|  |  |
| --- | --- |
| LASSO | MARSS |
| Juvenile per Spawner – Coho (Tables 9,15) | |
| F1-recon-120 (earlier fall reconnection) | F1-recon-120 (earlier fall reconnection) |
| F2-FA-diff (smaller fall pulse) | F1-FA-diff (larger fall pulse) |
| W1-wet-tim (earlier wet season start) | W1-wet-median-flow (larger wet season flows) |
|  | D1-DS-Mag-90 (larger early summer flows) |
|  | S2-sp-roc-max (slower max spring rate of change) |
| Juvenile per Spawner – Chinook (Tables 10, 16) | |
| W1-wet-median-flow (smaller wet season flows) | * D1-DS-Mag-90 (larger early summer flows) |
| S1-sp-tim (later spring recession start) | * S1-sp-roc-max (slower max spring rate of change) |
| S1-sp-roc-max (slower max spring rate of change) | * S1-sp-tim (earlier spring recession start) |
|  | * F1-recon-120 (earlier fall reconnection) |
|  | * W1-wet-median-flow (larger wet season flows) |
| Juvenile Abundance – Coho (Tables 11, 17 ) | |
| F1-FA-dif (larger fall pulse) | F1-FA-dif (larger fall pulse) |
| F2-FA-dif (smaller fall pulse) | F2-FA-dif (smaller fall pulse) |
| S2-sp-roc (faster spring rate of change) | W2-wet-median-flow (larger wet season flows) |
|  | D1-DS-Mag-90 (larger early summer flows) |
|  | S1-sp-roc-max (faster spring max rate of change) |
| Juvenile Abundance – Chinook (Tables 12, 18) | |
| W1-wet-median-flow (smaller wet season flows) | W1-wet-median-flow (smaller wet season flows) |
|  | S1-sp-roc-max (slower spring max rate of change) |
|  | W1-wet-tim (earlier wet season start) |
|  | F1-recon-120 (earlier fall reconnection) |
|  | F1-FA-diff (smaller fall pulse) |
| Juvenile Abundance (hydro+# spawners) – Coho (Tables 13, 19) | |
| F1-FA-diff (larger fall pulse) | F1-FA-diff (larger fall pulse) |
| F2-FA-dif (smaller fall pulse) | F1-recon-120 (earlier fall reconnection) |
| S1-SP-roc (slower spring rate of change) | D1-DS-mag-90 (larger early summer flows) |
|  | W1-wet-median-flow (larger wet season flows) |
|  | F2-recon-120 (earlier fall reconnection) |
| Juvenile Abundance (hydro + #spawners) - Chinook (Tables 14, 20) | |
| W1-wet-median-flow (smaller wet season flows) | S1-sp-roc-max (slower spring max rate of change) |
| Spawner abundance (greater abundance) | W1-wet-median-flow (smaller wet season flows) |
| S1-sp-roc-max (slower spring max rate of change) | F1-recon-120 (earlier fall reconnection) |
| W1-wet-tim (earlier wet season start) | W1-wet-tim (earlier wet season start) |
| S1-sp-tim (later spring recession start) | S1-sp-tim (later spring recession start) |

Notes:

* Coho juveniles per spawner:
  + Fall reconnection 120 (earlier) significant in both Lasso & MARSS models.
  + Both models also have WS metrics (larger WS median flow and early WS timing) as significant, suggesting larger/longer wet seasons good for reproduction. WS median flow is often correlated with WS timing, but not always.
  + Fall pulses are significant but in opposite directions for different years, suggesting conditions for one life stage may not be ideal for a different life stage. Flow variability from year to year could be beneficial. Or this suggests these predictors are correlated with other predictors.
  + Collectively, models suggest earlier fall reconnection a key predictor, and larger winter/spring flows (larger WS metrics and larger early summer flows (DS-mag-90 which correlates with WS-mag)) aid in more habitat and time for parr growth.
* Chinook juveniles per spawner:
  + SP max roc (slower, more gradual spring to summer transition) significant in both models (Lasso & MARSS)
  + Wet median flow and spring timing both significant but in opposite directions in each model. Suggests predictors may be correlated with other factors.
  + DS-mag-90 most significant in MARSS model (larger early summer flows), which correlates with larger SP flows, and larger WS median flows also significant. Suggests higher winter/spring flows may be key as higher flows give more habitat and time for fry growth before outmigrating.
  + Collectively, models suggest slower SP roc a key predictor, and higher spring flows, which both aid in more habitat and time for fry to smolt growth.
* Chinook juvenile abundance:
  + Wet season median flow (smaller – i.e. less large scouring floods) significant in all 4 models
  + MARSS models (with and w/out # spawners) show same 4 of 5 significant predictors (WS median flow, SP roc, WS timing, F1 reconnection)
  + Lasso w spawners has same 4 of 5 significant predictors as MARSS
  + Collectively, models suggest wet season median flow (smaller so less large scouring floods) a key predictor for chinook juvenile survival (logical), and also: slower roc aids outmigration, earlier wet season start provides earlier eggs and longer fry growing season, and earlier fall reconnection provides earlier spawning.
* Coho juvenile abundance:
  + Larger fall pulses significant in all 4 models (aids in upstream migration to better habitats)
  + MARSS models w and w/out spawners show same 3 of 5 significant predictors (FA-diff, DS-mag-90 (larger early summer flows), WS median flow). DS-mag-90 correlates with higher SP mags and higher DS-mag-50.
  + LASSO and MARS (w/out spawners) show same 3 significant predictors (FA-diff (larger yr 1 and smaller yr 2), SP roc). Faster SP max roc correlates with higher SP magnitudes.
  + Differences in models may indicate correlated predictors.
  + Collectively, models suggest larger fall pulses a key predictor for coho juvenile survival (logical as provides access to better habitats), and also: larger wet season flows and spring magnitudes which aid in providing more upstream habitat for juvenile (parr) growth. (MARSS models seem more consistent with regard to significant predictors, while lasso models have varying predictors that are easily correlated with others).
* For BOTH species – models suggest that while subtle differences in flow conditions may be more or less beneficial for certain life stages of each species, overall, earlier fall reconnections, earlier wet season starts, and later spring recession starts are beneficial for increased juvenile abundance and survival (none of the model results conflict with this). Variations in wet season median flows (larger or smaller), fall pulse differences (larger or smaller), and spring recession rates of change (slower or faster) can benefit different life stages of each species differently. Thus flow variation from year to year can help support differing life stage needs over time.

However, some questions – why weren’t SP-mag, SP-dur, DS-mag-50 (baseflow), DS-dur, and WS-mag-10 (baseflow) included in the analysis? Several of these would correlate with other predictors, but the selected predictors in Table 7 don’t match what was included in the models, and spring metrics (a question about spring outmigration flows in particular) aren’t included. SP-mag might correlate with WS-mag-50 (median flow), but they’re 2 different seasons affecting 2 different life stages, one of which is outmigration. Same with DS-mag-90 – it's highly correlated with both DS-mag-50 and SP-mag as it’s the transition between the 2 - better to pick SP-mag and DS-mag-50 as predictors since they’re in different seasons and affecting different life stages.

These questions, the correlations between predictors selected, and the varying results between models suggests to me that you shouldn’t select one “final predictive model” that focuses on only 2-3 flow predictors. Rather use the models to highlight commonalities that are more likely to be “correct” - i.e. the timings of reconnection and winter/spring starts.