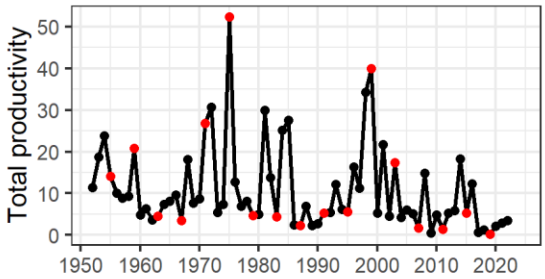
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
RickerPDO	1	1.73	3.27	6.58	12.81	23.35
PowerBasic	2	2.87	5.74	11.19	21.86	39.64
RickerCyc	2	0.67	1.50	3.82	8.95	21.86
RickerPi	4	0.87	1.71	3.24	6.54	11.72
RickerBasic	7	1.37	2.61	5.52	11.35	21.36
LLYAge4.SiblingAge5	99	4.83	8.36	15.38	28.30	49.00
LLY	99	4.83	8.36	15.38	28.30	49.00
PowerBasicCycAge	99	2.32	4.63	9.10	18.59	33.95
PowerSockeye	99	2.18	3.84	7.66	13.95	25.41
RickerSalmon_Total	99	0.03	0.12	0.53	1.90	5.64

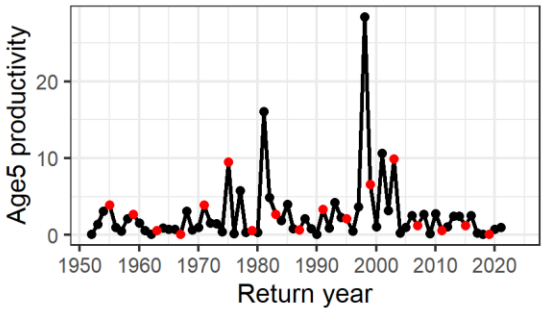
Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
RickerPDO	1	0.41	0.97	2.25	4.66	9.25
PowerBasic	2	0.45	1.11	2.47	5.88	11.90
RickerCyc	2	0.81	1.51	2.93	5.58	9.73
RickerPi	4	0.23	0.59	1.31	2.88	5.23
RickerBasic	7	0.42	1.02	2.35	5.61	10.70
LLYAge4.SiblingAge5	99	0.49	0.90	1.76	3.58	6.75
LLY	99	0.52	0.90	1.65	3.03	5.25
PowerBasicCycAge	99	0.88	1.80	3.77	7.64	14.65
PowerSockeye	99	0.40	0.86	2.05	4.23	8.53
RickerSalmon_Total	99	0.03	0.15	0.72	2.45	6.37

RawProd



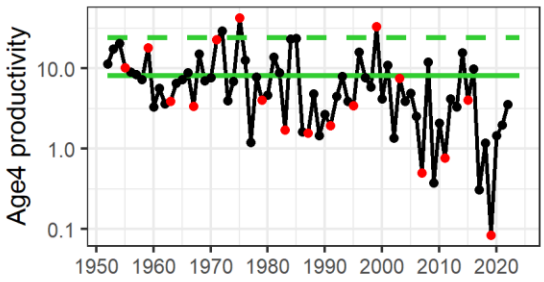


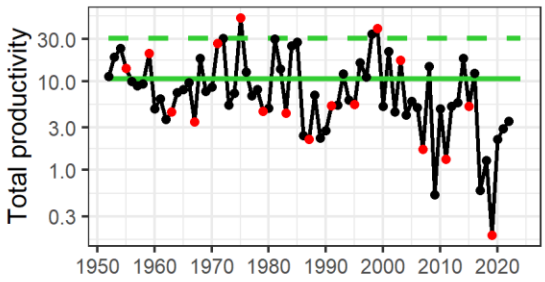


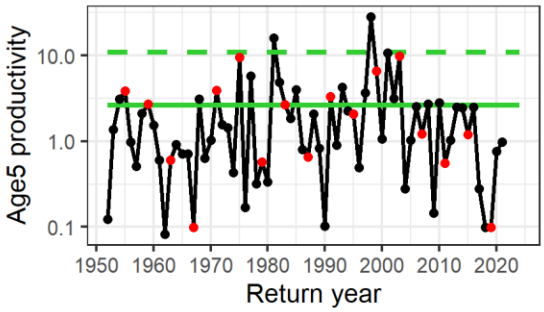
Raft

Brood_Year	Eff		Mean_run_size
2018	1756	*1* All Years	29085
2019	362	*2* Cyc Years	18429

logProd





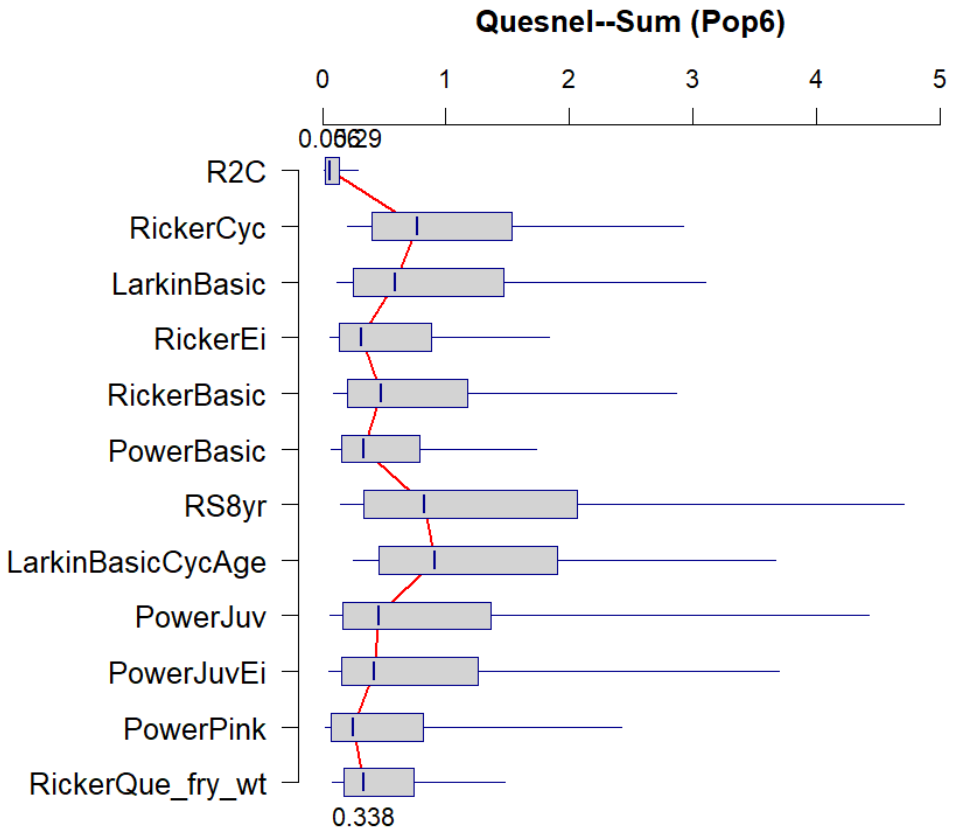


Raft

Brood_Year	Eff		Mean_run_size
2018	1756	*1* All Years	29085
2019	362	*2* Cyc Years	18429

Quesnel

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
R2C	2	10,818	23,582	56,050	133,225	290,406
RickerCyc	3	197,642	399,876	765,255	1,531,652	2,922,255
LarkinBasic	4	113,681	250,951	589,011	1,467,974	3,103,084
RickerEi	5	62,807	136,721	319,458	882,342	1,836,192
RickerBasic	6	92,310	197,607	474,898	1,177,892	2,866,293
PowerBasic	8	65,967	154,935	336,678	791,830	1,729,830
RS8yr	15	144,903	330,492	826,067	2,064,763	4,709,251
LarkinBasicCycAge	99	248,304	457,494	907,536	1,899,440	3,669,488
PowerJuv	99	58,692	167,384	454,087	1,360,232	4,424,594
PowerJuvEi	99	53,025	153,688	422,274	1,256,428	3,703,764
PowerPink	99	24,454	70,077	248,246	814,177	2,419,619

Model	Old.Rank	p10	p25	p50	p75	p90
RickerQue_fry_wt	99	82,469	174,680	337,731	740,168	1,481,917

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
R2C	2	6,617	14,424	34,283	81,487	177,626
RickerCyc	3	15,975	37,103	107,942	295,280	697,917
LarkinBasic	4	25,475	55,428	129,297	273,662	522,810
RickerEi	5	15,583	32,470	72,514	155,454	354,640
RickerBasic	6	18,408	41,979	103,967	226,448	493,245
PowerBasic	8	17,707	36,734	80,313	190,846	390,011
RS8yr	15	9,926	22,639	56,586	141,436	322,584
LarkinBasicCycAge	99	27,763	54,153	124,633	254,939	469,908
PowerJuv	99	7,271	18,897	58,900	169,855	468,051
PowerJuvEi	99	5,622	16,361	47,008	143,743	360,550
PowerPink	99	3,132	6,994	15,542	35,229	66,543
RickerQue_fry_wt	99	15,679	34,685	83,574	190,796	379,344

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
R2C	2	4,201	9,158	21,767	51,738	112,779
RickerCyc	3	181,667	362,774	657,313	1,236,372	2,224,338
LarkinBasic	4	88,206	195,523	459,714	1,194,312	2,580,273
RickerEi	5	47,224	104,251	246,944	726,888	1,481,551
RickerBasic	6	73,902	155,628	370,932	951,444	2,373,047
PowerBasic	8	48,260	118,202	256,365	600,984	1,339,819
RS8yr	15	134,978	307,853	769,481	1,923,326	4,386,667
LarkinBasicCycAge	99	220,540	403,341	782,903	1,644,501	3,199,580
PowerJuv	99	51,421	148,487	395,188	1,190,377	3,956,543
PowerJuvEi	99	47,403	137,327	375,265	1,112,685	3,343,213
PowerPink	99	21,321	63,083	232,704	778,947	2,353,076
RickerQue_fry_wt	99	66,790	139,995	254,157	549,372	1,102,573

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
R2C	2	0.48	1.04	2.46	5.85	12.76
RickerCyc	3	1.34	3.15	9.02	23.89	55.44
LarkinBasic	4	1.79	4.00	9.83	22.70	45.54

Model	Old.Rank	p10	p25	p50	p75	p90
RickerEi	5	1.09	2.34	5.60	12.78	29.89
RickerBasic	6	1.30	3.03	7.93	18.35	42.20
PowerBasic	8	1.24	2.65	6.03	15.00	31.83
RS8yr	15	1.10	2.51	6.27	15.67	35.74
LarkinBasicCycAge	99	2.27	4.56	10.67	22.68	43.29
PowerJuv	99	0.54	1.48	4.86	14.87	44.35
PowerJuvEi	99	0.43	1.30	4.03	12.99	34.83
PowerPink	99	0.23	0.59	1.74	4.82	11.88
RickerQue_fry_wt	99	5.77	12.21	23.62	51.76	103.62

Age4Prod

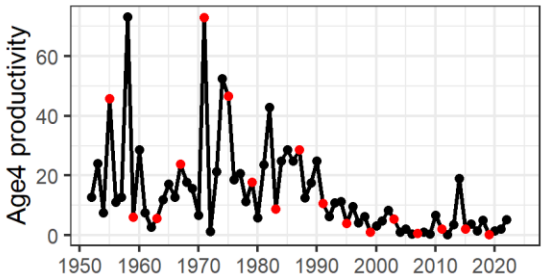
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
R2C	2	0.46	1.01	2.40	5.70	12.42
RickerCyc	3	1.12	2.59	7.55	20.65	48.80
LarkinBasic	4	1.78	3.88	9.04	19.14	36.56
RickerEi	5	1.09	2.27	5.07	10.87	24.80
RickerBasic	6	1.29	2.94	7.27	15.83	34.49
PowerBasic	8	1.24	2.57	5.62	13.34	27.27
RS8yr	15	0.69	1.58	3.96	9.89	22.56
LarkinBasicCycAge	99	1.94	3.79	8.71	17.83	32.86
PowerJuv	99	0.51	1.32	4.12	11.88	32.73
PowerJuvEi	99	0.39	1.14	3.29	10.05	25.21
PowerPink	99	0.22	0.49	1.09	2.46	4.65
RickerQue_fry_wt	99	1.10	2.43	5.84	13.34	26.53

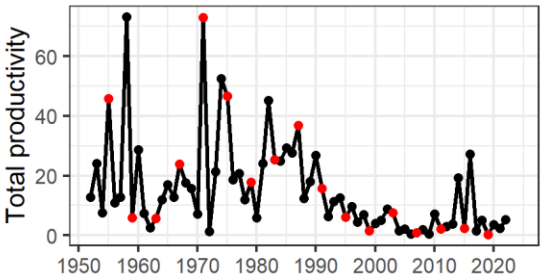
Age5Prod

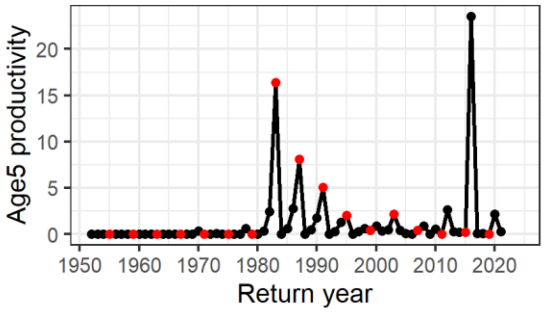
Model	Old.Rank	p10	p25	p50	p75	p90
R2C	2	0.01	0.03	0.07	0.16	0.34
RickerCyc	3	0.23	0.56	1.47	3.24	6.64
LarkinBasic	4	0.01	0.13	0.79	3.56	8.98
RickerEi	5	0.00	0.07	0.53	1.91	5.09
RickerBasic	6	0.01	0.09	0.66	2.52	7.71
PowerBasic	8	0.01	0.08	0.41	1.65	4.56
RS8yr	15	0.41	0.93	2.31	5.78	13.18

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasicCycAge	99	0.33	0.77	1.95	4.85	10.44
PowerJuv	99	0.03	0.16	0.75	2.99	11.62
PowerJuvEi	99	0.04	0.16	0.74	2.94	9.62
PowerPink	99	0.01	0.10	0.65	2.36	7.23
RickerQue_fry_wt	99	4.67	9.79	17.77	38.41	77.10

RawProd





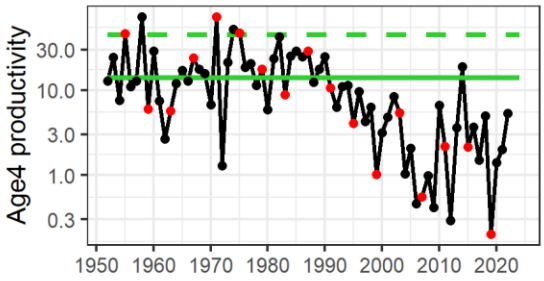


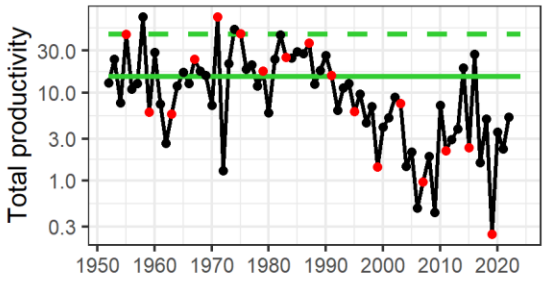
Quesnel

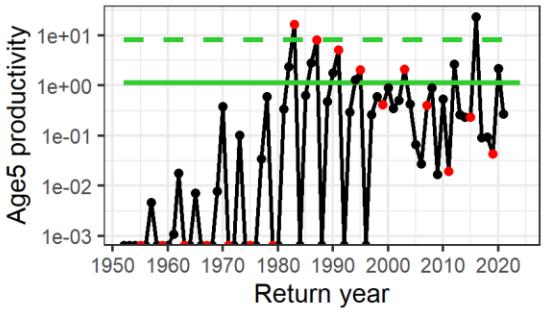
Brood_Year	Eff
2018	332730
2019	14301

		Mean_run_size
1	All Years	1198538
2	Cyc Years	95331

logProd







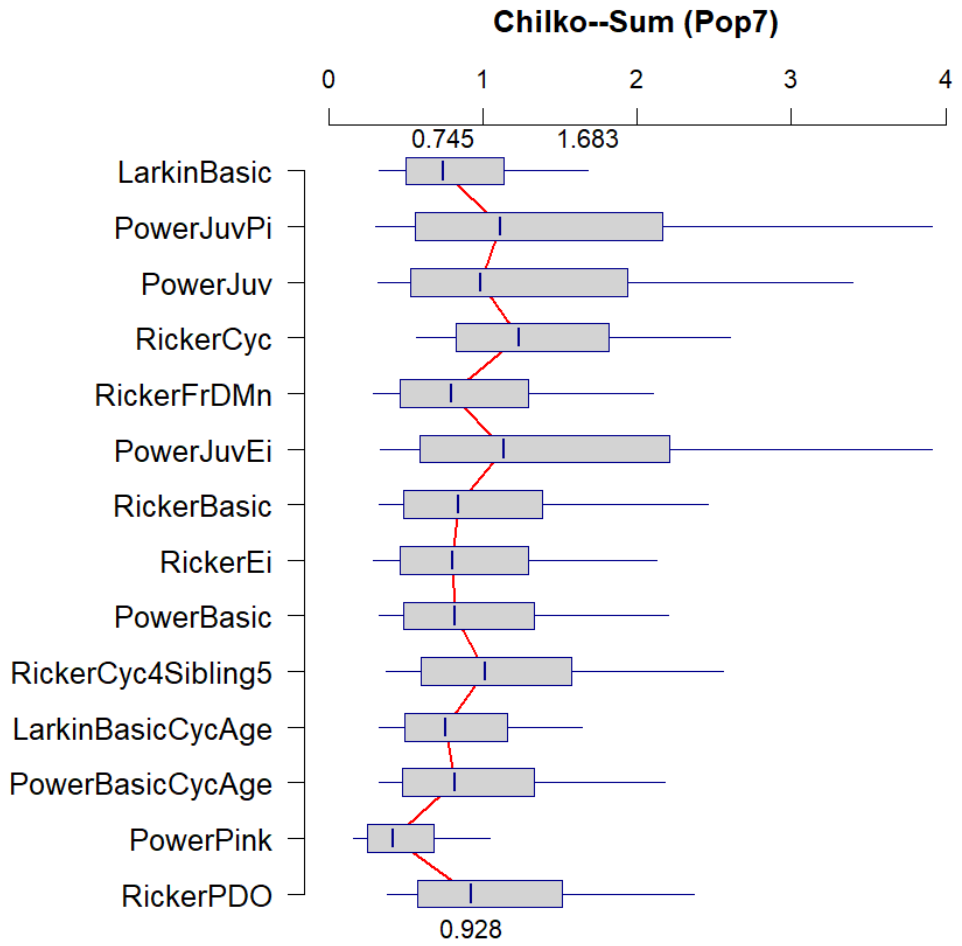
Quesnel

Brood_Year	Eff
2018	332730
2019	14301

		Mean_run_size
1	All Years	1198538
2	Cyc Years	95331

Chilko

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	326,846	497,992	745,210	1,133,854	1,683,309
PowerJuvPi	1	305,470	560,859	1,115,014	2,165,966	3,910,293
PowerJuv	3	318,596	533,011	985,953	1,935,521	3,400,998
RickerCyc	7	573,291	825,957	1,234,700	1,819,583	2,607,948
RickerFRDMean	11	293,353	461,381	795,067	1,293,761	2,108,553

