Improving Steelhead Forecasting: a Columbia River case study

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A forecast is a prediction of run size in the forthcoming year

Forecasts are used to manage harvest and hatchery broodstock collection

The Technical Advisory Committee (TAC) to the US v. Oregon Management Agreement forecast A-Index and B-Index steelhead returns to Bonneville Dam

A-Index and B-Index steelhead @ Bonneville Dam July – October

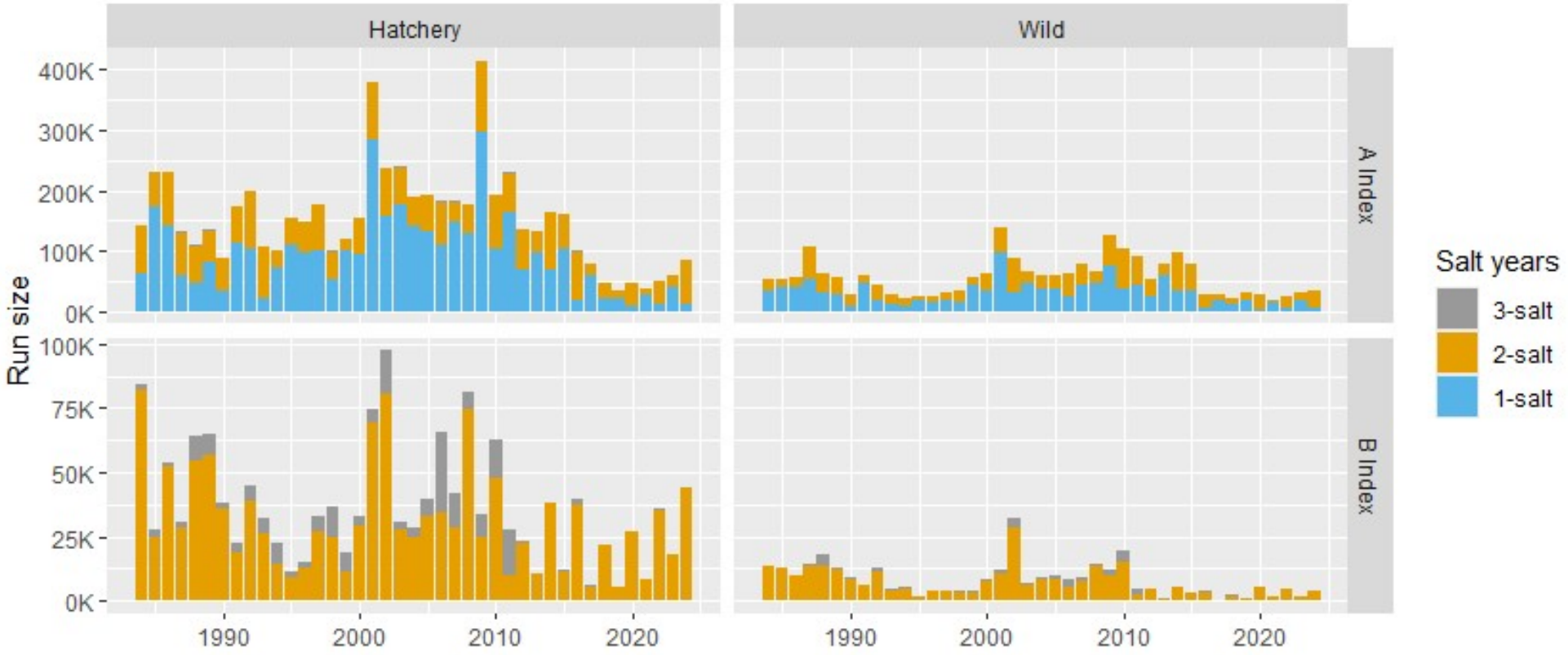
A-Index < 78 cm

- Primarily 1-salt

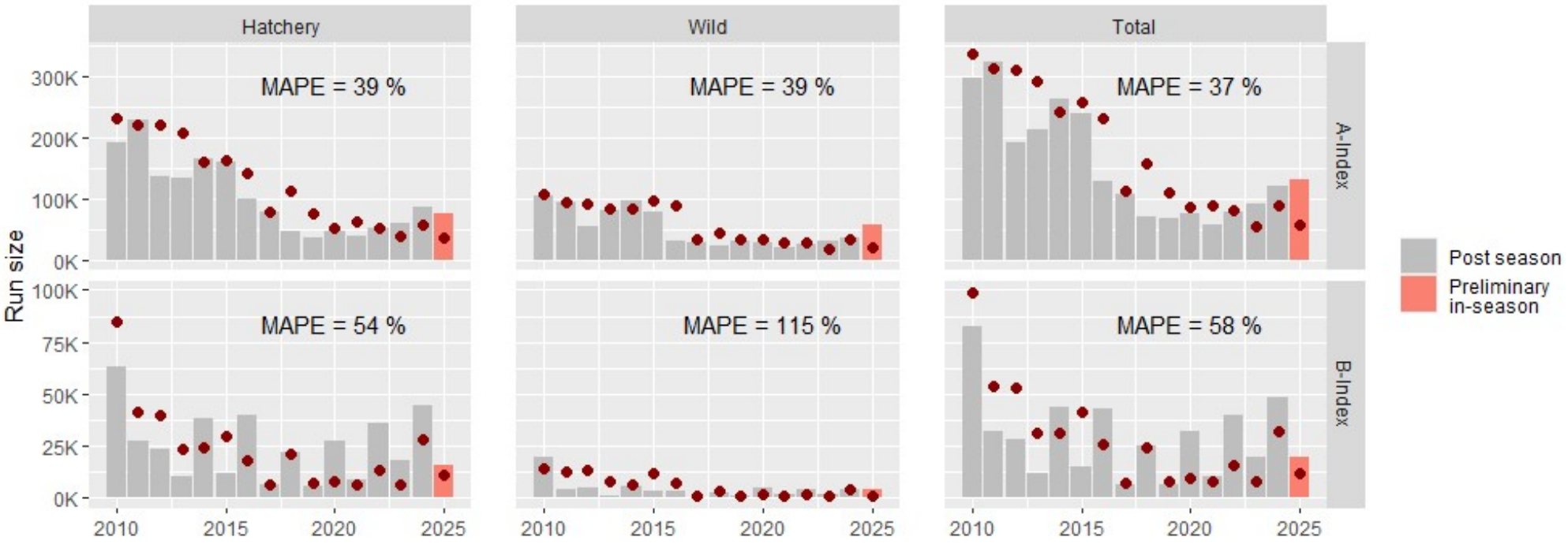
B-Index ≥ 78 cm

- Primarily return to Salmon and Clearwater River in Idaho
- Primarily 2-salt

Time series of returns by stock



TAC forecast (red point) performance



MAPE = 2010-2024 mean absolute percent error
MAPEs do not include the 2025 preliminary run size estimates

How should TAC develop 2026 forecasts?

Approach: Evaluate 10-year retrospective performance of different forecast methods

- Last year's return (i.e., lag 1 or random walk)
- Moving averages; 3-year, 5-year
- Moving averages of same parity (i.e., even/odd)
- TAC's 2025 approach
- ARIMA model ensembles

