SALMON METHODOLOGY REVIEW

Each year, the Scientific and Statistical Committee (SSC) and Salmon technical Team (STT) complete a methodology review to help assure new or significantly modified methodologies employed to estimate impacts of the Council's salmon management use the best available science. This review is preparatory to the Council's adoption, at the November meeting, of all proposed changes to be implemented in the coming season, or, in certain limited cases, providing directions for handling any unresolved methodology problems prior to the formulation of salmon management options the following March. Because there is insufficient time to review new or modified methods at the March meeting, the Council may reject their use if they have not been approved the preceding November.

The Methodology Review is also used as a forum to review updated stock conservation objective proposals, which allows the Council to approve updates at the November meeting and allows adequate time for planning fisheries in the subsequent year. The Salmon Fishery Management Plan (FMP) allows conservation objectives to be updated without a formal FMP amendment, provided a comprehensive technical review of the best scientific information available provides conclusive evidence that, in the view of the STT, SSC, and the Council, justifies a modification.

At its April 2014 meeting, the Council adopted the following priority candidate items that the SSC and STT may consider for the 2014 Salmon Methodology Review. Source entities to deliver detailed reports for SSC review are included in brackets with each candidate item.

The following were identified as priority items:

- Willapa Bay natural coho conservation objective, annual catch limit and status determination criteria (STT, Washington Department of Fish and Wildlife [WDFW]).
- Southern Oregon coastal Chinook conservation objective (Oregon Department of Fish and Wildlife).
- Standardized method for calculation of age-2 Fishery Regulation Assessment Model (FRAM) stock scalars (Model Evaluation Workgroup [MEW]).
- Progress report on new Chinook FRAM base period (MEW).
- New conservation objective for Grays Harbor Chinook (WDFW, Quinault Indian Nation).

These subjects and the responsible agencies were identified in a reminder email dated May 14, 2014, which requested agencies prepare to speak to the status of the subjects in terms of completeness and priority (Agenda Item D.1.a, Attachment 1).

During the 2014 preseason salmon process, the Council also expressed interest in a review of fishery impact estimation methodology relative to the Cape Flattery Control Zone. This and other review topics or conservation objective updates may be considered for review at this meeting, provided responsible agencies or individuals are prepared to justify their inclusion. All materials for review are to be received at the Council office at least two weeks prior to the review meeting of the SSC Salmon Subcommittee and STT, which is scheduled for October 21-23, 2014 in Portland.

Council Action:

1. **Determine if topics identified for review will be ready for the joint SSC Salmon Subcommittee - STT meeting in October.**
2. **Set priorities for review of methodologies and/or conservation objective update proposals**.

Reference Materials:

1. Agenda Item D.1.a, Attachment 1: May 14, 2014 email to the agencies from Mike Burner regarding preliminary topic selection.

Agenda Order:

a. Agenda Item Overview — Mike Burner
b. Reports and Comments of Advisory Bodies and Management Entities
c. Public Comment
d. **Council Action**: Adopt Final Review Priorities

PFMC
08/14/14

Agenda Item D.1.a
Attachment 1
September 2014

PRELIMINARY 2014 SALMON METHODOLOGY REVIEW TOPICS

From: Mike Burner - NOAA Affiliate [mailto:mike.burner@noaa.gov]

Sent: Wednesday, May 14, 2014 4:09 PM

To: Craig Foster; Doug Milward; Henry Yuen; Larrie LaVoy; Palmer, Melodie; Michael O'Farrell; Robert Kope; Sandy Zeiner; Andy Rankis; Angelika Hagen-Breaux; Ethan Clemons; Galen Johnson; Jim Packer; Key, Meisha; Owen S. Hamel; Pete Lawson; Will Satterthwaite

Cc: Mc Hugh, Peter A (DFW); Peter Dygert - NOAA Federal; Bob Turner - NOAA Federal; Heidi Taylor - NOAA Federal; Peggy Mundy; Chuck Tracy; Chris Kern; Yaremko, Marci; Anderson, Philip M (DFW); David Sones; Butch Smith; Gary Morishima; Susan Bishop - NOAA Federal; Calvin Frank; Craig Stone; Dave Bitts; Dave Hillemeier; Greg Johnson; Jerry Reinholdt; Jim Hie; Jim Olson; Kent Martin; Marc Gorelnik; Mike Sorensen; Paul Heikkila; Richard Heap; Richard Scully; Steve Watrous; Stuart Ellis; Cindy Le Fleur; Enrique Patiño; Hap Leon; Jeff Whisler; Jeromy Jording; Ray Beamesderfer; Kormos, Brett; Wendy Beeghley; Ed Waters; John DeVore - NOAA Affiliate; Jim Seger - NOAA Affiliate; Robert Conrad; Todd Confer

Subject: Preliminary 2014 Salmon Methodology Review Topics

At the April 2014 meeting in Vancouver, Washington, the Council identified potential topics for the 2014 salmon methodology review process. Parties responsible for completing the analyses are in parentheses. Tentative dates for the review are Tuesday, October 21 through Thursday, October 23. These dates may be adjusted when we know a little more about the final topics and workload for the meeting, but please reserve this three day window for now. Note that under this proposed schedule, draft analyses would be due to the Council office no later than October 7 to ensure adequate review time.

The following were identified as priority items:

- Willapa Bay natural coho conservation objective, annual catch limit and status determination criteria (Salmon Technical Team, Washington Department of Fish and Wildlife [WDFW]).
- Southern Oregon coastal Chinook conservation objective (Oregon Department of Fish and Wildlife).
- Standardized method for calculation of age-2 Fishery Regulation Assessment Model (FRAM) stock scalars (Model Evaluation Workgroup [MEW]).
- Progress report on new Chinook FRAM base period (MEW).
- New conservation objective for Grays Harbor Chinook (WDFW, Quinault Indian Nation).

The Council is scheduled to adopt the final list of review topics at its September 12-17, 2014 meeting in Spokane, Washington. Responsible parties should be prepared to report at that time if sufficient progress has been made to review the topic at the October 21-23 meeting.

PFMC
08/14/14

MODEL EVALUATION WORKGROUP REPORT ON SALMON METHODOLOGY REVIEW

The Model Evaluation Workgroup (MEW) has a few items ready for the Methodology Review agenda, all related to Chinook Fishery Regulation Assessment Model (FRAM) modeling. This past year considerable progress has been made on developing a Chinook FRAM Base Period using recent year Coded Wire Tag recoveries which should better represent current stock abundances and recent fishery patterns. The core algorithms of the Chinook FRAM model won't change; however, several issues have been identified within the model and are being addressed. The MEW believes methods that address a few of these issues can be reviewed prior to the completion of a updated Chinook Base Period. This would lessen the workload when the new Chinook Base Period comes before the Methodology Review group (anticipated October 2015). The first item is a progress report with work continuing through the summer of 2015; while the next two pertain to potential usage for 2015 pre-season planning process.

1. Progress Report: Development of new Chinook FRAM base period incorporating recent year (2007-2012) CWT recovery data, encounter rates, etc and modifications to FRAM algorithms on assessing sublegal and legal encounters and changes in minimum size limits.

2. Development of a standardized methodology for calculating Age-2 Chinook forecasts based upon the stock specific Age-3 forecast. This methodology will address the problem of setting Age 2 abundances when annual forecasts for FRAM stocks are in terms of Age-3 and older fish. Having Age-2 Chinook forecasts consistent with current production/abundance will help address Chinook FRAM's sensitivity to the age composition of forecasts, and will provide more year-to-year stability to stock-specific exploitation rates. Implementation of this methodology would also help address the discrepancies between observed sublegal encounters and model estimated values.

3. Method to update non-local Chinook stock impacts in terminal fisheries. Coded Wire Tag data has shown that the high rate of non-local stock impacts in the Terminal Hood Canal net fisheries and the Terminal South Puget Sound net fisheries in the present Chinook Base Period is unrealistic. An alternate method of calculating non-local impacts will be presented that will better estimate impacts on these stocks prior to the implementation of the new Chinook Base Period.

PFMC
09/05/14

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON SALMON METHODOLOGY REVIEW

Mr. Mike Burner briefed the Scientific and Statistical Committee (SSC) on the current list of proposed topics for the 2014 Salmon Methodology Review to be held October 21-23 in Portland, Oregon. The following items were identified for potential review this fall, and the lead entity for each work product is identified at the end of each item.

1. Conservation objectives, annual catch limits, and status determination criteria for Willapa Bay natural coho (STT and WDFW).
2. Conservation objectives for southern Oregon coastal Chinook (ODFW).
3. Standardized method to calculate Chinook age-2 FRAM stock recruit scalars (MEW).
4. Progress Report: new Chinook FRAM base period (MEW).
5. Escapement goal for Grays Harbor Chinook (WDFW and Quinault Indian Nation).
6. Review of fishery impact estimation methodology relative to the Cape Flattery Control Zone (WDFW).
7. Method to update non-local Chinook stock impacts in terminal fisheries in Chinook FRAM (MEW).

Materials to be reviewed should be submitted at least two weeks prior to the Methodology Review. Agencies should ensure that materials submitted to the SSC are technically sound, comprehensive, clearly documented, and identified by author. The SSC plans to review reports on these topics at the November meeting.

PFMC
09/12/14

SALMON TECHNICAL TEAM REPORT ON SALMON METHODOLOGY REVIEW

The Salmon Technical Team (STT) met via webinar in a joint session with the Model Evaluation Workgroup (MEW) on September 9 and reviewed potential topics for this year's methodology review:

- Willapa Bay natural coho conservation objective, annual catch limit and status determination criteria (STT, Washington Department of Fish and Wildlife [WDFW]).
- Southern Oregon coastal Chinook conservation objective (Oregon Department of Fish and Wildlife).
- New conservation objective for Grays Harbor Chinook (WDFW, Quinault Indian Nation).

The STT is planning to meet October 21-23, 2014 in Portland, Oregon with members of the Salmon Subcommittee of the Scientific and Statistical Committee (SSC) and the Model Evaluation Workgroup to review the proposed methodology revisions in preparation of final SSC and Council review at the November Council meeting.

PFMC
09/11/14

Agenda Item D.2
Situation Summary
September 2014

LOWER COLUMBIA RIVER NATURAL COHO HARVEST MATRIX

Lower Columbia natural (LCN) coho stocks in the Lower Columbia River evolutionarily significant unit (ESU) were listed as threatened under the Endangered Species Act (ESA) in 2005, and efforts to recover these populations often have a constraining effect on ocean and inriver salmon fisheries. Additionally, stocks on the Oregon side of the river have been listed under the Oregon ESA since 1999. Current and Federal ESA implementation has relied on a matrix approach that considers parental spawner escapement and marine survival as a harvest control rule to determine allowable fishery impacts. New information is available regarding the status of the populations since development of the current matrix control rule; thus, the Council has scheduled a review and possible revision of the matrix in current use.

At its June 2014 meeting, the Council received an update from the Lower Columbia River Natural Coho (LRC) Workgroup and was supportive of initial work products. The Council directed the LRC Workgroup to continue with development of alternative harvest matrices and analysis of their associated risks to Lower Columbia River natural coho. Additionally, the Council tasked the LRC Workgroup with drafting a purpose statement based on Council guidance including specifically the purpose of bringing forward new information on stock status into risk analyses and policy decisions.

The LRC Workgroup met at the Council office in Portland, Oregon on July 16 and August 14 to develop a range of alternative harvest matrices, and complete an analysis of risk (Agenda Item D.2.a, Attachment 1). The LRC Workgroup has also developed comments and recommendations including a draft purpose statement for this effort (Agenda Item D.2.b, LRC Workgroup Report). The Salmon Advisory Subpanel (SAS) will meet in a joint session with the LRC Workgroup on September 3 to review the alternatives and develop recommendations to the Council. A webinar meeting of the Salmon Technical Team and Model Evaluation Workgroup (MEW) will occur on September 9. LRC Workgroup Chair, Mr. Stuart Ellis, will present the reports to the Council at the September meeting.

The Council is tasked with approving a purpose statement, adopting a preliminary preferred alternative, and providing guidance on further development of alternative harvest matrices and the associated risk analysis. Final action on this matter is scheduled for the November Council meeting in Costa Mesa, California.

Council Action:

1. **Review and approve a purpose statement for the proposed action.**
2. **Consider alternatives and adopt a preliminary preferred alternative.**

Reference Materials:

1. Agenda Item D.2.a, Attachment 1: Review of Allowable Fishery Impacts to Lower Columbia River Natural Coho.
2. Agenda Item D.2.b, LRC Workgroup Report.

Agenda Order:

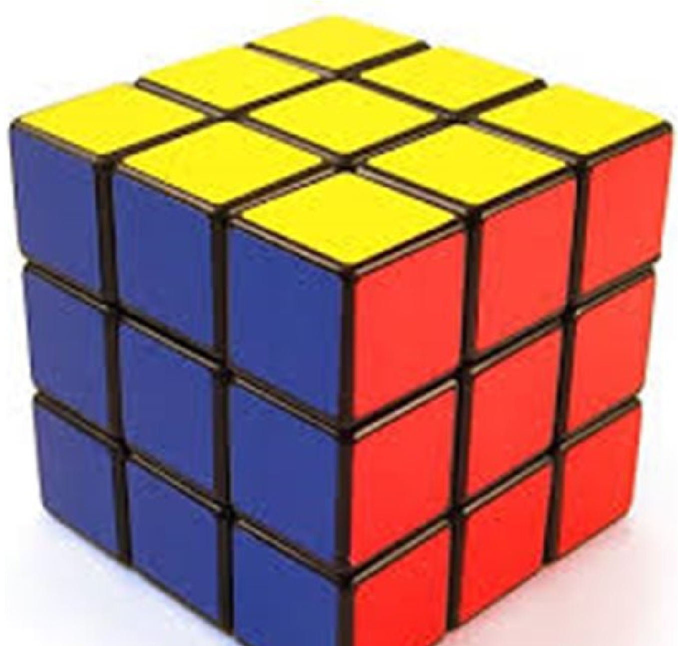
a. Agenda Item Overview — Mike Burner
b. Reports and Comments of Advisory Bodies and Management Entities
c. Public Comment
d. **Council Action**: Consider Alternatives for a Harvest Control Rule for Lower Columbia River Natural Coho and a Preliminary Preferred Alternative; Provide Additional Guidance as Necessary

PFMC
08/18/14

REVIEW OF ALLOWABLE FISHERY IMPACTS TO LOWER COLUMBIA RIVER NATURAL COHO

Lower Columbia Natural Coho Workgroup Report

Working Draft Analyses



August 17, 2014

Contents

1 INTRODUCTION

Lower Columbia natural (LCN) coho were listed as threatened under the Endangered Species Act (ESA) in 2005. Ocean and Columbia River salmon fisheries are regulated in part to limit exploitation rates on this stock. Harvest control rules are based on an abundance-based matrix approach which identifies allowable fishery impacts based on parental spawner escapement and marine survival. The current LCN harvest matrix has been in place since 2006 when NMFS completed a biological consultation for this ESU following listing under the federal ESA in 2005. Current fishing levels were effectively established in 2006 and 2007 when NMFS implemented further reductions under federal rules relative to those in place since 2001 under state rules. A more conservative strategy was adopted, in part due to the limited amount of data on status of LCN natural coho population upon which the previous strategy was based. Since that time, formal recovery plans including LCN coho have been adopted (LCFRB 2010; ODFW 2010; NMFS 2013) and new information on stock status has also been collected.

Table 1. Harvest management matrix for LCN coho showing fishery exploitation rates based on parental escapement and marine survival index.

Parental Escapement (% of full seeding)		Marine Survival Index (based on return of jacks per hatchery smolt)			
		Critical (<.08%)	Low (<.15%	Medium (<.40%)	High (>.40%)
High	>0.75	<8%	<15%	<30%	<45%
Medium	0.75 to 0.50	<8%	<15%	<20%	<38%
Low	0.50 to 0.20	<8%	<15%	<15%	<25%
Very Low	0.20 to 0.10	<8%	<11%	<11%	<11%
Critical	<0.10	0-8%	0-8%	0-8%	0-8%

The Council began a review process of current LCN harvest control rules in 2013. The 2013 salmon methodology review included a risk analysis of LCN coho harvest policy (November 2013 Briefing Book, Agenda Item C.2.s, Attachment 2, available on the Council web site). At the November 2013 Council session, the Scientific and Statistical Committee suggested improvements and found the risk analysis to be “sound” and “suitable for ranking the relative risk of various harvest scenarios.” The Salmon Advisory Subpanel (SAS) recommended additional review and deliberations with stakeholders. The Council agreed, and formed the ad hoc Lower Columbia Natural Coho Workgroup (LRC Workgroup) to further explore existing and alternative harvest policies, working closely with the SAS as had been the case in developing a new control rule for the lower Columbia River natural tule Chinook stock.

At its March 2014 meeting, the Council appointed LRC Workgroup members representing primarily technical and policy staff from State, Federal, and Tribal agencies. The work group was directed to provide guidance on the development of alternative harvest control rules bringing new information on stock status into risk analyses and policy decisions made about a decade ago. The LRC Workgroup was expected to work closely with the SAS. This report summarizes new information, technical analyses developed by the LCN Work Group.

2 Lower Columbia Coho Status

2.1 Columbia River Run

Hatchery-origin fish comprise the large majority of the lower Columbia River coho run. Numbers can vary substantially from year-to-year as coho encounter widely-varying conditions for marine survival related to environmental conditions particularly including coastal upwelling.

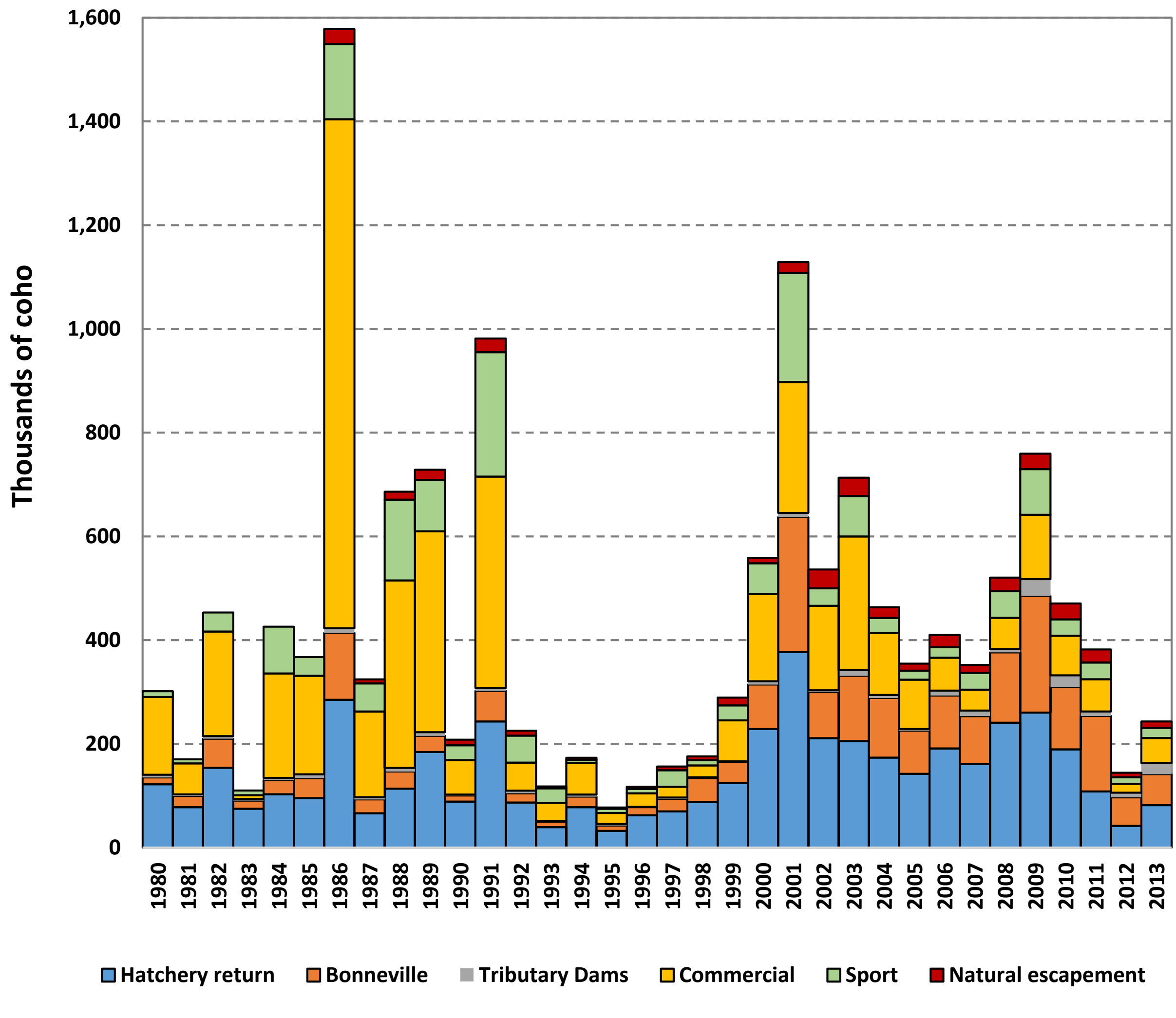


Figure 1. Columbia River return of coho, 1980-2013.

