Agenda Item E.1.a
Supplemental Presentation 1 (*Electronic Only)*
June 2024

Sacramento River Fall Chinook Workgroup Progress Report

June 2024

Prepared for:

Pacific Fishery Management Council

Prepared by:

Sacramento River Fall Chinook Workgroup and
Pacific Fishery Management Council Staff

Goals for today

Review Progress Report

Consider Questions from the Workgroup

Provide Guidance on Next Steps

Workgroup (WG) Terms of Reference

Develop potential improvements to Sacramento River fall Chinook (SRFC) assessment and management for Pacific Fishery Management Council (Council, PFMC) consideration that would:

a. Evaluate management measures currently in use, which includes:
    i. Reference points
    ii. Conservation objective
    iii. Harvest Control Rule
    iv. Also, consider the effect of environmental variables on the stability and accuracy of the management measures listed above.
b. Provide the Council with a work plan/timeline to
    i. develop alternative management measures as needed, that includes analysis of biological risks and fishery related benefits, and
    ii. design new, or update existing, abundance forecast methods and harvest models that may incorporate age-structure information, as is done for Klamath River fall Chinook.
c. Provide the Council with new or updated management measures, abundance forecast methods, and harvest models, as appropriate and supported by the available data.

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3.0 Evaluation of Current Management Measures

3.1 Reference Points

3.2 Conservation Objective

3.3 Harvest Control Rule

3.4 Environmental Variables and their implications for Management Measures

3.1 Reference Points

These are benchmarks used to determine stock status and establish conservation objectives and control rules to manage harvest (FMP p. 14).

Proxy-values may be used when data is insufficient for a direct estimate

(page 7)

S_{MSY} = lower bound of conservation objective (proxy)

F_{MSY} = 0.78, based on average of estimates made for 20 stocks (proxy).

MSST = 0.75 * S_{MSY}, reasoning for value of multipliers not well documented

F_{ABC} = 0.90 * F_{MSY}, reasoning for value of multipliers not well documented

3.2 Conservation Objective

In place since 1984

Range of 122,000 – 180,000 adult spawners in natural areas and hatcheries combined throughout Sacramento basin

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- Lower bound meant to be interim, based on uncertainty on RBDD
- Upper bound based on sum of multiple natural-area average escapements and hatchery goals, reported averages irreproducible
- Inclusion of hatchery escapement may no longer be warranted
- Current data suggests many conditions and/or circumstances no longer apply or are outdated

3.3 Harvest Control Rule

Defined in terms of Reference Points

Change to HCR form would require FMP amendment

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- Breakpoints in HCR depend on Reference Points
- At high abundance, exploitation rate capped at F_{ABC}
- At moderate abundance, F is specified to result in S_{MSY} spawners
- At low abundance, *de minimis* exploitation rates are allowed

3.4 Environmental Variables and their Implications for Management Measures

Environmental factors and biological responses

(page 11)

- Currently use the stoplight tables to show influence of environmental factors on salmon at varying life stages
- Strength of correlations change over time which poses challenges
- Environmental variables may have cumulative effects on populations and recruitment
- Year-specific escapement targets would rely on future environmental conditions

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4.0 Preliminary Identification of Management Measure Alternatives

Summarizes potential approaches for management measure alternatives, pros and cons, and approximate timelines

(page 12)

- 4.1 F_{MSY}
- 4.2 S_{MSY}
- 4.3 Minimum Stock Size Threshold (MSST)
- 4.4 Conservation Objective
- 4.5 Harvest Control Rule

4.1 F_{MSY}

The WG discussed five options for updating F_{MSY}.

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- **Update proxy** to a value more representative of SRFC
- **Spawner-recruit analysis based on abundance surrogate for natural area escapement**
- **Spawner-recruit analysis based on cohort reconstruction for natural area escapement**
- **Tributary-specific F_{MSY} values,** but there is limited data available
- **Year-specific F_{MSY} values,** but WG recommends against pursuing further

4.2 S_{MSY}

The WG discussed 10 options for updating S_{MSY}.

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- **Eliminate ‘interim’ lower bound**
- **Update status quo approach** based on mean escapement
- **Direct derivation from a spawner-recruit relationship** (either natural-area only or total)
- **Indirect derivation from spawner-juvenile production relationship**
- **Proxy based on escapement maximizing production,** easier to implement but foregoes some yield

4.2 S_{MSY} (Cont.)

The WG discussed 10 options for updating S_{MSY}.

