**Supplementary Material**. Additional details, tables and figures for Satterthwaite and Shelton "Methods for assessing and responding to bias and uncertainty in U.S. West Coast salmon abundance forecasts"

*Stocks and years excluded from analysis*

We excluded East Sound Bay Hatchery Chinook from our analysis due to exceptionally poor forecast performance (e.g., forecasts as much as 400x higher than the postseason abundance estimate) and some years with reports of zero returns for this low abundance stock, and excluded Salmon Trout Enhancement Project coho due to limited temporal coverage, low abundance, and one year with returns of zero. We excluded Skagit Hatchery Chinook data prior to 2004 due to several earlier preseason forecasts reported as 0.0. For Washington coastal coho stocks, PFMC reports provided information on forecast performance for 1984-1985 and 1990-2020, due to the gap in temporal coverage we excluded records for 1984-1985.

*Deviations from reported values in PFMC 2022a*

Although age-specific forecasts are supplied for Klamath River Fall Chinook (KRFC), we evaluated only the composite total adult forecast, since allowable exploitation rates on this stock are driven by expected total adult escapement in the absence of fishing (PFMC 2021a).

For Willapa Bay natural coho (WBC), a new forecasting method was adopted for use starting in 2022 (Auerbach et al. 2021, based on methods as detailed in DeFilippo et al. 2021), however the forecast is based on ensemble weighting of at least two methods with the option to add additional methods in the future. Thus, expected performance of the newly adopted, and potentially further revised, methods could not be evaluated at this time. We note however that it may be appropriate to use the internally-generated uncertainty estimates of the WBC forecast rather than quantifying its uncertainty using the approach described here.

Forecasts for Grays Harbor coho in 1993 and 1994 were reported as ranges, which we collapsed to their midpoints for this analysis.

*Supplemental guidance on escapement*

 In 2018, PFMC issued supplemental guidance to target an escapement of at least 151,000. In 2019, supplemental guidance specified an escapement target of at least 160,000. A higher escapement target was also set for 2022 fishery planning purposes, but incomplete data at the time of writing did not allow incorporating that year into the analyses presented here.