2.2 Lower Columbia River Natural

Salmon recovery plans adopted by Washington, Oregon, and NMFS, identify recovery objectives for LCN coho that designate a subset of all populations as primary targets for restoration to high levels of viability based on abundance, productivity spatial structure and diversity. A total of 16 of the 24 lower Columbia populations were identified in recovery plans as primary populations. The remainder were identified as contributing populations where recovery measures are expected to result in some improvement, or as stabilizing populations where measures are expected to prevent further declines. Of the primary populations, at least three were identified in each of the three spatial strata within the ESU. Primary populations of coho will require some of the most significant improvements in status, hence, will be most constraining to a viable recovery fishing strategy.

Previous application of the coho harvest matrix was based on Sandy and Clackamas coho which are two of the stronger populations in the ESU and the only two for which long-term stock assessment data were available. Over the last five to ten years, data has been collected on the status of additional natural populations.

Figure 2. Lower Columbia River coho populations – dark shading denotes "primary" populations identified in recover plans for improvement to high levels of viability.

Table 2. Lower Columbia River coho populations, recovery plan designations, stock assessment data availability, and stock-recruitment parameters for populations included in risk assessment. Seeding and stock-recruitment parameters are as reported in Kern and Zimmerman 2013 except Oregon population values are updated to include 2013 data.

	Population	State	Recovery Designation	Data years	Full seeding	Stock-recruit param. Prod.	Stock-recruit param. Capacity
Coast	Grays/Chinook	WA	Primary	2011-2012	1,100	2.09	1,500
	Eloch/Skam	WA	Primary	2011-2012	2,400	2.93	3,200
	Mill/Ab/Germ	WA	Contributing	2011-2012	--	--	--
	Youngs	OR	Stabilizing	2002-2013	--	--	--
	Big Creek	OR	Stabilizing	2002-2013	--	--	--
	Clatskanie	OR	Primary	2002-2013	1,200	5.33	3,400
	Scappoose	OR	Primary	2002-2013	1,200	2.21	4,400
Cascade	Lower Cowlitz	WA	Primary	2011-2012	3,900	3.50	5,400
	Upper Cowlitz	WA	Primary	2011-2012	--	--	--
	Cispus	WA	Primary	2011-2012	--	--	--
	Tilton	WA	Stabilizing	2011-2012	--	--	--
	Toutle SF	WA	Primary	2011-2012	3,200	2.43	5,000
	Toutle NF	WA	Primary	2011-2012			
	Coweeman	WA	Primary	2011-2012	900	2.64	1,500
	Kalama	WA	Contributing	2011-2012	--	--	--
	NF Lewis	WA	Contributing	2011-2012	--	--	--
	EF Lewis	WA	Primary	2011-2012	600	2.28	1,000
	Salmon	WA	Stabilizing	2011-2012	--	--	--
	Washougal	WA	Contributing	2011-2012	--	--	--
	Clackamas	OR	Primary	1974-2013	3,800	3.62	3,600
	Sandy	OR	Primary	1984-2013	1,300	4.18	1,500
Gorge	L Gorge	WA/OR	Primary	2011-2012	--	--	--
	U Gorge	WA	Primary[1]	--	--	--	--
	U Gorge/Hood	OR	Contributing	2002-2013	--	--	--

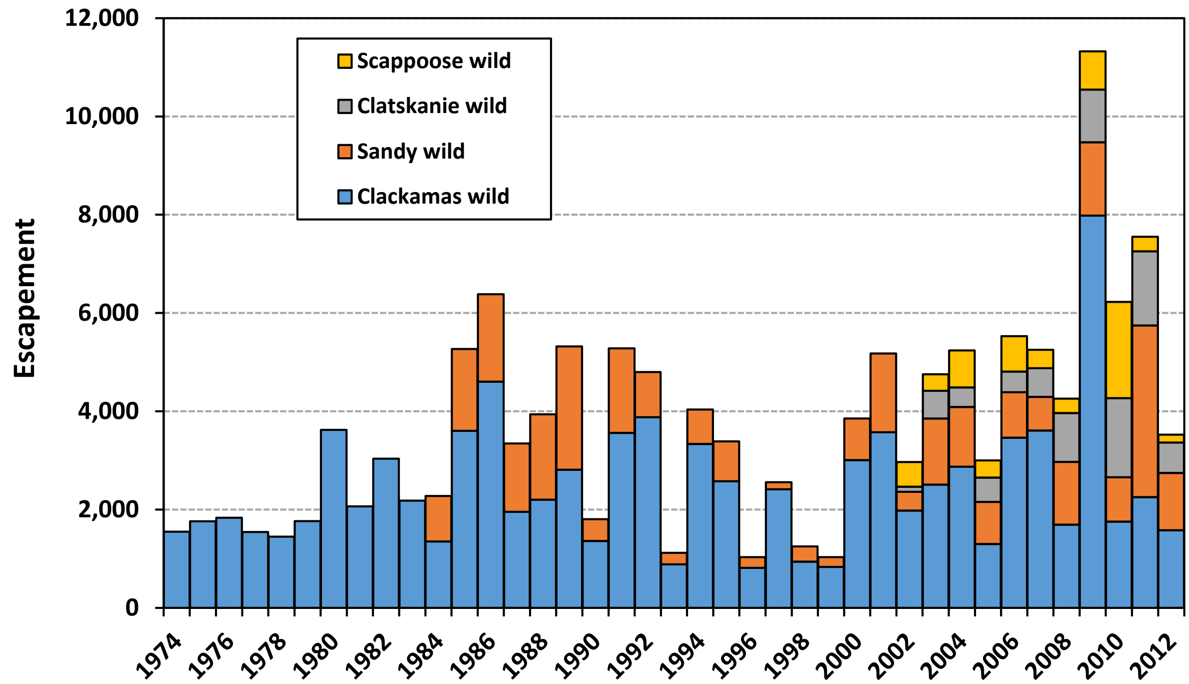


Figure 3. Escapement of LCN coho in selected Oregon tributaries. (Not all populations were surveyed in every year.)

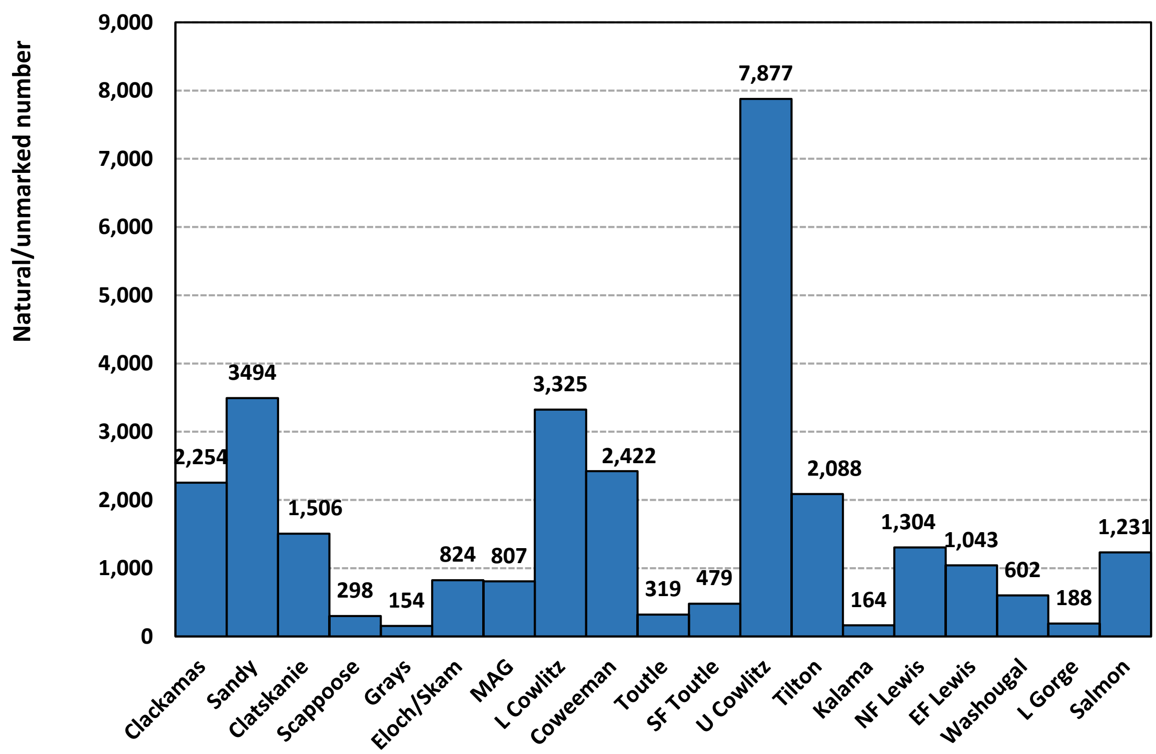


Figure 4. LCN coho abundance data by population for 2011.

2.3 Willamette coho

The Work Group reviewed current information on Willamette coho prepared by ODFW and NMFS. Willamette River tributaries upstream from Willamette Falls currently support naturally-produced coho that have often been the largest return of natural coho in the lower Columbia in recent years. Willamette coho were not included in the listed ESU, primarily because access was historically blocked by Willamette Falls. However, a naturally-producing population has become established following decades of hatchery releases, which were discontinued after 1996. Ladder counts at Willamette Falls provide some of the most accurate information on status of a naturally-producing coho population in the region.

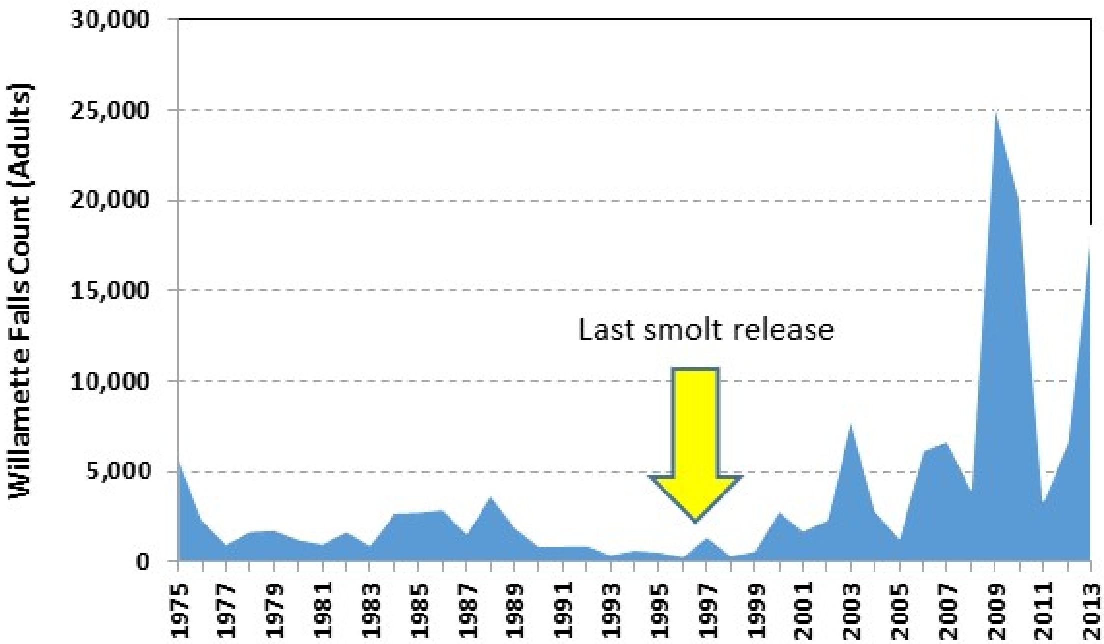


Figure 5. Willamette Falls coho counts.

The appropriate status of Willamette coho relative to the listed ESU and coho recovery goals has been debated by some. On the one hand, this population is not part of the ESU because it has colonized streams where it is not native. On the other hand, it appears to be a viable naturally-producing population which is the goal for the ESU.

The work group suggests that status of Willamette coho might inform our understanding of population dynamics and response to recent fishing patterns but does not change the need to develop effective fishing alternatives for management of listed coho populations throughout the designated ESU. The degree to which the Willamette population might be considered representative of other coho populations in the ESU is unknown. NMFS will review the classification of Willamette coho as part of the next formal 5-year status review scheduled for 2016. **NMFS advises that their consultation will be based on the current ESU. Willamette coho is not part of the ESU. Therefore, NMFS will not use Willamette information in writing the Biological Opinion.**

3 LCN Exploitation Rates

Annual exploitation rates of LCN coho have been substantially reduced from very high historical levels as management has shifted from maximizing harvest of hatchery fish to protecting natural populations. LCN coho are harvested in a wide range of marine and freshwater fisheries in Washington and Oregon as well as Canada.

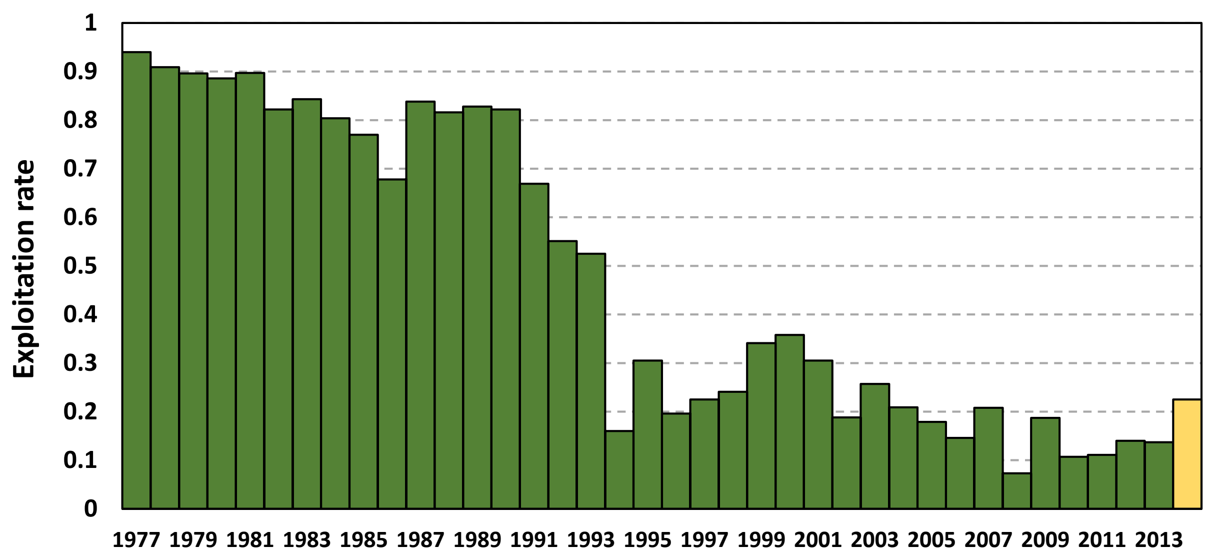


Figure 6. Annual exploitation rates of lower Columbia River natural coho, 1977-2013. The 2014 value is the preseason number.

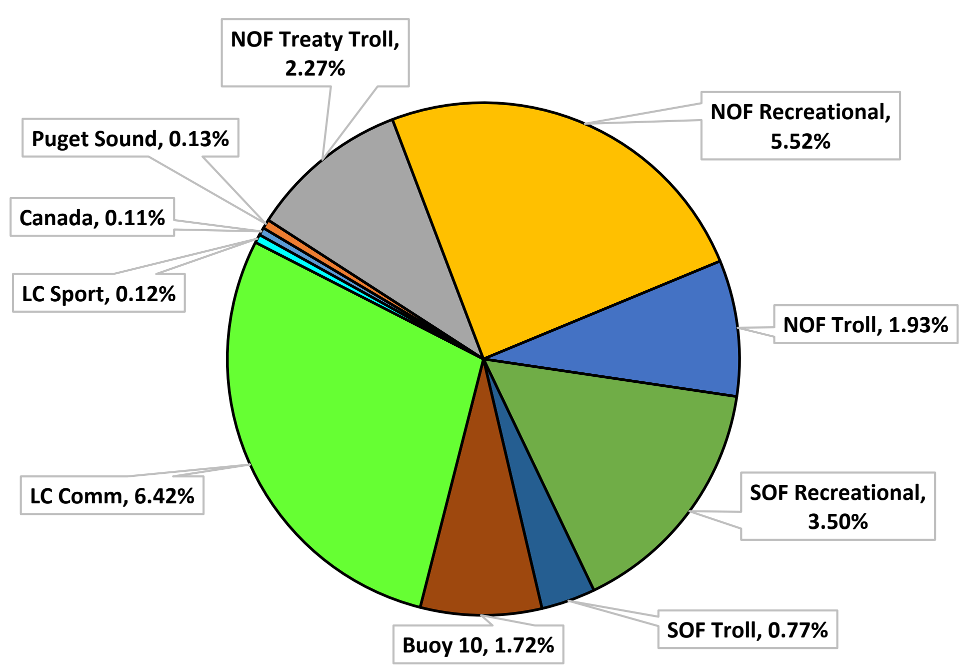


Figure 7. Distribution of expected 2014 fishery impacts on lower Columbia River natural coho salmon.

During recent years, exploitation rates have been limited from 8 to 22.5%. Exploitation rate has been limited to 15% in six of the last ten years. The weighted average exploitation rate during this period was 16%. Post-season rates have averaged approximately 1% less than pre-season limits during this period.

Relatively small differences in fishing rate limits can have substantial implications to fishery opportunity. For instance, fishing rates can be identified in the ocean or Columbia River fisheries corresponding to no coho target fisheries, full coho retention fisheries, and maximum potential rates given other constraints.

Table 3. Lower Columbia Natural adult coho conservation objectives and fishery impacts.[a]

Year	Objective	Pre-season	Post- season
2005	≤0.15	0.10	0.179
2006	≤0.15	0.10	0.146
2007	≤0.20	0.13	0.208
2008	≤0.08	0.08	0.073
2009	≤0.20	0.20	0.187
2010	≤0.15	0.15	0.107
2011	≤0.15	0.15	0.111
2012	≤0.15	0.15	0.14
2013	≤0.15	0.15	0.137
2014	≤0.225		
Avg.		*0.134*	*0.143*

[a] *rates do not include Columbia River tributary fisheries.*

Table 4. Frequency occurrence of specific conservation objectives for LCN coho, 2005-2013.

Rate	N	Frequency
8%	1	10%
15%	6	60%
20%	2	20%
22.5%	1	10%

Table 5. Fishery implications of conservation objectives.