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- **Proxy based on escapement optimizing production,** policy would need to identify desired fraction potential production
- **Proxy based on level of inland harvest opportunity**
- **Proxy based on habitat**
- **Accounting for San Joaquin Fall and/or Sacramento Late-Fall**
- **Year-specific metrics based on expected conditions for upcoming cohort,** but WG recommends against pursuing further

4.3 Minimum Stock Size Threshold (MSST)

(page 19)

May need to update if S_{MSY} is updated

Could develop alternative multiplier - but would be multi-year effort

4.4 Conservation Objective

(page 19)

- All S_{MSY} approaches could be considered for the conservation objective
- Eliminating lower bound could be rationalized, given it was meant to be ‘interim’
- Escapement of SRFC to Upper Sacramento has not stabilized as expected

4.5 Harvest Control Rule

Updating the harvest control rule would require little time, but analyzing costs and benefits could be more involved.

The WG discussed four approaches.

(page 20)

- **Update reference points,** without changing basic shape
- **Alternative escapement targets,** ex. Year-specific escapements or something other than S_{MSY}
- **Alternative forms**, ex. Eliminating or simplifying *de minimis,* matrix approach informed by risk tables
- **Uncertainty buffers** to account for forecasting and harvest planning model errors

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5.0 Workgroup Evaluation of Forecast and Harvest Models

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5.1 Abundance and Harvest Estimation (SI)

5.2 Preseason Abundance Forecast (SI Forecast)

5.3 Harvest Planning Model

5.1 Abundance and Harvest Estimation for Sacramento Index (SI)

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- SI developed in 2008 after abrupt decline of SRFC abundance
- SI has 3 components – ocean harvest, river harvest, and escapement
- Potential areas for improvement can be investigated
- SI does not account for age structure of adults nor most non-landed fishing mortality

5.2 Preseason Abundance Forecast (SI Forecast)

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- Tendency to over-forecast when abundance is low
- Over-forecasted postseason estimate in 7 out of last 10 years
- Changes in maturation rates would affect jack:adult ratios, a key driver of forecast method

5.3 Harvest Planning Model

Sacramento Harvest Model (SHM)

(page 22)

Consistently under-predicted postseason estimate of SRFC exploitation rate (ER) in recent years

New management tools to protect CA Coastal Chinook include use of trip limits and total harvest limits off the CA coast. Yet to be implemented

These tools may reduce the under-prediction of SRFC ER, but also have risk in setting limits too high if abundance is over-forecasted.

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6.0 Preliminary Identification of Forecast and Harvest Model

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6.1 Abundance and Harvest Estimation

6.2 Preseason Abundance Forecast

6.3 Harvest Planning Model

6.1 Abundance and Harvest Estimation

(page 22)

- Consider a KRFC-style cohort reconstruction
- Preliminary SRFC cohort-reconstructions are underway
- Ability to use full cohort reconstruction would depend on recovering enough tags from hatchery fish and age info on natural fish
- Consider an approach similar to SRWC (i.e. hatchery component only)

6.2 Preseason Abundance Forecast

The WG discussed four approaches.

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Updated SI forecast with updated model variants and sub-variants

Changes to forecast methods if moving to cohort reconstruction in place of SI

Incorporate uncertainty buffers, but would more appropriately be done in the control rule

Indicator-based forecasts, building on qualitative or categorical predictors developed for SRFC

6.3 Harvest Planning Model

The WG agreed it does not have sufficient expertise to lead development of an alternative SHM

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- Need to coordinate any changes with harvest models used for other CA stocks
- Challenges with new management measures implemented for California Coastal Chinook protection
- Potential alternatives for changes in reference points could affect the units used or basis for new models (hatchery /natural)

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7.0 Potential Approaches to Analyzing Alternatives

(page 25)

- Technique used in rebuilding analysis to project harvest and escapement under alterative strategies is intentionally simple
- Elements of the approach could be adapted to account for effects of natural-area spawning on future production
- Lifecycle model approach would be preferable to account for effects of spawning escapement on future production

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8.0 Working Group Key Questions (page 26)

(1) The WG noted apparently contrasting requirements in the FMP to focus on maximizing yield versus production (which cannot both be maximized). Therefore, **the WG wonders if a similar optimal but not necessarily maximal level of natural production could be identified and serve as the basis of the conservation objective and possible S_{MSY} proxy.**

(2) If the emphasis is on maximizing yield**, should that be yield of natural-origin fish (analogues to the approach for KRFC) or yield of the hatchery-natural aggregate**? If the emphasis is on natural production, **how should consideration be given to the need for sufficient hatchery broodstock**?