**Table S.1**. Summary of forecast performance for the shared period 2001-2020. Bold text denotes stocks where the 95% confidence interval *C* excluded 1.0.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | post:pre ratio |  |  |  |  |  |  |  |  |
| Species | Stock | *C20* | CV20 | 80% CI20 | 95% CI20 | $$σ\_{20}$$ | $$σ\_{0,20}$$ |
| Chinook | SRFC | 0.85 | 56% | 0.73 | - | 0.99 | 0.67 | - | 1.07 | 0.52 | 0.55 |
| KRFC | 0.88 | 55% | 0.76 | - | 1.02 | 0.70 | - | 1.10 | 0.51 | 0.53 |
| Columbia URB | 1.00 | 34% | 0.91 | - | 1.10 | 0.87 | - | 1.16 | 0.33 | 0.33 |
| Columbia LRW | 1.05 | 51% | 0.92 | - | 1.21 | 0.85 | - | 1.30 | 0.48 | 0.48 |
| Columbia LRH | 1.00 | 39% | 0.90 | - | 1.12 | 0.85 | - | 1.18 | 0.37 | 0.37 |
| Columbia SCH | 0.87 | 56% | 0.75 |  | 1.01 | 0.69 |  | 1.09 | 0.52 | 0.54 |
| Columbia MCB | 1.02 | 39% | 0.92 |  | 1.14 | 0.86 |  | 1.21 | 0.38 | 0.38 |
| Nook.-Samish H&N | 0.88 | 44% | 0.78 | - | 0.99 | 0.73 | - | 1.06 | 0.42 | 0.44 |
| Skagit Natural | 1.00 | 41% | 0.89 | - | 1.12 | 0.84 | - | 1.19 | 0.39 | 0.39 |
| Stillaguamish Natural | 1.05 | 45% | 0.93 | - | 1.19 | 0.87 | - | 1.27 | 0.43 | 0.43 |
| Snohomish Hatchery | 0.85 | 52% | 0.74 | - | 0.98 | 0.68 | - | 1.05 | 0.49 | 0.52 |
| **Snohomish Natural** | **0.61** | **69%** | **0.51** | **-** | **0.73** | **0.46** | **-** | **0.81** | **0.63** | **0.80** |
| Tulalip Hatchery | 0.82 | 117% | 0.63 | - | 1.07 | 0.55 | - | 1.23 | 0.93 | 0.95 |
| So Puget Sound H | 1.05 | 38% | 0.94 | - | 1.16 | 0.89 | - | 1.23 | 0.37 | 0.37 |
| **So Puget Sound N** | **0.67** | **75%** | **0.55** | **-** | **0.81** | **0.50** | **-** | **0.89** | **0.66** | **0.78** |
| SJdF Hat + Nat | 1.11 | 36% | 1.00 | - | 1.22 | 0.95 | - | 1.29 | 0.35 | 0.37 |
| Hood Canal H+N | 1.13 | 44% | 1.00 | - | 1.27 | 0.94 | - | 1.36 | 0.42 | 0.44 |
| Coho | Col. Hat early | 0.91 | 62% | 0.77 | - | 1.07 | 0.71 | - | 1.17 | 0.57 | 0.58 |
| Col. Hat late | 0.87 | 61% | 0.74 | - | 1.02 | 0.68 | - | 1.12 | 0.56 | 0.58 |
| OR Coast Natural | 1.17 | 89% | 0.94 | - | 1.46 | 0.84 | - | 1.63 | 0.76 | 0.78 |
| OR Coast N of Blanco | 0.85 | 103% | 0.67 | - | 1.08 | 0.58 | - | 1.23 | 0.85 | 0.87 |
| **CA+OR Co S of Blanco** | **0.50** | **131%** | **0.37** | **-** | **0.66** | **0.32** | **-** | **0.77** | **1.00** | **1.23** |
| OPI-H Total | 0.87 | 57% | 0.75 | - | 1.02 | 0.69 | - | 1.10 | 0.53 | 0.55 |
| Quillayute Fall | 0.91 | 48% | 0.80 | - | 1.03 | 0.74 | - | 1.11 | 0.45 | 0.46 |
| Hoh River | 1.02 | 51% | 0.89 | - | 1.18 | 0.83 | - | 1.27 | 0.48 | 0.49 |
| Queets River | 0.84 | 87% | 0.68 | - | 1.04 | 0.60 | - | 1.17 | 0.75 | 0.77 |
| Grays Harbor | 0.95 | 67% | 0.80 | - | 1.13 | 0.73 | - | 1.24 | 0.61 | 0.61 |
| Skagit River | 0.94 | 133% | 0.70 | - | 1.25 | 0.60 | - | 1.46 | 1.01 | 1.01 |
| Stillaguamish River | 1.09 | 100% | 0.86 | - | 1.38 | 0.76 | - | 1.57 | 0.83 | 0.84 |
| Hood Canal | 0.96 | 86% | 0.78 | - | 1.19 | 0.70 | - | 1.34 | 0.74 | 0.74 |
| Snohomish | 0.95 | 91% | 0.76 | - | 1.19 | 0.67 | - | 1.34 | 0.78 | 0.78 |
| Str. Juan de Fuca | 0.79 | 88% | 0.63 | - | 0.98 | 0.56 | - | 1.09 | 0.76 | 0.80 |