Exploitation Rate	Fishery
10%	No retention
10-20%	Mark-selective
20-25%	Coho target
30%	Maximum usable

4 Analysis of Current Matrix Efficacy

The current harvest control rule is based on a matrix approach that determines allowable fishery impacts based on parental spawner escapement and marine survival. This matrix is complex, including specific harvest rates for 20 combinations of five escapement and four survival index categories. This complexity makes it difficult for managers and fishers to understand and evaluate the implications of different alternatives.

The Work Group examined the technical basis of the general matrix strategy and the specific definition of categories. Based on this examination, it was concluded that the current matrix complexity may not be necessary or entirely effective. Harvest rates are the same for many matrix cells and several categories and cells seldom or never occur. Natural coho abundance and recruits per spawner was strongly correlated with a marine survival index based on hatchery jacks/smolt, so there is a justifiable rationale for a related abundance-based harvest strategy. However, abundance was weakly related to parental escapement which calls into question the definition of five parental escapement categories, particularly since natural coho escapement is also measured with substantial error in most populations.

4.1 Marine Survival Index

Marine survival of LCN coho is highly variable. The high marine survival category (>0.4%) has not been achieved by LCN coho. Returns of lower Columbia hatchery adult coho are highly correlated with the marine survival index based on jack returns per smolts – this indicates that this MSI provides a relatively robust forecast of adult returns and hence, marine conditions which likely affected both hatchery and wild coho.

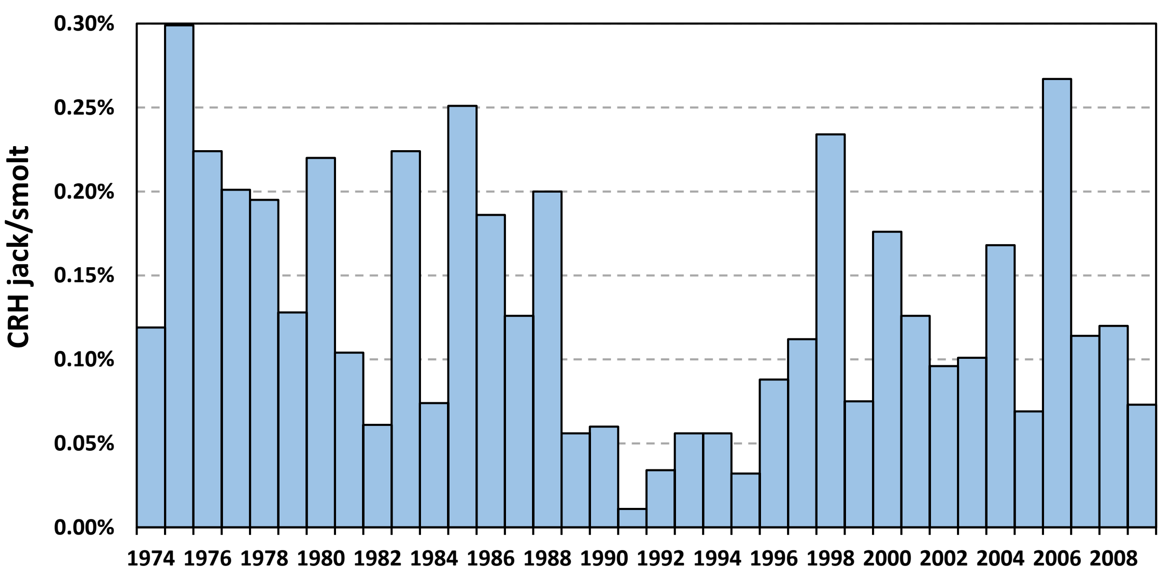


Figure 8. Marine survival index based on the percentage return of hatchery smolts returning after one year in the ocean as jacks, 1974-2009.

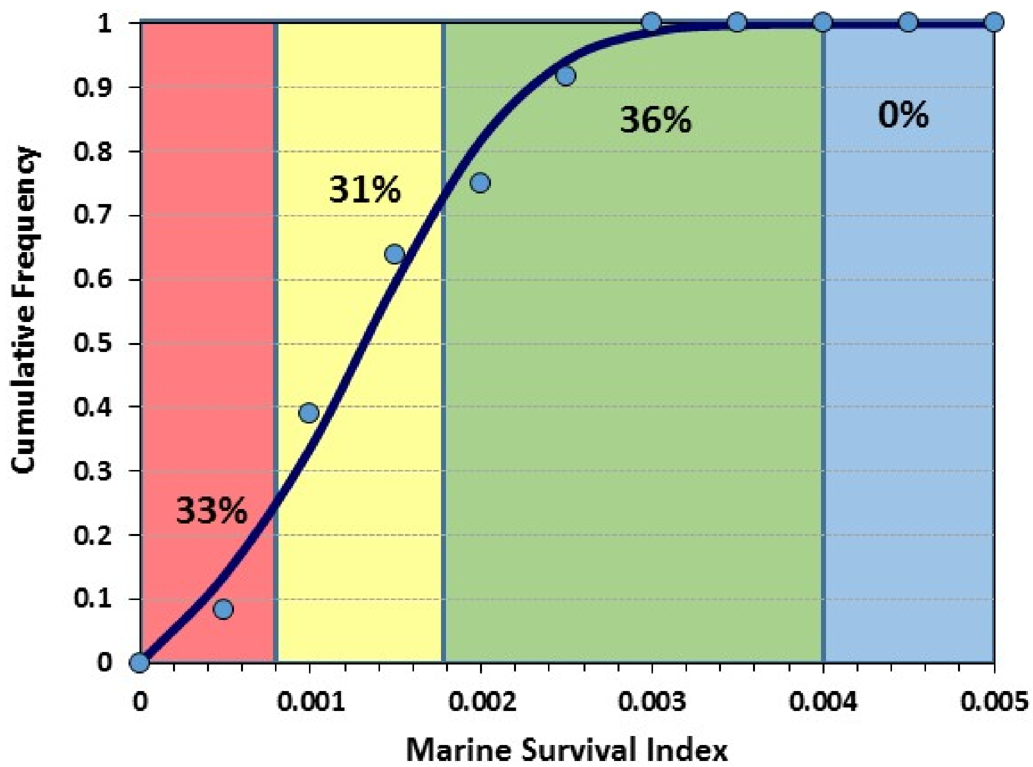


Figure 9. Cumulative frequency distribution of Columbia River hatchery coho marine survival index, 1974-2009. Categories identified in the LCN coho harvest matrix are identified along with observed frequencies for each category.

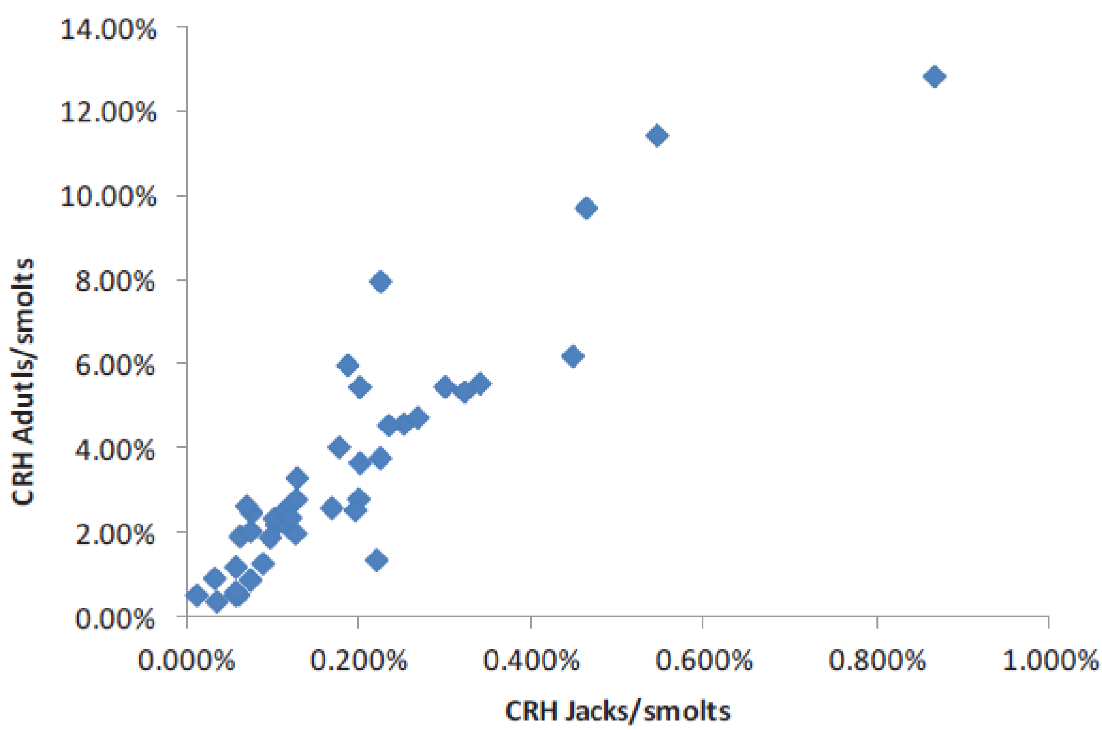


Figure 10. Relationship between returns of Columbia River hatchery jacks and adults in the following year, 1974-2009.

4.2 Population Seeding Levels

Spawner abundance is very weakly correlated with subsequent returns for LCN coho populations where data is sufficient to evaluation these relationships. Marine survival index counts for a much larger proportion of the variability in return. This pattern is commonly seem among coho populations throughout the eastern Pacific.

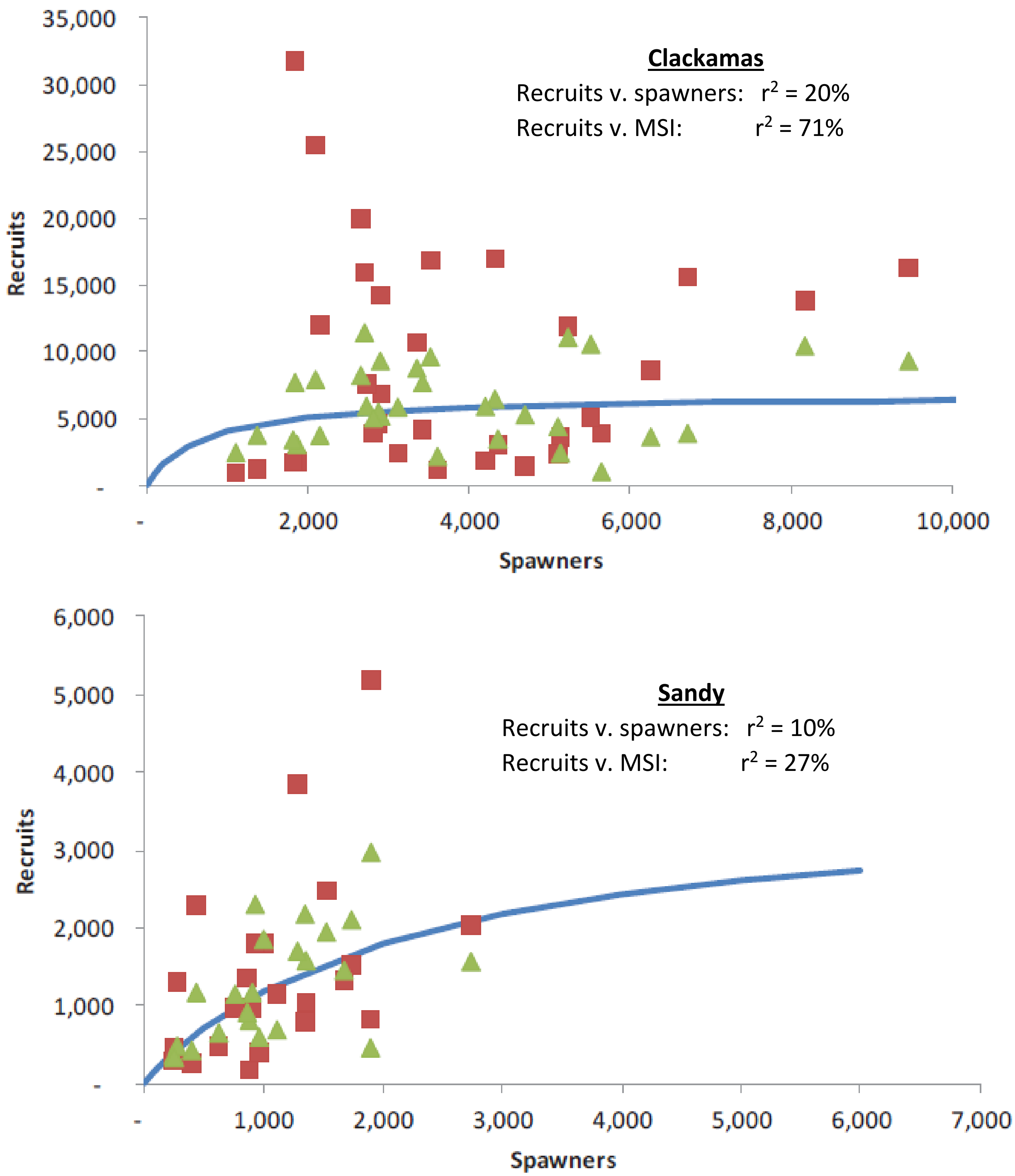


Figure 11. Stock-recruitment relationships for Clackamas (top) and Sandy (bottom) natural coho populations (Kern and Zimmerman 2013).

Seeding levels of less than 40% of full seeding estimates are rarely if ever observed among lower Columbia River coho populations. In part, this reflects the low capacity and productivity of these populations in the current habitat conditions.

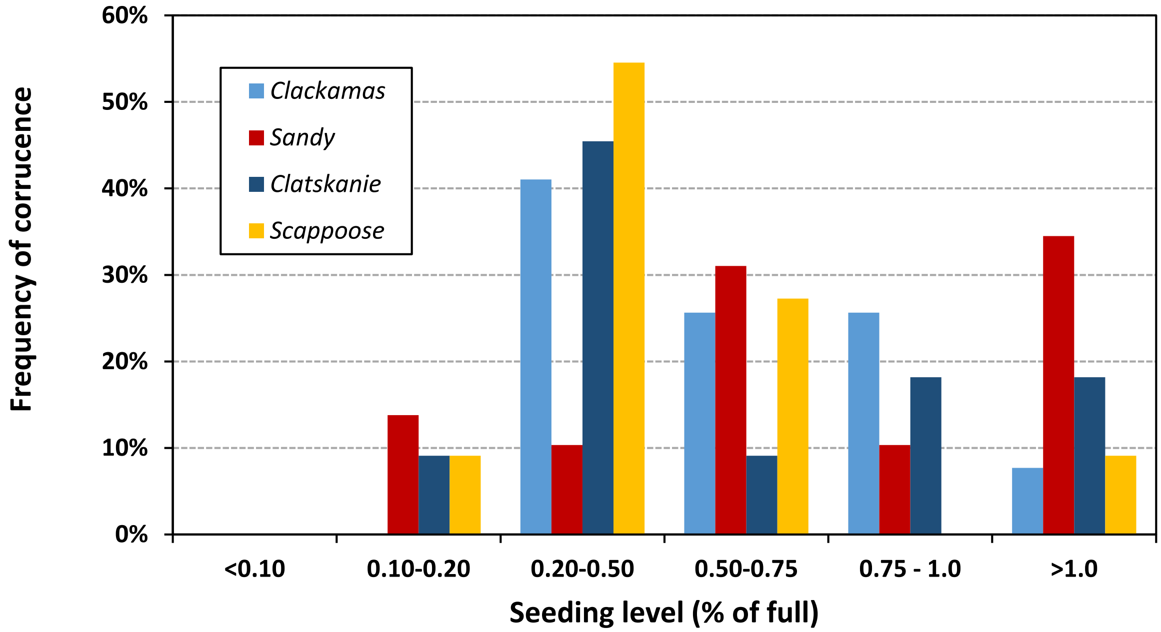


Figure 12. Frequency distribution of seeding relative to full seeding levels for Oregon LCN populations, 1974-2012 (as available).

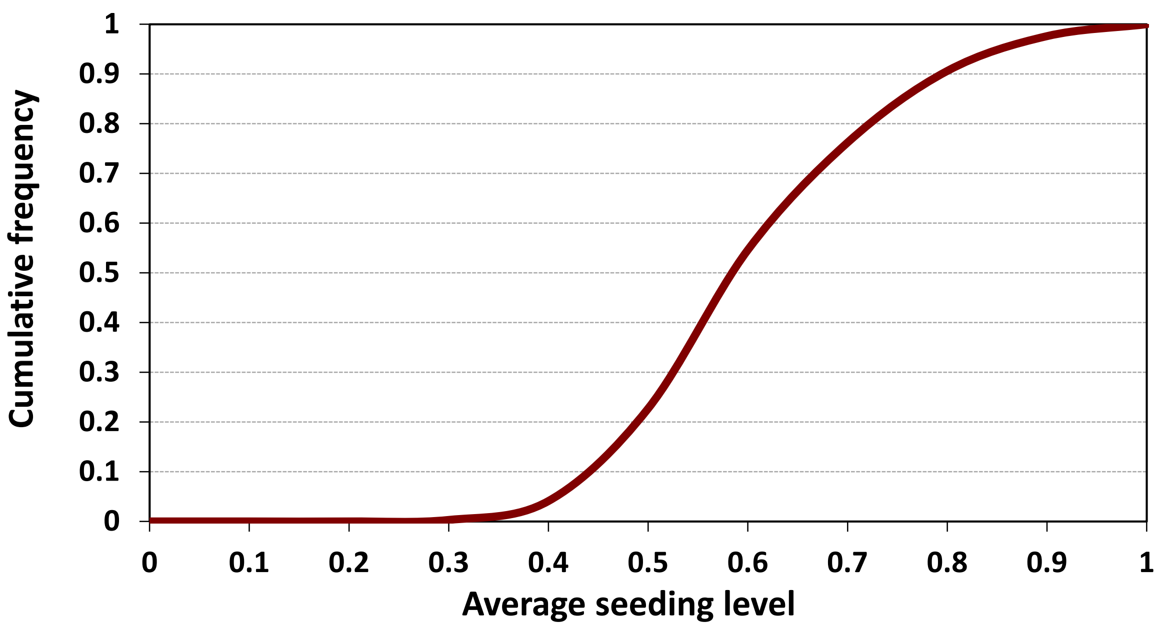


Figure 13. Cumulative frequency distribution for average seeding level of selected primary LCN coho populations in risk assessment model simulations based on historical stock-recruitment data and normal variation in marine survival. Populations include Clatskanie, Scappoose, Elochoman/Skamokowa, Grays/Chinook, Clackamas, Sandy, L Cowlitz, Toutle, Coweeman, and EF Lewis.

4.3 Cell Frequency of Occurrence

Many cells in the current matrix are rarely or never utilized because cell thresholds were based on values which have not been observed in the historical data. Prospective projects using the risk model indicate that many cells will not be utilized under normal variation in parental seeding or marine survival. Historical threshold values were based on fish population dynamics theory and the best available data at the time. However, subsequent analysis based on empirical data indicates that the historical matrix design is unnecessarily complicated and may not achieve the desired effects.

Table 6. Projected frequency of occurrence of combinations of marine survival and parental seeding level (average of all populations) under the current matrix.

Parental Escapement (% of full seeding)		Marine Survival Index (based on return of jacks per hatchery smolt)			
		Critical (<.08%)	Low (<.15%	Medium (<.40%)	High (>.40%)
High	**>0.75**	6%	11%	8%	0%
Medium	**0.75 to 0.50**	16%	29%	20%	0%
Low	**0.50 to 0.20**	3%	5%	3%	0%
Very Low	**0.20 to 0.10**	0%	0%	0%	0%
Critical	**<0.10**	0%	0%	0%	0%

Table 7. Pros and cons for including seeding level in the harvest matrix.