Model	Old.Rank	p10	p25	p50	p75	p90
PowerJuvEi	13	332,861	591,727	1,135,272	2,208,629	3,909,781
RickerBasic	14	324,536	485,656	844,782	1,390,403	2,460,556
RickerEi	17	288,136	464,740	804,715	1,296,908	2,127,029
PowerBasic	27	328,682	487,578	819,305	1,331,986	2,206,096
RickerCycAge4.SiblingAge5	99	374,575	600,727	1,018,820	1,574,467	2,562,615
LarkinBasicCycAge	99	330,798	496,591	757,462	1,156,948	1,643,657
PowerBasicCycAge	99	324,112	480,787	815,996	1,335,514	2,181,016
PowerPink	99	163,999	254,001	417,517	679,747	1,045,152
RickerPDO	99	382,807	575,393	928,207	1,518,641	2,368,187

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
LarkinBasic	1	176,099	284,796	485,683	820,940	1,317,984
PowerJuvPi	1	211,367	415,349	865,677	1,827,270	3,481,528
PowerJuv	3	221,304	397,212	790,988	1,682,598	3,100,413
RickerCyc	7	340,874	542,855	913,789	1,382,024	2,229,334
RickerFRDMean	11	176,091	300,424	571,022	1,052,246	1,827,713
PowerJuvEi	13	241,004	448,322	893,161	1,877,612	3,529,591
RickerBasic	14	184,094	314,362	588,270	1,096,676	2,027,046
RickerEi	17	166,815	285,922	572,739	1,038,591	1,777,834
PowerBasic	27	185,849	308,900	562,204	1,039,541	1,812,827
RickerCycAge4.SiblingAge5	99	340,874	542,855	913,789	1,382,024	2,229,334
LarkinBasicCycAge	99	172,499	280,390	491,875	816,382	1,315,882
PowerBasicCycAge	99	187,219	307,088	549,623	1,032,837	1,841,375
PowerPink	99	62,030	113,349	198,093	387,157	617,037
RickerPDO	99	227,882	379,961	674,048	1,228,475	2,149,501

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	150,747	213,196	259,526	312,914	365,324
PowerJuvPi	1	94,103	145,510	249,337	338,696	428,766
PowerJuv	3	97,292	135,799	194,965	252,922	300,585
RickerCyc	7	232,417	283,102	320,911	437,559	378,614
RickerFRDMean	11	117,262	160,957	224,046	241,516	280,840
PowerJuvEi	13	91,857	143,405	242,111	331,017	380,189
RickerBasic	14	140,442	171,294	256,513	293,726	433,510
RickerEi	17	121,321	178,818	231,976	258,317	349,196
PowerBasic	27	142,832	178,678	257,101	292,445	393,270
RickerCycAge4.SiblingAge5	99	33,700	57,872	105,031	192,443	333,281
LarkinBasicCycAge	99	158,299	216,201	265,588	340,565	327,775
PowerBasicCycAge	99	136,893	173,699	266,373	302,677	339,642
PowerPink	99	101,969	140,652	219,425	292,590	428,115
RickerPDO	99	154,925	195,432	254,159	290,166	218,686

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	2.46	4.00	6.92	11.81	19.15
PowerJuvPi	1	2.85	5.62	11.74	25.01	48.16
PowerJuv	3	2.99	5.38	10.74	22.98	42.73
RickerCyc	7	4.70	7.53	12.76	19.56	31.84
RickerFRDMean	11	2.42	4.17	7.97	14.74	25.71
PowerJuvEi	13	3.24	6.05	12.11	25.67	48.72

Model	Old.Rank	p10	p25	p50	p75	p90
RickerBasic	14	2.54	4.36	8.22	15.41	28.60
RickerEi	17	2.30	3.98	8.00	14.58	25.06
PowerBasic	27	2.55	4.28	7.85	14.64	25.74
RickerCycAge4.SiblingAge5	99	2.45	3.96	6.78	11.49	18.52
LarkinBasicCycAge	99	2.42	3.96	7.02	11.75	19.11
PowerBasicCycAge	99	2.58	4.27	7.70	14.55	26.08
PowerPink	99	0.90	1.68	3.02	5.92	9.79
RickerPDO	99	3.13	5.26	9.39	17.20	30.18

Age4Prod

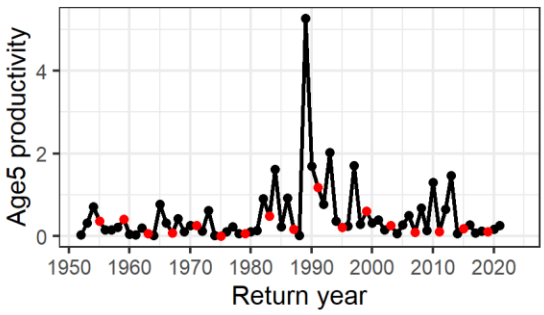
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
LarkinBasic	1	2.36	3.82	6.51	11.00	17.66
PowerJuvPi	1	2.83	5.56	11.60	24.48	46.65
PowerJuv	3	2.97	5.32	10.60	22.54	41.54
RickerCyc	7	4.57	7.27	12.24	18.52	29.87
RickerFRDMean	11	2.36	4.03	7.65	14.10	24.49
PowerJuvEi	13	3.23	6.01	11.97	25.16	47.29
RickerBasic	14	2.47	4.21	7.88	14.69	27.16
RickerEi	17	2.24	3.83	7.67	13.92	23.82
PowerBasic	27	2.49	4.14	7.53	13.93	24.29
RickerCycAge4.SiblingAge5	99	4.57	7.27	12.24	18.52	29.87
LarkinBasicCycAge	99	2.31	3.76	6.59	10.94	17.63
PowerBasicCycAge	99	2.51	4.11	7.36	13.84	24.67
PowerPink	99	0.83	1.52	2.65	5.19	8.27
RickerPDO	99	3.05	5.09	9.03	16.46	28.80

Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	0.10	0.18	0.41	0.81	1.49
PowerJuvPi	1	0.02	0.05	0.14	0.53	1.51
PowerJuv	3	0.02	0.06	0.14	0.44	1.19
RickerCyc	7	0.13	0.26	0.52	1.04	1.97
RickerFRDMean	11	0.06	0.14	0.32	0.64	1.23
PowerJuvEi	13	0.01	0.05	0.15	0.51	1.43
RickerBasic	14	0.07	0.14	0.34	0.72	1.44

Model	Old.Rank	p10	p25	p50	p75	p90
RickerEi	17	0.07	0.15	0.32	0.66	1.24
PowerBasic	27	0.06	0.14	0.32	0.71	1.45
RickerCycAge4.SiblingAge5	99	0.09	0.15	0.27	0.50	0.86
LarkinBasicCycAge	99	0.11	0.21	0.43	0.81	1.48
PowerBasicCycAge	99	0.07	0.15	0.34	0.71	1.41
PowerPink	99	0.07	0.16	0.37	0.73	1.52
RickerPDO	99	0.07	0.17	0.36	0.74	1.38

RawProd

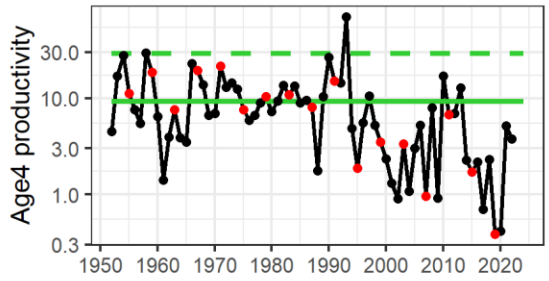


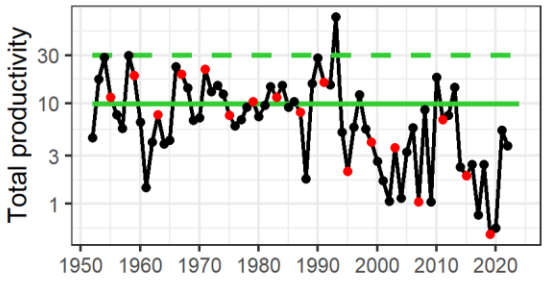
Chilko

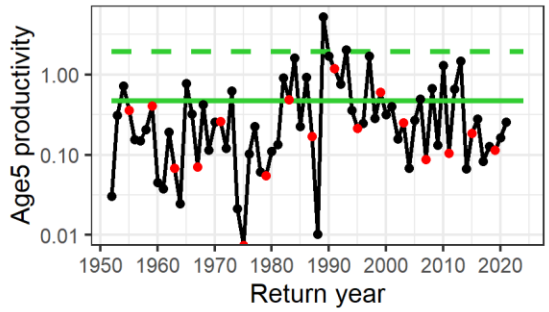
Brood_Year	Eff
2018	388737
2019	74636

		Mean_run_size
1	All Years	1337647
2	Cyc Years	1397215

logProd







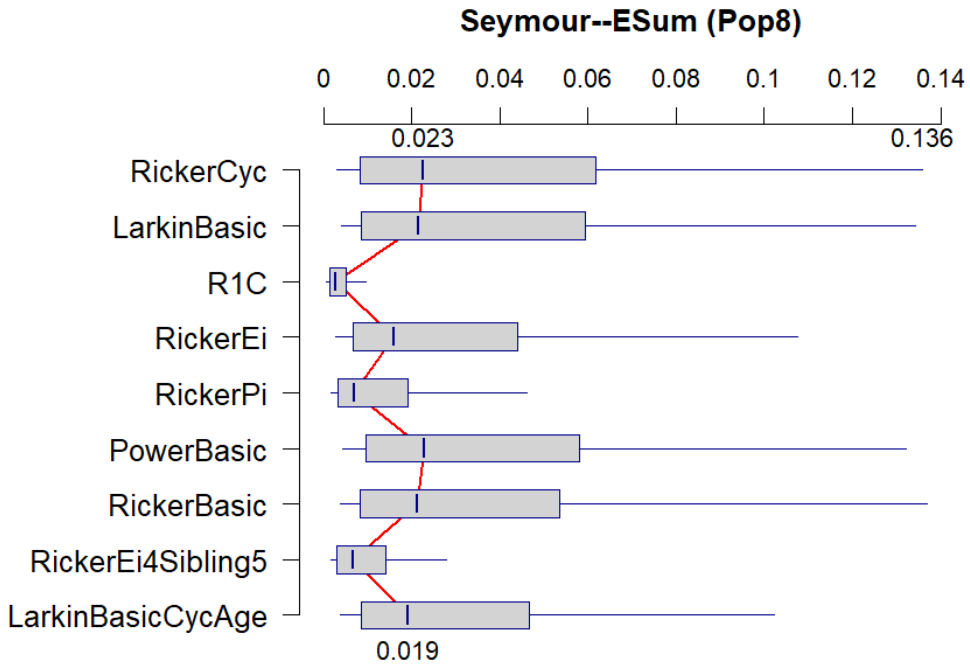
Chilko

Brood_Year	Eff
2018	388737
2019	74636

		Mean_run_size
1	All Years	1337647
2	Cyc Years	1397215

Seymour

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
RickerCyc	1	2,974	8,188	22,693	61,759	135,913
LarkinBasic	2	4,166	8,539	21,466	59,515	134,341
R1C	2	741	1,359	2,664	5,224	9,576
RickerEi	5	2,732	6,803	15,860	44,082	107,565
RickerPi	6	1,698	3,226	6,984	19,281	46,079
PowerBasic	9	4,343	9,716	22,863	58,151	132,183
RickerBasic	9	3,764	8,268	21,232	53,512	136,837
RickerEiAge4.SiblingAge5	99	1,564	3,125	6,804	14,063	27,946
LarkinBasicCycAge	99	3,848	8,444	19,136	46,648	102,331

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
RickerCyc	1	535	1,254	3,443	8,908	22,272
LarkinBasic	2	1,181	2,146	4,411	8,163	14,752
R1C	2	646	1,185	2,323	4,555	8,351
RickerEi	5	871	1,628	3,473	6,628	12,060
RickerPi	6	573	1,020	1,898	3,475	6,421
PowerBasic	9	1,398	2,710	5,996	12,419	25,384
RickerBasic	9	1,288	2,228	4,478	8,936	17,677
RickerEiAge4.SiblingAge5	99	871	1,628	3,473	6,628	12,060
LarkinBasicCycAge	99	1,218	2,219	4,396	8,450	14,808

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
RickerCyc	1	2,438	6,934	19,250	52,851	113,641
LarkinBasic	2	2,986	6,393	17,055	51,352	119,589
R1C	2	95	174	341	669	1,226
RickerEi	5	1,861	5,176	12,387	37,454	95,505
RickerPi	6	1,124	2,206	5,086	15,806	39,658
PowerBasic	9	2,945	7,005	16,867	45,732	106,799
RickerBasic	9	2,475	6,041	16,755	44,576	119,160
RickerEiAge4.SiblingAge5	99	692	1,497	3,331	7,434	15,886
LarkinBasicCycAge	99	2,630	6,225	14,740	38,198	87,523

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
RickerCyc	1	0.79	1.88	5.24	13.78	34.48
LarkinBasic	2	1.73	3.18	6.68	12.78	23.61
R1C	2	0.95	1.74	3.41	6.69	12.26
RickerEi	5	1.28	2.41	5.24	10.30	19.33
RickerPi	6	0.84	1.50	2.84	5.35	10.09
PowerBasic	9	2.05	4.00	8.96	18.86	39.15
RickerBasic	9	1.89	3.29	6.75	13.83	27.96
RickerEiAge4.SiblingAge5	99	2.29	4.58	9.98	20.62	40.98
LarkinBasicCycAge	99	1.79	3.29	6.61	13.00	23.27

Age4Prod

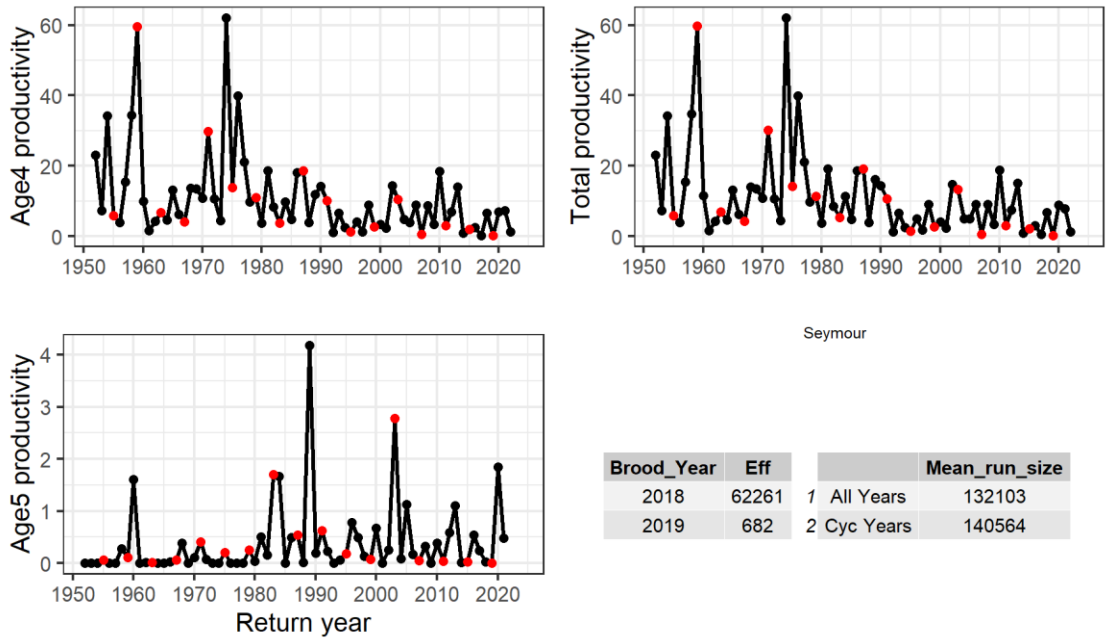
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
RickerCyc	1	0.78	1.84	5.05	13.06	32.66
LarkinBasic	2	1.73	3.15	6.47	11.97	21.63
R1C	2	0.95	1.74	3.41	6.68	12.24
RickerEi	5	1.28	2.39	5.09	9.72	17.68
RickerPi	6	0.84	1.50	2.78	5.10	9.41
PowerBasic	9	2.05	3.97	8.79	18.21	37.22
RickerBasic	9	1.89	3.27	6.57	13.10	25.92
RickerEiAge4.SiblingAge5	99	1.28	2.39	5.09	9.72	17.68
LarkinBasicCycAge	99	1.79	3.25	6.45	12.39	21.71

Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
RickerCyc	1	0.01	0.04	0.19	0.71	1.82
LarkinBasic	2	0.00	0.03	0.21	0.81	1.98
R1C	2	0.00	0.00	0.01	0.01	0.02
RickerEi	5	0.00	0.02	0.15	0.58	1.65
RickerPi	6	0.00	0.01	0.06	0.26	0.67
PowerBasic	9	0.00	0.03	0.17	0.65	1.93
RickerBasic	9	0.00	0.03	0.18	0.73	2.04
RickerEiAge4.SiblingAge5	99	1.02	2.20	4.88	10.90	23.29

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasicCycAge	99	0.00	0.04	0.17	0.61	1.56

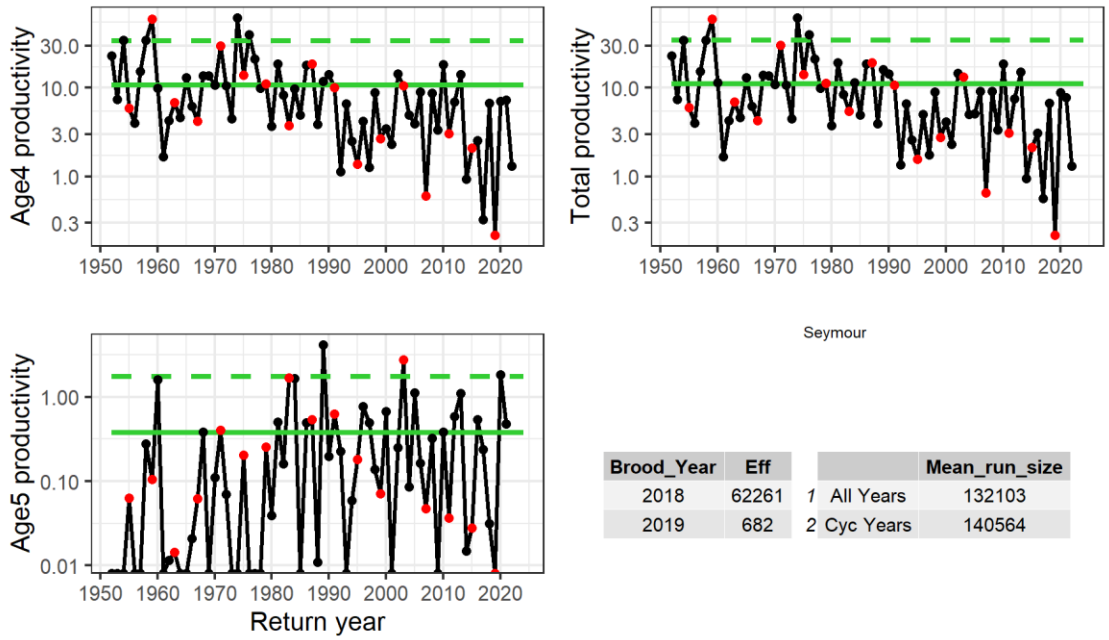
RawProd



Brood_Year	Eff
2018	62261
2019	682

		Mean_run_size
1	All Years	132103
2	Cyc Years	140564

logProd

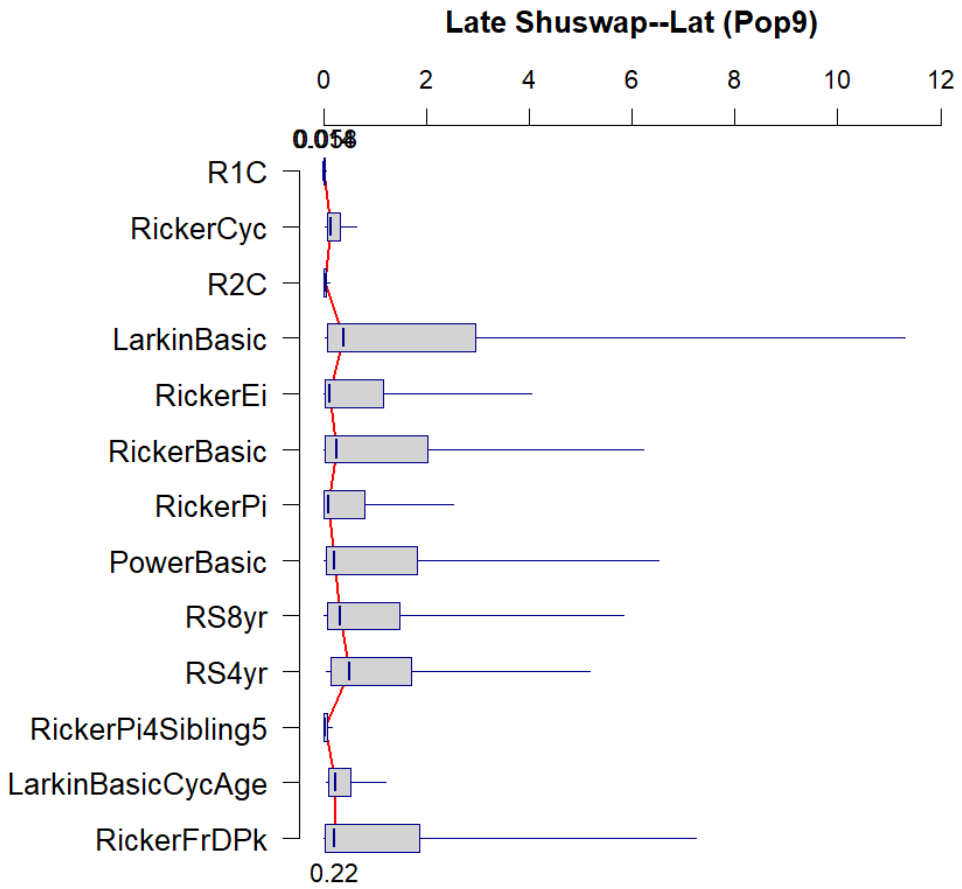


Brood_Year	Eff
2018	62261
2019	682

		Mean_run_size
1	All Years	132103
2	Cyc Years	140564

Late Shuswap

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
R1C	1	3,260	6,444	13,741	29,299	57,920
RickerCyc	2	35,863	70,160	152,201	316,619	653,603
R2C	4	4,269	9,233	21,756	51,264	110,877
LarkinBasic	5	21,525	65,260	387,348	2,963,632	11,304,245
RickerEi	6	8,584	23,644	130,639	1,163,150	4,047,765
RickerBasic	7	13,544	40,286	261,905	2,018,729	6,217,967
RickerPi	10	6,305	16,984	92,695	796,428	2,516,699
PowerBasic	11	12,521	42,296	222,205	1,823,537	6,513,209