**Table S.2**. Coefficients and associated p-values of models fitting log(postseason:preseason) for each stock as a function of year. Positive coefficients indicate a tendency to over-forecast early in the time series relative to late in the time series, negative coefficients indicate an increasing tendency toward over-forecasting later in the time series.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Stock | Years | Coef | p |
| Chinook | SRFC | 1995 | - | 2021 | -0.009 | 0.44 |
|  | KRFC | 1985 | - | 2021 | -0.019 | **0.02** |
|  | Columbia URB | 1984 | - | 2021 | -0.006 | 0.18 |
|  | Columbia LRW | 1988 | - | 2021 | -0.007 | 0.35 |
|  | Columbia LRH | 1984 | - | 2021 | -0.005 | 0.36 |
|  | Columbia SCH | 1984 | - | 2021 | -0.011 | 0.11 |
|  | Columbia MCB | 1990 | - | 2021 | 0.000 | 0.95 |
|  | Columbia Summer | 2012 | - | 2021 | 0.017 | 0.68 |
|  | Nooksack-Samish H&N | 1993 | - | 2020 | -0.015 | 0.12 |
|  | Skagit Hatchery | 2004 | - | 2020 | -0.037 | 0.26 |
|  | Skagit Natural | 1993 | - | 2020 | -0.007 | 0.52 |
|  | Stillaguamish Natural | 1995 | - | 2020 | 0.008 | 0.43 |
|  | Snohomish Hatchery | 1994 | - | 2020 | -0.003 | 0.83 |
|  | Snohomish Natural | 1993 | - | 2020 | -0.010 | 0.44 |
|  | Tulalip Hatchery | 1993 | - | 2020 | -0.044 | **0.04** |
|  | So Puget Sound H | 1993 | - | 2020 | -0.014 | 0.12 |
|  | So Puget Sound N | 1993 | - | 2020 | 0.017 | 0.22 |
|  | SJdF Hat + Nat | 1993 | - | 2020 | 0.016 | 0.08 |
|  | Hood Canal H+N | 1994 | - | 2020 | -0.018 | 0.25 |
| coho | Col. Hat early | 1996 | - | 2021 | -0.021 | 0.16 |
|  | Col. Hat late | 1996 | - | 2021 | -0.016 | 0.33 |
|  | Lower Col. N | 2007 | - | 2021 | -0.002 | 0.97 |
|  | OR Coast Natural | 1996 | - | 2021 | -0.004 | 0.86 |
|  | OR Coast N of Blanco | 1996 | - | 2021 | 0.018 | 0.41 |
|  | CA+OR Coast S of Blanco | 1996 | - | 2021 | -0.070 | **0.002** |
|  | OPI-H Total | 1996 | - | 2021 | -0.018 | 0.20 |
|  | Quillayute Fall | 1990 | - | 2020 | -0.005 | 0.62 |
|  | Hoh River | 1990 | - | 2020 | -0.011 | 0.29 |
|  | Queets River | 1990 | - | 2020 | -0.035 | **0.01** |
|  | Grays Harbor | 1990 | - | 2020 | 0.002 | 0.90 |
|  | Willapa Bay | 2010 | - | 2020 | -0.123 | 0.11 |
|  | Skagit River | 1997 | - | 2020 | -0.009 | 0.75 |
|  | Stillaguamish River | 1990 | - | 2020 | 0.046 | **0.01** |
|  | Hood Canal | 1990 | - | 2020 | -0.002 | 0.89 |
|  | Snohomish | 1990 | - | 2020 | 0.004 | 0.77 |
|  | Str. Juan de Fuca | 1990 | - | 2020 | -0.016 | 0.27 |