Drop

- Measurement error
- Unknowns/Assumptions
- Population complexity
- Returns not strongly correlated
- Risks not sensitive
- Risk-equivalent alternatives
- Simplify application

Keep

- Established practice
- Stock-recruitment theory
- Perception value

5 RISK ASSESSMENT

Conservation risks associated with alternative fishing strategies were analyzed with the same methodology developed by ODFW and WDFW for LCN coho in 2013 using an adaptation of the Lower Columbia River tule fall Chinook risk model.

5.1 Methodology

5.1.1 Model Description

The model analyzes effects of fishing on natural population status using a stochastic stock-recruitment model in a Population Viability Analysis framework like that employed in salmon ESA status assessments and recovery plans. Spawner-recruit functions and full seeding levels were developed for all populations. Methods varied depending on available data, accounting for differences between the Washington and Oregon recovery plans. Relative risk and opportunity for a range of harvest strategies and harvest matrices was evaluated using a stochastic population viability analysis (PVA). This analysis incorporated new information from eight populations, in addition to the Clackamas and Sandy populations, into the framework for evaluating alternative harvest management matrices for LCN coho.

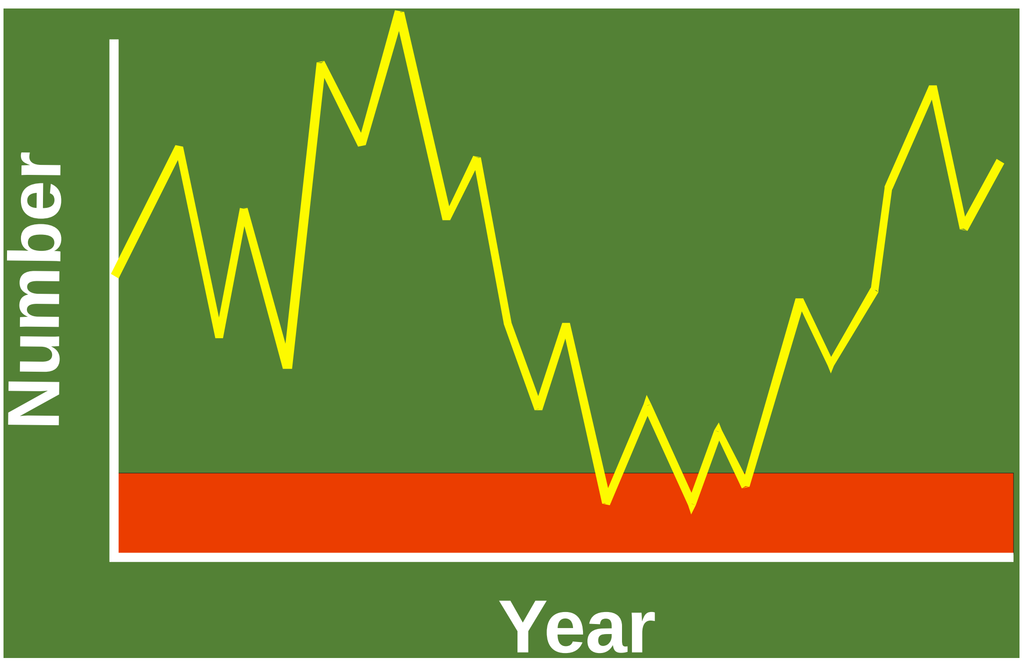


Figure 14. Population risks are assessed In the population viability analysis based on the projected frequency of falling below a critical population level of concern.

5.1.2 SSC Review of Methodology

The 2013 LCN assessment was vetted in a 2013 salmon methodology review (November 2013 Briefing Book, Agenda Item C.2.s, Attachment 2, available on the Council web site). At the November 2013 Council session, the Scientific and Statistical Committee evaluated the data reconstruction techniques used and technical aspects of the PVA. They concluded that the analysis framework is suitable for ranking the relative risk of various harvest scenarios. Numerical estimates of extinction risk from the model should be considered as index values only, and in no way represent actual probabilities of extinction. The analysis is complex, and the SSC identified several areas where alternative analytical techniques could be applied. However, the basic technique and application are sound, and relative rankings of scenarios are not likely to be greatly affected by the statistical refinements suggested.

One strength of the proposed analysis framework is that it characterizes the relative risk from alternative harvest scenarios to the entire LCN coho evolutionarily significant unit, rather than simply the two healthiest populations (the Sandy and Clackamas). The SSC recommended using the shorter 1993 to 2009 data sets for the Sandy and Clackamas populations and subsequent analyses incorporated this refinement.

The SSC noted that populations used in the analysis do not exactly match those in the Fishery Regulation and Assessment Model (FRAM) model and suggested that differences will need to be reconciled before a resulting harvest strategy can be applied. However, upon further evaluation, the LCN technical work group found that significant revisions to FRAM would not be required.

The SSC also noted that continued monitoring of LCN coho populations should help refine capacity and productivity estimates for Oregon populations and allow for empirical estimates for Washington populations. Investigation of alternative metrics to better represent marine survival of LCN coho, similar to approaches used for the OCN coho harvest matrix, were also recommended for future examination.

5.1.3 Populations Considered

Previous application of the coho harvest matrix was based on Sandy and Clackamas coho which are two of the stronger populations in the ESU and the only two for which long-term stock assessment data were available. Rates were previously indexed to Sandy and Clackamas coho seeding levels in part because data on other coho populations was quite limited. However, Sandy and Clackamas may or may not be representative of many of the weaker populations in the ESU. Therefore, reduced fishing rates were implemented as a precautionary measure for protecting significant coho populations throughout the ESU.

Since the federal listing of coho in 2005, substantial new information on the status of natural coho populations has been collected by ODFW and WDFW. This data now provides a means of conducting a formal risk assessment to demonstrate the likely effects of proposed harvest strategies as identified by NMFS in a 2011 guidance letter. This risk assessment incorporates recent data which now provides an empirical basis for assessment of representative populations in addition to the Sandy and Clackamas.

The work group assessed conservation risks of the fishery strategy based on effects on primary populations, as designated by ESA salmon recovery plans and representative of all three spatial strata of the Evolutionary Significant Unit (ESU). An essential objective of the fishing strategy for LCN coho is to avoid jeopardizing long term viability or precluding recovery of LCN coho. Primary populations include a subset of all populations as identified as primary targets for restoration to high levels of viability based on abundance, productivity spatial structure and diversity. Primary populations of coho will require some of the most significant improvements in status, hence, will be most constraining to a viable recovery fishing strategy.

Seeding levels used in matrix strategies as a basis for selecting fishing rates were based on a based on ten primary LCN populations where reasonably robust assessment data is available. These populations include Clatskanie, Scappoose, Elochoman/Skamakowa, Grays/Chinook (Coast Strata), and Clackamas, Sandy, Lower Cowlitz, Toutle, Coweeman, and East Fork Lewis (Cascade strata). Seeding level of parental escapement is expressed as a percentage of the full seeding level. Percentages greater than 100% are set at 100%. Full seeding levels for Oregon populations were defined based on a combination of stock-recruitment and habitat analyses. Full seeding levels for Washington populations were defined as equilibrium abundance in stock-recruitment parameters inferred with the Ecosystem Diagnosis and Treatment Model from assessments of the available habitat quantity and quality.

Viability risks associated with alternative fishing strategies were calculated with the model for each population. The work group compared effects of fishing strategies on LCN risk based on: 1) median risk value for all populations and 2) average risk value for the five highest risk populations among those evaluated. The five weakest populations were selected to provide a precautionary assessment of fishery-related risks. These populations were at the greatest absolute risk and the most sensitive to changes in exploitation rates. These populations were identified by model sensitivity analysis to differences in fixed exploitation rates.

5.1.4 Alternative Model Structures

The workgroup evaluated a number of alternative matrix structures as follows:

Model 1 - Current Matrix (Sandy-Clackamas Seeding)

Parental Escapement (% of full seeding)		Marine Survival Index (based on return of jacks per hatchery smolt)			
		Critical (<.08%)	Low (<.15%	Medium (<.40%)	High (>.40%)
High	>0.75	<8%	<15%	<30%	<45%
Medium	0.75 to 0.50	<8%	<15%	<20%	<38%
Low	0.50 to 0.20	<8%	<15%	<15%	<25%
Very Low	0.20 to 0.10	<8%	<11%	<11%	<11%
Critical	<0.10	0-8%	0-8%	0-8%	0-8%

Model 2 – Fixed Rate

- Same rate in every year regardless of seeding level or marine survival

Model 3 – Current Matrix (Population Average Seeding)

- Same categories and rates as Model 1.

Model 4 – 1x4 Matrix

Marine Survival Index			
Critical	Low	Medium	High
ER ≤__%	ER ≤__%	ER ≤__%	ER ≤__%

Model 5 – 1x5 Matrix

Marine Survival Index				
Critical	Low	Medium	High	V High
ER ≤__%	ER ≤__%	ER ≤__%	ER ≤__%	ER ≤__%

Model 6 – Continuous

Marine Survival Index	
Critical	Low - High
ER ≤10%	ER 10 - 30%

Model 7 – 2x5 Matrix

Marine Survival Index				
Critical	Low	Medium	High	V High
ER ≤__%	ER ≤__%	ER ≤__%	ER ≤__%	ER ≤__%
ER ≤__%	ER ≤__%	ER ≤__%	ER ≤__%	ER ≤__%

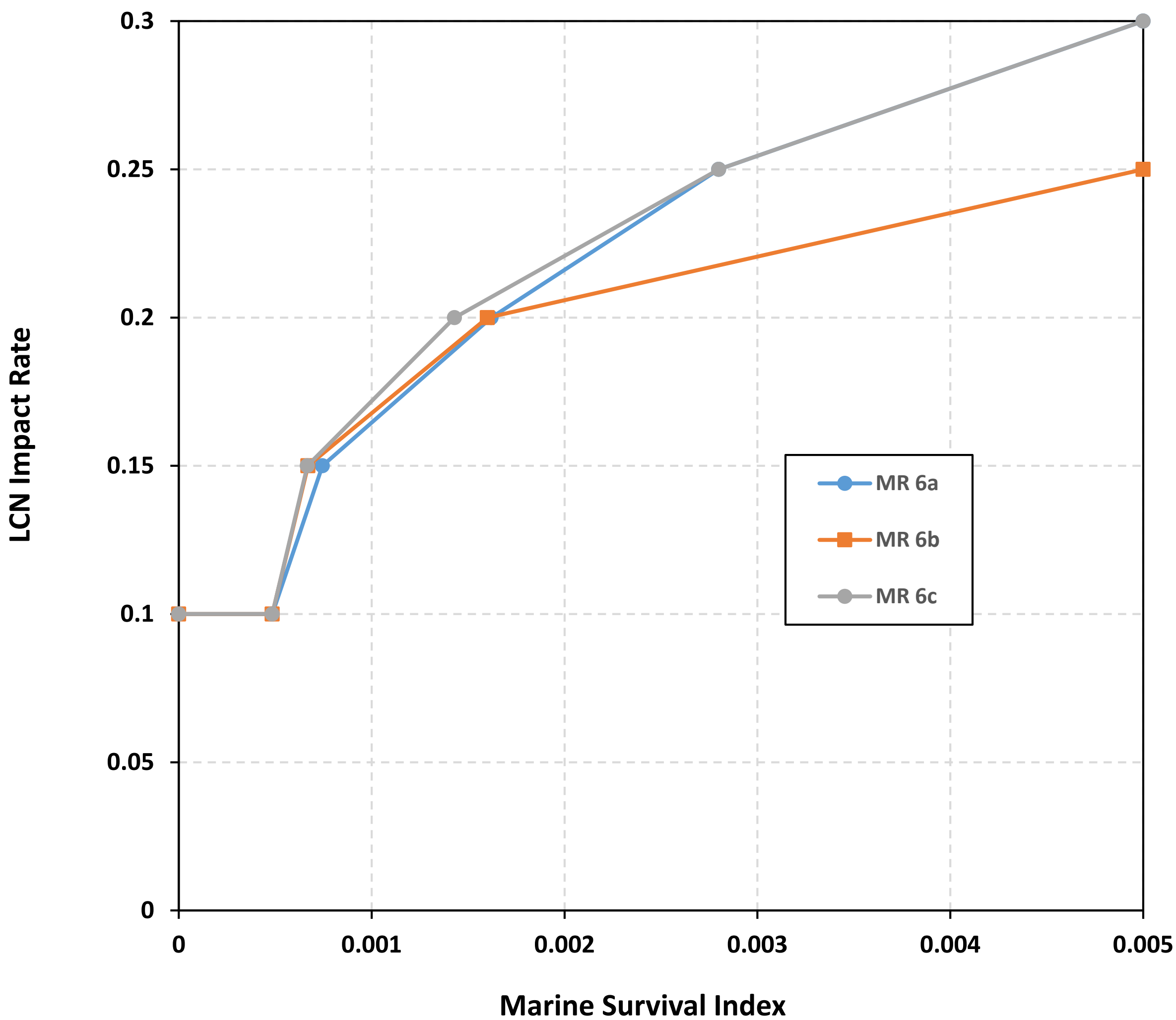


Figure 15. Examples of continuous models.

5.2 Results

5.2.1 Population risk sensitivity to fishing

Risks are relatively insensitive to fishing within the 10 to 30% range of exploitation under consideration for LCN coho for all but the smaller, less-productive populations evaluated. The median value for all populations considered in this analysis is also relatively insensitive to fishing rates in the current range due to inclusion of the larger, more productive populations in the ESU. The high risk average is more sensitive to fishing rates in the current range and represents the weaker populations among those targeted in the recovery plan for high levels of viability or substantial levels of improvement. We should also note that the ESU also includes smaller, less productive populations identified as stabilizing or contributing in the recovery plans. These populations were not modeled but will also be expected to be relatively insensitive to effects of fishing – risks will be high even when little or no fishing mortality occurs.

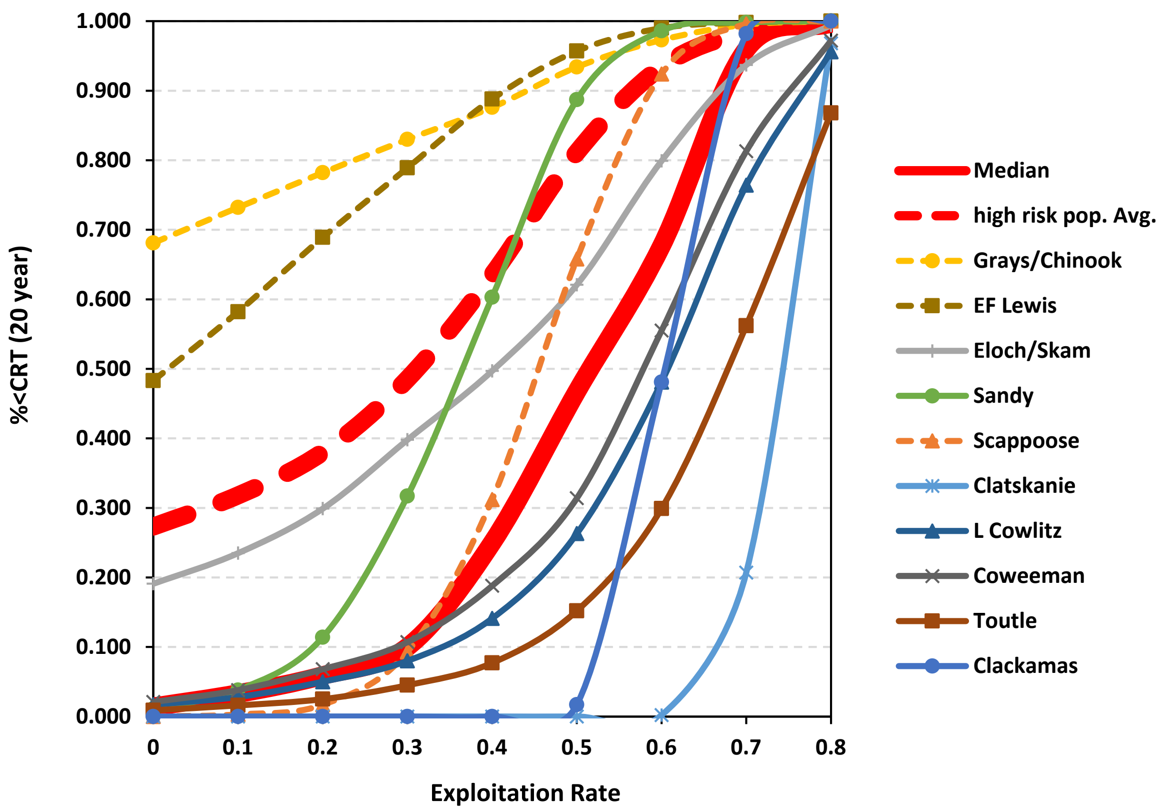


Figure 16. Population risk response to fixed annual exploitation rates and depiction of summary metrics utilized for comparison of the relative effects of alternative fishery strategies. Metrics included median risk value for all populations and average risk value for the five highest risk populations among those evaluated. Risk is based on the frequency of simulations where wild spawning escapement falls below critical levels during three successive years over a 20-year period.

5.2.2 Effects of Fishery Alternatives

1. Comparable levels of risk can be achieved with a variety of exploitation rate strategies. For instance, the current coho matrix produces population risk levels equivalent to a fixed 15-16% harvest rate. However, abundance-based management defined by a matrix approach can provide significant fishery benefits by allowing increased opportunity during large return years when risks of low escapement are negligible.
2. Neither median nor the 5-population average risks are particularly sensitive to exploitation rate strategy within the range under consideration.
3. Small levels of risk are associated with a greater frequency of higher exploitation rates in years of good marine survival indices.
4. Effective exploitation rates and risks are not particularly sensitive to low seeding levels because of a very low incidence of occurrence.
5. Risks are directly and positively correlated with effective exploitation rates.
6. It will be difficult to significantly reduce already-low fishery-related risk levels and further risk reductions would have significant fishery repercussions. Unlike tule Fall Chinook, current low fishing levels for LCN coho may not provide room for a "win-win" strategy where both reduced risk and increased flexibility can be achieved. The win-win solution was possible for Fall Chinook where fishing rates because substantially greater and within an effective range. A number of alternative fishery strategies might increase fishery opportunities with no or little effective increase in wild population risk. A key consideration will be whether marginal increases in model-derived risks relative to the current level are significant in the broader context of current coho information and status.

Table 8. Model runs.