2025 TAC forecast methodologies

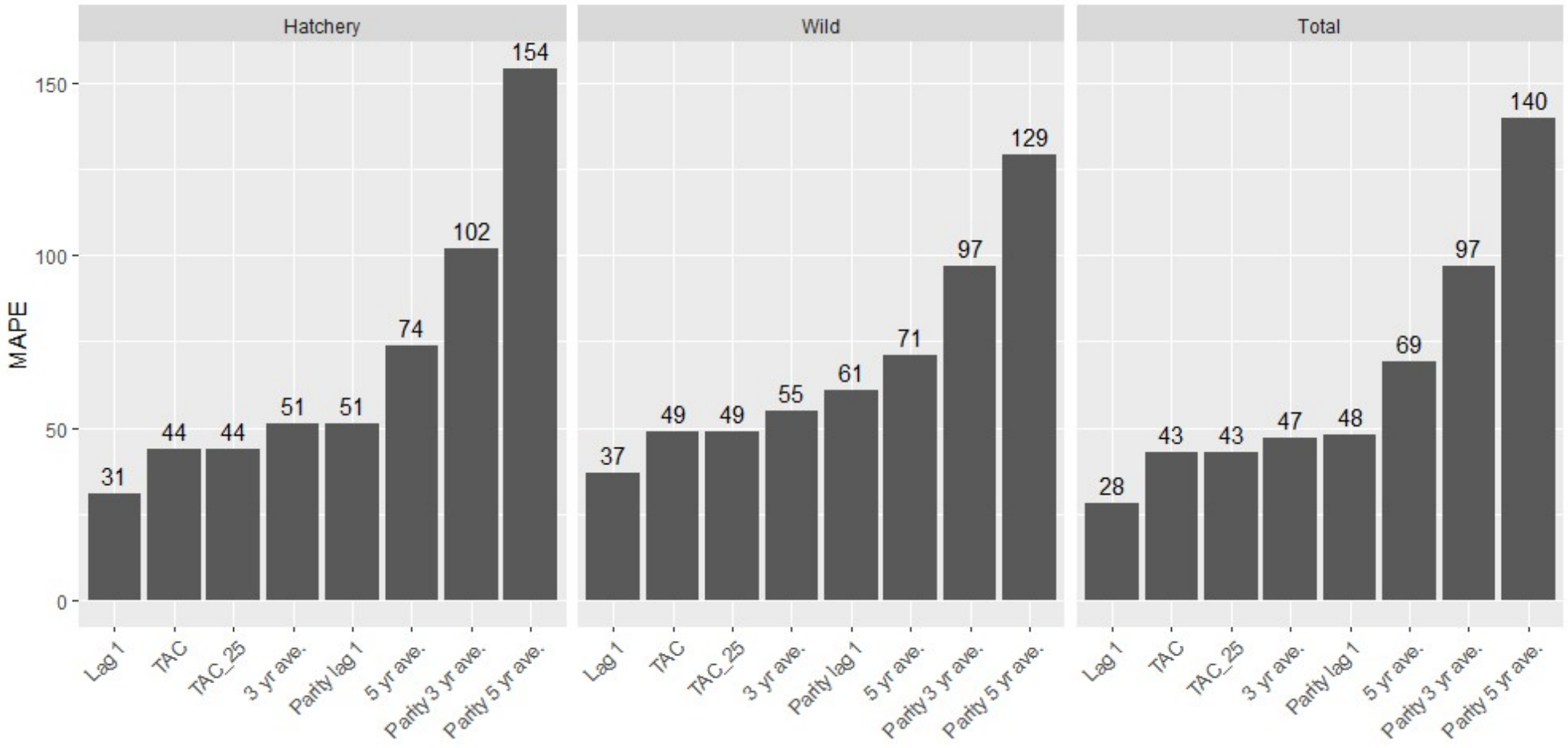
A Index

- 5-year average of 1-salt, 3-salt, and repeat spawners
- Sibling regression with 1-salt for 2-salt (2008-present data on log scale)