Model	Old.Rank	p10	p25	p50	p75	p90
RS8yr	17	18,009	70,794	323,981	1,482,672	5,828,259
RS4yr	19	49,064	147,926	504,154	1,718,229	5,180,407
RickerPiAge4.SiblingAge5	99	3,080	8,590	24,716	65,494	162,164
LarkinBasicCycAge	99	52,856	105,045	236,189	533,014	1,203,394
RickerFRDpeak	99	11,190	35,606	219,795	1,869,502	7,243,075

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
R1C	1	2,798	5,532	11,795	25,150	49,716
RickerCyc	2	3,225	6,863	17,409	43,530	100,613
R2C	4	3,664	7,925	18,674	44,003	95,173
LarkinBasic	5	2,143	7,280	20,835	47,418	100,268
RickerEi	6	711	3,382	10,571	24,240	55,250
RickerBasic	7	1,215	4,411	14,285	39,128	87,727
RickerPi	10	462	2,103	6,197	15,113	30,534
PowerBasic	11	1,020	4,720	13,514	36,191	80,706
RS8yr	17	508	1,997	9,139	41,822	164,400
RS4yr	19	1,589	4,791	16,328	55,648	167,776
RickerPiAge4.SiblingAge5	99	462	2,103	6,197	15,113	30,534
LarkinBasicCycAge	99	7,529	14,444	30,298	62,093	119,592
RickerFRDpeak	99	1,181	4,292	12,503	32,713	75,296

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
R1C	1	462	913	1,946	4,150	8,203
RickerCyc	2	32,637	63,297	134,793	273,089	552,990
R2C	4	605	1,308	3,081	7,261	15,704
LarkinBasic	5	19,382	57,980	366,513	2,916,214	11,203,977
RickerEi	6	7,873	20,262	120,068	1,138,910	3,992,514
RickerBasic	7	12,329	35,876	247,620	1,979,601	6,130,240
RickerPi	10	5,843	14,881	86,498	781,315	2,486,165
PowerBasic	11	11,501	37,576	208,691	1,787,347	6,432,504
RS8yr	17	17,501	68,797	314,842	1,440,850	5,663,859

Model	Old.Rank	p10	p25	p50	p75	p90
RS4yr	19	47,475	143,135	487,826	1,662,581	5,012,631
RickerPiAge4.SiblingAge5	99	2,618	6,487	18,518	50,380	131,631
LarkinBasicCycAge	99	45,327	90,601	205,891	470,920	1,083,802
RickerFRDpeak	99	10,008	31,314	207,292	1,836,789	7,167,779

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
R1C	1	0.82	1.62	3.45	7.35	14.53
RickerCyc	2	0.96	2.06	5.22	13.02	30.10
R2C	4	1.07	2.32	5.46	12.86	27.82
LarkinBasic	5	0.63	2.13	6.47	17.46	43.37
RickerEi	6	0.21	0.99	3.18	8.49	21.19
RickerBasic	7	0.35	1.29	4.40	13.94	33.32
RickerPi	10	0.13	0.62	1.90	5.39	12.06
PowerBasic	11	0.30	1.38	4.14	12.76	31.68
RS8yr	17	0.17	0.67	3.06	14.01	55.08
RS4yr	19	0.52	1.58	5.38	18.33	55.26
RickerPiAge4.SiblingAge5	99	0.14	0.62	1.83	4.48	9.08
LarkinBasicCycAge	99	2.22	4.29	9.07	18.75	36.35
RickerFRDpeak	99	0.35	1.25	3.81	11.85	31.00

Age4Prod

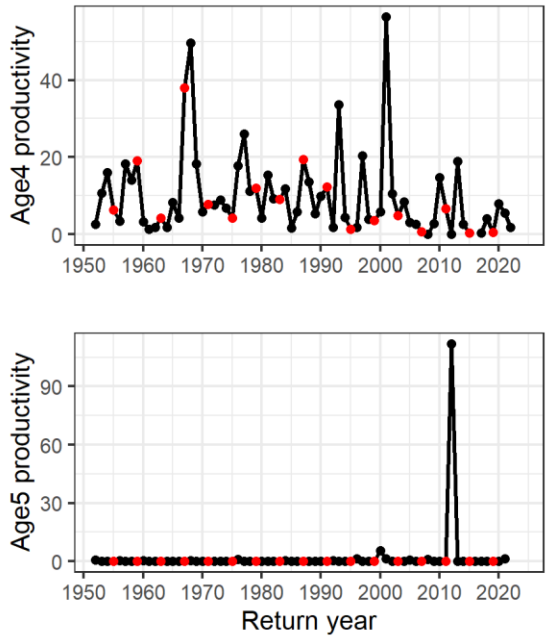
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
R1C	1	0.82	1.62	3.44	7.35	14.52
RickerCyc	2	0.94	2.00	5.08	12.71	29.38
R2C	4	1.07	2.31	5.45	12.85	27.80
LarkinBasic	5	0.63	2.13	6.08	13.85	29.28
RickerEi	6	0.21	0.99	3.09	7.08	16.14
RickerBasic	7	0.35	1.29	4.17	11.43	25.62
RickerPi	10	0.13	0.61	1.81	4.41	8.92
PowerBasic	11	0.30	1.38	3.95	10.57	23.57
RS8yr	17	0.15	0.58	2.67	12.21	48.01
RS4yr	19	0.46	1.40	4.77	16.25	49.00

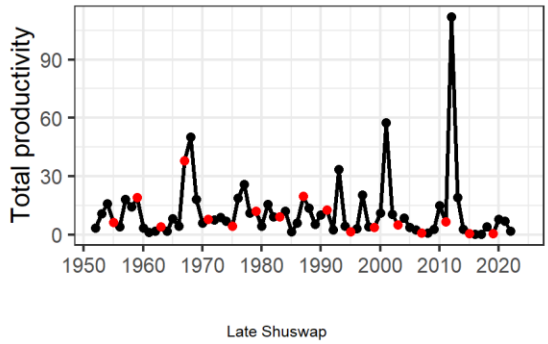
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
RickerPiAge4.SiblingAge5	99	0.13	0.61	1.81	4.41	8.92
LarkinBasicCycAge	99	2.20	4.22	8.85	18.13	34.93
RickerFRDpeak	99	0.35	1.25	3.65	9.55	21.99

Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
R1C	1	0.00	0.00	0.00	0.01	0.01
RickerCyc	2	0.02	0.05	0.14	0.31	0.71
R2C	4	0.00	0.00	0.00	0.01	0.02
LarkinBasic	5	0.00	0.01	0.38	3.61	14.08
RickerEi	6	0.00	0.00	0.09	1.41	5.05
RickerBasic	7	0.00	0.00	0.23	2.51	7.70
RickerPi	10	0.00	0.00	0.09	0.98	3.14
PowerBasic	11	0.00	0.00	0.19	2.19	8.11
RS8yr	17	0.02	0.09	0.39	1.80	7.07
RS4yr	19	0.06	0.18	0.61	2.08	6.26
RickerPiAge4.SiblingAge5	99	0.00	0.01	0.02	0.06	0.16
LarkinBasicCycAge	99	0.03	0.07	0.22	0.61	1.42
RickerFRDpeak	99	0.00	0.00	0.16	2.29	9.01

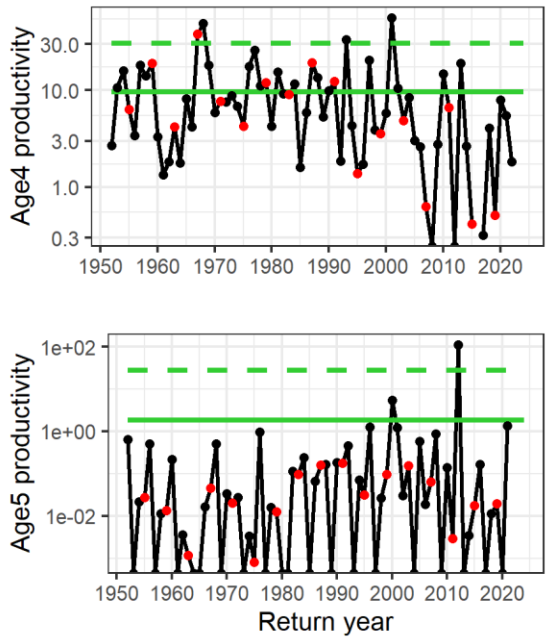
RawProd

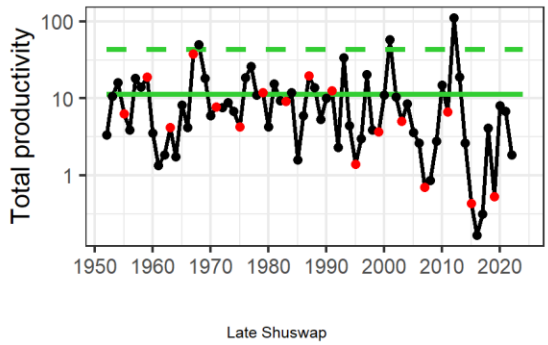




Brood_Year	Eff		Mean_run_size
2018	801099	*1* All Years	2144750
2019	3424	*2* Cyc Years	1157384

logProd

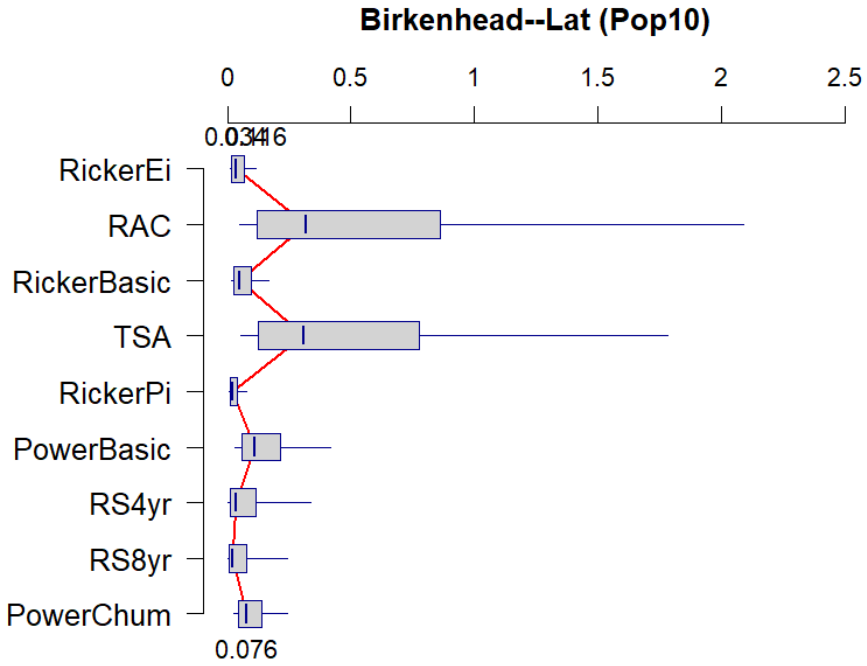




Brood_Year	Eff		Mean_run_size
2018	801099	*1* All Years	2144750
2019	3424	*2* Cyc Years	1157384

Birkenhead

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
RickerEi	1	9,180	17,309	33,845	65,797	115,814
RAC	2	49,179	119,531	320,645	860,138	2,090,599
RickerBasic	2	14,611	25,402	49,522	94,041	166,629
TSA	4	53,603	122,909	309,039	777,039	1,781,728
RickerPi	4	6,703	11,351	19,991	41,150	76,476
PowerBasic	6	28,964	56,911	108,786	213,964	416,984
RS4yr	16	3,451	10,218	34,125	113,975	337,430
RS8yr	17	1,940	6,095	21,743	77,569	243,688
PowerChum	99	25,596	43,026	75,544	139,708	241,271

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
RickerEi	1	1,510	3,117	7,106	16,909	36,691
RAC	2	31,831	77,367	207,540	556,730	1,353,156
RickerBasic	2	2,405	4,870	11,258	26,518	54,627
TSA	4	34,695	79,554	200,028	502,944	1,153,237

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
RickerPi	4	1,172	2,374	5,534	11,948	23,874
PowerBasic	6	6,604	14,360	36,247	88,908	205,706
RS4yr	16	1,385	4,099	13,691	45,727	135,377
RS8yr	17	698	2,194	7,827	27,923	87,723
PowerChum	99	5,906	12,427	25,925	56,863	108,887

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
RickerEi	1	7,670	14,193	26,738	48,888	79,123
RAC	2	17,347	42,164	113,105	303,407	737,443
RickerBasic	2	12,206	20,532	38,264	67,523	112,002
TSA	4	18,908	43,355	109,011	274,095	628,492
RickerPi	4	5,531	8,977	14,457	29,202	52,601
PowerBasic	6	22,360	42,551	72,539	125,056	211,279
RS4yr	16	2,067	6,118	20,434	68,248	202,052
RS8yr	17	1,242	3,901	13,916	49,646	155,965
PowerChum	99	19,690	30,599	49,618	82,846	132,384

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
RickerEi	1	1.22	2.51	6.17	14.84	30.74
RAC	2	18.44	44.82	120.24	322.56	783.99
RickerBasic	2	1.83	3.88	9.30	22.03	46.00
TSA	4	20.10	46.09	115.89	291.40	668.16
RickerPi	4	0.88	1.87	4.32	9.75	20.25
PowerBasic	6	4.33	9.41	23.90	58.79	133.97
RS4yr	16	0.98	2.91	9.73	32.48	96.17
RS8yr	17	0.52	1.65	5.87	20.94	65.78
PowerChum	99	3.84	8.18	17.50	38.72	78.47

Age4Prod

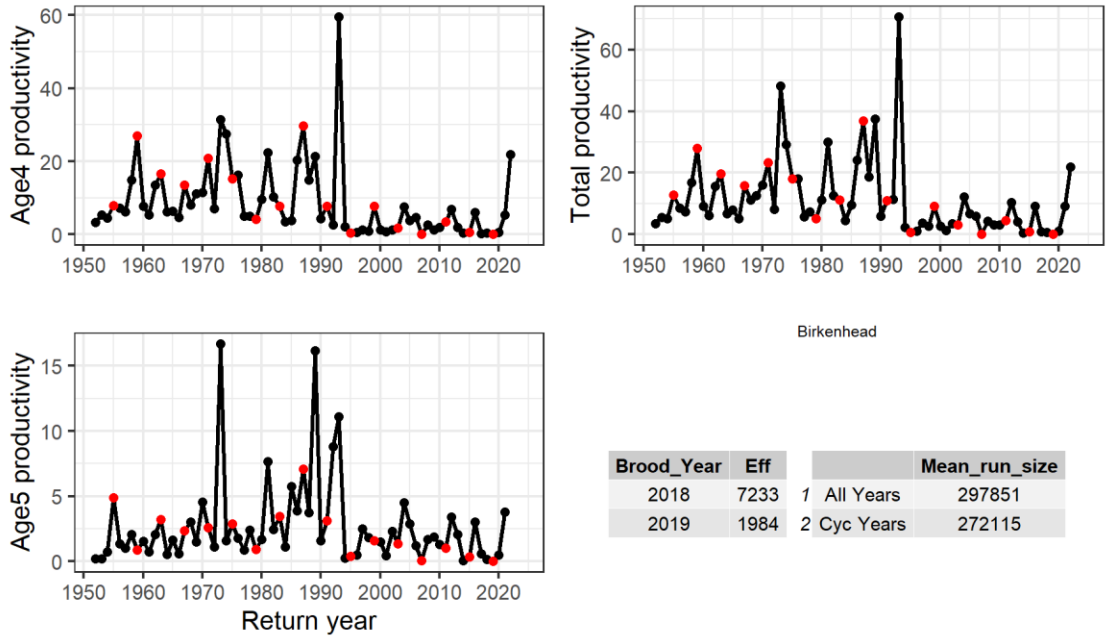
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
RickerEi	1	0.76	1.57	3.58	8.52	18.49
RAC	2	16.04	39.00	104.61	280.61	682.03
RickerBasic	2	1.21	2.45	5.67	13.37	27.53

Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
TSA	4	17.49	40.10	100.82	253.50	581.27
RickerPi	4	0.59	1.20	2.79	6.02	12.03
PowerBasic	6	3.33	7.24	18.27	44.81	103.68
RS4yr	16	0.70	2.07	6.90	23.05	68.23
RS8yr	17	0.35	1.11	3.95	14.07	44.22
PowerChum	99	2.98	6.26	13.07	28.66	54.88

Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
RickerEi	1	0.46	0.94	2.59	6.31	12.25
RAC	2	2.40	5.83	15.64	41.95	101.96
RickerBasic	2	0.62	1.43	3.63	8.67	18.47
TSA	4	2.61	5.99	15.07	37.90	86.89
RickerPi	4	0.29	0.68	1.53	3.73	8.22
PowerBasic	6	1.00	2.17	5.63	13.97	30.29
RS4yr	16	0.29	0.85	2.83	9.44	27.93
RS8yr	17	0.17	0.54	1.92	6.86	21.56
PowerChum	99	0.87	1.92	4.44	10.06	23.58