Model	No.	Structure	Rates (%)	Frequencies (%)	Seeding categories	Effective ER	Risk median	Risk 5 high
actual	--	--	8/15/20/22.5	10/60/20/10	--	16.0%	--	--
1	a	Current (Sandy/Clack)	8/11/15/20/25/30/38+	24/0/54/17/0/5/1	0/0.10/0.20/0.50/0.75	15.1%	0.044	0.342
2	a	Fixed	0	100	--	0%	0.014	0.273
2	b	Fixed	8	100	--	8%	0.028	0.307
2	c	Fixed	12	100	--	12%	0.037	0.329
2	d	Fixed	16	100	--	16%	0.050	0.354
2	e	Fixed	18	100	--	18%	0.053	0.366
2	f	Fixed	19	100	--	19%	0.056	0.372
2	g	Fixed	20	100	--	20%	0.059	0.380
3	a	Current (all pops)	8/11/15/20/25/30/38+	24/0/48/20/0/8/1	0/0.10/0.20/0.50/0.75	15.7%	0.045	0.346
4	a	1 x 4	8/15/20/25	10/70/11/9	--	15.7%	0.046	0.350
4	b	1 x 4	10/15/20/25	10/25/60/5	--	18.0%	0.054	0.364
4	c	1 x 4	**8/15/20/25**	10/25/60/5	--	17.8%	0.054	0.363
5	a	1 x 5	8/15/20/25/30	10/65/15/5/5	--	15.7%	0.046	0.349
5	b	1 x 5	**10/15/20/25/30**	**10/35/45/5/5**	--	18.0%	0.053	0.364
5	c	1 x 5	10/15/20/25/30	**10/20/55/10/5**	--	19.0%	0.056	0.369
5	d	1 x 5	10/15/20/25/30	**10/10/55/20/5**	--	20.0%	0.059	0.377
6	a	Continuous	10/10-15/15-20/20-25/25-30	5/15/53/22/5	--	18.0%	0.054	0.363
6	b	Continuous	10/10-15/15-20/20-25/25-30	5/10/58/27/0	--	18.0%	0.054	0.363
6	c	Continuous	10/10-15/15-20/20-25/25-30	5/10/50/30/5	--	18.6%	0.055	0.368
7	5b1	2 x 5	10/15/20/25/30	= 10/35/45/5/5	--	18.0%	0.053	0.364
			10/10/15/20/25	0/100 =	**0/.3**			
7	5b2	2 x 5	10/15/20/25/30	= 14/36/40/5/4	--	17.5%	0.051	0.361
			10/10/15/20/25	12/88 =	**0/.5**			
7	5b3	2 x 5	10/15/20/25/30	= 12/39/30/5/3	--	16.3%	0.047	0.350
			10/10/15/20/25	38/62 =	**0/.6**			

Effective exploitation rate is the weighted average in all years.

Median risk includes all model populations.

5-high risk is the average for the 5 highest risk and most sensitive model populations.

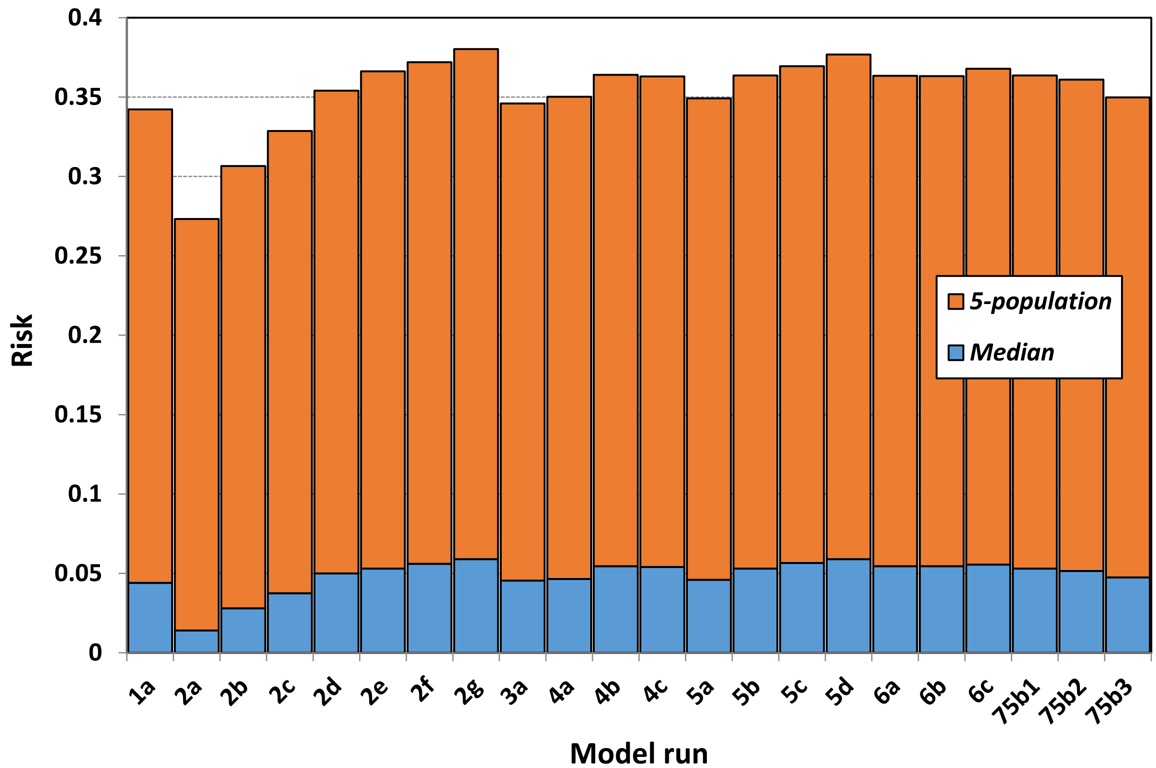


Figure 17. LCN population risks corresponding to alternative exploitation rate strategies.

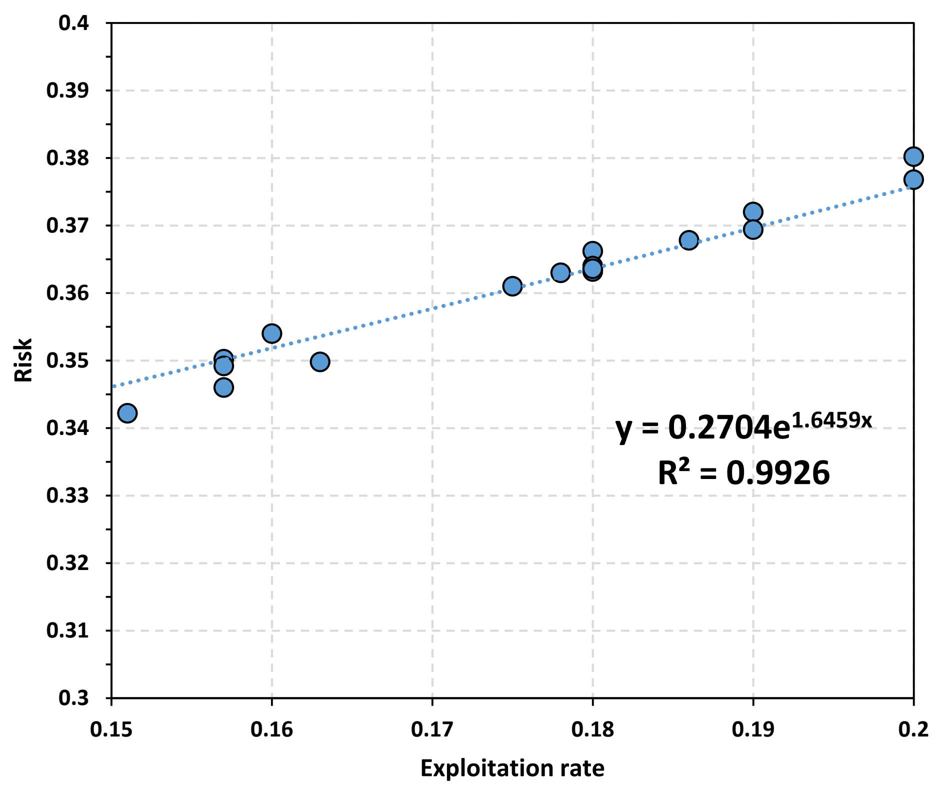


Figure 18. Relationship of effective exploitation rate and average risk for the 5 highest risk and most sensitive model populations.

5.2.3 Key Uncertainties

- Productivity parameters of representative populations.
- Productivity and abundance trends (especially relative to marine survival and seeding levels).
- Hatchery-related assumptions, hatchery fractions, and effects of hatchery management.
- Target vs. limit outcomes of allowable rates.
- Population-specific exploitation rates relative to early/late, hatchery/wild run timing.
- Similar marine survival patterns

5.3 Effect of Fishing on Hatchery-Origin Spawners

The work group examined the technical feasibility of evaluating risk tradeoffs between fishing effects on spawning escapements and the incidence of hatchery-origin strays in natural production areas. Hatchery-origin coho dominate the Columbia River return and these fish are primarily produced for fishery mitigation purposes. Consequently, it is difficult to separate fishery and hatchery effects in considerations of natural coho population status. As a result, recovery plans adopted by Washington, Oregon and NMFS include a series of closely-related and complementary fishery and hatchery measures including:

a) Elimination of some hatchery programs.
b) Changing production and release sites to meet HSRG criteria.
c) Establishing wild fish refuges.
d) Considering weirs (although difficult for coho)
e) Collecting data on natural escapements of hatchery-origin fish.
f) Fishery measures.

In this fishery risk assessment, conservation risks of fishery alternatives are being evaluated based on the frequency of critical low natural spawning escapements which potentially reduce long-term population viability. Higher fishing rates can increase risk by increasing the likelihood of small escapements. Higher fishing rates might also reduce risk by removing larger numbers of hatchery fish which impact natural population productivity. Higher productivity will increase long-term viability as populations are less likely to fall to critical low levels and more likely to rebound quickly. The 2013 coho risk assessment discussed this relationship but did not incorporate changes to productivity that might accrue from reduced hatchery spawning.

The impact of hatchery-origin spawners on wild productivity is uncertain and subject to considerable debate. However, the *Hatchery Scientific Review Group* (HSRG) has developed tools for evaluating hatchery spawner impacts on natural population productivity based on a number of assumptions. These relationships were used in a comprehensive hatchery review for the Columbia Basin by the HSRG, and were included as a component of the Washington recovery plan. These efforts led to the implementation of a series of hatchery reforms, which, for coho, included elimination of some programs, program changes, establishment of wild fish refuges, and increased stock assessment.

The Work Group will examined the feasibility of including fishery-hatchery interaction effects in assessing conservation risks based on tools developed by the HSRG. Results of this exploration follow and suggest that increased harvest opportunity afforded in mark selective fisheries can produce nominal reductions in risk by decreasing hatchery-origin spawners in natural spawning areas. This may partially ameliorate risks associated with higher fishing rates although quantification of the associated benefit is subject to numerous assumptions.

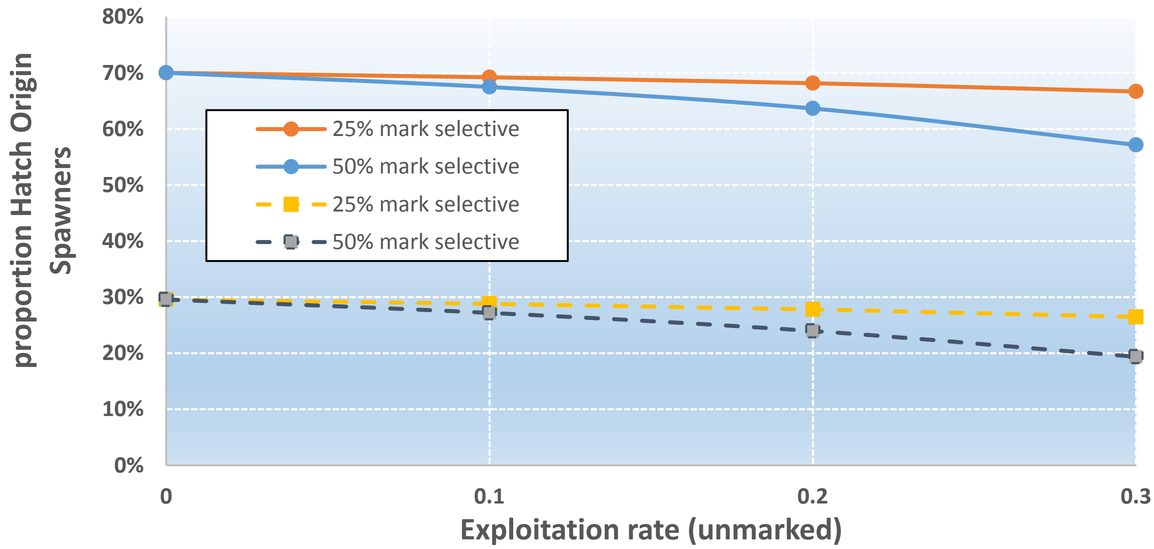


Figure 19. Hypothetical example of the effect of exploitation in mark-selective fisheries on the incidence of hatchery-origin spawners in natural production areas.

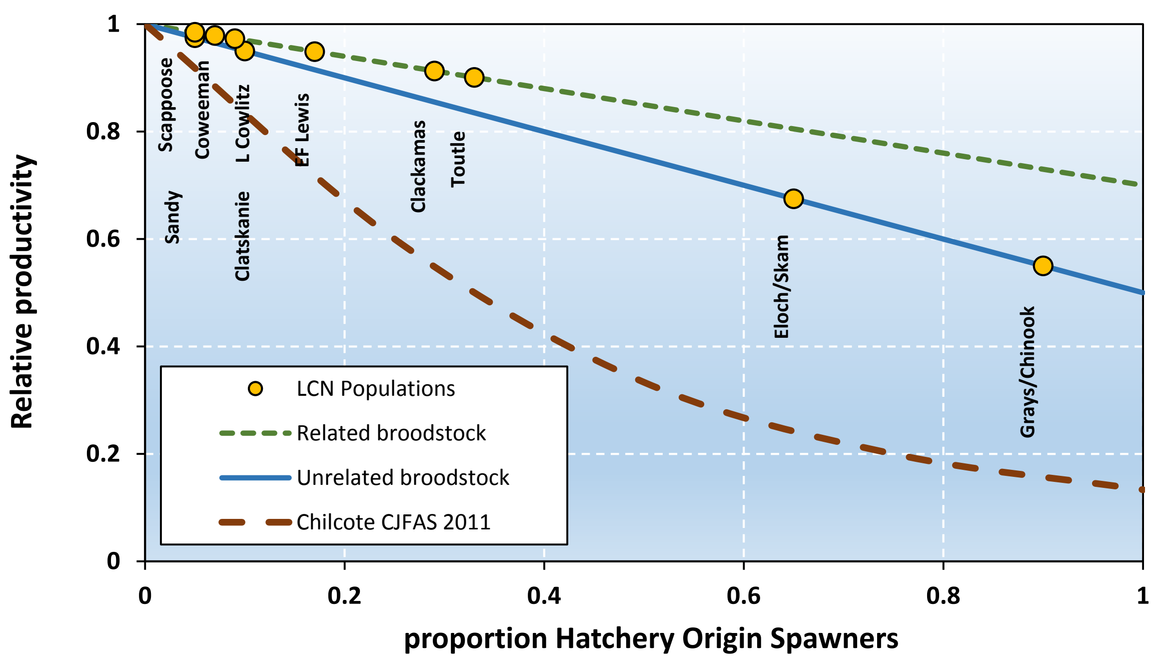


Figure 20. Example relationships of relative productivity to the proportion of hatchery spawners based on population-specific hatchery contributions and relative fitness assumptions documented in the Washington salmon recovery plan. Alernative assumptions by Chilcote et al. (2011) are also depicted.

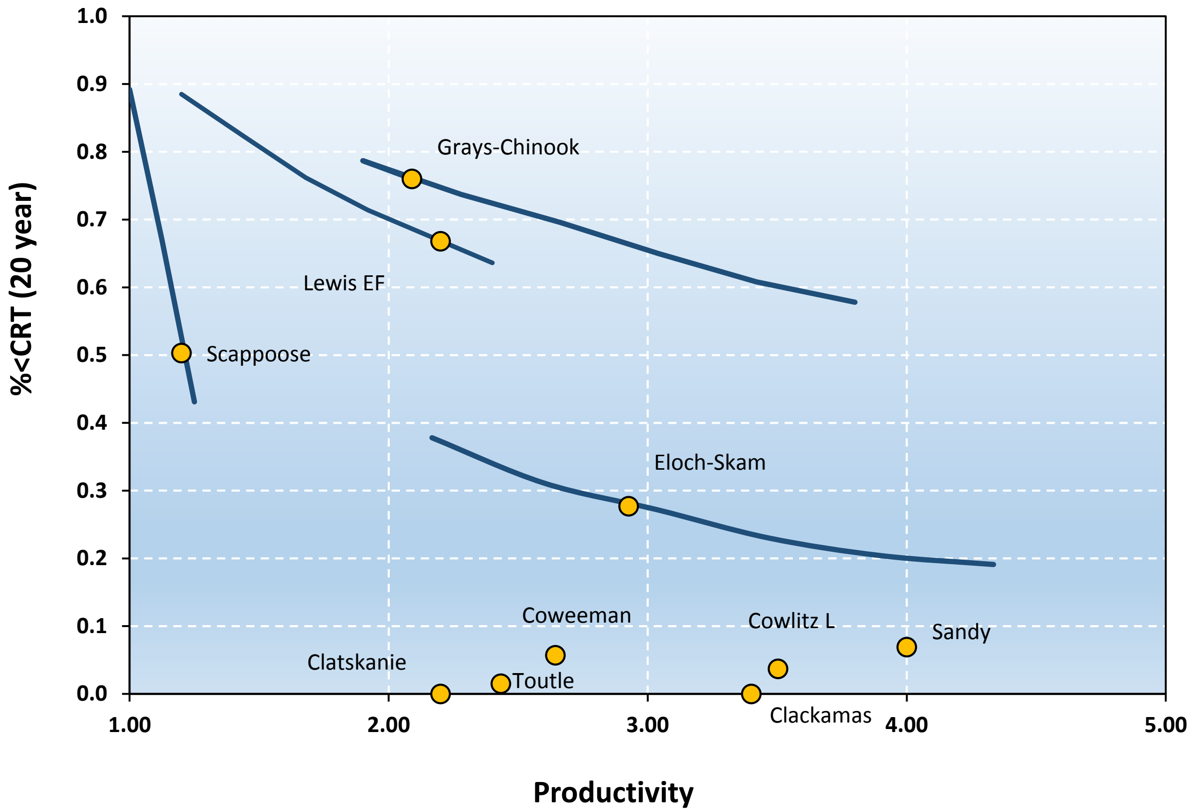


Figure 21. Relationship of risk to population productivity based on risk model sensitivity to changes in hatchery origin spawners from zero to 100%. Points represent current levels.