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9.0 Workgroup Needs – Resources and Expertise

(page 27)

- Additional expertise in lifecycle modeling
- Need for expertise in water management and prediction of future water conditions
- Further coordination with and feedback from the STT on changes to methodologies
- Ecosystem Workgroup presentation

Goals for today

- Review Progress Report
- Consider Working Group Questions
- Provide Guidance on Next Steps

Extra Slides

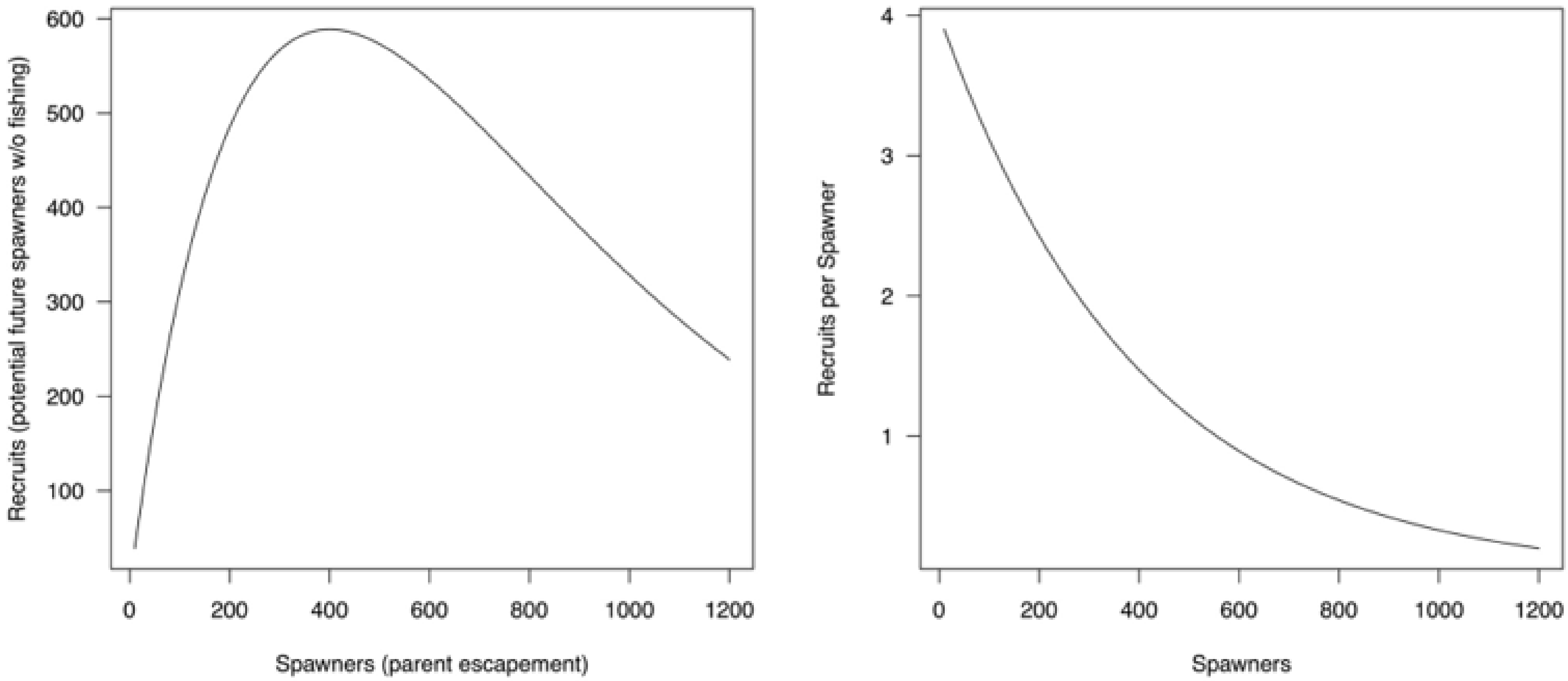

Figure A1. *Ricker spawner-recruit relationship at the population (a) or per spawner (b) level. The solid curve denotes the number of recruits (y-axis) predicted to be produced at any level of parent escapement (x-axis). The plotted curve is not driven by data for any stock and the values used for α and β were chosen arbitrarily for illustrative purposes.*