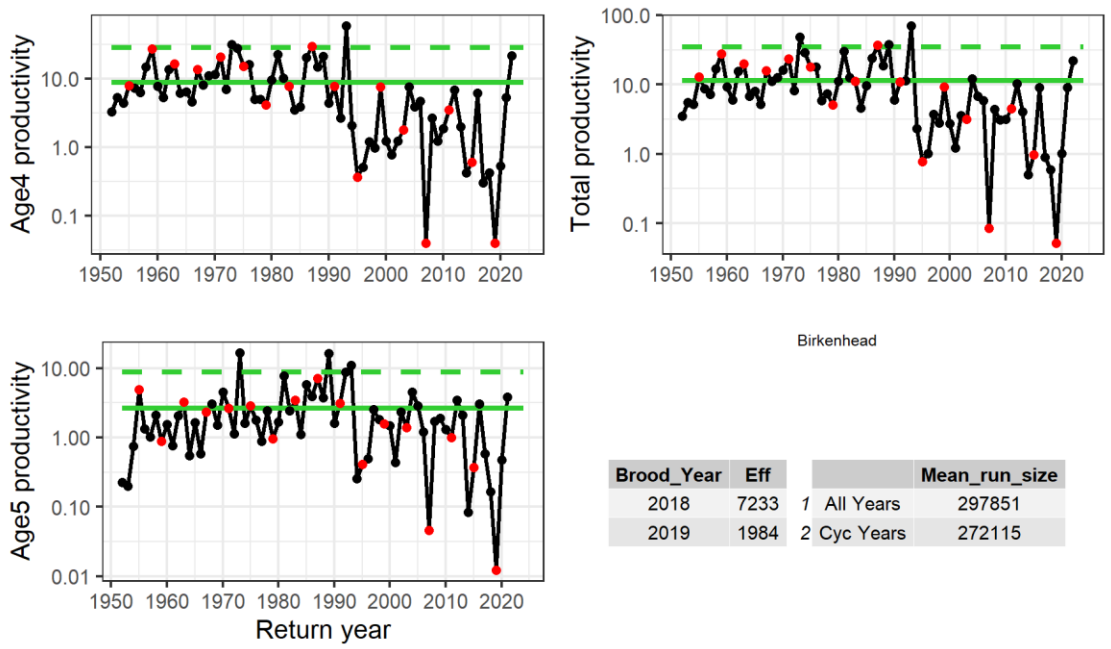
RawProd



Brood_Year	Eff
2018	7233
2019	1984

		Mean_run_size
1	All Years	297851
2	Cyc Years	272115

logProd

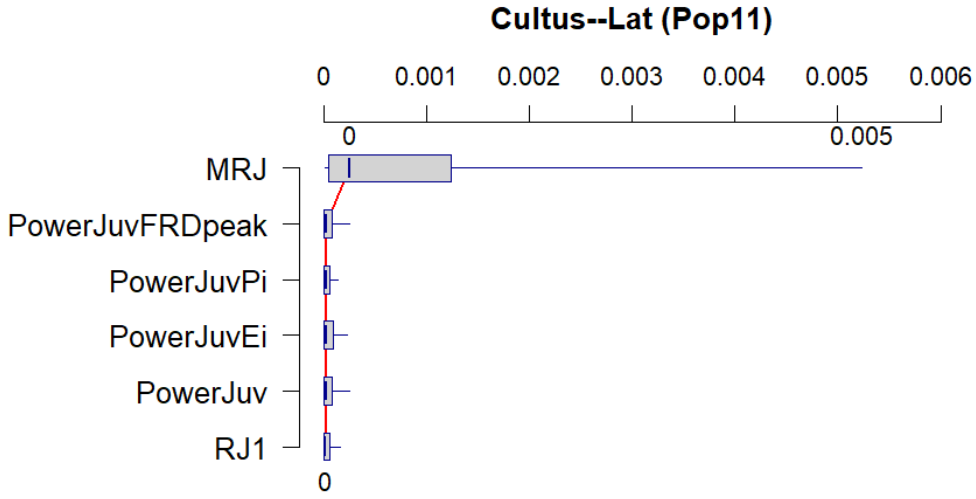


Brood_Year	Eff
2018	7233
2019	1984

		Mean_run_size
1	All Years	297851
2	Cyc Years	272115

Cultus

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
MRJ	1	12	50	249	1,238	5,235
PowerJuvFRDpeak	2	3	8	27	85	249
PowerJuvPi	3	3	8	21	58	145

Model	Old.Rank	p10	p25	p50	p75	p90
PowerJuvEi	6	3	8	28	90	235
PowerJuv	9	3	7	26	88	253
RJ1	14	2	6	19	58	163

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
MRJ	1	1	5	25	124	525
PowerJuvFRDpeak	2	0	1	2	7	18
PowerJuvPi	3	1	2	4	10	24
PowerJuvEi	6	0	1	3	8	20
PowerJuv	9	0	1	3	7	16
RJ1	14	0	1	2	8	21

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
MRJ	1	11	45	224	1,113	4,709
PowerJuvFRDpeak	2	2	7	24	79	230
PowerJuvPi	3	2	6	17	48	121
PowerJuvEi	6	2	7	25	82	215
PowerJuv	9	2	6	24	81	236
RJ1	14	2	5	16	51	142

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
MRJ	1	0.18	0.75	3.74	18.57	78.54
PowerJuvFRDpeak	2	0.04	0.10	0.33	1.11	3.22
PowerJuvPi	3	0.06	0.15	0.42	1.16	2.92
PowerJuvEi	6	0.05	0.12	0.37	1.18	3.25
PowerJuv	9	0.05	0.12	0.38	1.14	3.09
RJ1	14	0.04	0.10	0.33	1.02	2.84

Age4Prod

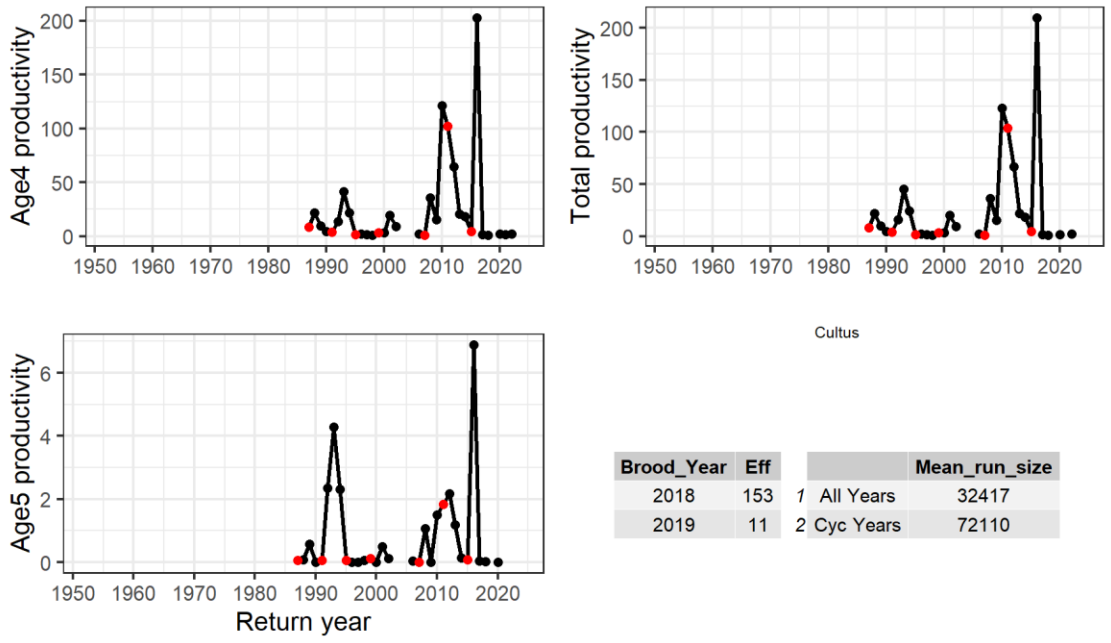
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
MRJ	1	0.11	0.46	2.27	11.29	47.76

Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
PowerJuvFRDpeak	2	0.04	0.09	0.22	0.63	1.68
PowerJuvPi	3	0.06	0.14	0.34	0.86	2.15
PowerJuvEi	6	0.04	0.10	0.26	0.68	1.78
PowerJuv	9	0.04	0.10	0.26	0.61	1.48
RJ1	14	0.03	0.07	0.22	0.69	1.91

Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
MRJ	1	0.07	0.30	1.47	7.28	30.78
PowerJuvFRDpeak	2	0.00	0.02	0.11	0.49	1.54
PowerJuvPi	3	0.00	0.01	0.08	0.30	0.78
PowerJuvEi	6	0.00	0.02	0.11	0.49	1.47
PowerJuv	9	0.00	0.02	0.12	0.53	1.62
RJ1	14	0.01	0.03	0.11	0.33	0.93

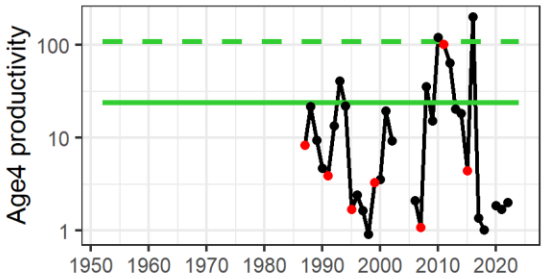
RawProd

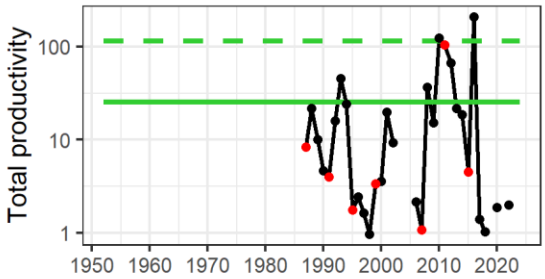


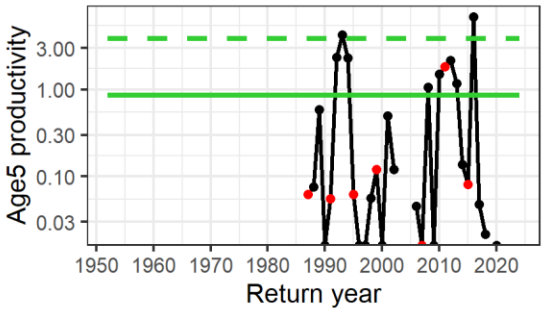
Brood_Year	Eff
2018	153
2019	11

		Mean_run_size
1	All Years	32417
2	Cyc Years	72110

logProd







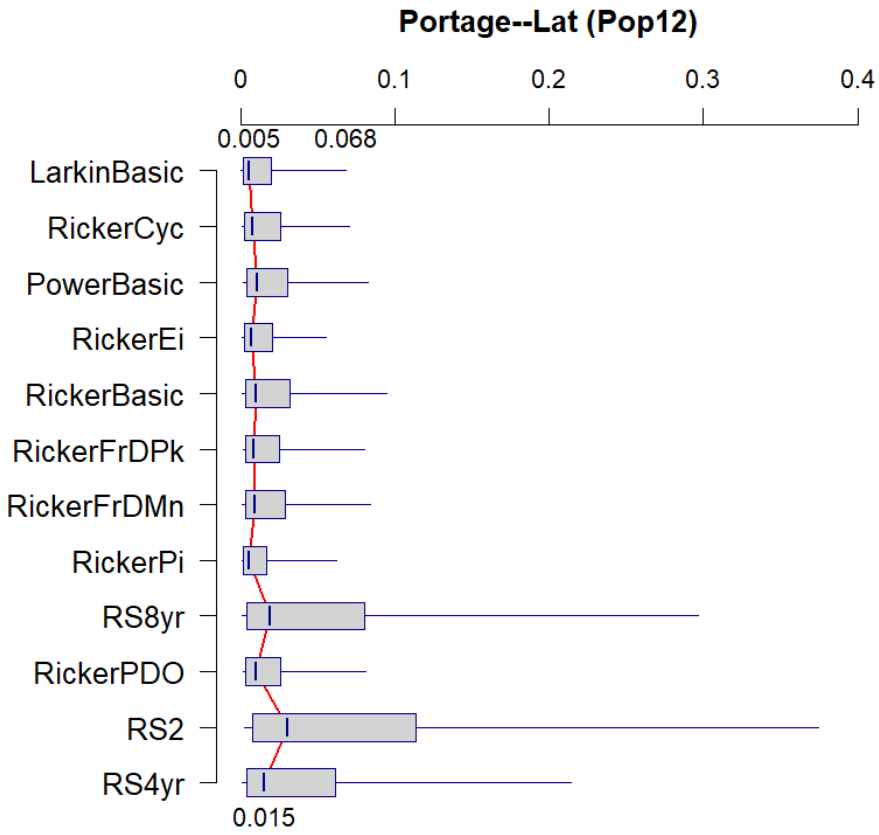
Cultus

Brood_Year	Eff
2018	153
2019	11

		Mean_run_size
1	All Years	32417
2	Cyc Years	72110

Portage

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	549	1,556	5,349	19,789	68,105
RickerCyc	2	777	2,282	7,947	26,325	70,699
PowerBasic	3	1,746	3,969	10,733	30,601	82,362
RickerEi	6	896	2,391	6,939	20,487	55,540
RickerBasic	7	1,373	3,419	9,973	32,112	94,719
RickerFRDpeak	8	1,440	3,378	8,615	25,146	80,267
RickerFRDMean	10	1,258	3,166	9,231	28,970	84,263
RickerPi	11	827	2,028	5,711	16,846	61,972
RS8yr	13	1,191	4,402	18,805	80,337	296,839
RickerPDO	14	1,513	3,618	10,455	26,063	80,838
RS2	17	2,450	8,064	30,287	113,759	374,333

Model	Old.Rank	p10	p25	p50	p75	p90
RS4yr	18	1,073	3,762	15,167	61,147	214,445

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
LarkinBasic	1	168	399	979	2,478	6,123
RickerCyc	2	137	456	1,700	6,902	21,026
PowerBasic	3	593	1,362	3,545	8,819	21,654
RickerEi	6	313	712	1,820	4,699	10,892
RickerBasic	7	471	1,009	2,693	7,444	20,744
RickerFRDpeak	8	460	1,217	3,193	7,907	17,641
RickerFRDMean	10	394	948	2,665	7,109	17,107
RickerPi	11	275	654	1,658	4,263	10,709
RS8yr	13	90	333	1,421	6,069	22,424
RickerPDO	14	591	1,451	3,580	10,139	22,949
RS2	17	32	104	390	1,464	4,817
RS4yr	18	82	288	1,162	4,686	16,434

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	381	1,156	4,370	17,311	61,983
RickerCyc	2	641	1,827	6,246	19,423	49,673
PowerBasic	3	1,153	2,607	7,188	21,781	60,708
RickerEi	6	583	1,678	5,119	15,789	44,648
RickerBasic	7	902	2,410	7,280	24,669	73,975
RickerFRDpeak	8	980	2,161	5,422	17,239	62,626
RickerFRDMean	10	864	2,219	6,566	21,861	67,156
RickerPi	11	552	1,374	4,052	12,583	51,263
RS8yr	13	1,101	4,069	17,384	74,268	274,415
RickerPDO	14	922	2,166	6,875	15,924	57,889
RS2	17	2,419	7,960	29,897	112,295	369,516
RS4yr	18	991	3,474	14,005	56,462	198,011

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	0.65	1.54	3.86	10.19	26.39
RickerCyc	2	0.53	1.75	6.61	27.13	82.77
PowerBasic	3	2.28	5.24	13.72	34.54	86.09

Model	Old.Rank	p10	p25	p50	p75	p90
RickerEi	6	1.20	2.74	7.07	18.64	44.12
RickerBasic	7	1.81	3.89	10.44	29.38	83.06
RickerFRDpeak	8	1.77	4.68	12.34	30.89	70.70
RickerFRDMean	10	1.51	3.65	10.33	27.93	68.59
RickerPi	11	1.06	2.52	6.43	16.81	43.54
RS8yr	13	0.40	1.46	6.24	26.66	98.50
RickerPDO	14	2.27	5.59	13.84	39.51	90.77
RS2	17	0.23	0.75	2.83	10.64	35.03
RS4yr	18	0.36	1.26	5.10	20.54	72.05

Age4Prod

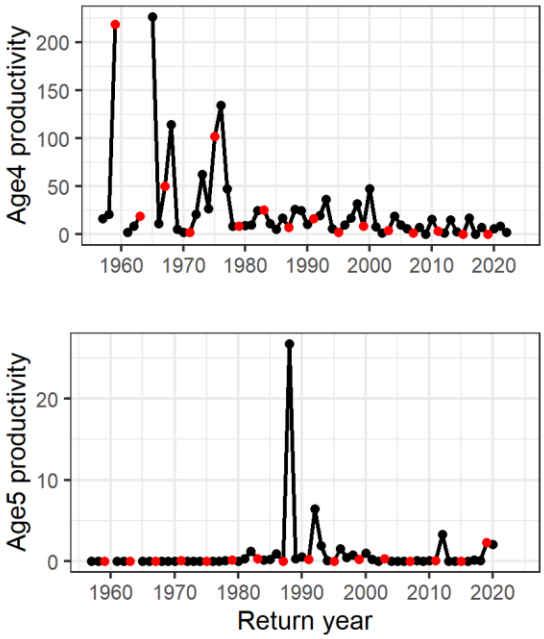
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
LarkinBasic	1	0.65	1.54	3.76	9.53	23.55
RickerCyc	2	0.53	1.75	6.54	26.55	80.87
PowerBasic	3	2.28	5.24	13.63	33.92	83.29
RickerEi	6	1.20	2.74	7.00	18.07	41.89
RickerBasic	7	1.81	3.88	10.36	28.63	79.78
RickerFRDpeak	8	1.77	4.68	12.28	30.41	67.85
RickerFRDMean	10	1.51	3.65	10.25	27.34	65.80
RickerPi	11	1.06	2.52	6.38	16.40	41.19
RS8yr	13	0.35	1.28	5.46	23.34	86.25
RickerPDO	14	2.27	5.58	13.77	39.00	88.26
RS2	17	0.12	0.40	1.50	5.63	18.53
RS4yr	18	0.32	1.11	4.47	18.02	63.21

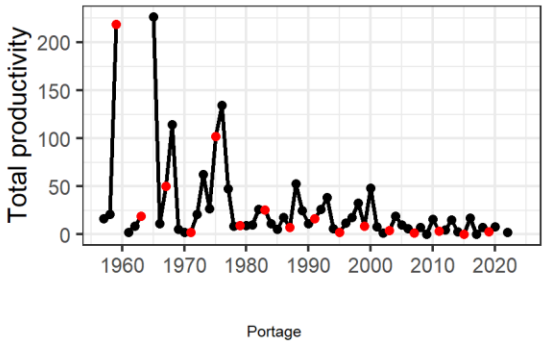
Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	0.00	0.00	0.10	0.66	2.84
RickerCyc	2	0.00	0.00	0.07	0.58	1.90
PowerBasic	3	0.00	0.00	0.09	0.62	2.81
RickerEi	6	0.00	0.00	0.07	0.56	2.23
RickerBasic	7	0.00	0.00	0.08	0.75	3.28
RickerFRDpeak	8	0.00	0.00	0.05	0.48	2.85
RickerFRDMean	10	0.00	0.00	0.08	0.59	2.79
RickerPi	11	0.00	0.00	0.05	0.42	2.35
RS8yr	13	0.05	0.18	0.78	3.32	12.25

Model	Old.Rank	p10	p25	p50	p75	p90
RickerPDO	14	0.00	0.00	0.07	0.51	2.50
RS2	17	0.11	0.36	1.33	5.01	16.50
RS4yr	18	0.04	0.16	0.63	2.52	8.84