**Table S.3**. Performance of raw or adjusted forecasts for the period after the first ten years as measured via Mean Absolute Percent Error (MAPE, a) or Median Log Accuracy Ratio (MLAR, b). *C* is the median postseason:preseason ratio estimated for the first ten years of data. Start year indicates the beginning of the period over which performance was tested. Note that *C* estimates for the first decade were not always concurrent with the longer-term conclusions regarding bias. Bold text indicates the adjustment (or lack thereof) performing best (closest to zero error, regardless of sign for MLAR) for each stock-performance metric combination. Italics in the bias corrected, no buffer (i.e., P\*=0.50) column indicate cases where the bias-adjusted forecast outperformed the “raw” forecast receiving neither a bias correction nor a buffer. (Some cases appear to be ties at the precision reported in the table, but optimal choices were identified at full precision.)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| a) MAPE |  | First Decade |  |  | Apply bias correction | Assume unbiased |
| Sp. | Stock | *C* | 80% CI | Start | raw | no buffer | P\*=0.45 | P\*=0.40 | P\*=0.33 | P\*=0.45 | P\*=0.40 | P\*=0.33 |
| Chnk | SRFC | 1.08 | 0.97 | - | 1.22 | 2005 | 63% | *60%* | 56% | 52% | **48%** | 58% | 54% | 50% |
|  | KRFC | 1.03 | 0.78 | - | 1.35 | 1995 | 48% | 51% | 46% | 42% | 39% | 44% | 41% | **38%** |
|  | Columbia URB | 1.12 | 1.04 | - | 1.20 | 1994 | 26% | 31% | 29% | 28% | 27% | 26% | 25% | **25%** |
|  | Columbia LRW | 1.20 | 1.06 | - | 1.36 | 1998 | 32% | 40% | 37% | 35% | 33% | 32% | **31%** | 32% |
|  | Columbia LRH | 0.96 | 0.85 | - | 1.09 | 1994 | **25%** | 27% | 26% | 26% | 26% | 25% | 26% | 27% |
|  | Columbia SCH | 1.05 | 0.92 | - | 1.21 | 1994 | 44% | 46% | 43% | 41% | 39% | 42% | 40% | **38%** |
|  | Columbia MCB | 1.01 | 0.90 | - | 1.14 | 2000 | 29% | 31% | 29% | 28% | 27% | 28% | 27% | **27%** |
|  | Nook.-Samish H&N | 1.08 | 0.90 | - | 1.29 | 2003 | 42% | *40%* | 34% | 30% | **26%** | 37% | 31% | 27% |
|  | Skagit Natural | 1.22 | 0.98 | - | 1.52 | 2003 | 27% | 34% | 30% | 27% | 25% | 25% | **23%** | 24% |
|  | Stillaguamish Natural | 1.03 | 0.93 | - | 1.15 | 2005 | 37% | 39% | 38% | 37% | 35% | 36% | 35% | **34%** |
|  | Snohomish Hatchery | 1.04 | 0.83 | - | 1.32 | 2004 | 45% | *41%* | 37% | 36% | 34% | 39% | 36% | **34%** |
|  | Snohomish Natural | 0.79 | 0.68 | - | 0.91 | 2003 | 115% | *75%* | 71% | 67% | **63%** | 103% | 93% | 81% |
|  | Tulalip Hatchery | 1.86 | 1.49 | - | 2.33 | 2003 | 163% | 221% | 200% | 180% | 156% | 148% | 134% | **118%** |
|  | So Puget Sound H | 1.19 | 1.06 | - | 1.34 | 2003 | 30% | 39% | 36% | 33% | 28% | 28% | **27%** | 27% |
|  | So Puget Sound N | 0.78 | 0.68 | - | 0.89 | 2003 | 112% | *66%* | 64% | 62% | **59%** | 100% | 89% | 76% |
|  | SJdF Hat + Nat | 0.90 | 0.77 | - | 1.06 | 2003 | **32%** | 32% | 33% | 34% | 36% | 33% | 34% | 36% |
|  | Hood Canal H+N | 1.46 | 1.05 | - | 2.04 | 2004 | 43% | 59% | 52% | 46% | 42% | **41%** | 41% | 43% |
| coho | Col. Hat early | 1.05 | 0.87 | - | 1.27 | 2006 | 66% | 66% | 60% | 55% | **50%** | 61% | 57% | 51% |