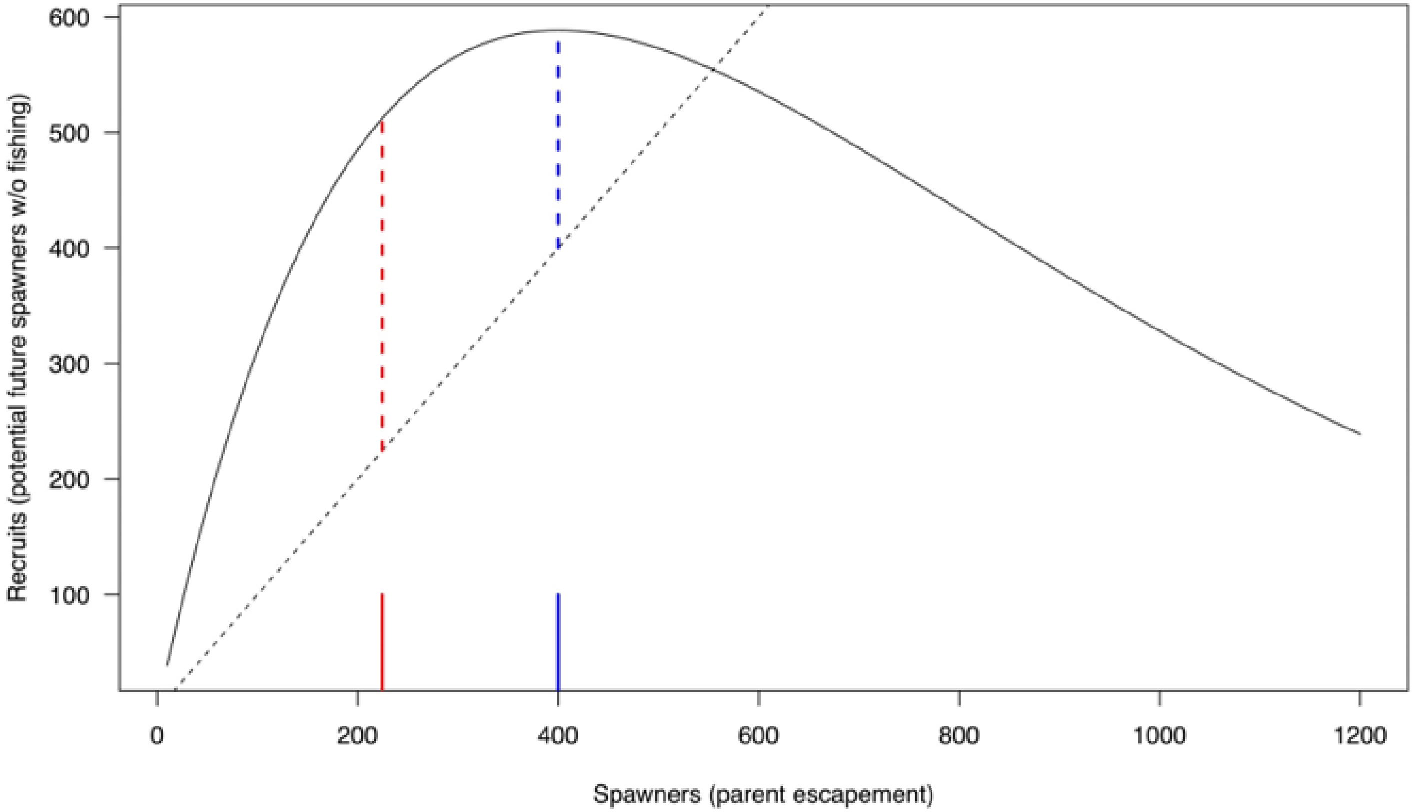

Figure A2*. Target escapement levels maximizing production or sustainable yield for a Ricker spawner-recruit relationship. The dotted line is the 1:1 line where spawners and recruits are equal. The solid blue line denotes the escapement maximizing production (S_{MP}) and the height of the dashed blue line denotes the expected yield from targeting escapement equal to S_{MP}. The solid red line denotes the escapement maximizing sustainable yield (S_{MSY}) and the height of the dashed red line denotes the yield expected from targeting escapement equal to S_{MSY} (maximum sustainable yield, MSY).*