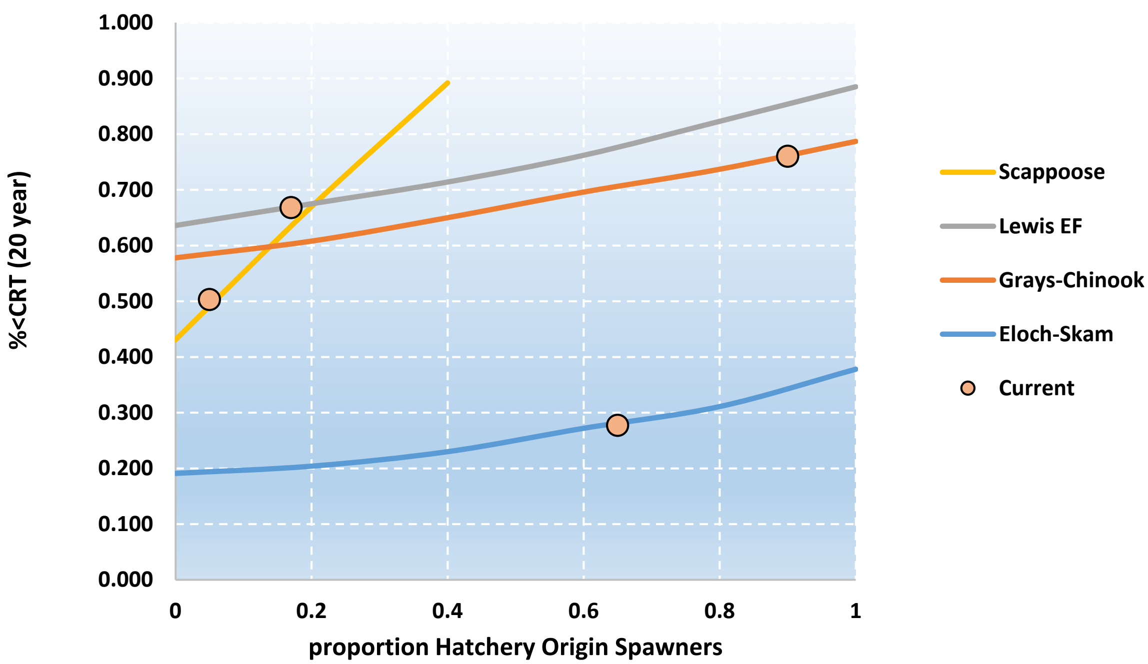
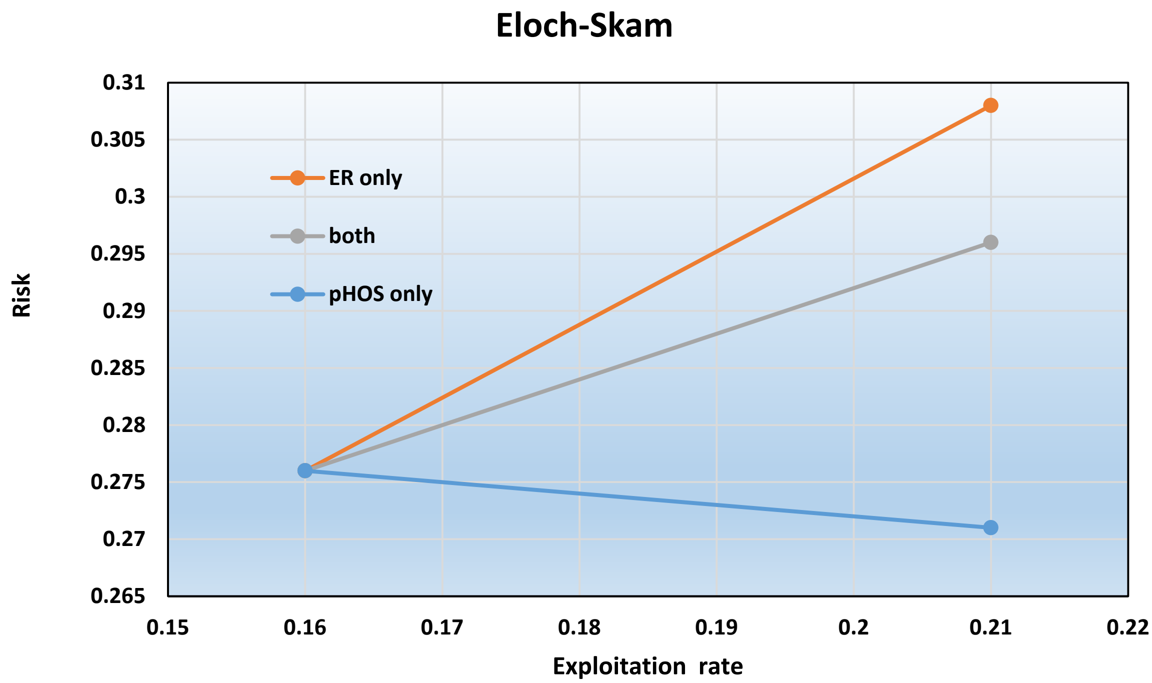


Figure 22. Relationship between hatchery contribution and risk based on model simulations of changes in population productivity associated with changes in the proportion of hatchery-origin spawners.



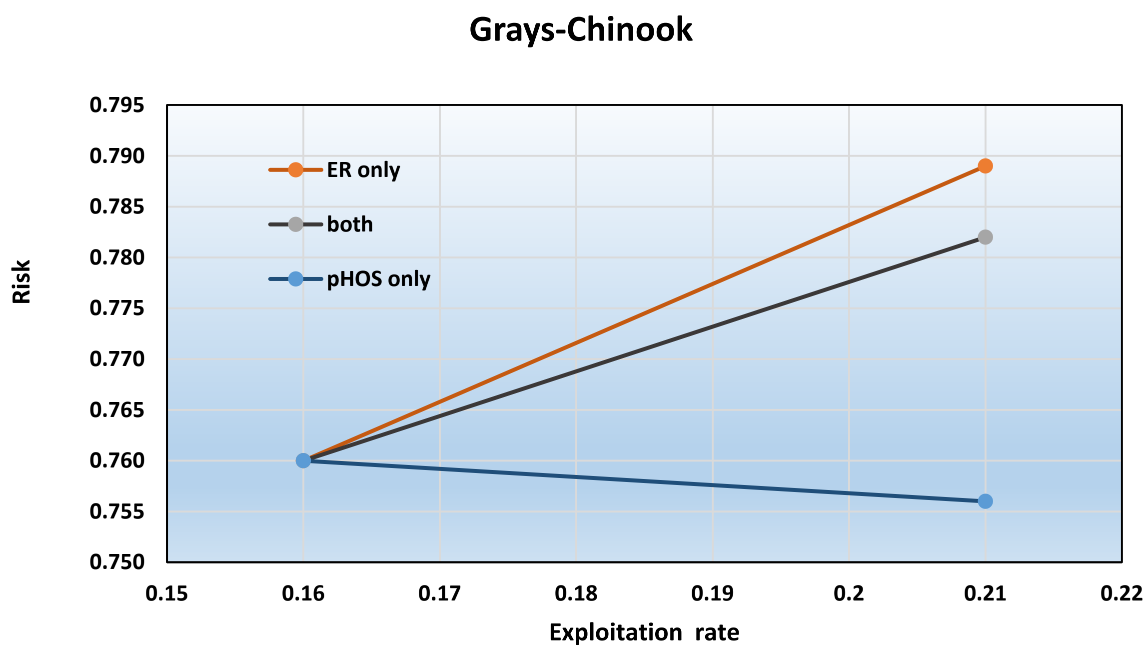


Figure 23. **Effects of increased exploitation on risk with and without consideration of hatchery contributon effects. This example assumes that all of the increase in exploitation occurs in a mark-selective fishery with 20% catch and release mortality.**

6 REFERENCES

Chilcote et al. 2011. Canadian Journal of Fisheries and Aquatic Sciences.

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WDFW and ODFW. 2014. 2014 Joint staff report: stock status and fisheries for fall Chinook salmon, coho salmon, chum salmon, summer steelhead, and white sturgeon.

Lower Columbia Natural Coho Model Runs highlighted during the September 3rd meeting of the Salmon Advisory Subpanel and the ad hoc Lower Columbia River Natural Coho Workgroup

Model	No.	Structure	Exploitation Rates (%)[a]	Frequencies (%)	Seeding categories	Effective ER[b]	Risk 5 high[c]
actual	--	Current (Sandy/Clack)	8/15/20/22.5	10/60/20/10	--	16.0%	--
3	a	Current (all pops)	8/11/15/20/25/30/38+	24/0/48/20/0/8/1	0/0.10/0.20/0.50/0.75	15.7%	0.346
4	b	1 x 4	10/15/20/25	10/25/60/5	--	18.0%	0.364
5	b	1 x 5	10/15/20/25/30	10/35/45/5/5	--	18.0%	0.364
6	b	Continuous	10/10-15/15-20/20-25/25-30	5/10/58/27/0	--	18.0%	0.363
6	c	Continuous	10/10-15/15-20/20-25/25-30	5/10/50/30/5	--	18.6%	0.368
7	5b1	2 x 5	10/15/20/25/30	= 10/35/45/5/5	--	18.0%	0.364
			10/10/15/20/25	0/100 =	0/.3		
8	a	1 x 3 (new)[d]	10/19/22.5	15/60/25	--	18.5%	0.365
9	a	2 x 5 (new)[d]	10/15/20/22/30	= 7/17/52/21/3	--	18.0%	0.369
		(weak strata)	10/10/15/20/22	12/88 =	0/.4		

[a] *Exploitation rates include only ocean and Columbia River mainstem fisheries – tributary fishery impacts are in addition.*

[b] *Effective exploitation rate is the weighted average in all years.*

[c] *5-high risk is the average for the 5 highest risk and most sensitive model populations.*

[d] *Identified in 09/03/14 SAS/LRC WG meeting.*

Selected Model Run Description

"Actual" describes current exploitation rates and frequencies for the last 10 years under the current harvest matrix which is based on Sandy and Clackamas population seeding levels.

Model 3a is the current matrix based on an average seeding by all primary populations in the dataset rather than just Sandy and Clackamas.

Model 4b is a simplified matrix based only on marine survival with annual exploitation rates from 10% to 25% and an effective average exploitation rate of 18% (based on preliminary NMFS discussions). Note that moving from an effective exploitation rate of 16% to 18% produces only a 1.8% increase in low population risk for the weak populations in the dataset.

Model 5b is similar to 4a but includes 30% as the top end. Frequencies were adjusted to maintain effective exploitation rate at 18%. Adding higher annual rates on the top end requires increasing frequencies in the low range to stay even.

Model 6b is a continuous variation on 5b which graduates changes in allowable rates across steps. This version is consistent with an effective average exploitation rate of 18%.

Model 6c is similar to 6b but allows for higher annual exploitation rates on the top end. This version produces an effective average exploitation rate of 18.6%. It highlights marginal risk impacts of small increases in effective exploitation rates.

Model 7-5b1 is similar to 5b but also identifies reduced annual exploitation rates under conditions of low seeding. In this example, the seeding level was selected as a contingency in the event that substantially-lower marine survival rates occur in the future. Note that a comparable low-seeding row can be added to any of the 0ne-row matrix alternatives.

Model 8a is a new model run discussed at the SAS meeting. It is a simple 1x3 model topping out at 22.5%. This version produces an effective average exploitation rate of 18.5%.

Model 9a is a new model run discussed at the SAS meeting. It includes seeding level based on the weakest of the Cascade and Coast strata when considered separately. This alternative produces similar outcomes to the other models but includes a more-detailed and explicit treatment of weak-stock management in the design.[1]

[1] *This alternative uses strata-specific seeding criteria rather than average population seeding criteria reflected in Model 7-5b1. This alternative uses average seeding among the populations in each strata to determine their fraction of full seeding. The row in the matrix would be determined by the lesser stratum. This alternative also suggests a definition of "critical" marine survival based approximately upon the lowest observed marine survival rate, seen in brood year 1991.*

AD HOC LOWER COLUMBIA RIVER NATURAL COHO WORKGROUP REPORT ON THE LOWER COLUMBIA RIVER COHO HARVEST MATRIX

The Lower Columbia River Natural Coho Workgroup (LRC Workgroup) met twice at the Council office in Portland since the June 2014 Council meeting to continue to develop reports and recommendations on updating the information on status of Lower Columbia River coho stocks, evaluating alternative harvest policies, and assessing relative population risk of alternative harvest policies. Through the development of the proposed alternatives and risk assessment, the LRC Workgroup discussed the following policy issues and recommendations.

One criteria in the development of alternatives was to incorporate data for additional populations within the ESU, beyond the two (Clackamas and Sandy Rivers) in the current harvest matrix. The alternatives the LRC Workgroup is considering, and the risk analyses conducted, include ten primary populations from Oregon and Washington from two strata of the ESU.

When possible, simple is better. The LRC Workgroup agrees that because many cells within the existing matrix have rarely been relevant in practice, the current matrix may be overly complex. As was observed with the original Amendment 13 matrix for Oregon Coast coho (prior to 2013-2014 revisions), some of these metrics are relatively unresponsive to changing conditions and to conservation and fishery needs over time. Simplifying the harvest matrix was one of several criteria in the development of the alternatives and is reflected in the LRC Workgroup's draft purpose statement for this effort:

> *"Council intent is to incorporate new information on Lower Columbia River natural coho populations and stock status, evaluate the risk of various harvest strategies on populations across the Evolutionarily Significant Unit (ESU), and determine if a revised harvest policy can be developed that simplifies existing harvest rules and optimizes fishing strategies consistent with acceptable conservation risk tolerances."*

Available data for coho salmon suggests that marine survival is often more influential than parental abundance (seeding levels) in determining future abundance and, by extension, population risk. Therefore, the LRC Workgroup felt that the parental spawner categories of the existing harvest matrix provided a good opportunity for simplification. Some members of the workgroup expressed concern that the effect of parental abundance may be much more important at very low levels, and therefore keeping a low seeding "floor" should be considered. The members of the LRC Workgroup agree that a revised harvest matrix should likely put more weight on marine survival than the current version does. The current population viability (PVA) model indicates low sensitivity of relative risk to the inclusion or exclusion of parental seeding as a metric. Thus, the concept of including a low or very low seeding level, below which additional reductions in exploitation rates are implemented may be more of a precautionary policy to address uncertainty than a technical approach to managing model-estimated risk. In other words, even though the PVA model indicates low sensitivity to seeding effects, acknowledgment that data for these populations are still relatively limited may warrant maintaining a parental seeding "floor" to address uncertainty of future conditions. The LRC Workgroup has discussed averaging the seeding levels of the ten primary populations to evaluate if the ESU is below a potential parental seeding "floor".

A further simplification is recommended in the marine survival metrics. Values exceeding the current "high" marine survival index of 0.0040 occur very rarely in the historic observations, and have not been observed since the 1970s. As a result, the presence of such high values in the matrix has little effect on results. The workgroup is instead examining ways to distribute categories for marine survival based upon frequency of occurrence (e.g., low = 25th percentile of values, medium = 26-50th percentile of values, etc.).

The risk analyses conducted indicate that the changes in risk of different harvest strategies are small over the range of the relatively low exploitation rates in the proposed alternatives. However, in part because the exploitation rates being evaluated are relatively low, analyses to date have not indicated a likelihood of achieving a "win-win" - a situation where average exploitation rates could be increased while reducing overall relative risk. However, the LRC Workgroup believes that many of the alternatives could provide improved fishing opportunity without substantially increasing relative risk to the ESU.

To help frame the issue and develop a range of alternatives, the National Marine Fisheries Service (NMFS) representatives provided some preliminary direction that focuses on achieving fishery management goals while minimizing increased relative risk to the ESU. Use of the existing matrix has resulted in an average exploitation rate of approximately 16 percent since implementation, and modeling results yield a similar long-term average when applying the current management framework. NMFS stated that fishery stability and performance could likely be improved with a relatively small increase in relative risk and average exploitation rate, and suggested that potential alternatives should have an average exploitation rate no higher than approximately 18 percent.

The accounting of coho impacts occurring from targeted or incidental catch in recreational fisheries in Washington and Oregon tributaries of the Columbia River has not been consistent historically or geographically. According to fishery management plans submitted to NMFS by the states in 2005, these fisheries are estimated to have relatively low impact rates on LCN coho. Including these impacts in the exploitation rates in the ocean and mainstem harvest matrix would likely have a small but constraining effect on ocean and mainstem fisheries relative to current policy. The LRC Workgroup notes that the states must provide guidance on this issue but wanted to notify the Council and public of the potential consideration of recreational Columbia River tributary fisheries in the context of overall risk to the ESU.

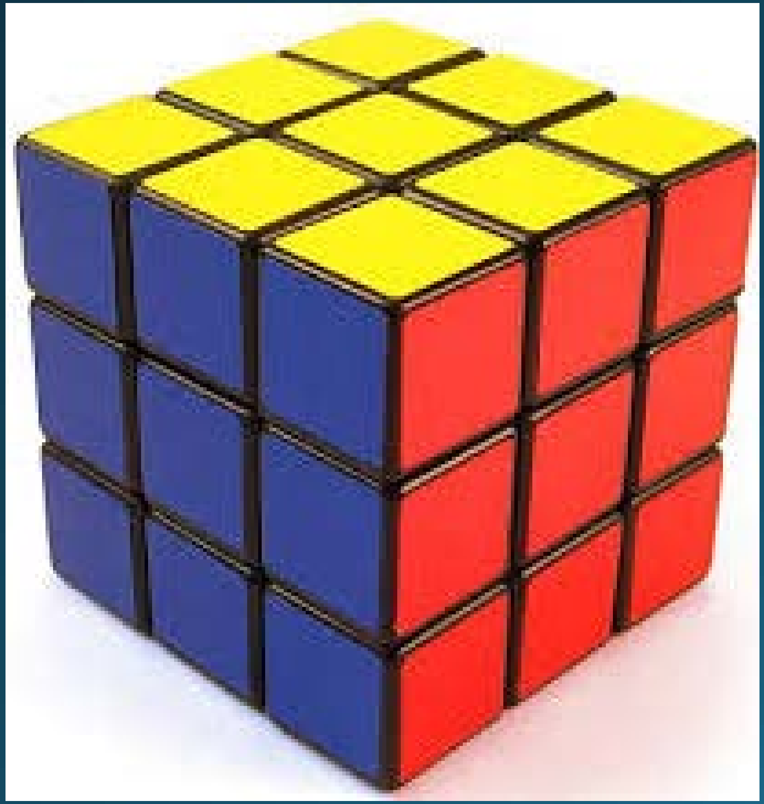
The LRC Workgroup recommends that the Council adopt the proposed purpose statement and continue to work towards a revised harvest matrix of LCN coho in a manner that is consistent with the Oregon and Washington recovery plans.

The LRC Workgroup recommends the Council schedule a review of any new harvest policy three years after its implementation. In addition to providing an opportunity to review effectiveness, the LRC Workgroup notes that ongoing research and monitoring programs will provide new information on ESU populations that may be helpful in resolving or reducing current uncertainties. NMFS will be conducting the 5-year status review of the ESU in 2015.