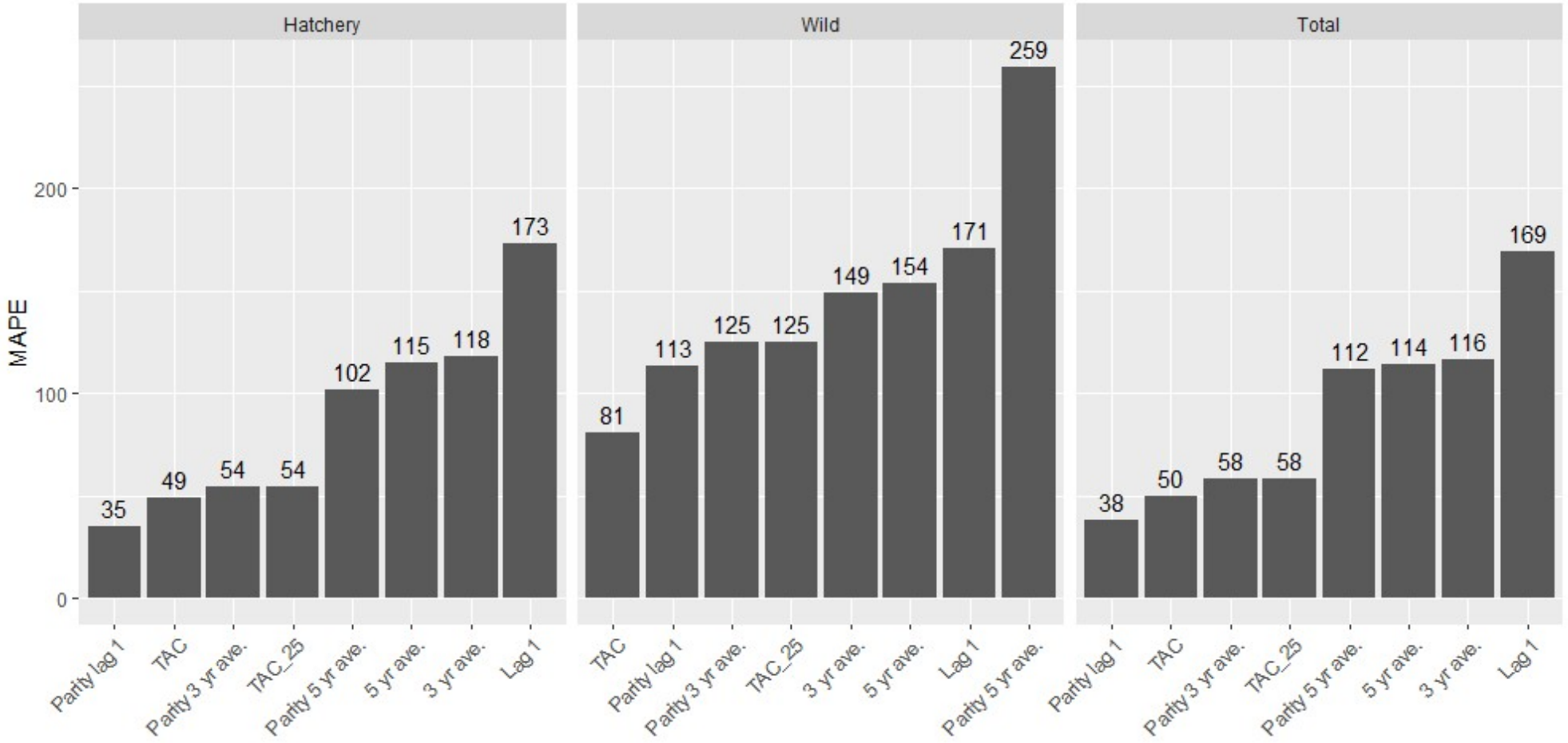
B Index

- 3-year average of years with the same *parity* (i.e., even/odd)

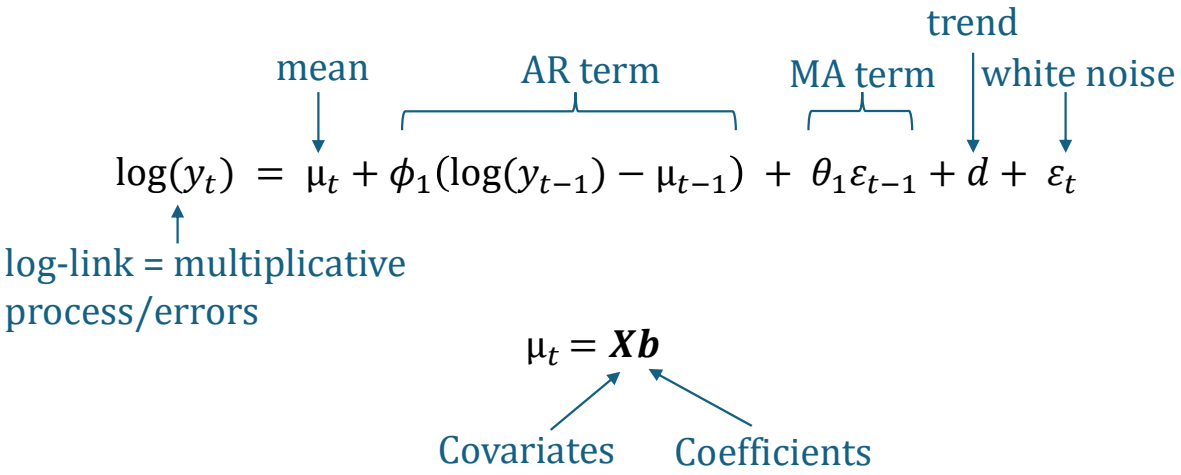
A-index performance



B-index performance



Can ARIMA models do better?