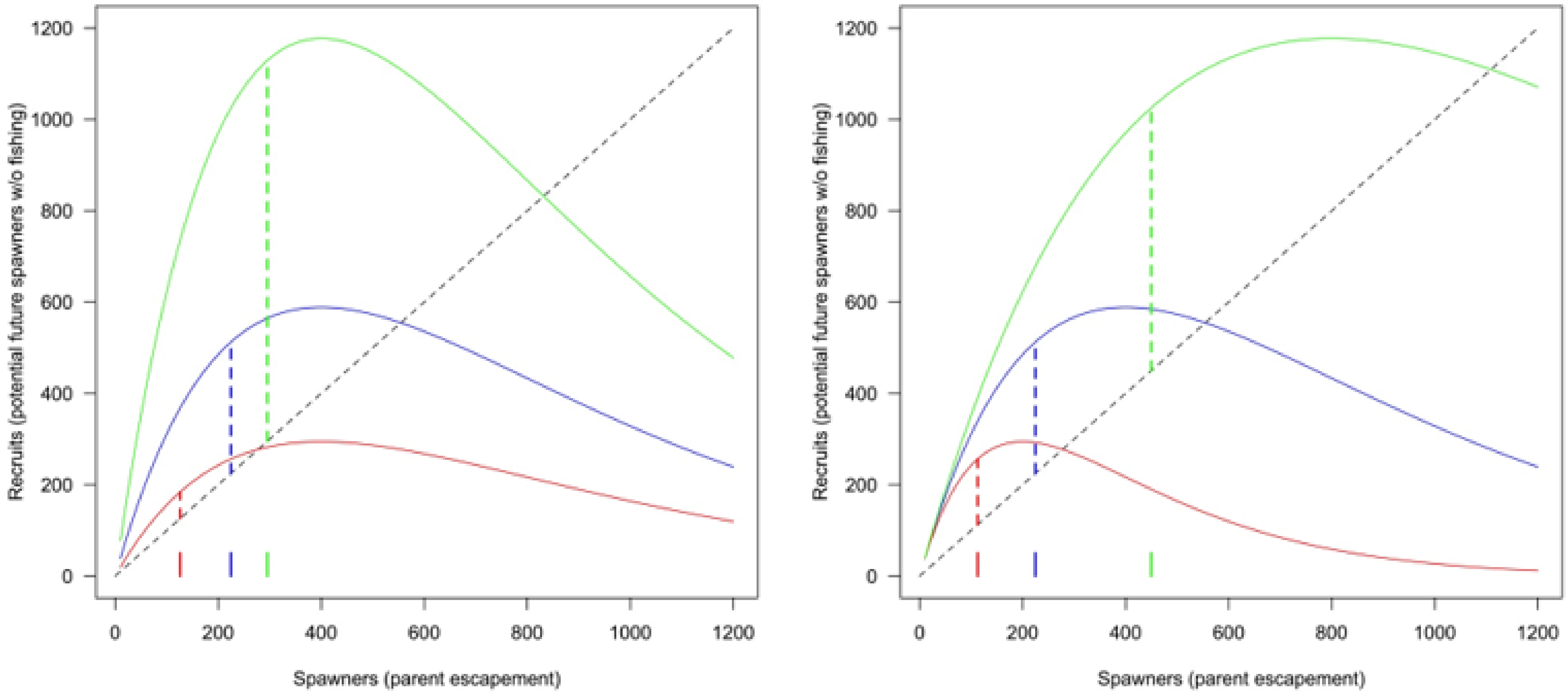

***Figure A3**. Effects of changing per capita productivity (α, left panel) or capacity/strength of density dependence (β, right panel) for a Ricker spawner-recruit relationship. In the left panel, the red curve has the lowest value for α and the green curve has the highest. In the right panel, the green curve has the lowest value for β and the red curve has the highest.*