RawProd

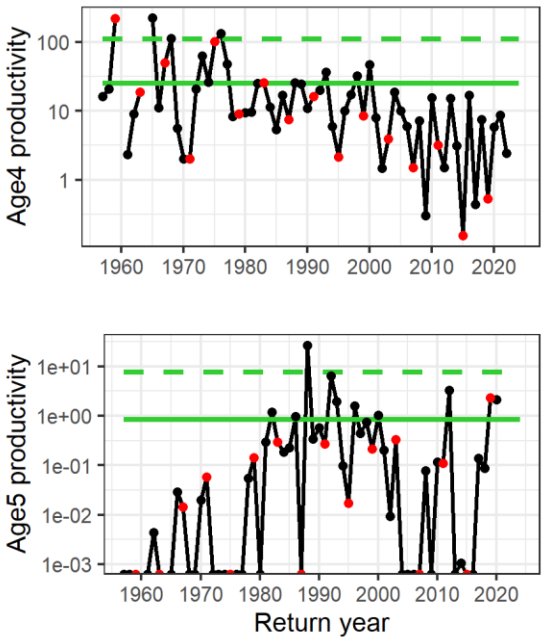


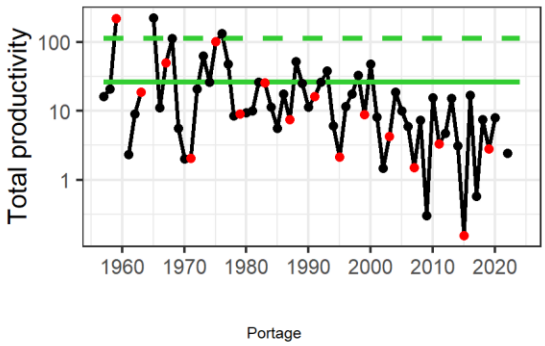


Brood_Year	Eff
2018	22395
2019	260

	Mean_run_size
All Years	39419
Cyc Years	20144

logProd



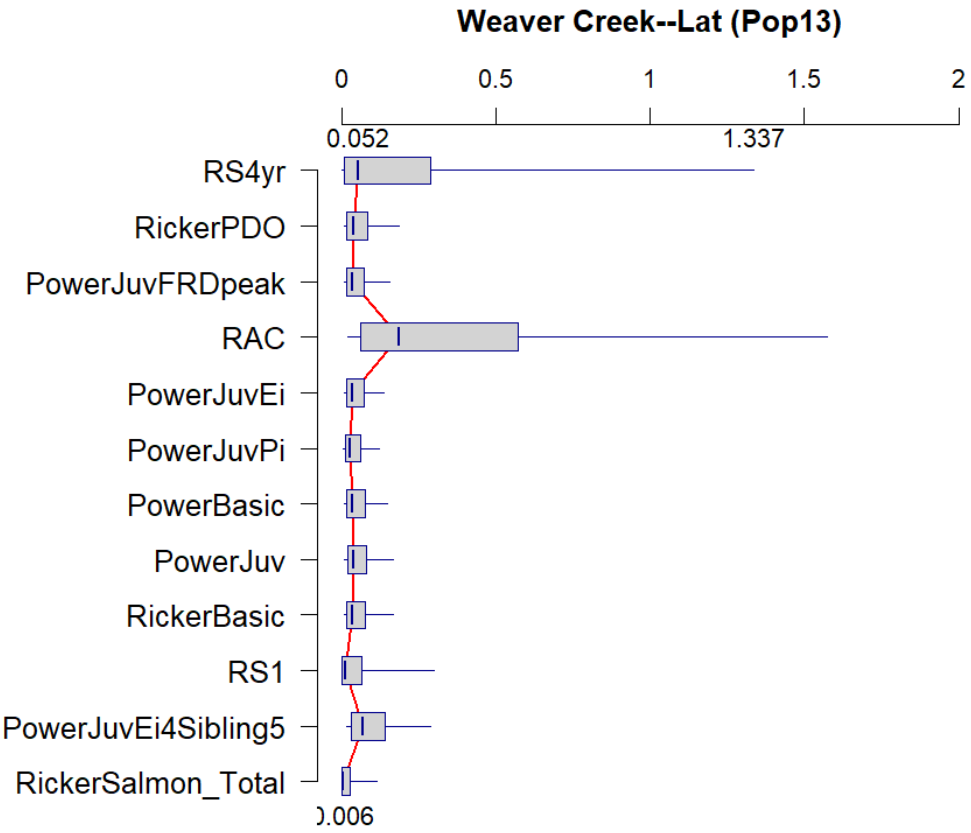


Brood_Year	Eff
2018	22395
2019	260

	Mean_run_size
All Years	39419
Cyc Years	20144

Weaver

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
RS4yr	1	2,057	9,537	52,435	288,291	1,336,715
RickerPDO	3	8,509	17,663	40,375	86,224	188,211
PowerJuvFRDpeak	7	8,368	15,991	34,553	71,524	157,465
RAC	8	21,801	60,070	185,238	571,222	1,573,935
PowerJuvEi	9	7,633	15,890	33,682	72,113	136,494

Model	Old.Rank	p10	p25	p50	p75	p90
PowerJuvPi	13	6,327	12,182	27,451	60,051	123,015
PowerBasic	14	8,008	16,811	36,027	76,617	148,840
PowerJuv	14	8,574	18,399	40,714	81,493	169,354
RickerBasic	23	7,714	15,929	36,236	76,784	167,699
RS1	31	457	2,122	11,683	64,329	298,666
PowerJuvEiAge4.SiblingAge5	99	16,598	32,055	67,952	140,397	288,053
RickerSalmon_Total	99	268	1,154	5,784	28,302	113,174

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
RS4yr	1	584	2,707	14,884	81,834	379,438
RickerPDO	3	2,244	4,956	11,894	32,046	67,781
PowerJuvFRDpeak	7	1,880	4,469	11,172	28,014	63,389
RAC	8	15,748	43,391	133,804	412,615	1,136,913
PowerJuvEi	9	1,779	3,763	9,477	22,557	54,819
PowerJuvPi	13	1,526	3,547	8,760	20,716	48,985
PowerBasic	14	2,188	5,032	12,589	31,175	70,674
PowerJuv	14	2,250	5,271	13,182	30,358	63,730
RickerBasic	23	1,881	4,153	9,600	24,502	60,074
RS1	31	1	3	17	91	422
PowerJuvEiAge4.SiblingAge5	99	1,779	3,763	9,477	22,557	54,819
RickerSalmon_Total	99	7	63	468	2,509	14,384

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
RS4yr	1	1,473	6,830	37,551	206,457	957,277
RickerPDO	3	6,265	12,707	28,481	54,179	120,430
PowerJuvFRDpeak	7	6,487	11,521	23,381	43,510	94,076
RAC	8	6,053	16,679	51,434	158,607	437,022
PowerJuvEi	9	5,854	12,127	24,205	49,557	81,676

Model	Old.Rank	p10	p25	p50	p75	p90
PowerJuvPi	13	4,801	8,635	18,692	39,335	74,030
PowerBasic	14	5,820	11,779	23,438	45,442	78,166
PowerJuv	14	6,324	13,127	27,532	51,135	105,624
RickerBasic	23	5,833	11,776	26,635	52,282	107,625
RS1	31	456	2,119	11,667	64,238	298,244
PowerJuvEiAge4.SiblingAge5	99	14,819	28,291	58,475	117,840	233,234
RickerSalmon_Total	99	261	1,092	5,316	25,793	98,790

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
RS4yr	1	0.75	3.47	19.06	104.78	485.83
RickerPDO	3	2.32	5.31	13.15	37.02	81.00
PowerJuvFRDpeak	7	1.98	4.81	12.29	31.70	74.09
RAC	8	16.22	44.70	137.84	425.07	1171.24
PowerJuvEi	9	1.85	4.12	10.91	26.76	65.64
PowerJuvPi	13	1.59	3.81	9.73	23.93	57.85
PowerBasic	14	2.26	5.33	13.72	34.78	79.93
PowerJuv	14	2.32	5.60	14.56	35.14	74.97
RickerBasic	23	1.96	4.51	10.99	29.18	72.09
RS1	31	0.05	0.25	1.38	7.61	35.31
PowerJuvEiAge4.SiblingAge5	99	1.85	4.12	10.91	26.76	65.64
RickerSalmon_Total	99	0.01	0.09	0.75	3.96	22.17

Age4Prod

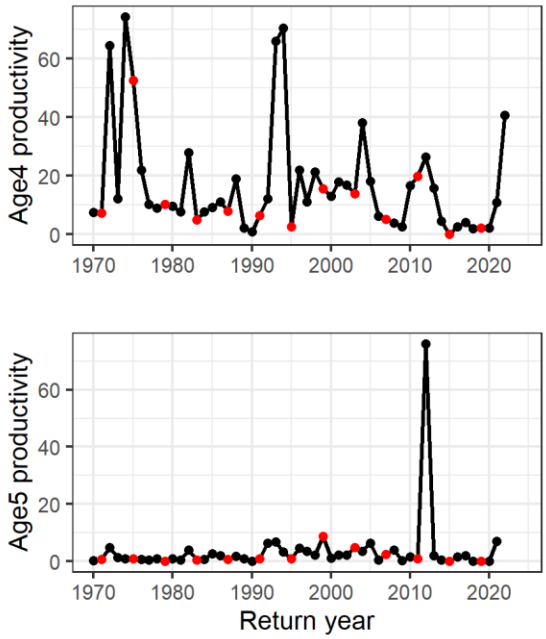
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
RS4yr	1	0.58	2.67	14.66	80.62	373.83
RickerPDO	3	2.21	4.88	11.72	31.57	66.78
PowerJuvFRDpeak	7	1.85	4.40	11.01	27.60	62.45
RAC	8	15.51	42.75	131.83	406.52	1120.11
PowerJuvEi	9	1.75	3.71	9.34	22.22	54.01
PowerJuvPi	13	1.50	3.49	8.63	20.41	48.26
PowerBasic	14	2.16	4.96	12.40	30.71	69.63
PowerJuv	14	2.22	5.19	12.99	29.91	62.79
RickerBasic	23	1.85	4.09	9.46	24.14	59.19
RS1	31	0.00	0.00	0.02	0.09	0.42

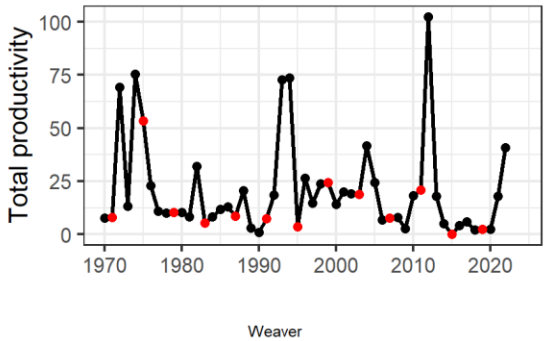
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
PowerJuvEiAge4.SiblingAge5	99	1.75	3.71	9.34	22.22	54.01
RickerSalmon_Total	99	0.01	0.06	0.46	2.47	14.17

Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
RS4yr	1	0.17	0.80	4.39	24.16	112.00
RickerPDO	3	0.11	0.43	1.44	5.45	14.22
PowerJuvFRDpeak	7	0.12	0.41	1.28	4.10	11.64
RAC	8	0.71	1.95	6.02	18.56	51.13
PowerJuvEi	9	0.10	0.41	1.57	4.54	11.63
PowerJuvPi	13	0.09	0.31	1.10	3.52	9.59
PowerBasic	14	0.10	0.37	1.31	4.07	10.30
PowerJuv	14	0.10	0.41	1.57	5.23	12.18
RickerBasic	23	0.11	0.42	1.53	5.04	12.90
RS1	31	0.05	0.25	1.37	7.52	34.89
PowerJuvEiAge4.SiblingAge5	99	0.10	0.41	1.57	4.54	11.63
RickerSalmon_Total	99	0.00	0.03	0.29	1.49	8.00

RawProd

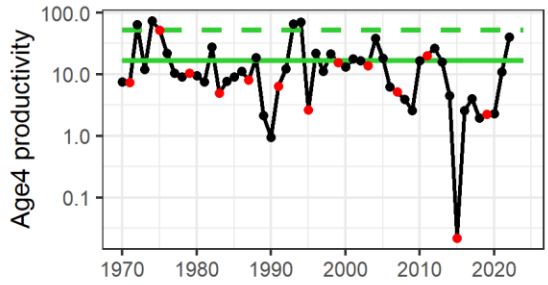


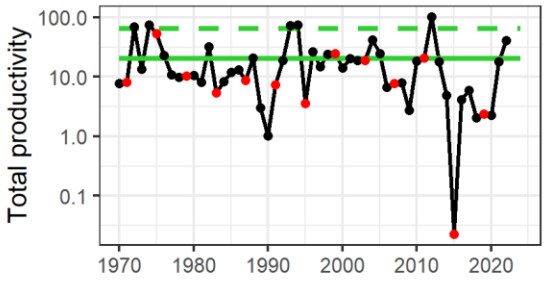


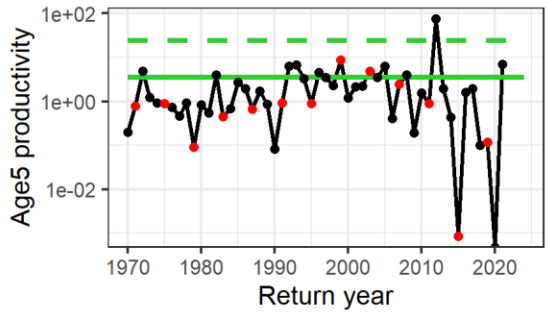
Brood_Year	Eff
2018	8547
2019	1015

	Mean_run_size
1 All Years	299797
2 Cyc Years	160825

logProd







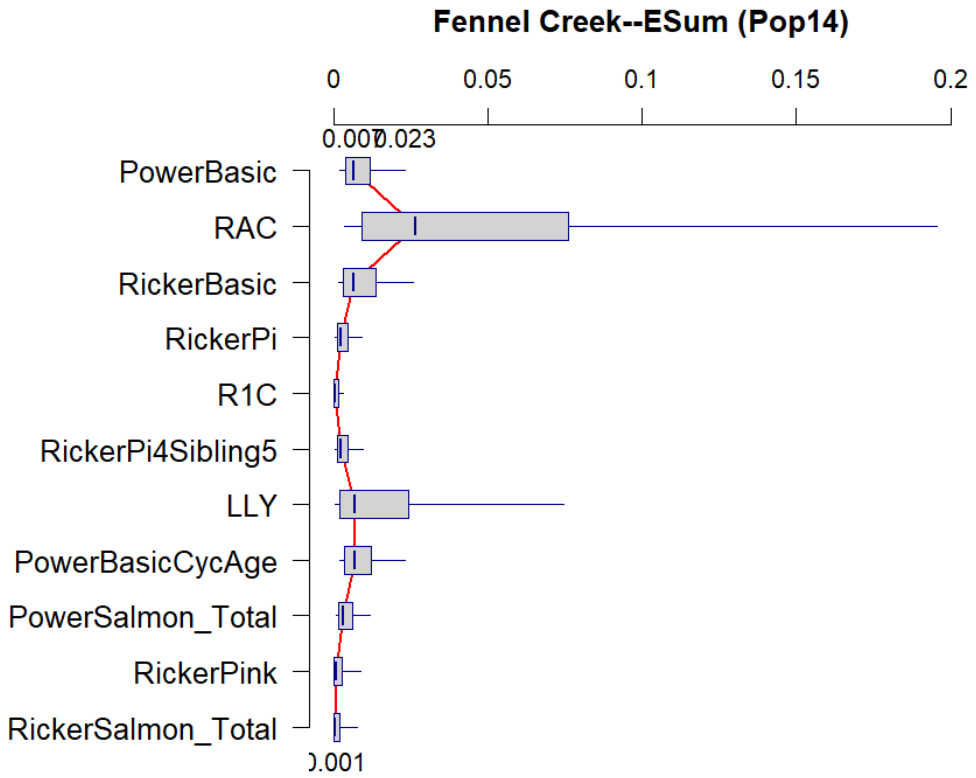
Weaver

Brood_Year	Eff
2018	8547
2019	1015

		Mean_run_size
1	All Years	299797
2	Cyc Years	160825

Upper Barriere(Fennell)

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
PowerBasic	1	2,178	3,732	6,737	11,931	23,288
RAC	2	3,628	9,331	26,653	76,131	195,795
RickerBasic	3	1,775	3,320	6,583	13,783	25,917
RickerPi	6	696	1,196	2,344	4,787	9,335
R1C	8	149	304	676	1,501	3,077
RickerPiAge4.SiblingAge5	99	674	1,264	2,437	4,836	9,455
LLY	99	652	2,002	6,965	24,237	74,457
PowerBasicCycAge	99	1,915	3,466	6,866	12,402	23,108
PowerSalmon_Total	99	976	1,624	3,162	6,370	11,994
RickerPink	99	74	235	938	2,901	8,720
RickerSalmon_Total	99	58	185	621	2,078	7,671

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
PowerBasic	1	676	1,384	3,176	6,963	14,226
RAC	2	2,620	6,738	19,247	54,976	141,387
RickerBasic	3	395	951	2,406	5,449	13,326
RickerPi	6	173	379	831	1,913	4,430
R1C	8	107	220	488	1,084	2,222
RickerPiAge4.SiblingAge5	99	173	379	831	1,913	4,430
LLY	99	470	1,445	5,030	17,502	53,767
PowerBasicCycAge	99	644	1,363	3,088	6,725	14,332
PowerSalmon_Total	99	96	182	361	725	1,351
RickerPink	99	1	4	17	65	192
RickerSalmon_Total	99	1	5	21	99	341

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
PowerBasic	1	1,502	2,348	3,561	4,968	9,063
RAC	2	1,008	2,593	7,406	21,155	54,408
RickerBasic	3	1,380	2,369	4,177	8,334	12,591
RickerPi	6	523	817	1,513	2,874	4,905
R1C	8	41	85	188	417	855
RickerPiAge4.SiblingAge5	99	500	885	1,606	2,923	5,024
LLY	99	181	556	1,935	6,735	20,690
PowerBasicCycAge	99	1,271	2,102	3,778	5,678	8,775
PowerSalmon_Total	99	881	1,441	2,800	5,645	10,643
RickerPink	99	73	231	921	2,836	8,528
RickerSalmon_Total	99	57	181	600	1,979	7,331

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
PowerBasic	1	2.77	5.73	13.44	29.66	61.26
RAC	2	10.67	27.45	78.41	223.97	576.02
RickerBasic	3	1.71	4.23	10.90	24.99	61.13
RickerPi	6	0.75	1.69	3.77	8.92	20.70
R1C	8	0.44	0.90	1.99	4.42	9.05
RickerPiAge4.SiblingAge5	99	1.01	2.07	4.29	9.34	20.39
LLY	99	1.92	5.89	20.49	71.30	219.05

Model	Old.Rank	p10	p25	p50	p75	p90
PowerBasicCycAge	99	2.61	5.63	13.01	28.75	61.90
PowerSalmon_Total	99	0.68	1.40	3.07	6.67	12.91
RickerPink	99	0.03	0.13	0.65	2.18	6.74
RickerSalmon_Total	99	0.02	0.07	0.38	1.66	6.33

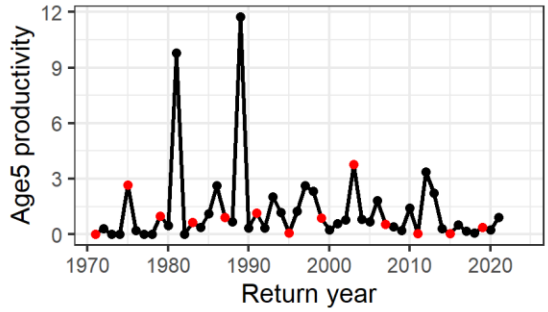
Age4Prod

Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
PowerBasic	1	2.57	5.26	12.08	26.47	54.09
RAC	2	9.96	25.62	73.18	209.03	537.59
RickerBasic	3	1.50	3.62	9.15	20.72	50.67
RickerPi	6	0.66	1.44	3.16	7.27	16.85
R1C	8	0.41	0.84	1.86	4.12	8.45
RickerPiAge4.SiblingAge5	99	0.66	1.44	3.16	7.27	16.85
LLY	99	1.79	5.50	19.12	66.55	204.44
PowerBasicCycAge	99	2.45	5.18	11.74	25.57	54.49
PowerSalmon_Total	99	0.36	0.69	1.37	2.76	5.14
RickerPink	99	0.00	0.01	0.06	0.25	0.73
RickerSalmon_Total	99	0.00	0.02	0.08	0.38	1.30

Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
PowerBasic	1	0.20	0.47	1.36	3.18	7.17
RAC	2	0.71	1.83	5.23	14.94	38.42
RickerBasic	3	0.21	0.61	1.75	4.27	10.46
RickerPi	6	0.09	0.25	0.61	1.65	3.86
R1C	8	0.03	0.06	0.13	0.29	0.60
RickerPiAge4.SiblingAge5	99	0.35	0.63	1.13	2.06	3.55
LLY	99	0.13	0.39	1.37	4.76	14.61
PowerBasicCycAge	99	0.16	0.44	1.27	3.18	7.40
PowerSalmon_Total	99	0.31	0.71	1.69	3.91	7.77
RickerPink	99	0.03	0.11	0.59	1.93	6.01
RickerSalmon_Total	99	0.02	0.06	0.30	1.29	5.04

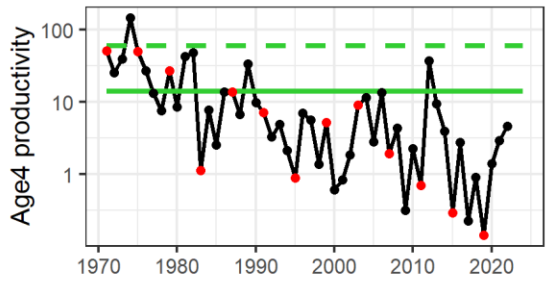
RawProd

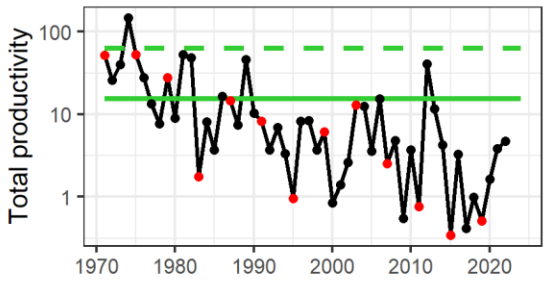


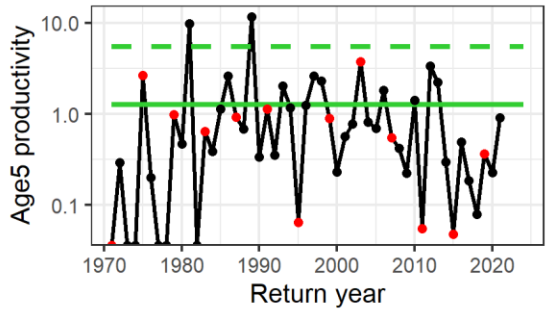
Upper Barriere(Fennell)

Brood_Year	Eff		Mean_run_size
2018	1416	*1* All Years	20219
2019	263	*2* Cyc Years	25612

logProd





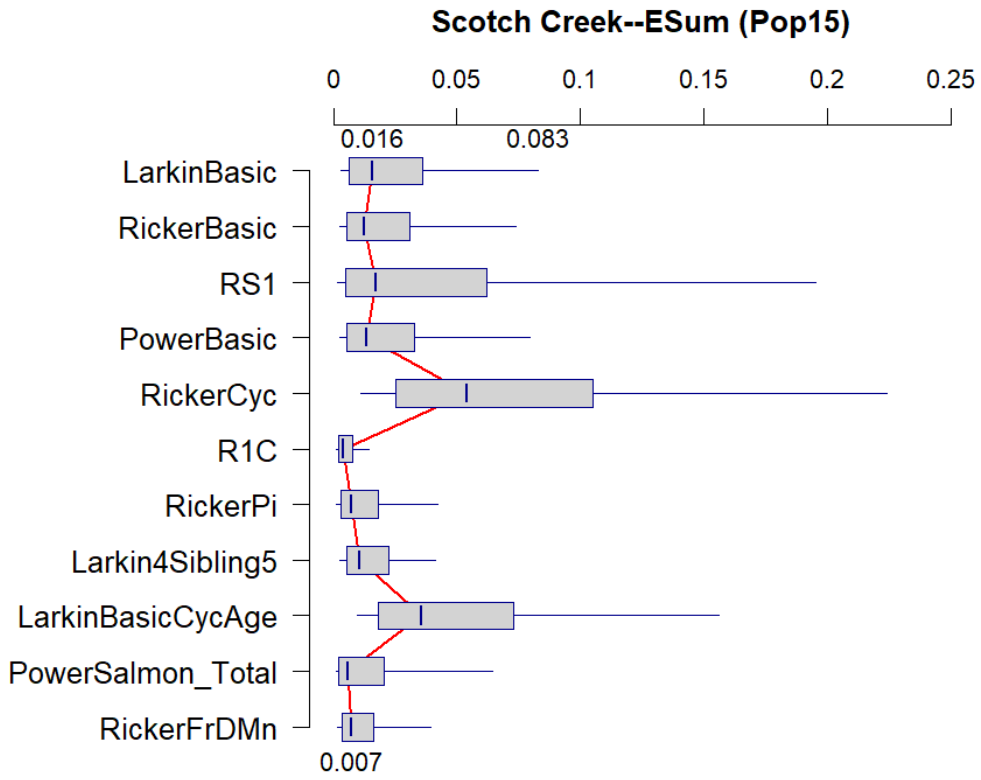


Upper Barriere(Fennell)

Brood_Year	Eff		Mean_run_size
2018	1416	*1* All Years	20219
2019	263	*2* Cyc Years	25612

Scotch

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	2,973	6,205	15,561	35,958	82,997
RickerBasic	2	2,499	5,529	12,597	30,856	74,026
RS1	3	1,519	4,799	17,231	61,866	195,482
PowerBasic	10	2,558	5,578	13,330	32,547	79,664
RickerCyc	11	11,120	25,356	53,935	105,240	224,138
R1C	13	1,059	1,959	3,881	7,688	14,222
RickerPi	16	1,344	2,947	7,452	17,986	42,329
LarkinBasicAge4.SiblingAge5	99	2,679	5,145	10,734	22,520	41,508
LarkinBasicCycAge	99	9,662	17,904	35,727	73,112	155,940
PowerSalmon_Total	99	935	2,122	5,828	20,448	64,361
RickerFRDMean	99	1,691	3,488	7,351	16,163	39,628

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
LarkinBasic	1	1,362	2,764	5,999	13,271	24,106
RickerBasic	2	1,044	2,427	5,441	13,168	28,264
RS1	3	35	111	397	1,426	4,506
PowerBasic	10	1,329	2,719	6,316	15,135	35,108
RickerCyc	11	277	940	3,324	10,682	34,711
R1C	13	633	1,170	2,318	4,592	8,496
RickerPi	16	713	1,424	3,176	7,143	16,036
LarkinBasicAge4.SiblingAge5	99	1,362	2,764	5,999	13,271	24,106
LarkinBasicCycAge	99	1,262	2,460	5,584	12,686	21,642
PowerSalmon_Total	99	261	537	1,257	2,636	5,146
RickerFRDMean	99	880	1,648	3,731	7,573	16,034

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	1,611	3,441	9,562	22,687	58,891
RickerBasic	2	1,455	3,102	7,156	17,688	45,762
RS1	3	1,484	4,688	16,834	60,440	190,976
PowerBasic	10	1,229	2,859	7,015	17,412	44,556
RickerCyc	11	10,842	24,416	50,611	94,558	189,427
R1C	13	426	789	1,563	3,095	5,726
RickerPi	16	630	1,523	4,276	10,843	26,293
LarkinBasicAge4.SiblingAge5	99	1,316	2,381	4,735	9,249	17,402
LarkinBasicCycAge	99	8,400	15,444	30,143	60,426	134,298
PowerSalmon_Total	99	674	1,585	4,571	17,812	59,215
RickerFRDMean	99	811	1,840	3,620	8,589	23,595

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	1.37	2.79	6.15	14.02	26.52
RickerBasic	2	1.05	2.45	5.55	13.66	30.02
RS1	3	0.09	0.27	0.97	3.50	11.05
PowerBasic	10	1.34	2.74	6.41	15.60	36.89
RickerCyc	11	0.47	1.51	4.75	13.76	41.37

Model	Old.Rank	p10	p25	p50	p75	p90
R1C	13	0.65	1.21	2.39	4.73	8.76
RickerPi	16	0.72	1.44	3.25	7.45	17.16
LarkinBasicAge4.SiblingAge5	99	1.42	2.87	6.21	13.69	24.89
LarkinBasicCycAge	99	1.37	2.77	6.44	14.92	26.78
PowerSalmon_Total	99	0.26	0.55	1.35	3.25	7.28
RickerFRDMean	99	0.89	1.66	3.80	7.87	16.90

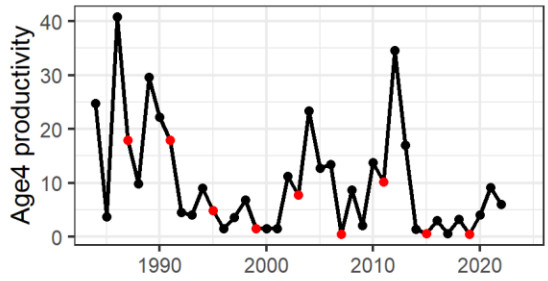
Age4Prod

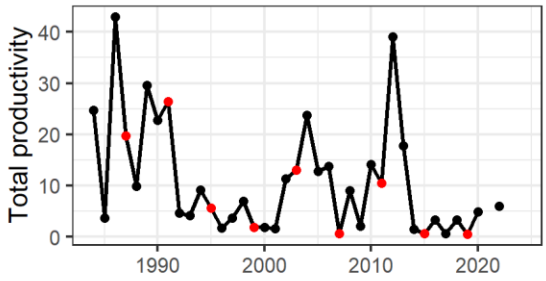
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
LarkinBasic	1	1.37	2.79	6.05	13.38	24.30
RickerBasic	2	1.05	2.45	5.48	13.27	28.49
RS1	3	0.04	0.11	0.40	1.44	4.54
PowerBasic	10	1.34	2.74	6.37	15.26	35.39
RickerCyc	11	0.28	0.95	3.35	10.77	34.99
R1C	13	0.64	1.18	2.34	4.63	8.56
RickerPi	16	0.72	1.44	3.20	7.20	16.17
LarkinBasicAge4.SiblingAge5	99	1.37	2.79	6.05	13.38	24.30
LarkinBasicCycAge	99	1.27	2.48	5.63	12.79	21.82
PowerSalmon_Total	99	0.26	0.54	1.27	2.66	5.19
RickerFRDMean	99	0.89	1.66	3.76	7.63	16.16

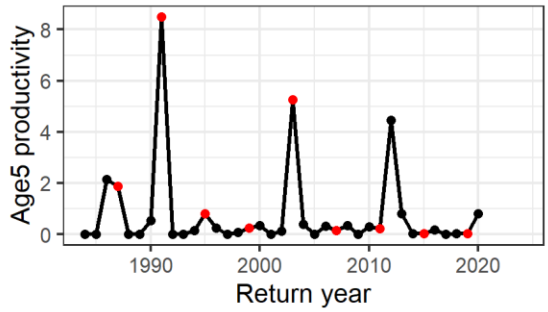
Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	0.00	0.01	0.11	0.64	2.22
RickerBasic	2	0.00	0.00	0.07	0.39	1.53
RS1	3	0.05	0.16	0.57	2.06	6.51
PowerBasic	10	0.00	0.00	0.04	0.35	1.49
RickerCyc	11	0.19	0.56	1.40	2.99	6.38
R1C	13	0.01	0.03	0.05	0.11	0.20
RickerPi	16	0.00	0.00	0.04	0.25	0.99
LarkinBasicAge4.SiblingAge5	99	0.04	0.08	0.16	0.32	0.59
LarkinBasicCycAge	99	0.10	0.29	0.81	2.13	4.97
PowerSalmon_Total	99	0.00	0.01	0.09	0.59	2.09
RickerFRDMean	99	0.00	0.00	0.03	0.23	0.73

RawProd





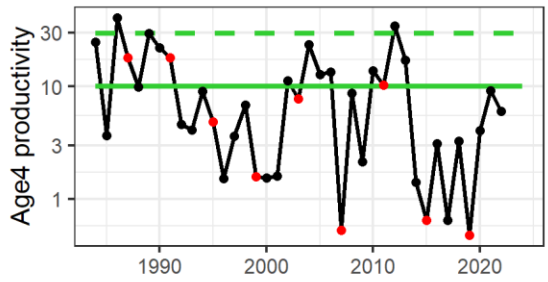


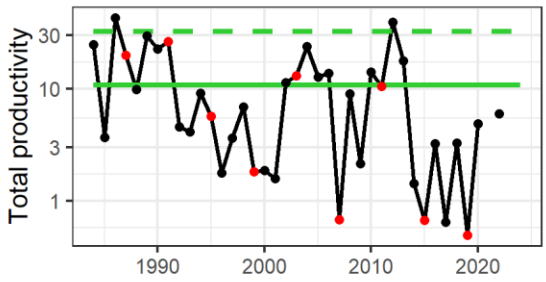
Scotch

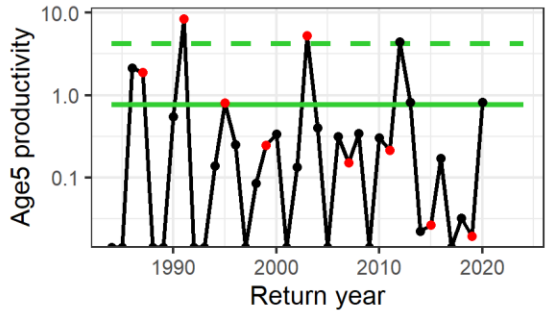
Brood_Year	Eff
2018	29348
2019	992

		Mean_run_size
1	All Years	104683
2	Cyc Years	17860

logProd







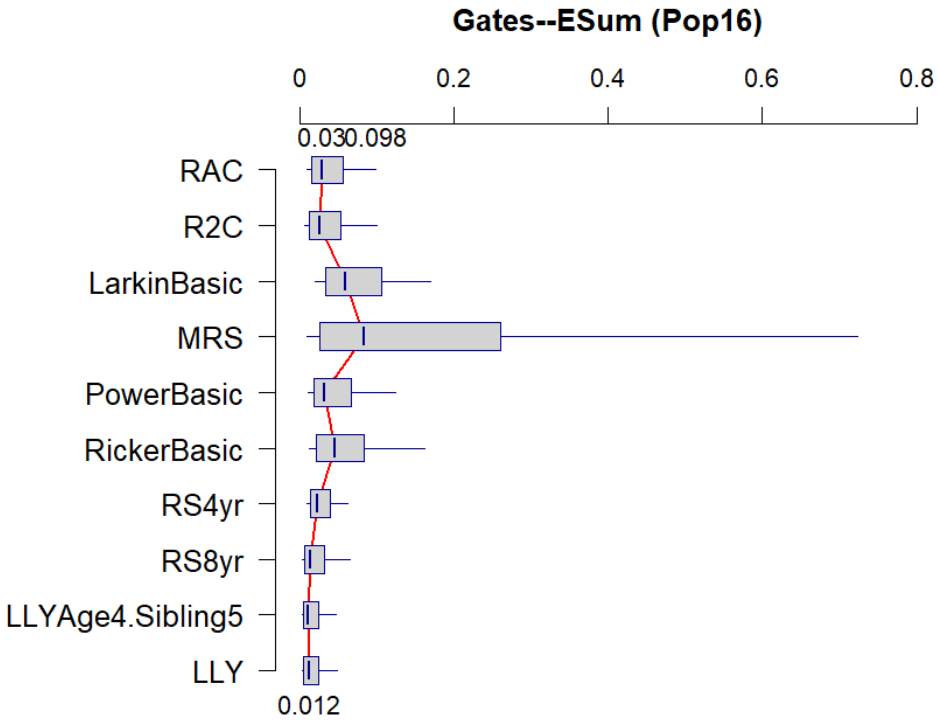
Scotch

Brood_Year	Eff
2018	29348
2019	992

		Mean_run_size
1	All Years	104683
2	Cyc Years	17860

Gates

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
RAC	1	9,057	15,937	29,861	55,949	98,453
R2C	2	6,590	12,567	25,746	52,749	100,593
LarkinBasic	3	20,367	33,937	58,931	106,181	169,676
MRS	3	9,648	26,820	83,520	260,088	722,986
PowerBasic	6	10,402	17,949	32,771	67,798	124,550
RickerBasic	9	12,286	22,291	45,552	83,811	162,523
RS4yr	11	9,214	14,473	23,902	39,474	62,003
RS8yr	16	3,257	6,615	14,535	31,935	64,856
LLYAge4.SiblingAge5	99	2,881	5,603	11,721	24,533	47,562
LLY	99	2,945	5,718	11,955	24,993	48,538

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
RAC	1	8,307	14,618	27,390	51,320	90,307
R2C	2	6,045	11,527	23,616	48,385	92,270
LarkinBasic	3	18,076	31,762	55,581	102,475	167,208

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
MRS	3	9,375	26,060	81,153	252,716	702,494
PowerBasic	6	7,910	14,438	28,952	62,054	118,446
RickerBasic	9	10,365	18,800	41,272	81,076	154,854
RS4yr	11	9,004	14,143	23,357	38,574	60,589
RS8yr	16	3,173	6,445	14,160	31,111	63,183
LLYAge4.SiblingAge5	99	2,701	5,245	10,966	22,925	44,522
LLY	99	2,701	5,245	10,966	22,925	44,522

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
RAC	1	749	1,319	2,471	4,629	8,146
R2C	2	545	1,040	2,130	4,364	8,323
LarkinBasic	3	2,291	2,174	3,349	3,706	2,468
MRS	3	273	760	2,367	7,372	20,492
PowerBasic	6	2,492	3,511	3,819	5,744	6,104
RickerBasic	9	1,921	3,490	4,280	2,735	7,669
RS4yr	11	210	330	545	900	1,414
RS8yr	16	84	171	375	824	1,673
LLYAge4.SiblingAge5	99	180	357	755	1,608	3,040
LLY	99	244	473	989	2,068	4,016

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
RAC	1	2.15	3.78	7.08	13.27	23.35
R2C	2	1.56	2.98	6.11	12.51	23.86
LarkinBasic	3	3.79	6.79	12.12	22.94	38.04
MRS	3	2.06	5.73	17.84	55.54	154.40
PowerBasic	6	1.74	3.29	6.83	15.08	29.75
RickerBasic	9	2.22	4.16	9.28	18.73	36.53
RS4yr	11	1.95	3.06	5.05	8.34	13.09
RS8yr	16	0.69	1.41	3.09	6.78	13.78
LLYAge4.SiblingAge5	99	0.66	1.28	2.69	5.64	10.89
LLY	99	0.70	1.36	2.84	5.93	11.51

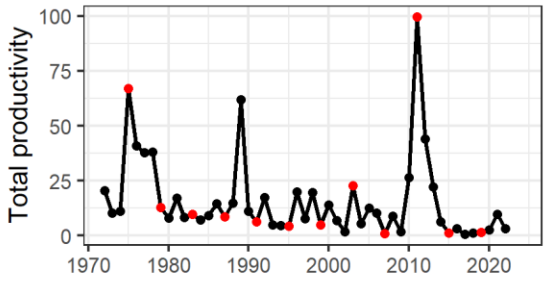
Age4Prod

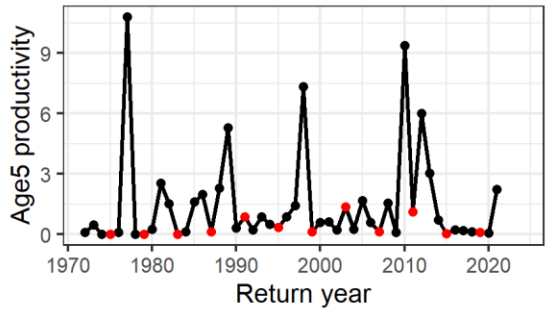
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
RAC	1	1.67	2.94	5.51	10.33	18.17
R2C	2	1.22	2.32	4.75	9.74	18.57
LarkinBasic	3	3.64	6.39	11.19	20.62	33.65
MRS	3	1.89	5.24	16.33	50.86	141.38
PowerBasic	6	1.59	2.91	5.83	12.49	23.84
RickerBasic	9	2.09	3.78	8.31	16.32	31.16
RS4yr	11	1.81	2.85	4.70	7.76	12.19
RS8yr	16	0.64	1.30	2.85	6.26	12.72
LLYAge4.SiblingAge5	99	0.54	1.06	2.21	4.61	8.96
LLY	99	0.54	1.06	2.21	4.61	8.96

Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
RAC	1	0.48	0.84	1.57	2.94	5.18
R2C	2	0.35	0.66	1.35	2.77	5.29
LarkinBasic	3	0.15	0.39	0.94	2.31	4.39
MRS	3	0.17	0.48	1.50	4.69	13.03
PowerBasic	6	0.15	0.38	1.00	2.59	5.91
RickerBasic	9	0.13	0.38	0.98	2.41	5.36
RS4yr	11	0.13	0.21	0.35	0.57	0.90
RS8yr	16	0.05	0.11	0.24	0.52	1.06
LLYAge4.SiblingAge5	99	0.11	0.23	0.48	1.02	1.93
LLY	99	0.15	0.30	0.63	1.31	2.55

RawProd

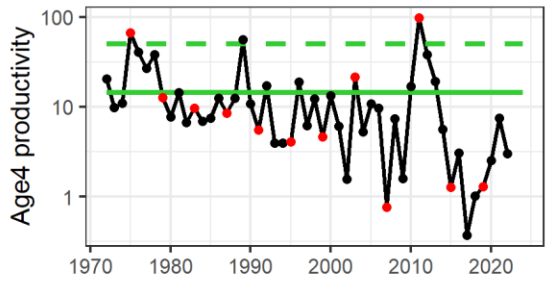


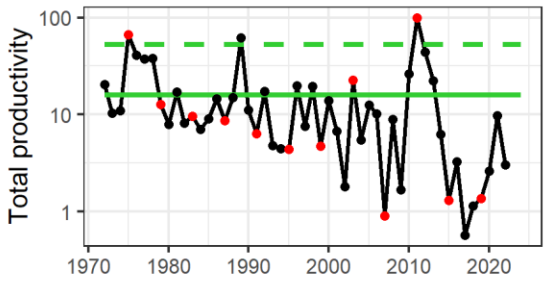


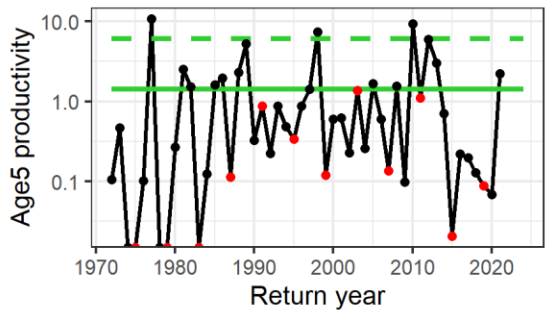
Gates

Brood_Year	Eff		Mean_run_size
2018	1573	1 All Years	48712
2019	4969	2 Cyc Years	27846

logProd





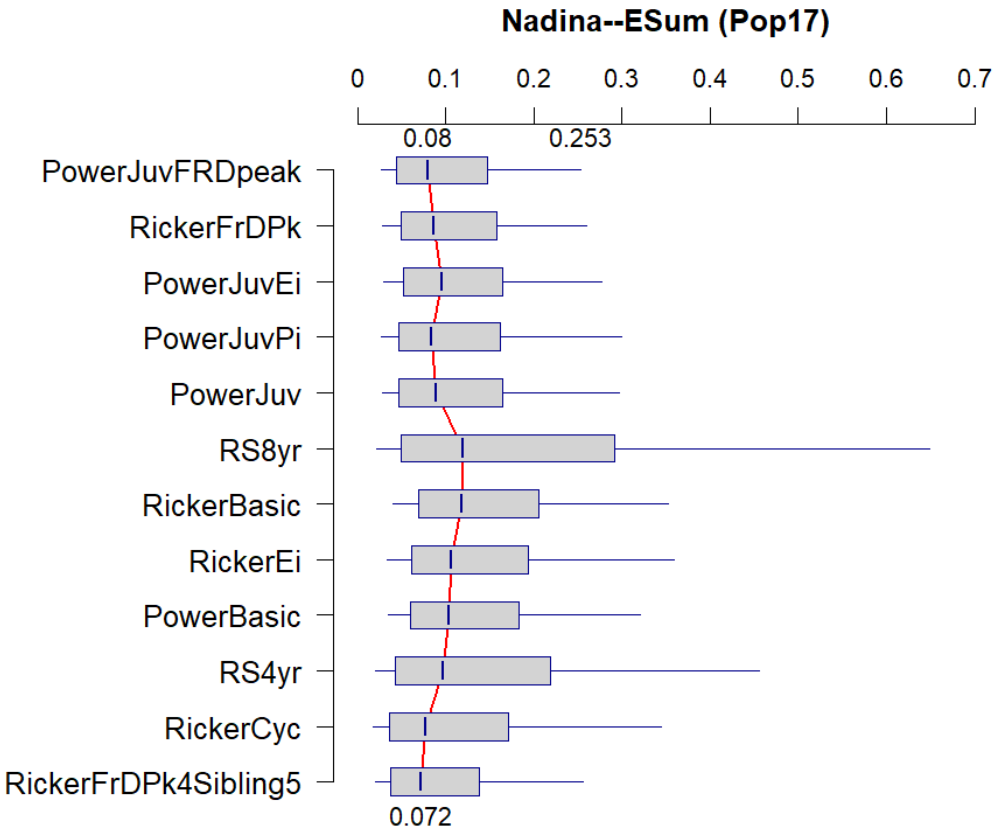


Gates

Brood_Year	Eff		Mean_run_size
2018	1573	1 All Years	48712
2019	4969	2 Cyc Years	27846

Nadina

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
PowerJuvFRDpeak	2	26,957	44,683	80,316	147,311	253,466
RickerFRDpeak	2	27,948	48,929	86,617	157,506	260,518
PowerJuvEi	5	29,356	52,031	96,194	164,843	277,090
PowerJuvPi	5	27,252	46,973	84,499	162,264	300,210
PowerJuv	8	28,280	47,260	89,101	164,143	297,513
RS8yr	14	21,982	49,019	119,498	291,308	649,617
RickerBasic	15	40,155	69,040	118,412	205,146	353,057
RickerEi	16	34,025	60,954	106,649	194,200	359,008
PowerBasic	20	34,980	60,276	104,281	183,636	320,904
RS4yr	24	20,713	43,064	97,119	219,021	455,366
RickerCyc	27	17,492	36,327	76,890	171,610	345,186
RickerFrDPk60kAge4.SiblingAge5	99	20,323	37,291	71,751	138,378	256,458

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
PowerJuvFRDpeak	2	8,238	14,020	26,451	51,296	89,692
RickerFRDpeak	2	10,059	18,533	35,617	69,940	126,518
PowerJuvEi	5	9,356	16,999	31,447	61,539	104,200
PowerJuvPi	5	8,512	15,321	29,258	55,081	94,391
PowerJuv	8	9,132	17,683	32,501	57,660	100,912
RS8yr	14	5,896	13,148	32,052	78,136	174,243
RickerBasic	15	12,382	22,598	46,376	82,465	149,369
RickerEi	16	12,049	21,741	41,219	82,934	150,728
PowerBasic	20	11,009	21,169	42,790	77,180	136,775
RS4yr	24	7,019	14,593	32,910	74,219	154,308
RickerCyc	27	6,834	14,321	32,386	73,865	159,367
RickerFrDPk60kAge4.SiblingAge5	99	10,059	18,533	35,617	69,940	126,518

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
PowerJuvFRDpeak	2	18,719	30,662	53,865	96,014	163,774
RickerFRDpeak	2	17,889	30,396	51,000	87,567	134,000
PowerJuvEi	5	20,000	35,032	64,747	103,305	172,891
PowerJuvPi	5	18,740	31,652	55,241	107,183	205,818
PowerJuv	8	19,148	29,577	56,601	106,483	196,601
RS8yr	14	16,086	35,871	87,445	213,172	475,374
RickerBasic	15	27,774	46,442	72,036	122,682	203,688
RickerEi	16	21,976	39,213	65,430	111,267	208,280
PowerBasic	20	23,971	39,107	61,491	106,456	184,129
RS4yr	24	13,694	28,471	64,208	144,802	301,058
RickerCyc	27	10,658	22,006	44,505	97,745	185,819
RickerFrDPk60kAge4.SiblingAge5	99	10,264	18,758	36,133	68,438	129,940

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
PowerJuvFRDpeak	2	3.23	5.35	9.62	17.64	30.35
RickerFRDpeak	2	1.04	1.85	3.77	7.83	14.24
PowerJuvEi	5	1.17	2.23	4.45	9.13	16.21
PowerJuvPi	5	1.06	2.01	4.11	8.36	15.31
PowerJuv	8	1.14	2.30	4.49	8.72	16.30
RS8yr	14	0.98	2.19	5.34	13.03	29.06

Model	Old.Rank	p10	p25	p50	p75	p90
RickerBasic	15	1.53	2.91	6.31	11.86	22.62
RickerEi	16	1.48	2.78	5.57	11.66	22.48
PowerBasic	20	1.37	2.73	5.76	10.99	20.28
RS4yr	24	1.08	2.24	5.05	11.38	23.66
RickerCyc	27	0.82	1.73	4.11	10.10	22.47
RickerFrDPk60kAge4.SiblingAge5	99	1.24	2.36	4.77	9.77	18.28

Age4Prod

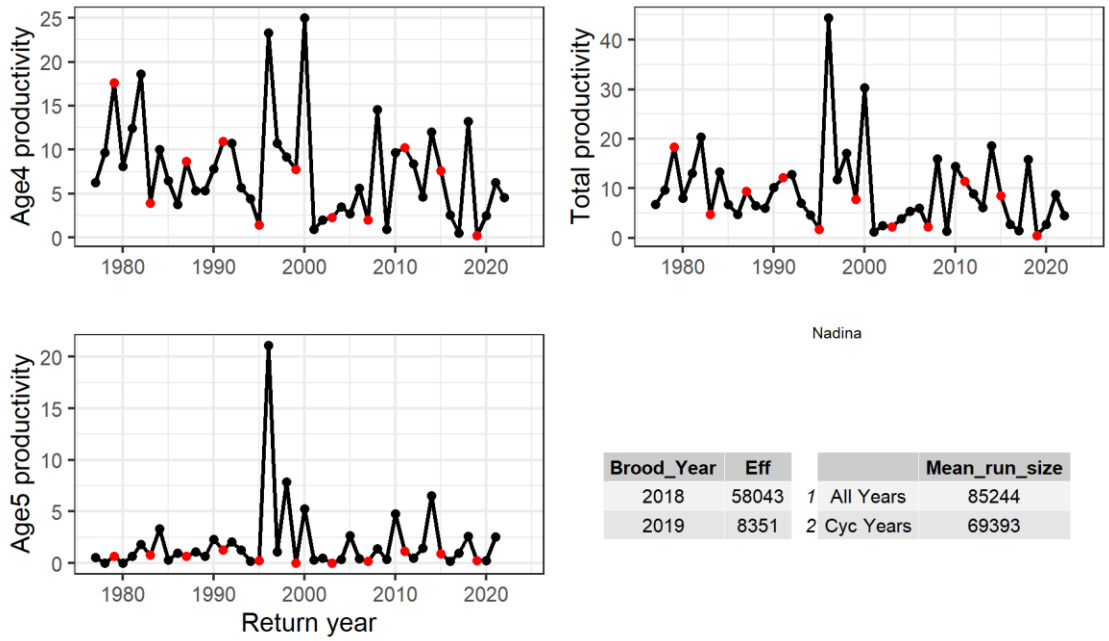
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
PowerJuvFRDpeak	2	0.99	1.68	3.17	6.14	10.74
RickerFRDpeak	2	1.20	2.22	4.27	8.37	15.15
PowerJuvEi	5	1.12	2.04	3.77	7.37	12.48
PowerJuvPi	5	1.02	1.83	3.50	6.60	11.30
PowerJuv	8	1.09	2.12	3.89	6.90	12.08
RS8yr	14	0.71	1.57	3.84	9.36	20.86
RickerBasic	15	1.48	2.71	5.55	9.87	17.89
RickerEi	16	1.44	2.60	4.94	9.93	18.05
PowerBasic	20	1.32	2.53	5.12	9.24	16.38
RS4yr	24	0.84	1.75	3.94	8.89	18.48
RickerCyc	27	0.82	1.71	3.88	8.85	19.08
RickerFrDPk60kAge4.SiblingAge5	99	1.20	2.22	4.27	8.37	15.15

Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
PowerJuvFRDpeak	2	0.06	0.17	0.60	1.69	3.50
RickerFRDpeak	2	0.03	0.14	0.51	1.40	3.13
PowerJuvEi	5	0.05	0.19	0.68	1.77	3.74
PowerJuvPi	5	0.04	0.18	0.61	1.76	4.00
PowerJuv	8	0.04	0.18	0.60	1.81	4.21
RS8yr	14	0.28	0.62	1.51	3.67	8.19
RickerBasic	15	0.05	0.20	0.76	1.99	4.73
RickerEi	16	0.03	0.18	0.64	1.72	4.43
PowerBasic	20	0.05	0.20	0.63	1.74	3.90
RS4yr	24	0.24	0.49	1.11	2.49	5.19
RickerCyc	27	0.00	0.02	0.24	1.25	3.39

Model	Old.Rank	p10	p25	p50	p75	p90
RickerFrDPk60kAge4.SiblingAge5	99	0.03	0.14	0.51	1.40	3.13

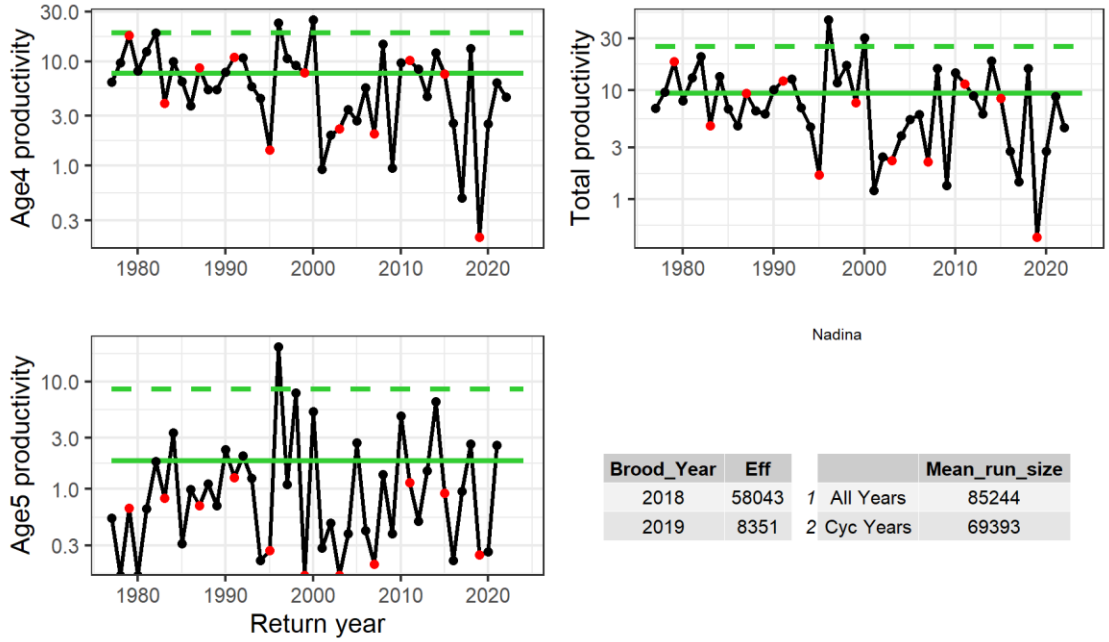
RawProd



Brood_Year	Eff
2018	58043
2019	8351

		Mean_run_size
1	All Years	85244
2	Cyc Years	69393

logProd

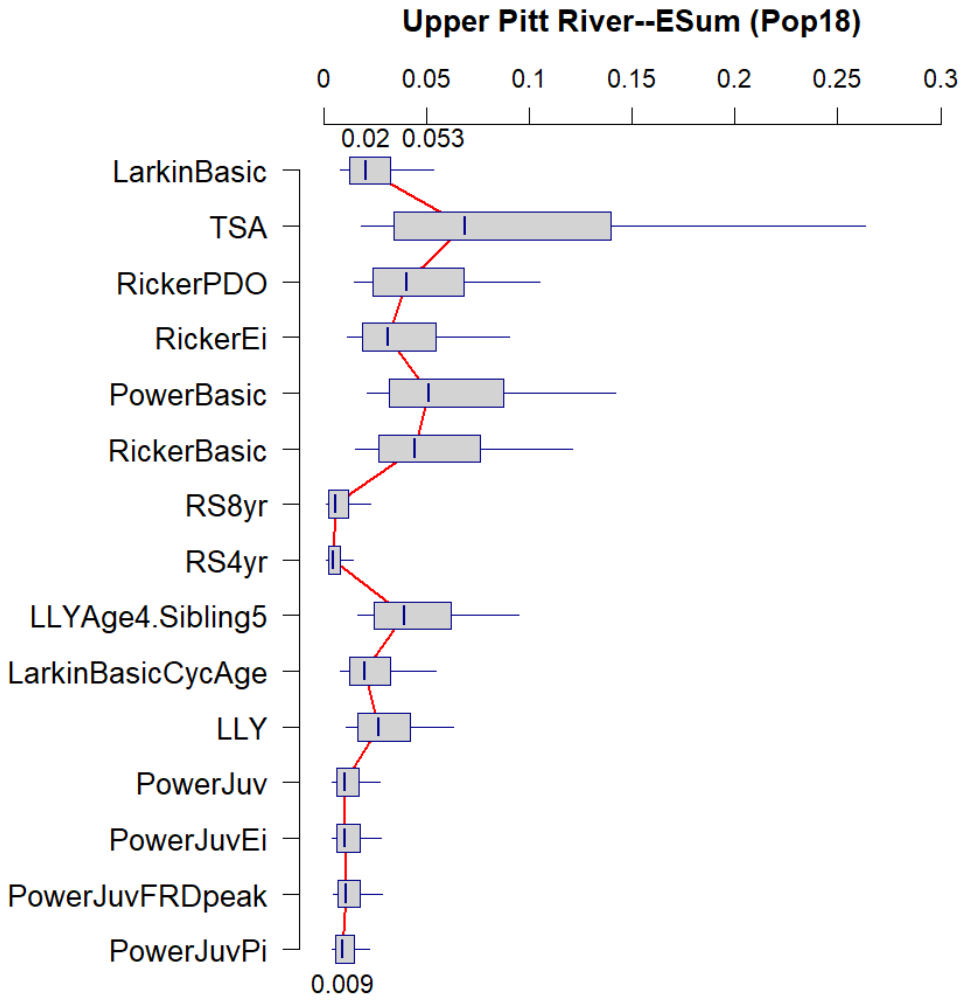


Brood_Year	Eff
2018	58043
2019	8351

		Mean_run_size
1	All Years	85244
2	Cyc Years	69393

Pitt

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	8,044	12,799	20,370	32,422	53,305
TSA	2	18,135	34,176	69,099	139,711	263,283
RickerPDO	3	15,011	23,896	40,601	68,198	104,923
RickerEi	4	11,565	18,958	31,418	54,681	90,375
PowerBasic	5	21,229	31,815	51,230	87,819	142,254
RickerBasic	9	15,403	26,835	44,601	76,396	121,298
RS8yr	16	1,405	2,728	5,704	11,926	23,161
RS4yr	17	1,425	2,468	4,546	8,374	14,509
LLYAge4.SiblingAge5	99	16,405	24,756	39,279	62,214	94,855