[1] *Equation shown is generic ARIMA model (bold = matrix operations)*
[2] *Actual model structure for each covariate set selected by* ***auto.arima*** *function in* ***forecast*** *package*
[3] *Differencing, used in some models, not shown*

Covariates – up to 3 total per model

- A-Index 1 salt
- PDO
- NPGO
- Nino3.4
- Even/odd indicators
- Even/odd * year

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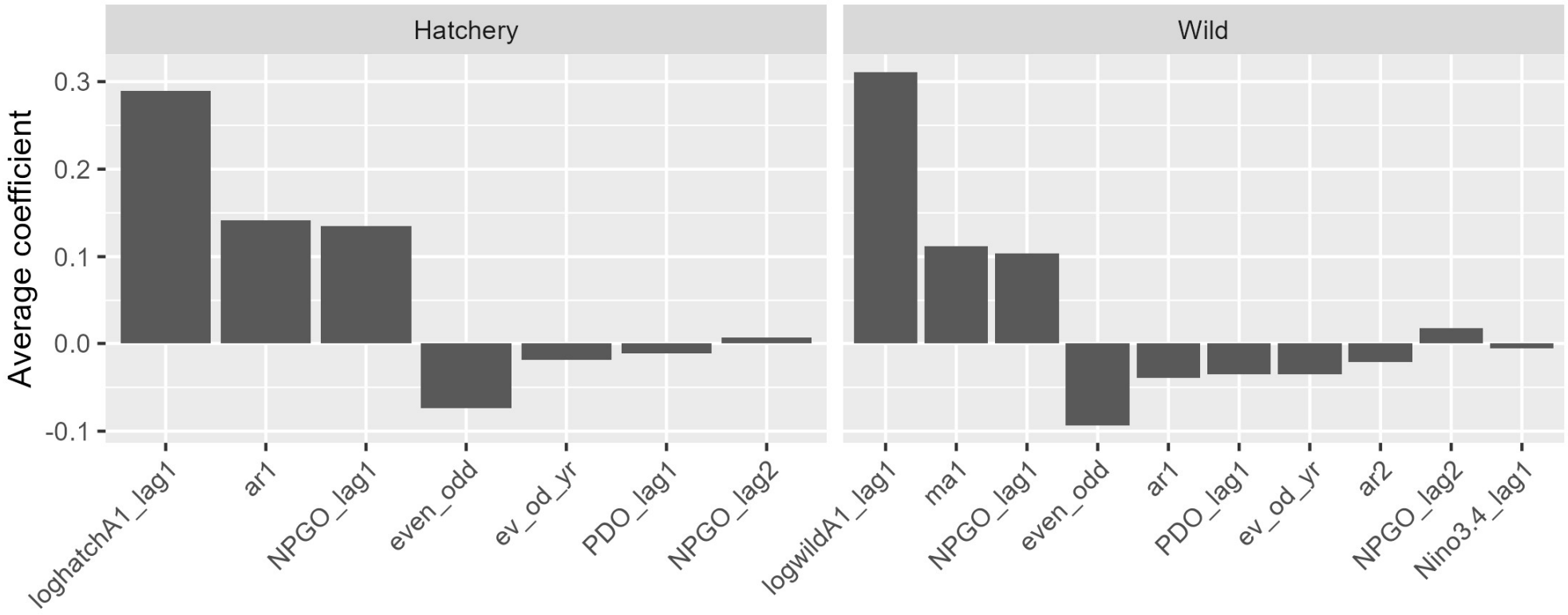
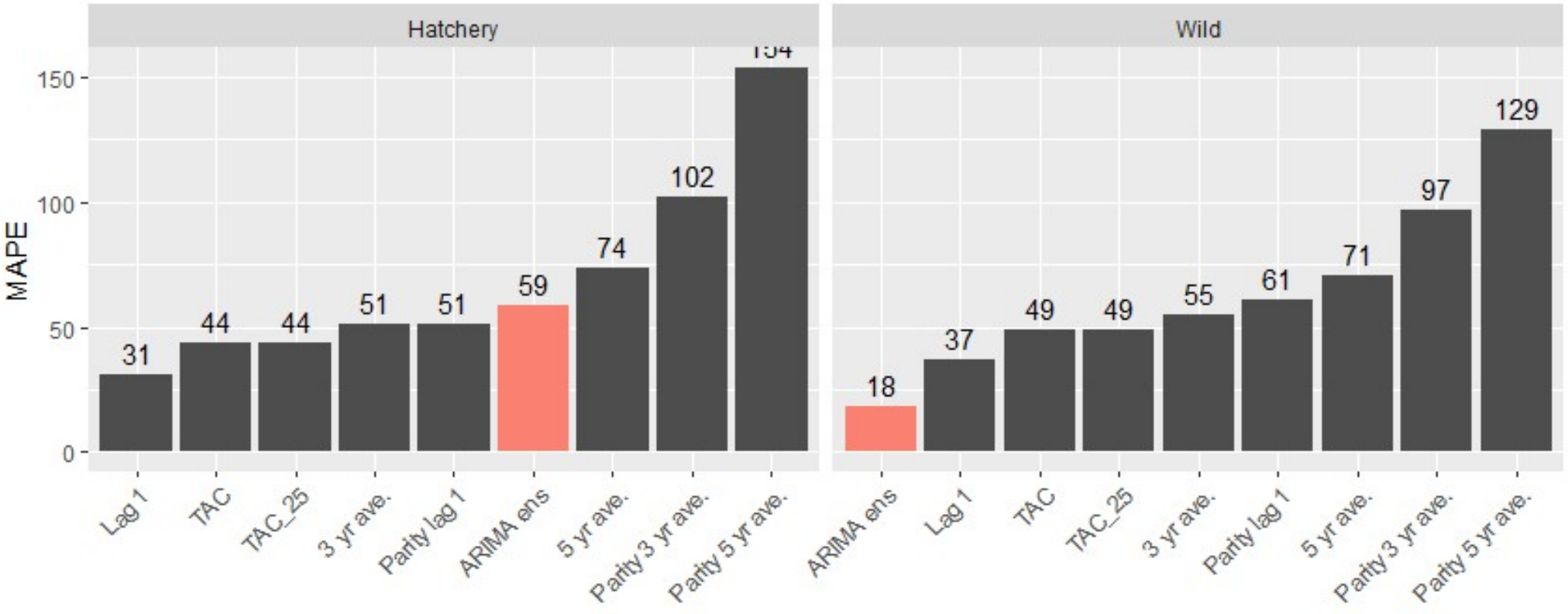
Averaging predictions with different covariates