|  | Col. Hat late | 0.90 | 0.71 | - | 1.13 | 2006 | 72% | *68%* | 63% | 58% | **52%** | 67% | 62% | 56% |
|  | OR Coast Natural | 1.28 | 0.94 | - | 1.75 | 2006 | 76% | 90% | 84% | 78% | 71% | 71% | 67% | **61%** |
|  | OR Coast N of Blanco | 0.66 | 0.51 | - | 0.84 | 2006 | 101% | *85%* | 80% | 77% | **72%** | 92% | 86% | 79% |
|  | CA+OR Co S Blanco | 1.06 | 0.82 | - | 1.36 | 2006 | 319% | *208%* | 185% | 165% | **139%** | 278% | 241% | 196% |
|  | OPI-H Total | 0.96 | 0.81 | - | 1.14 | 2006 | 68% | *64%* | 59% | 54% | **49%** | 63% | 59% | 53% |
|  | Quillayute Fall | 0.95 | 0.74 | - | 1.23 | 2000 | 37% | *35%* | 33% | **31%** | 32% | 34% | 32% | 32% |
|  | Hoh River | 1.23 | 0.97 | - | 1.57 | 2000 | 35% | 46% | 41% | 37% | 36% | **35%** | 35% | 36% |
|  | Queets River | 1.21 | 0.93 | - | 1.57 | 2000 | 78% | 94% | 83% | 73% | 62% | 69% | 62% | **52%** |
|  | Grays Harbor | 0.70 | 0.56 | - | 0.86 | 2000 | 60% | *55%* | 52% | 48% | 47% | 56% | 52% | **47%** |
|  | Skagit River | 0.87 | 0.61 | - | 1.24 | 2007 | 109% | *108%* | 97% | 87% | **74%** | 98% | 88% | 74% |
|  | Stillaguamish River | 0.35 | 0.27 | - | 0.46 | 2000 | 78% | *64%* | 63% | 64% | 67% | 71% | 67% | **62%** |
|  | Hood Canal | 0.65 | 0.44 | - | 0.96 | 2000 | 64% | *56%* | 51% | 49% | 51% | 55% | 51% | **49%** |
|  | Snohomish | 0.62 | 0.53 | - | 0.73 | 2000 | 81% | *74%* | 70% | 66% | **63%** | 76% | 71% | 65% |
|  | Str. Juan de Fuca | 1.13 | 0.90 | - | 1.43 | 2000 | 94% | 97% | 89% | 83% | 76% | 86% | 79% | **72%** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| b) MLAR |  | First Decade |  |  | Apply bias correction | Assume unbiased |
| Sp. | Stock | *C* | 80% CI | Start | raw | no buffer | P\*=0.45 | P\*=0.40 | P\*=0.33 | P\*=0.45 | P\*=0.40 | P\*=0.33 |
| Chnk | SRFC | 1.08 | 0.97 | - | 1.22 | 2005 | 0.30 | *0.17* | 0.11 | **0.05** | -0.04 | 0.23 | 0.17 | 0.07 |
|  | KRFC | 1.03 | 0.78 | - | 1.35 | 1995 | 0.13 | 0.15 | 0.08 | 0.01 | -0.08 | 0.07 | **0.00** | -0.10 |
|  | Columbia URB | 1.12 | 1.04 | - | 1.20 | 1994 | **-0.01** | 0.11 | 0.09 | 0.06 | 0.02 | -0.05 | -0.08 | -0.13 |
|  | Columbia LRW | 1.20 | 1.06 | - | 1.36 | 1998 | -0.07 | 0.12 | 0.07 | **0.02** | -0.05 | -0.12 | -0.18 | -0.26 |
|  | Columbia LRH | 0.96 | 0.85 | - | 1.09 | 1994 | -0.03 | 0.02 | **-0.02** | -0.07 | -0.13 | -0.08 | -0.12 | -0.19 |
|  | Columbia SCH | 1.05 | 0.92 | - | 1.21 | 1994 | 0.06 | 0.08 | 0.04 | **-0.01** | -0.08 | 0.02 | -0.03 | -0.10 |
|  | Columbia MCB | 1.01 | 0.90 | - | 1.14 | 2000 | 0.05 | 0.10 | 0.05 | 0.01 | -0.06 | **0.00** | -0.04 | -0.11 |
|  | Nook.-Samish H&N | 1.08 | 0.90 | - | 1.29 | 2003 | 0.24 | 0.24 | 0.19 | 0.13 | **0.05** | 0.19 | 0.13 | 0.06 |
|  | Skagit Natural | 1.22 | 0.98 | - | 1.52 | 2003 | 0.08 | 0.15 | 0.09 | 0.03 | -0.06 | **0.02** | -0.05 | -0.13 |
|  | Stillaguamish Natural | 1.03 | 0.93 | - | 1.15 | 2005 | -0.12 | ***-0.11*** | -0.15 | -0.19 | -0.24 | -0.16 | -0.20 | -0.25 |
|  | Snohomish Hatchery | 1.04 | 0.83 | - | 1.32 | 2004 | 0.13 | *0.07* | **0.00** | -0.07 | -0.18 | 0.06 | -0.01 | -0.11 |