PFMC
8/21/14

Agenda Item D.2.b
Supplemental LRC Workgroup PowerPoint
September 2014

LCN Coho Harvest Matrix



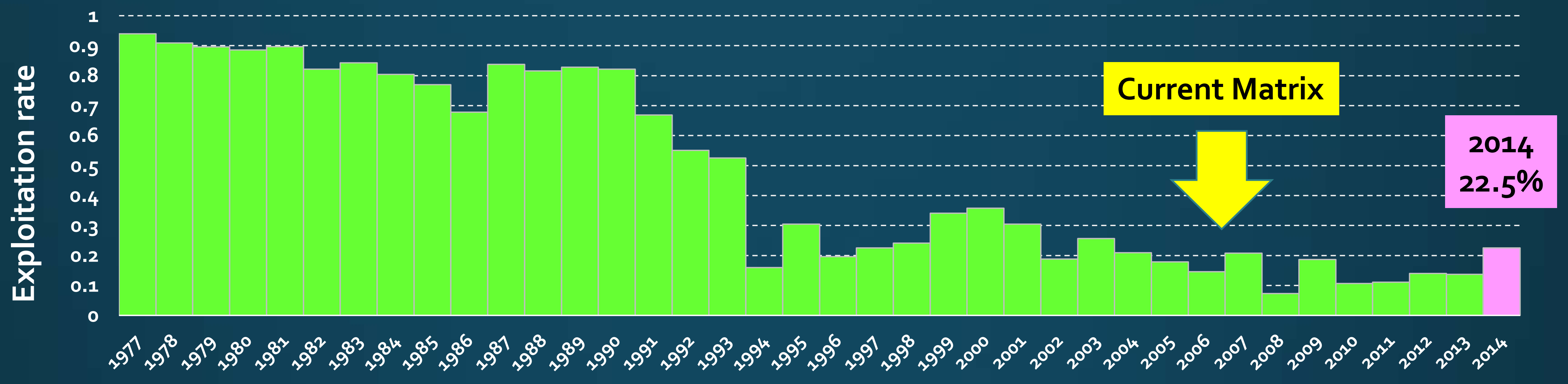
PFMC

September 12, 2014

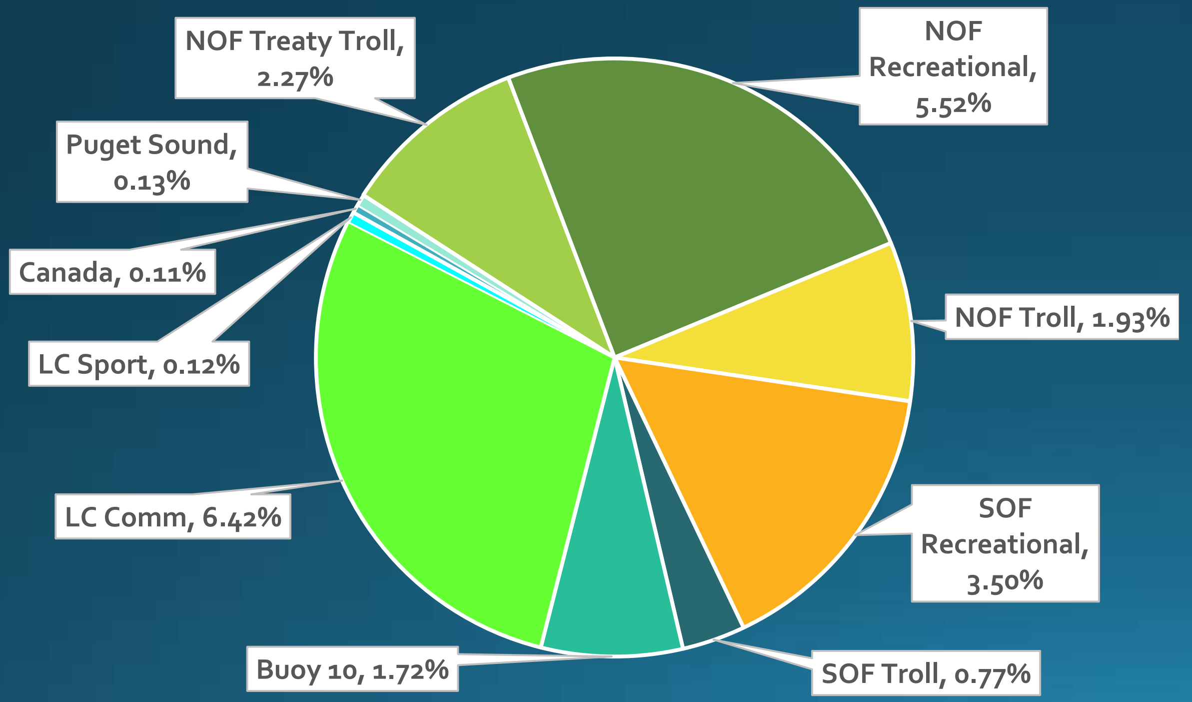
Today's Topics

- Background
- Analysis of Matrix Structure
- Possible New Matrix Structure

Fishing rates



PFMC 2014 LCN Exploitation Rates



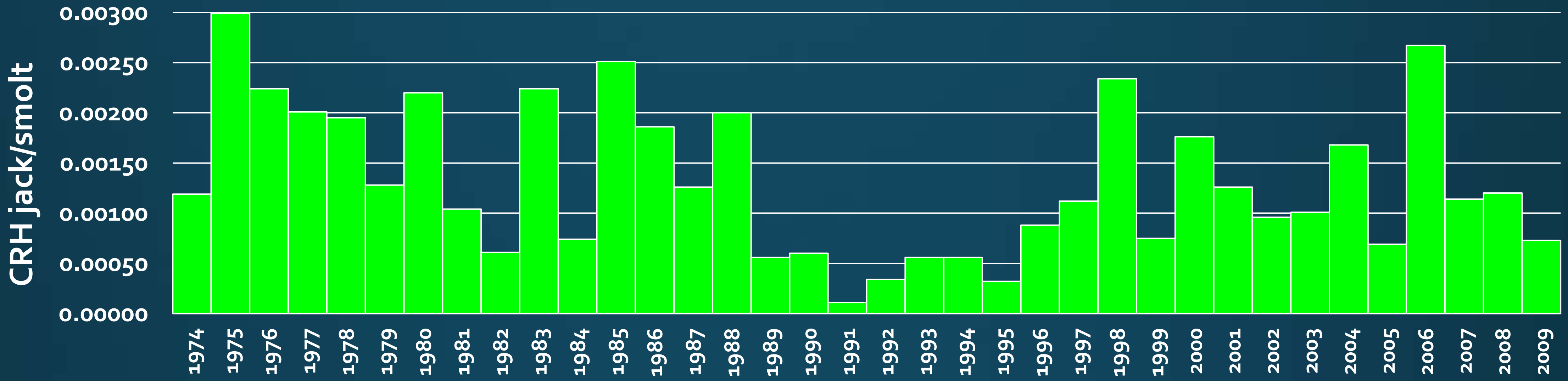
2005 – 2014 Objectives

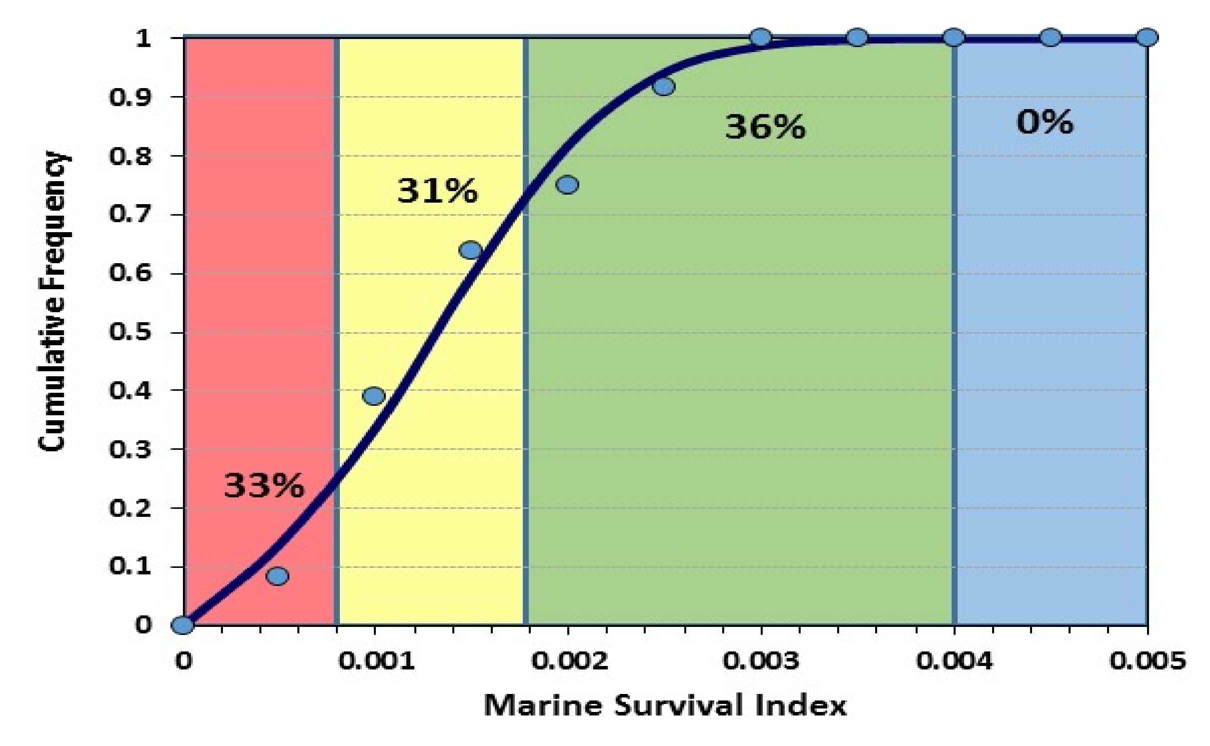
Rate	Frequency
8%	10%
15%	60%
20%	22%
22.5%	10%

LCN Harvest Control Rule

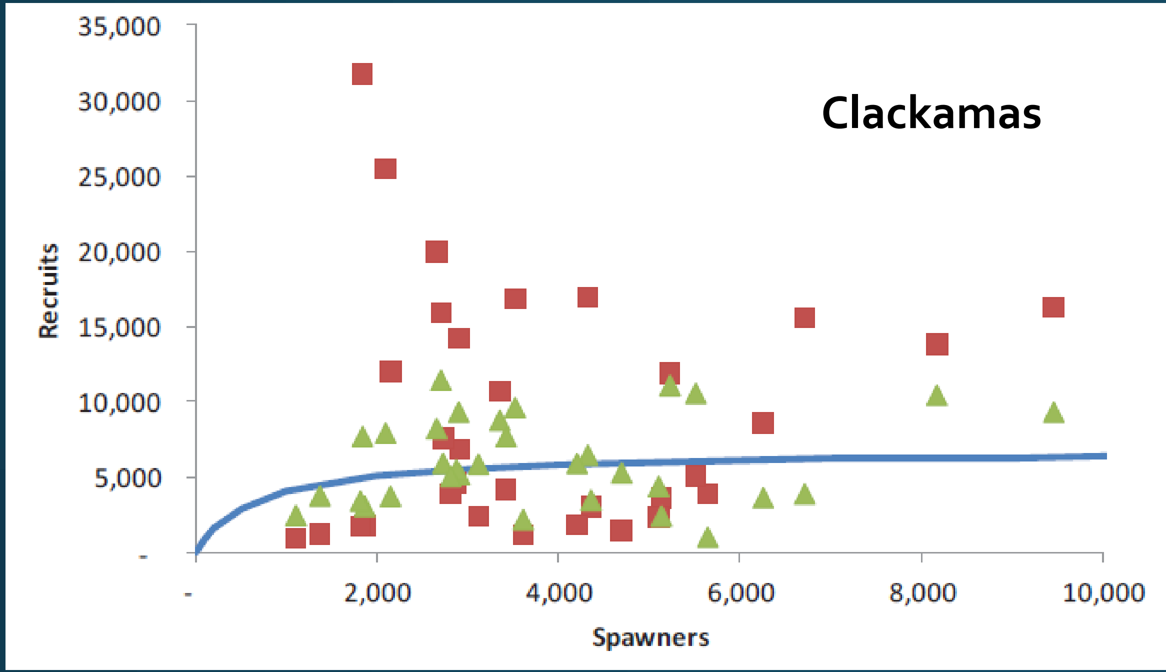
Parental Escapement (% of full seeding)		Marine Survival Index (based on return of jacks per hatchery smolt)			
		Critical (<.08%)	Low (<.15%)	Medium (<.40%)	High (>.40%)
High	>0.75	<8%	<15%	<30%	<45%
Medium	0.75 to 0.50	<8%	<15%	<20%	<38%
Low	0.50 to 0.20	<8%	<15%	<15%	<25%
Very Low	0.20 to 0.10	<8%	<11%	<11%	<11%
Critical	<0.10	0-8%	0-8%	0-8%	0-8%

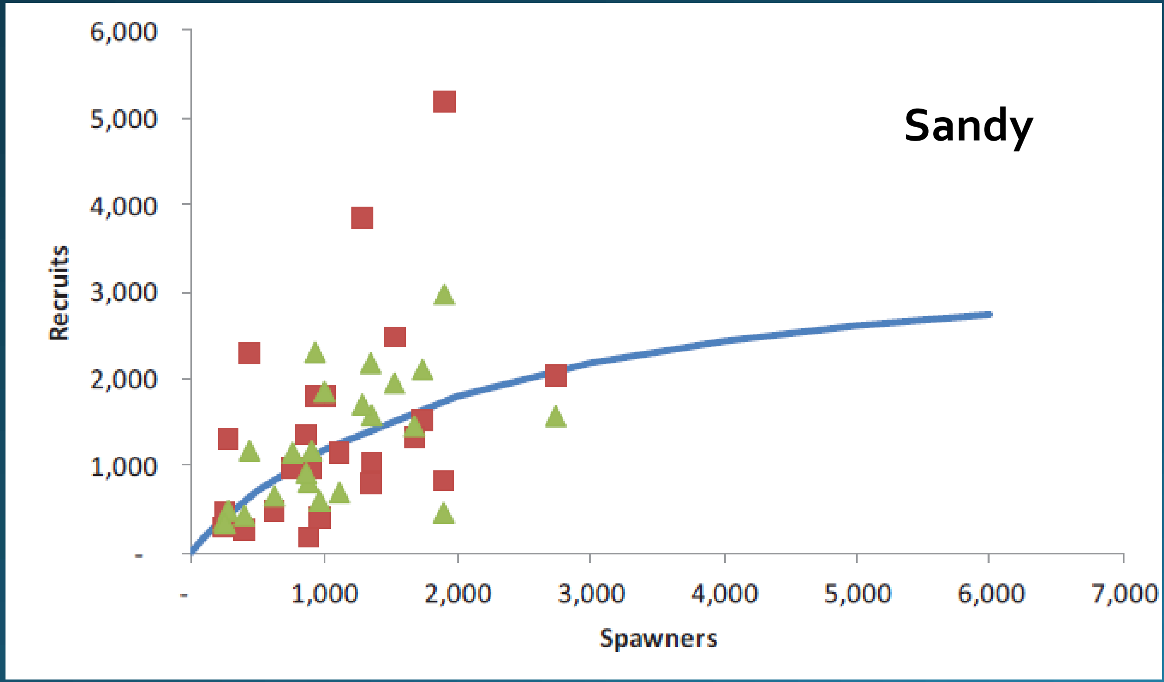
Marine Survival Index





Seeding Levels





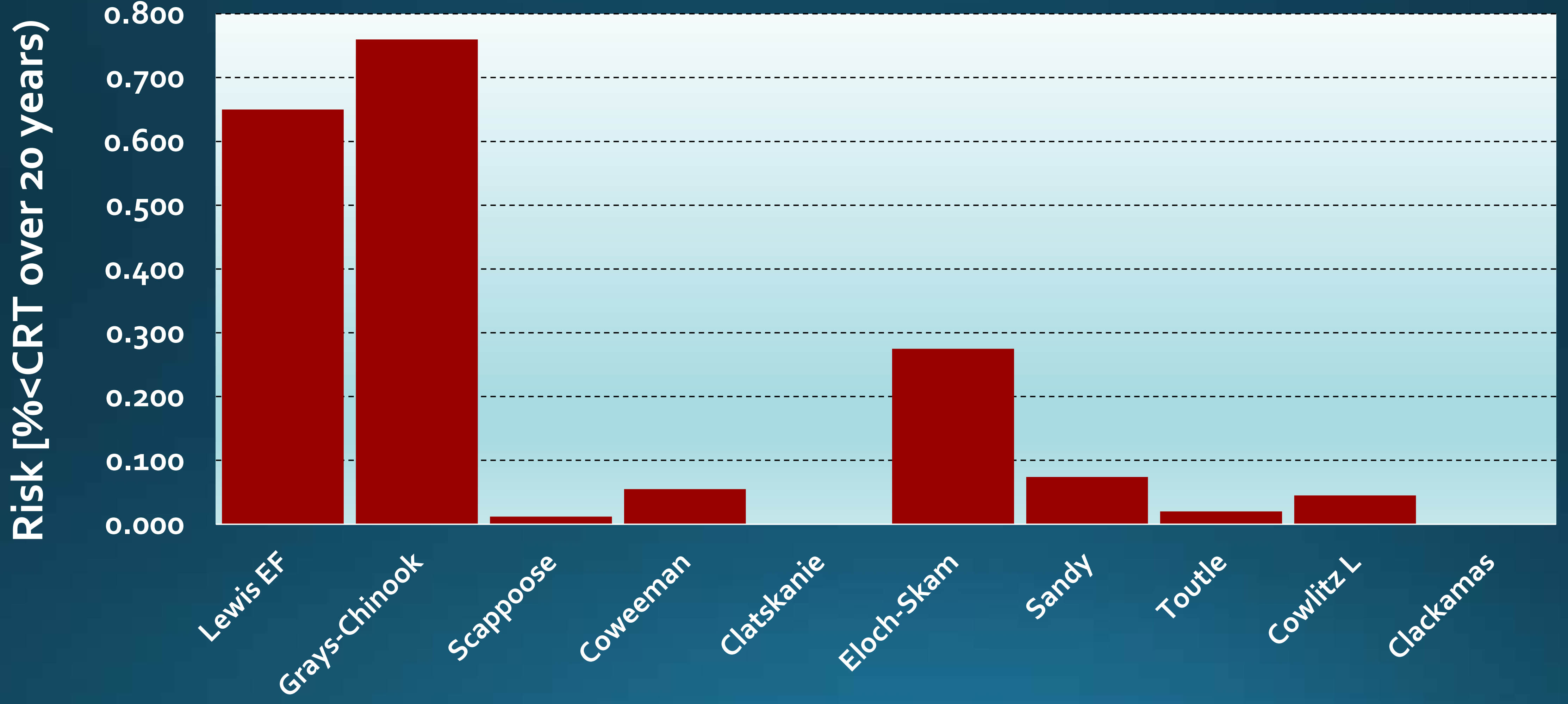
v. Recruits

	r^2
Spawners	20%
MSI	71%

	r^2
Spawners	10%
MSI	27%

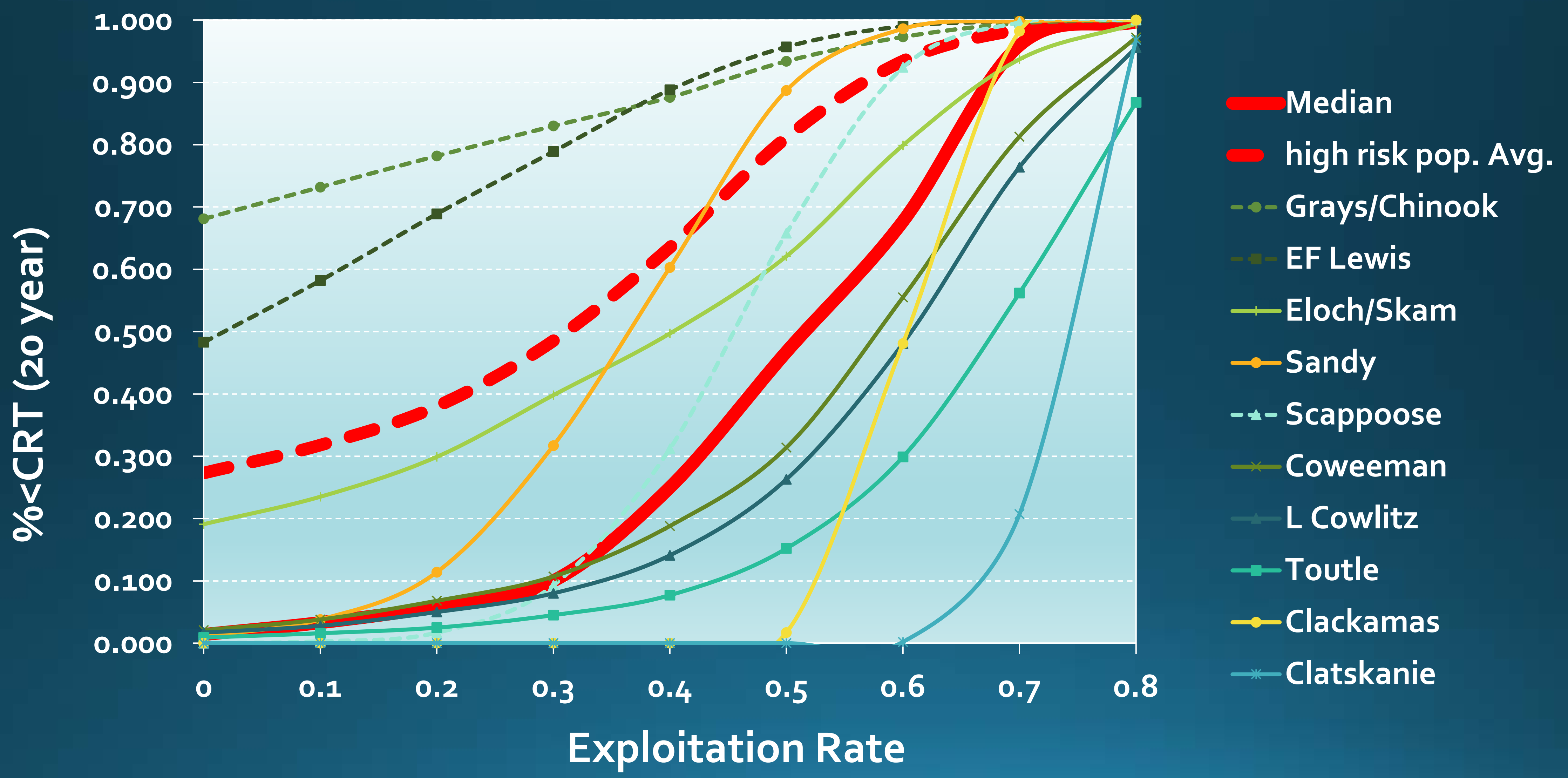
(1993-2009 data)