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasicCycAge	99	7,957	12,673	20,204	32,811	54,545
LLY	99	11,215	16,900	26,654	42,036	63,344
PowerJuv	99	3,927	6,214	10,405	17,438	27,284
PowerJuvEi	99	4,371	6,592	10,406	17,737	28,197
PowerJuvFRDpeak	99	4,459	6,719	10,744	17,641	28,692
PowerJuvPi	99	4,211	5,955	9,287	15,054	22,507

Age4FC

Model	Old.Rank	p10.age4	p25.age4	p50.age4	p75.age4	p90.age4
LarkinBasic	1	430	894	1,895	3,655	6,434
TSA	2	7,070	13,323	26,938	54,465	102,639
RickerPDO	3	721	1,498	3,089	6,306	11,624
RickerEi	4	552	1,073	2,143	4,135	8,411
PowerBasic	5	1,640	3,625	7,431	15,263	27,214
RickerBasic	9	750	1,359	2,835	5,608	10,892
RS8yr	16	171	333	696	1,455	2,825
RS4yr	17	260	450	830	1,528	2,647
LLYAge4.SiblingAge5	99	4,372	6,589	10,391	16,388	24,694
LarkinBasicCycAge	99	314	660	1,344	2,960	5,252
LLY	99	4,372	6,589	10,391	16,388	24,694
PowerJuv	99	357	723	1,497	2,954	5,439
PowerJuvEi	99	387	739	1,549	2,950	5,488
PowerJuvFRDpeak	99	380	765	1,702	3,159	5,666
PowerJuvPi	99	403	756	1,485	2,898	5,124

Age5FC

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	7,614	11,904	18,475	28,767	46,871
TSA	2	11,065	20,853	42,162	85,246	160,644
RickerPDO	3	14,290	22,398	37,512	61,892	93,299
RickerEi	4	11,013	17,885	29,275	50,546	81,964
PowerBasic	5	19,590	28,190	43,799	72,556	115,040
RickerBasic	9	14,653	25,476	41,765	70,788	110,406
RS8yr	16	1,233	2,395	5,008	10,471	20,336
RS4yr	17	1,165	2,018	3,717	6,846	11,862
LLYAge4.SiblingAge5	99	12,033	18,167	28,888	45,827	70,161
LarkinBasicCycAge	99	7,643	12,013	18,860	29,851	49,293

Model	Old.Rank	p10	p25	p50	p75	p90
LLY	99	6,843	10,312	16,263	25,649	38,650
PowerJuv	99	3,570	5,491	8,908	14,484	21,845
PowerJuvEi	99	3,985	5,853	8,857	14,787	22,709
PowerJuvFRDpeak	99	4,079	5,953	9,041	14,481	23,026
PowerJuvPi	99	3,807	5,199	7,802	12,156	17,383

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	1.02	1.82	3.33	5.84	10.07
TSA	2	4.98	9.38	18.96	38.33	72.24
RickerPDO	3	1.90	3.33	6.43	11.57	19.83
RickerEi	4	1.52	2.68	4.87	9.01	15.89
PowerBasic	5	2.60	4.77	8.99	17.32	30.96
RickerBasic	9	1.94	3.68	6.95	12.48	21.77
RS8yr	16	0.26	0.50	1.04	2.17	4.22
RS4yr	17	0.29	0.50	0.92	1.70	2.95
LLYAge4.SiblingAge5	99	7.94	11.98	19.01	30.11	45.91
LarkinBasicCycAge	99	0.99	1.83	3.12	5.62	9.93
LLY	99	3.08	4.64	7.31	11.53	17.38
PowerJuv	99	0.54	0.95	1.84	3.44	5.95
PowerJuvEi	99	0.60	0.99	1.83	3.42	6.37
PowerJuvFRDpeak	99	0.58	1.02	1.92	3.57	6.31
PowerJuvPi	99	0.57	0.94	1.66	3.13	5.29

Age4Prod

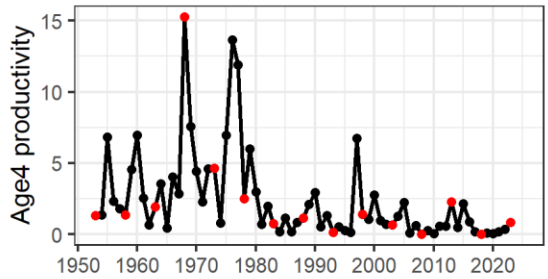
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
LarkinBasic	1	0.21	0.43	0.92	1.77	3.11
TSA	2	3.42	6.45	13.04	26.36	49.68
RickerPDO	3	0.35	0.72	1.50	3.05	5.63
RickerEi	4	0.27	0.52	1.04	2.00	4.07
PowerBasic	5	0.79	1.75	3.60	7.39	13.17
RickerBasic	9	0.36	0.66	1.37	2.71	5.27
RS8yr	16	0.08	0.16	0.34	0.70	1.37
RS4yr	17	0.13	0.22	0.40	0.74	1.28
LLYAge4.SiblingAge5	99	2.12	3.19	5.03	7.93	11.95
LarkinBasicCycAge	99	0.15	0.32	0.65	1.43	2.54

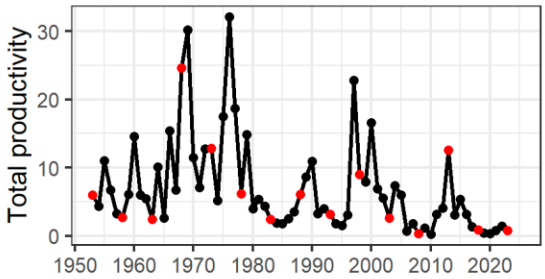
Model	Old.Rank	p10.age4.prod	p25.age4.prod	p50.age4.prod	p75.age4.prod	p90.age4.prod
LLY	99	2.12	3.19	5.03	7.93	11.95
PowerJuv	99	0.17	0.35	0.72	1.43	2.63
PowerJuvEi	99	0.19	0.36	0.75	1.43	2.66
PowerJuvFRDpeak	99	0.18	0.37	0.82	1.53	2.74
PowerJuvPi	99	0.20	0.37	0.72	1.40	2.48

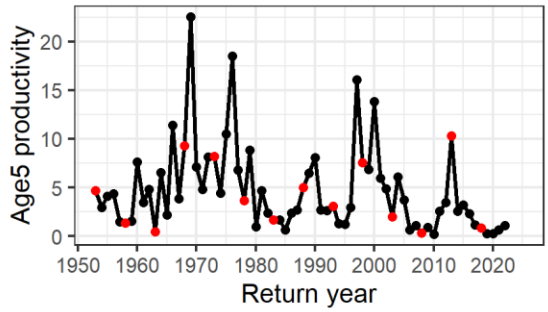
Age5Prod

Model	Old.Rank	p10	p25	p50	p75	p90
LarkinBasic	1	0.81	1.39	2.42	4.07	6.95
TSA	2	1.55	2.93	5.92	11.97	22.56
RickerPDO	3	1.56	2.60	4.94	8.52	14.20
RickerEi	4	1.25	2.16	3.83	7.00	11.82
PowerBasic	5	1.81	3.02	5.40	9.93	17.79
RickerBasic	9	1.58	3.02	5.57	9.77	16.50
RS8yr	16	0.17	0.34	0.70	1.47	2.86
RS4yr	17	0.16	0.28	0.52	0.96	1.67
LLYAge4.SiblingAge5	99	0.96	1.45	2.28	3.60	5.43
LarkinBasicCycAge	99	0.84	1.51	2.47	4.19	7.38
LLY	99	0.96	1.45	2.28	3.60	5.43
PowerJuv	99	0.37	0.59	1.12	2.01	3.32
PowerJuvEi	99	0.41	0.63	1.08	1.99	3.71
PowerJuvFRDpeak	99	0.40	0.65	1.10	2.04	3.57
PowerJuvPi	99	0.38	0.57	0.94	1.72	2.81

RawProd







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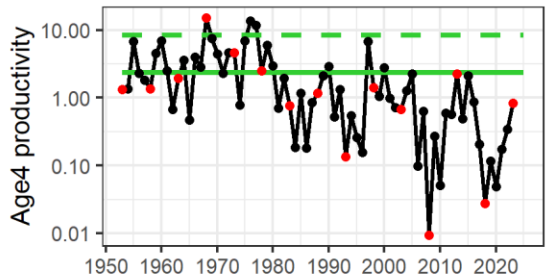
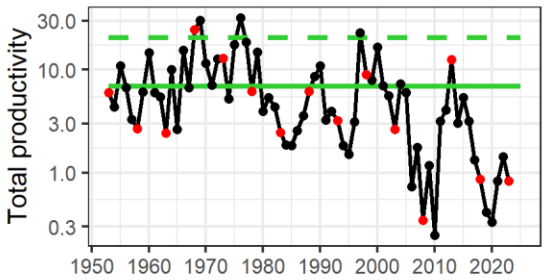
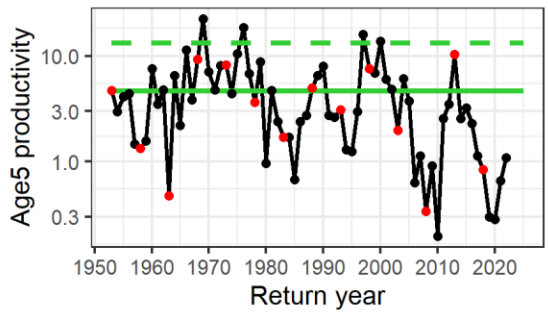
Brood_Year	Eff		Mean_run_size
2018	7121	*1* All Years	66498
2019	2066	*2* Cyc Years	63981

logProd





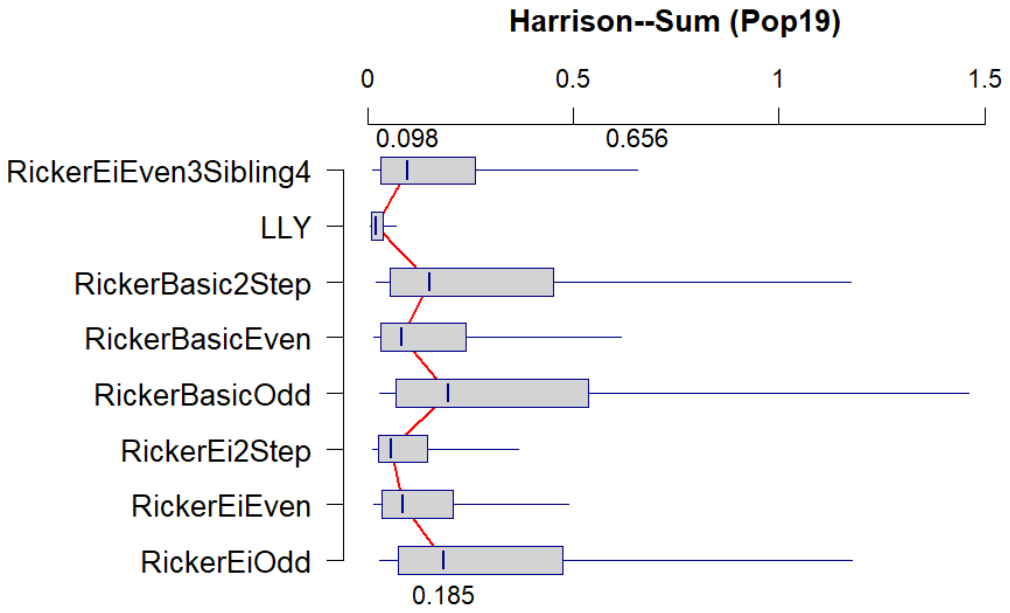


Pitt

Brood_Year	Eff		Mean_run_size
2018	7121	*1* All Years	66498
2019	2066	*2* Cyc Years	63981

Harrison

Forecast:All models



TotalFC

Model	Old.Rank	p10	p25	p50	p75	p90
RickerEiEvenAge3.SiblingAge4	99	11,119	32,794	97,893	262,833	656,468
LLY	99	5,658	10,246	19,819	38,336	69,419
RickerBasic2Step	99	20,836	55,173	150,268	452,453	1,173,826
RickerBasicEven	99	15,378	33,437	83,905	238,245	616,224
RickerBasicOdd	99	27,968	70,277	197,324	537,667	1,462,380
RickerEi2Step	99	12,754	27,437	58,903	146,701	365,903
RickerEiEven	99	16,410	35,159	85,336	207,846	488,270
RickerEiOdd	99	29,956	73,767	184,685	475,379	1,177,202

Age4FC

Model	Old.Rank	p10	p25	p50	p75	p90
RickerEiEvenAge3.SiblingAge4	99	5,140	12,280	30,970	80,674	189,018
LLY	99	3,955	7,163	13,854	26,798	48,527
RickerBasic2Step	99	20,836	55,173	150,268	452,453	1,173,826
RickerBasicEven	99	10,663	15,523	21,057	29,241	22,942
RickerBasicOdd	99	27,968	70,277	197,324	537,667	1,462,380
RickerEi2Step	99	8,268	14,335	18,299	31,201	37,131
RickerEiEven	99	10,432	14,645	18,414	25,687	20,820
RickerEiOdd	99	NA	NA	NA	NA	NA

Age3FC

Model	Old.Rank	p10.age3	p25.age3	p50.age3	p75.age3	p90.age3
RickerEiEvenAge3.SiblingAge4	99	5,978	20,515	66,923	182,159	467,450
LLY	99	1,703	3,084	5,965	11,537	20,892
RickerBasic2Step	99	0	0	0	0	0
RickerBasicEven	99	4,715	17,913	62,847	209,004	593,281
RickerBasicOdd	99	0	0	0	0	0
RickerEi2Step	99	4,486	13,101	40,604	115,499	328,772
RickerEiEven	99	5,978	20,515	66,923	182,159	467,450
RickerEiOdd	99	NA	NA	NA	NA	NA

TotalProd

Model	Old.Rank	p10	p25	p50	p75	p90
RickerEiEvenAge3.SiblingAge4	99	8.31	24.51	73.16	196.44	490.63
LLY	99	2.99	5.41	10.47	20.25	36.68
RickerBasic2Step	99	15.26	38.60	118.32	327.65	752.07
RickerBasicEven	99	0.68	1.85	5.47	15.96	39.63
RickerBasicOdd	99	18.37	48.41	145.80	383.38	897.75
RickerEi2Step	99	0.95	2.21	6.73	17.26	38.36
RickerEiEven	99	0.71	1.91	5.67	15.56	38.39
RickerEiOdd	99	21.09	52.93	127.56	372.52	915.49

Age4Prod

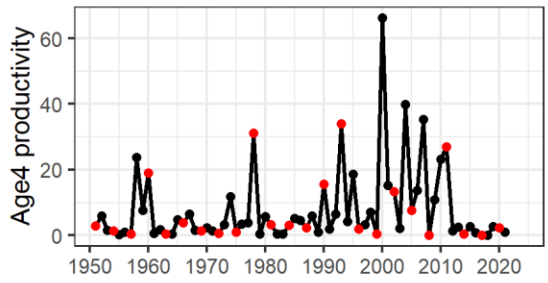
Model	Old.Rank	p10	p25	p50	p75	p90
RickerEiEvenAge3.SiblingAge4	99	0.10	0.24	0.61	1.58	3.70
LLY	99	2.96	5.35	10.35	20.03	36.27
RickerBasic2Step	99	15.26	38.60	118.32	327.65	752.07
RickerBasicEven	99	0.57	1.46	4.15	11.76	27.25
RickerBasicOdd	99	18.37	48.41	145.80	383.38	897.75
RickerEi2Step	99	0.87	1.99	6.05	14.99	32.38
RickerEiEven	99	0.60	1.56	4.61	12.17	28.95
RickerEiOdd	99	21.09	52.93	127.56	372.52	915.49

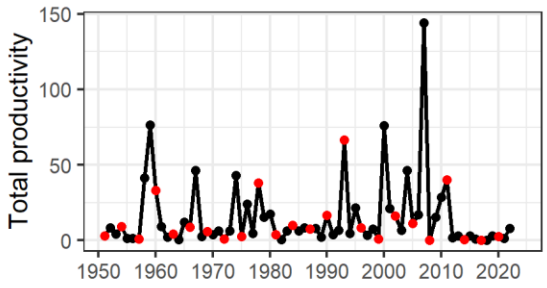
Age3Prod

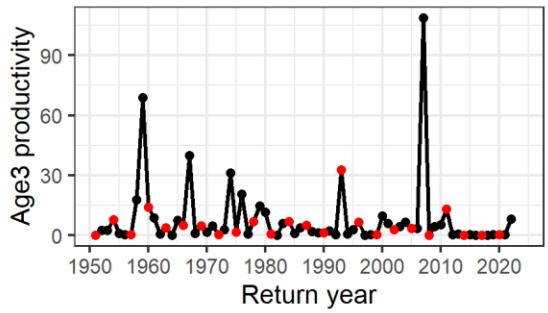
Model	Old.Rank	p10	p25	p50	p75	p90
RickerEiEvenAge3.SiblingAge4	99	0.12	0.40	1.31	3.57	9.15
LLY	99	0.03	0.06	0.12	0.23	0.41

Model	Old.Rank	p10	p25	p50	p75	p90
RickerBasic2Step	99	0.00	0.00	0.00	0.00	0.00
RickerBasicEven	99	0.11	0.40	1.32	4.20	12.37
RickerBasicOdd	99	0.00	0.00	0.00	0.00	0.00
RickerEi2Step	99	0.08	0.22	0.68	2.26	5.97
RickerEiEven	99	0.11	0.35	1.06	3.40	9.45
RickerEiOdd	99	0.00	0.00	0.00	0.00	0.00

RawProd





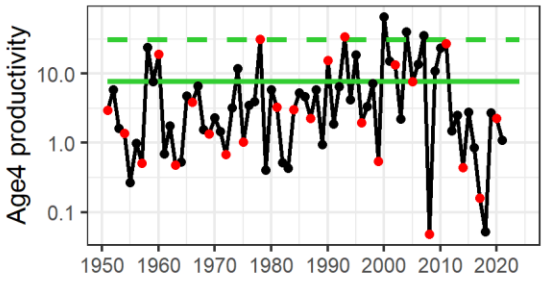


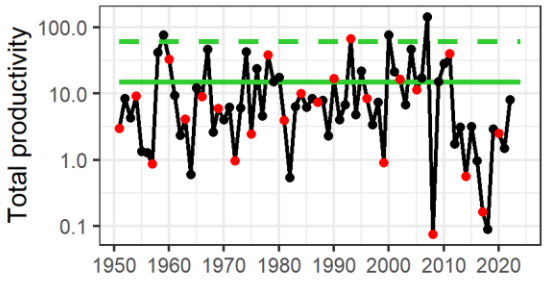
Harrison

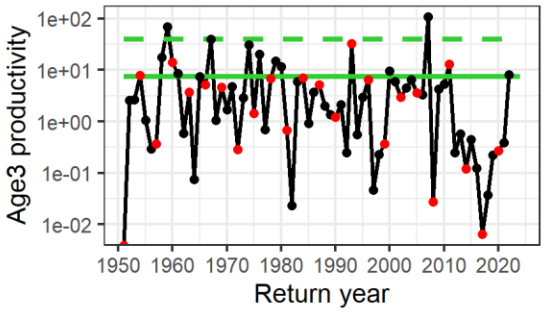
Brood_Year	Eff
2019	1338
2020	51062

		Mean_run_size
1	All Years	117145
2	Cyc Years	71009

logProd







Harrison

Brood_Year	Eff
2019	1338
2020	51062

		Mean_run_size
1	All Years	117145
2	Cyc Years	71009

Misc Stocks

FC models

Stock.Name	p10	p25	p50	p75	p90
EShu	20,801	44,326	99,838	186,427	320,898
Taseko	5	12	25	45	65
Chilliwack	1,053	2,396	4,981	10,007	18,793
Nahalatch	1,084	2,468	5,131	10,307	19,358
N.Thomp.Trib	88	246	463	964	2,005
N.Thomp.River	745	2,083	3,920	8,156	16,972
Widgeon	80	294	648	1,078	2,026
Non-Shuswap	304	1,122	2,471	4,108	7,722