|  | Snohomish Natural | 0.79 | 0.68 | - | 0.91 | 2003 | 0.32 | **0.01** | -0.05 | -0.12 | -0.21 | 0.25 | 0.17 | 0.07 |
|  | Tulalip Hatchery | 1.86 | 1.49 | - | 2.33 | 2003 | 0.08 | 0.46 | 0.36 | 0.26 | 0.12 | **-0.02** | -0.12 | -0.26 |
|  | So Puget Sound H | 1.19 | 1.06 | - | 1.34 | 2003 | 0.06 | 0.19 | 0.14 | 0.09 | 0.03 | **0.02** | -0.03 | -0.09 |
|  | So Puget Sound N | 0.78 | 0.68 | - | 0.89 | 2003 | 0.42 | ***-0.07*** | -0.14 | -0.20 | -0.30 | 0.33 | 0.23 | 0.09 |
|  | SJdF Hat + Nat | 0.90 | 0.77 | - | 1.06 | 2003 | **-0.20** | -0.22 | -0.27 | -0.32 | -0.40 | -0.25 | -0.30 | -0.38 |
|  | Hood Canal H+N | 1.46 | 1.05 | - | 2.04 | 2004 | -0.08 | 0.22 | 0.13 | **0.02** | -0.10 | -0.17 | -0.26 | -0.39 |
| coho | Col. Hat early | 1.05 | 0.87 | - | 1.27 | 2006 | 0.25 | *0.22* | 0.15 | 0.08 | -0.02 | 0.18 | 0.11 | **0.01** |
|  | Col. Hat late | 0.90 | 0.71 | - | 1.13 | 2006 | 0.20 | *0.18* | 0.11 | **0.04** | -0.07 | 0.12 | 0.05 | -0.06 |
|  | OR Coast Natural | 1.28 | 0.94 | - | 1.75 | 2006 | -0.25 | ***-0.10*** | -0.20 | -0.30 | -0.45 | -0.35 | -0.46 | -0.60 |
|  | OR Coast N of Blanco | 0.66 | 0.51 | - | 0.84 | 2006 | **0.04** | -0.27 | -0.37 | -0.48 | -0.61 | -0.06 | -0.17 | -0.33 |
|  | CA+OR Co S Blanco | 1.06 | 0.82 | - | 1.36 | 2006 | 0.82 | *0.61* | 0.53 | 0.44 | **0.32** | 0.72 | 0.63 | 0.48 |
|  | OPI-H Total | 0.96 | 0.81 | - | 1.14 | 2006 | 0.27 | *0.22* | 0.16 | 0.10 | **0.02** | 0.22 | 0.16 | 0.07 |
|  | Quillayute Fall | 0.95 | 0.74 | - | 1.23 | 2000 | 0.09 | *0.07* | **0.00** | -0.07 | -0.18 | 0.02 | -0.05 | -0.16 |
|  | Hoh River | 1.23 | 0.97 | - | 1.57 | 2000 | -0.03 | 0.15 | 0.08 | **0.01** | -0.09 | -0.09 | -0.16 | -0.26 |
|  | Queets River | 1.21 | 0.93 | - | 1.57 | 2000 | 0.33 | 0.53 | 0.44 | 0.35 | 0.22 | 0.24 | 0.14 | **0.01** |
|  | Grays Harbor | 0.70 | 0.56 | - | 0.86 | 2000 | **0.03** | -0.06 | -0.13 | -0.21 | -0.32 | -0.04 | -0.12 | -0.23 |
|  | Skagit River | 0.87 | 0.61 | - | 1.24 | 2007 | 0.15 | 0.16 | 0.05 | -0.06 | -0.23 | **0.04** | -0.07 | -0.24 |
|  | Stillaguamish River | 0.35 | 0.27 | - | 0.46 | 2000 | **-0.24** | -0.71 | -0.82 | -0.94 | -1.10 | -0.37 | -0.50 | -0.68 |
|  | Hood Canal | 0.65 | 0.44 | - | 0.96 | 2000 | 0.16 | *0.05* | -0.06 | -0.16 | -0.33 | **0.04** | -0.08 | -0.26 |
|  | Snohomish | 0.62 | 0.53 | - | 0.73 | 2000 | **-0.07** | -0.19 | -0.27 | -0.34 | -0.46 | -0.15 | -0.23 | -0.35 |
|  | Str. Juan de Fuca | 1.13 | 0.90 | - | 1.43 | 2000 | 0.11 | *0.09* | **-0.01** | -0.10 | -0.24 | 0.04 | -0.04 | -0.15 |

**Figure S.1.** Forecast error for SRFC as a function of the postseason abundance estimate, along with best fit linear model of the logged ratio between the preseason forecast and the postseason abundance estimate.



**Figure S.2**. Fit of modeled lognormal distributions to annual observations of postseason:preseason ratios for each stock.



**Figure S.3**. Trends in forecast performance over time for each stock, including best fit model of the logged ratio between the postseason estimate and preseason forecast (*R*) over time. Downward slope of the best fit line indicates a tendency toward increased over-forecasting later in the time series.