2. Some populations have more risk than others



@ 16% exploitation rate

3. Risk not highly sensitive to fishing at low rates



4. Different structures can produce equivalent risks

Parental Escapement (% of full seeding)		Marine Survival Index (based on return of jacks per hatchery smolt)			
		Critical (<.08%)	Low (<.15%	Medium (<.40%)	High (>.40%)
High	>0.75	<8%	<15%	<30%	<45%
Medium	0.75 to 0.50	<8%	<15%	<20%	<38%
Low	0.50 to 0.20	<8%	<15%	<15%	<25%
Very Low	0.20 to 0.10	<8%	<11%	<11%	<11%
Critical	<0.10	0-8%	0-8%	0-8%	0-8%

=

15-16%

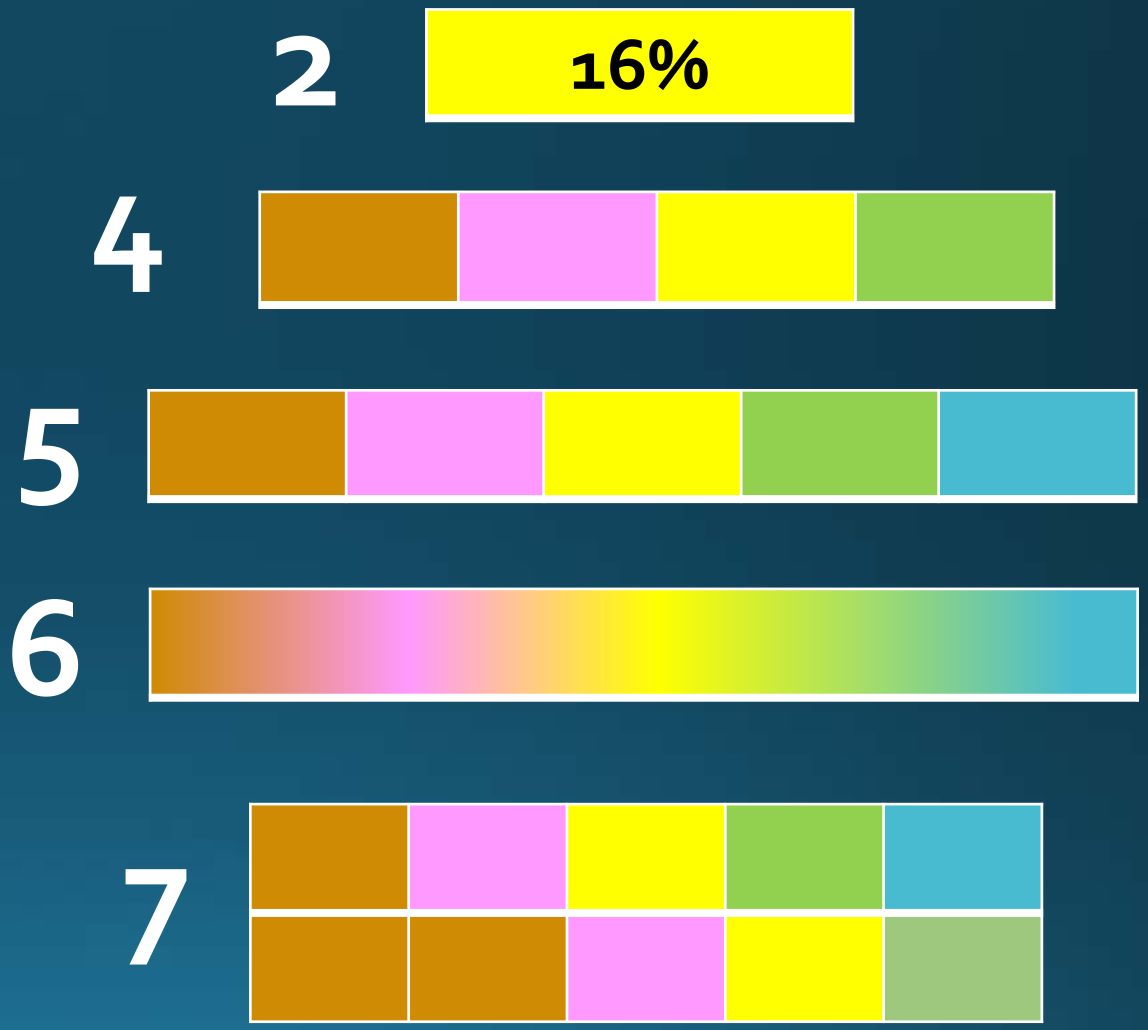
Fishery Effects

Exploitation Rate	Fishery
8-10%	No coho retention
10-20%	Mark-selective
20-25%	Coho target
30%	Maximum usable

Matrix alternatives

1 & 3

Parental Escapement (% of full seeding)		Marine Survival Index (based on return of jacks per hatchery smolt)			
		Critical (<.08%)	Low (<.15%	Medium (<.40%)	High (>.40%)
High	>0.75	<8%	<15%	<30%	<45%
Medium	0.75 to 0.50	<8%	<15%	<20%	<38%
Low	0.50 to 0.20	<8%	<15%	<15%	<25%
Very Low	0.20 to 0.10	<8%	<11%	<11%	<11%
Critical	<0.10	0-8%	0-8%	0-8%	0-8%



Example Alternatives

Model	No.	Structure	Exploitation Rates (%)[a]	Frequencies (%)	Seeding categories	Effective ER[b]	Risk 5 high[c]
actual	--	Current (Sandy/Clack)	8/15/20/22.5	10/60/20/10	--	16.0%	--
3	a	Current (all pops)	8/11/15/20/25/30/38+	24/0/48/20/0/8/1	0/0.10/0.20/0.50/0.75	15.7%	0.346
4	b	1 x 4	10/15/20/25	10/25/60/5	--	18.0%	0.364
5	b	1 x 5	10/15/20/25/30	10/35/45/5/5	--	18.0%	0.364
6	b	Continuous	10/10-15/15-20/20-25/25-30	5/10/58/27/0	--	18.0%	0.363
6	c	Continuous	10/10-15/15-20/20-25/25-30	5/10/50/30/5	--	18.6%	0.368
7	5b1	2 x 5	10/15/20/25/30	= 10/35/45/5/5	--	18.0%	0.364
			10/10/15/20/25	0/100 =	0/.3		
8	a	1 x 3 (new)[d]	10/19/22.5	15/60/25	--	18.5%	0.365
9	a	2 x 5 (new)[d]	10/15/20/22/30	= 7/17/52/21/3	--	18.0%	0.369
		(weak strata)	10/10/15/20/22	12/88 =	0/.4		

[a] Exploitation rates include only ocean and Columbia River mainstem fisheries – tributary fishery impacts are in addition.
[b] Effective exploitation rate is the weighted average in all years.
[c] 5-high risk is the average for the 5 highest risk and most sensitive model populations.
[d] Identified in 09/03/14 SAS/TWG meeting.

Model	No.	Structure	Rates (%)	Frequencies (%)	Seeding categories	Effective ER	Risk median	5 high
actual	--	--	8/15/20/22.5	10/60/20/10	--	16.0%	--	--
1	a	Current (Sandy/Clack)	8/11/15/20/25/30/38+	24/0/54/17/0/5/1	0/0.10/0.20/0.50/0.75	15.1%	0.044	0.342
2	a	Fixed	0	100	--	0%	0.014	0.273
2	b	Fixed	8	100	--	8%	0.028	0.307
2	c	Fixed	12	100	--	12%	0.037	0.329
2	d	Fixed	16	100	--	16%	0.050	0.354
2	e	Fixed	18	100	--	18%	0.053	0.366
2	f	Fixed	19	100	--	19%	0.056	0.372
2	g	Fixed	20	100	--	20%	0.059	0.380
3	a	Current (all pops)	8/11/15/20/25/30/38+	24/0/48/20/0/8/1	0/0.10/0.20/0.50/0.75	15.7%	0.045	0.346
4	a	1 x 4	8/15/20/25	10/70/11/9	--	15.7%	0.046	0.350
4	b	1 x 4	10/15/20/25	10/25/60/5	--	18.0%	0.054	0.364
4	c	1 x 4	8/15/20/25	10/25/60/5	--	17.8%	0.054	0.363
5	a	1 x 5	8/15/20/25/30	10/65/15/5/5	--	15.7%	0.046	0.349
5	b	1 x 5	10/15/20/25/30	10/35/45/5/5	--	18.0%	0.053	0.364
5	c	1 x 5	10/15/20/25/30	10/20/55/10/5	--	19.0%	0.056	0.369
5	d	1 x 5	10/15/20/25/30	10/10/55/20/5	--	20.0%	0.059	0.377
6	a	Continuous	10/10-15/15-20/20-25/25-30	5/15/53/22/5	--	18.0%	0.054	0.363
6	b	Continuous	10/10-15/15-20/20-25/25-30	5/10/58/27/0	--	18.0%	0.054	0.363
6	c	Continuous	10/10-15/15-20/20-25/25-30	5/10/50/30/5	--	18.6%	0.055	0.368
7	5b1	2 x 5	10/15/20/25/30	= 10/35/45/5/5	--	18.0%	0.053	0.364
			10/10/15/20/25	0/100 =	0/.3			
7	5b2	2 x 5	10/15/20/25/30	= 14/36/40/5/4	--	17.5%	0.051	0.361
			10/10/15/20/25	12/88 =	0/.5			
7	5b3	2 x 5	10/15/20/25/30	= 12/39/30/5/3	--	16.3%	0.047	0.350
			10/10/15/20/25	38/62 =	0/.6			

SALMON ADVISORY SUBPANEL REPORT ON LOWER COLUMBIA RIVER COHO HARVEST MATRIX

The Salmon Advisory Subpanel (SAS) met in a joint session with the ad hoc Lower Columbia River Natural Coho Workgroup (LRC Workgroup) in Portland, Oregon on September 3rd and provides the following comments.

The SAS is encouraged by the ongoing LRC Workgroup effort to simplify the harvest policy for Lower Columbia River natural (LCN) coho and to explore options that allow greater fishery management flexibility and opportunity without adding substantial risks to stock recovery. The SAS notes that the States of Oregon and Washington have collected, and continue to collect, new information on the status of these stocks since they were listed under the Endangered Species Act in 2005. This new information in greatly appreciated and warrants a renewed analysis of the status and management of LCN coho.

A simplified matrix structure substantially enhances the ability to understand and weigh fishery implications of various alternatives. The risk analysis was informative in helping to understand the relative effects of fishery alternatives on LCN coho. It is clear that comparable levels of risk may be produced by a variety of more or less complicated harvest control rules.

Focusing risk analyses on the weakest primary populations identified in State and Federal recovery plans provides a conservative standard for evaluating fishery alternatives. However, the SAS urges caution in the application of weak stock fishery management for the Lower Columbia River coho evolutionarily significant unit (ESU) because several populations are depressed and relatively unproductive due to habitat limitations and exhibit a reasonable chance of reaching critically low levels in the absence of fishing. Fishing restrictions alone will not achieve stock recovery and will need to be coupled with habitat reforms and conservation.

At current fishing levels, it is clear that small changes in effective average annual exploitation rates have a very small impact on LCN coho conservation risks. Further reductions in fishing rate from current level do not provide large risk reductions. Small increases in exploitation rates and an abundance-based fishery strategy can provide substantial fishery benefits with a negligible cost in risk.

The SAS feels that annual exploitation rates of 10 percent to 30 percent are appropriate for consideration in fishery alternatives. A rate of 10 percent is necessary to conduct Chinook-only fisheries. The current LCN coho matrix includes rates as low as 8 percent, but this rate is not sufficient to account for incidental coho mortality in Chinook-directed fisheries, particularly in years of high Chinook abundance. The risk analysis showed that managing for 10 percent rather than 8 percent at the low end had a negligible effect on risk. A rate of 30 percent on the high end is appropriate for accessing large returns of Columbia River hatchery coho in years of good marine survival. This opportunity is particularly important to the long-term economic viability of Columbia River target coho fisheries. Within these high and low limits, fishing strategies and harvest policy should provide for meaningful fishing rates in the middle range of marine survival where we will be operating most of the time. Continuous, rather than stepped matrix structures, might be considered to soften the fishery effects of small differences in marine survival index estimates around the step thresholds in exploitation rate.

Working with the preceding concepts and criteria and the options presented the risk analysis (Agenda Item D.2.a, Attachment 1) as well as the options discussed at the September 3rd meeting (Agenda Item D.2.a, Attachment 2) the SAS recommends focusing future analyses and considerations on the options shown in the attached table.

The SAS agrees with the recommendation of the LRC Workgroup that any new harvest approach be reviewed three years after implementation. This will allow an opportunity to review new stock status information, collected by Washington and Oregon, to respond to the results of a National Marine Fisheries Service status review of the ESU scheduled for 2015, and to evaluate the initial performance of a new harvest policy. The SAS would like to recognize the importance of the monitoring efforts by Oregon and Washington and strongly recommends that these effort continue.

The Council is tentatively scheduled to develop a final recommendation to NMFS at the November 2014 Council meeting. The SAS feels that a final recommendation should not come at the expense of a quality product with stakeholder support. The SAS is encouraged by the work completed to date, but recognizes that there is work to be done. To that end, the SAS is planning to meet with the LRC Workgroup in mid-October to review Council guidance and to further refine the recommendations. The SAS is also planning to attend the November 2014 Council meeting in Costa Mesa, California.

Model	No.	Structure	Exploitation Rates (%)[a]	Frequencies (%)	Seeding categories	Effective ER[b]	Risk 5 high[c]
actual	--	Current (Sandy/Clack)	8/15/20/22.5	10/60/20/10	--	16.0%	--
3	a	Current (all pops)	8/11/15/20/25/30/38+	24/0/48/20/0/8/1	0/0.10/0.20/0.50/0.75	15.7%	0.346
4	b	1 x 4	10/15/20/25	10/25/60/5	--	18.0%	0.364
5	b	1 x 5	10/15/20/25/30	10/35/45/5/5	--	18.0%	0.364
6	b	Continuous	10/10-15/15-20/20-25/25-30	5/10/58/27/0	--	18.0%	0.363
6	c	Continuous	10/10-15/15-20/20-25/25-30	5/10/50/30/5	--	18.6%	0.368
7	5b1	2 x 5	10/15/20/25/30	= 10/35/45/5/5	--	18.0%	0.364
			10/10/15/20/25	0/100 =	0/.3		
8	a	1 x 3 (new)[d]	10/19/22.5	15/60/25	--	18.5%	0.365

[a] *Exploitation rates include only ocean and Columbia River mainstem fisheries – tributary fishery impacts are in addition.*

[b] *Effective exploitation rate is the weighted average in all years.*

[c] *5-high risk is the average for the 5 highest risk and most sensitive model populations.*

[d] *Identified in 09/03/14 SAS/LRC WG meeting.*

PFMC
09/11/14

Agenda Item D.2.b
Supplemental SSC Report
September 2014

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON LOWER COLUMBIA RIVER NATURAL COHO HARVEST MATRIX

The Scientific and Statistical Committee (SSC) reviewed the document "Review of allowable fishery impacts to Lower Columbia River natural coho, Lower Columbia Natural Coho Workgroup Report, Working Draft Analyses" (Agenda Item D.2.a, Attachment 1). Mr. Chris Kern of the Oregon Department of Fish and Wildlife was available to answer questions.

The Workgroup Report provides little methodological detail, however much can be inferred from the "Harvest strategy risk assessment for Lower Columbia natural coho" document from the November 2013 Council meeting (Item C.2.a Attachment 2). The SSC previously noted that "numerical estimates of extinction risk from the model should be considered as index values only, and in no way represent actual probabilities of extinction." Thus, while rankings of different management scenarios in terms of population risk are likely to be relatively robust, there is substantial uncertainty in the baseline magnitude of risk, and also the amount of change in risk among alternatives.

The SSC identified multiple arguments for retaining at least some parental seeding categories in the harvest matrix. Although the Workgroup Report states that low seeding levels were rarely observed in the past, the time series for many populations span only a few years, and even the longest time series are inadequate to characterize the probability of occurrence of rare events. Simulated population dynamics should not be considered a reliable quantitative prediction of the frequency of low seeding levels in the future. In addition, seeding levels are determined from data on wild populations, while the current marine survival index is derived from a hatchery proxy.

Lack of clarity on methodological details, as well as apparent inconsistencies among tables, figures, and text in the report hindered thorough review, and the SSC requests that future workgroup reports identify a point of contact for technical clarifications.

The SSC supports re-assessing the suitability of the harvest matrix periodically as additional information on population capacity and productivity becomes available.

PFMC
09/12/14

Agenda Item D.2.b
Supplemental STT Report
September 2014

SALMON TECHNICAL TEAM REPORT ON THE LOWER COLUMBIA RIVER NATURAL COHO HARVEST MATRIX

The Salmon Technical Team (STT) reviewed Agenda Item D.2.a, Review of Allowable Fishery Impacts to Lower Columbia River Natural Coho, and participated in a joint webinar with the Model Evaluation Workgroup (MEW) on September 9, 2014 where the work of the Lower Columbia Natural Coho Workgroup was discussed. This statement's comments are confined to the contents of Agenda Item D.2.a and not to technical details of the risk analysis. The risk analysis model was presented in October 2013 at the Methodology Review (though not fully attended by the STT or the Salmon Subcommittee of the Scientific and Statistical Committee [SSC] owing to the federal government furlough) and was reviewed by the full SSC at the November 2013 and April 2014 Council meetings.

There are several instances in the report where figures, tables, and text are not consistent with each other. For example, in Section 4.1 the text states that the high marine survival category (>0.4 percent) has not been achieved. However, Figure 10 has six values that exceed 0.3 percent, including four in the high category, exceeding 0.4 percent. It is now understood that the instances of high marine survival were achieved prior to 1974, and the data considered for this part of the analysis excludes data prior to 1974 (the data range in the Figure 10 caption was mislabeled). A second example of a text/figure mismatch concerns Figure 11, which depicts the stock-recruitment relationships for the Clackamas and Sandy Rivers. This figure contains many more years of data than the truncated (1993-2009) dataset that was used to estimate the parameters used in the risk analysis. It is our understanding that these and other mismatches will be corrected in the final report.

The first sentence of Section 5.2.1 states that "Risks are relatively insensitive to fishing within the 10 to 30 percent range of exploitation under consideration for LCN coho for all but the smaller, less productive populations evaluated." While this may be valid when evaluating median risk levels (Figure 16), this is not the case for the Sandy River, which shows a rapid acceleration in risk with increasing exploitation rates below 30 percent. This is noteworthy because the Sandy population is one of the larger populations in the Evolutionarily Significant Unit.

Very low or critical parental seeding levels are projected to never occur under the current matrix. Furthermore, Table 7 mentions several valid reasons for potentially dropping parental seeding level from the control rule. However, an unprecedented stock collapse may occur in the future, and having some provision for extremely low seeding levels could serve as a backstop to authorizing excessive fishing on a very depressed natural population. For the set of control rules presented in Agenda Item D.2.a and Supplemental Attachment 2, most do not include parental seeding levels as part of the matrix. The STT recognizes the value of including parental seeding levels during periods of poor productivity for a risk-averse approach, but acknowledges that the relationship between spawners and recruitment is weak. Consideration should be given to providing a range of alternatives for public review that includes control rules with seeding levels as well as those based on only marine survival.

PFMC
09/11/14