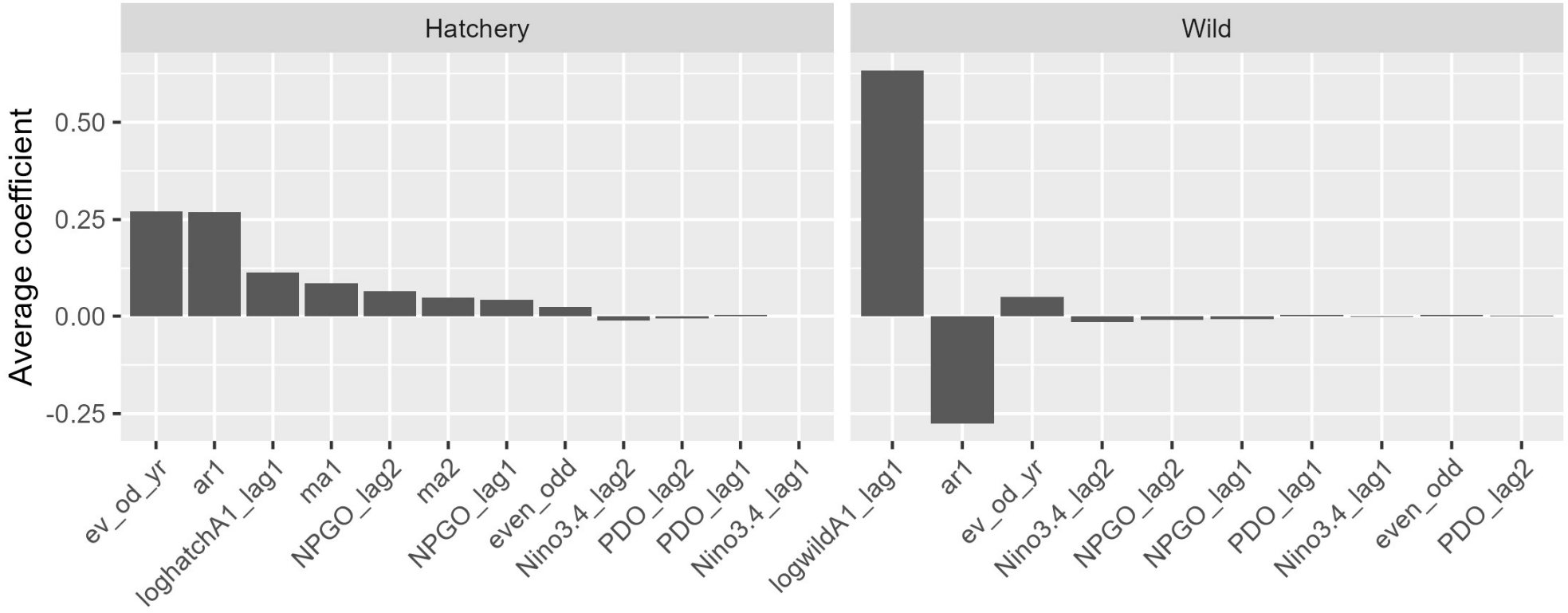
A-index covariates



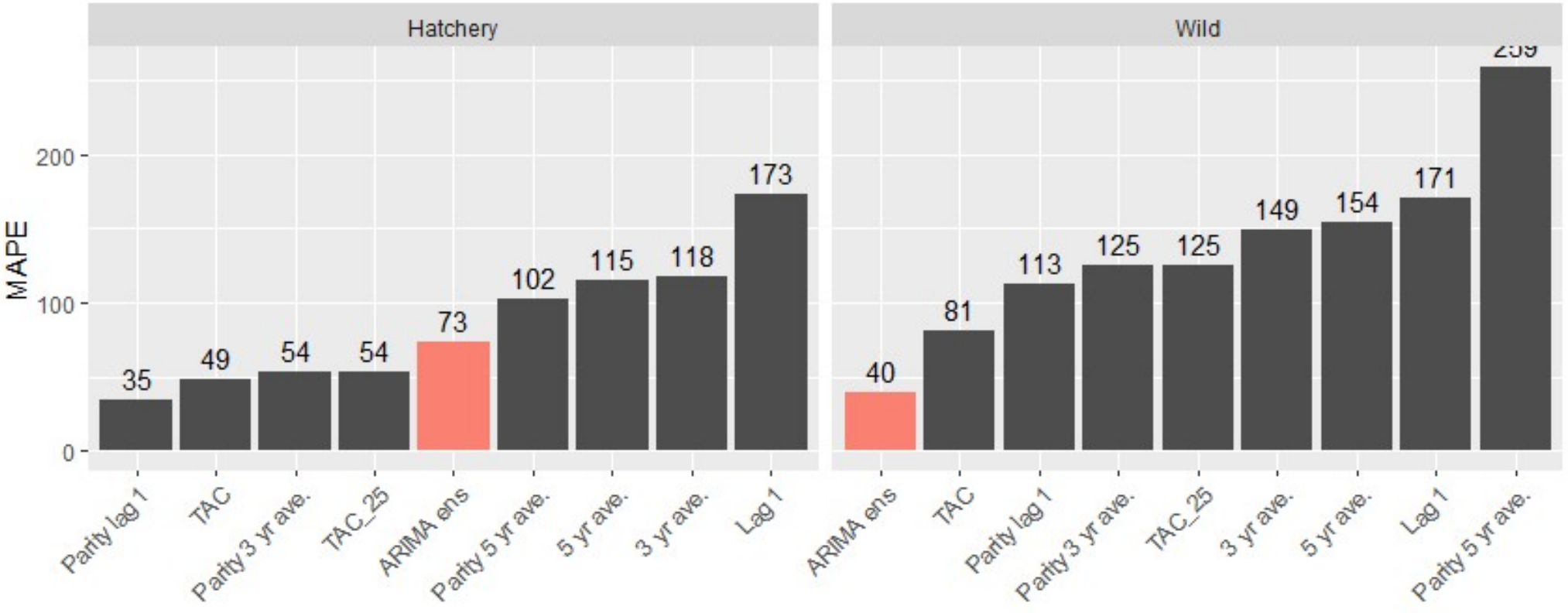
A-Index performance



B-index covariates



B-Index performance



How should TAC forecast 2026?

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Lag 1 for hatchery A-Index

Lag 1 of same parity for hatchery B-Index

ARIMA ensembles for wild components

Why was ARIMA better for wild than hatchery?

ARIMA models could be used in-season

Add dam counts as covariates

June dam counts as early indicator

Questions or comments?