Agenda Item D.3
Attachment 1
November 2016

Chinook Base Period Update for the Fishery Regulation Assessment Model (FRAM)

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Introduction

FRAM is the Chinook model used by the Pacific Fishery Management Council to evaluate ocean fisheries and by Washington co-managers (State and Tribes) to evaluate Puget Sound fisheries and ESA objectives. Coded wire tag (CWT) recoveries provide the stock-fishery exploitation rates that are the foundation of FRAM. The current FRAM model is based on CWT data from the late 1970s to early 1980s (referred to as the "old" base period). Significant changes have occurred in stock abundances, distribution, fishing seasons, and fishery structure since this time frame.

The primary purpose of the FRAM base period update project is to develop a contemporary dataset of CWT recoveries, catch, and escapement that can be used with the existing FRAM structure, algorithms, and data processing.

The Chinook FRAM base period update project began in 2014 with the formation of a base period work group comprised of federal, state and tribal technical staff familiar with FRAM. The new base period is built from CWT groups from 2005-08 brood years, which contribute to 2007-13 fisheries. The fishery and time strata in Chinook FRAM are unchanged from the current structure. Stock coverage for the new base period is the same as in the existing FRAM base period, with the exception of adding a fall Chinook stock from the mid-Oregon coast (MOC).

Programs to process and summarize CWT recoveries, produce cohort reconstructions, and calculate exploitation rates were consolidated and rewritten in Visual Studio.NET. Additionally, in order to take advantage of the quality control steps taken by the Pacific Salmon Commission's (PSC) Chinook Technical Committee (CTC), the FRAM work group initially ran the new CWT data through the Cohort Analysis System (CAS) used by the CTC. The original CAS database contained some but not all CWT groups needed for the new FRAM base period, so new tag groups were added to fill the gaps in the database. This revised CAS was run through FRAMBUILDER, a program that maps CWT recoveries to FRAM fishery and time strata, to produce a CWT recovery data set for use in the FRAM base period calibration programs.

Two methods were changed to produce the new base period; (1) estimates of stock-age-specific fishing mortality for sublegal fish and (2) the derivation/implementation of growth functions. These changes were reviewed and approved during PFMC's 2015 Methodology Review process (Johnson et al. 2015, McHugh et al. 2015).

Project Status

The work group has completed all major tasks associated with the production of a new Chinook FRAM base period. Output from the new base period exercise has been distributed for review to co-managers and other regional stock and fishery experts. Output is distributed in the form of post-season model runs, exploitation rate summaries/comparisons, and stock/fishery graphs. The work group is now focused on addressing issues identified during the initial review, a rigorous quality control process, and completing project documentation. Review and quality control includes a final review of all inputs, comparisons between calibration output and estimates from other methodologies when possible (e.g., GSI estimates of fishery stock composition in ocean fisheries and analyses from the CTC), and investigation of potential outliers.

Process and Timelines for Implementation

In order to utilize the new base period during the 2017 PFMC and North-of-Falcon process, the following completion deadlines have been established:

- Co-manager review and QAQC – November 2016
- Review and potential revision of FRAM-based management objectives by co-managers and NOAA – January 2017
- Final co-manager decision on base period adoption – January/February 2017

Preliminary Results

Lower Columbia River Natural Tules (LCN)

The new Chinook base period generally produces lower LCN exploitation rates. Average exploitation rates from 2005-2014 post-season model runs are 40.6% old versus 38.7% new base period.

Table 1: Annual Lower Columbia Natural Adult Equivalent (AEQ) Exploitation Rates in the Old (BY 1974-79) and New Base Period (BY 2005-2008)

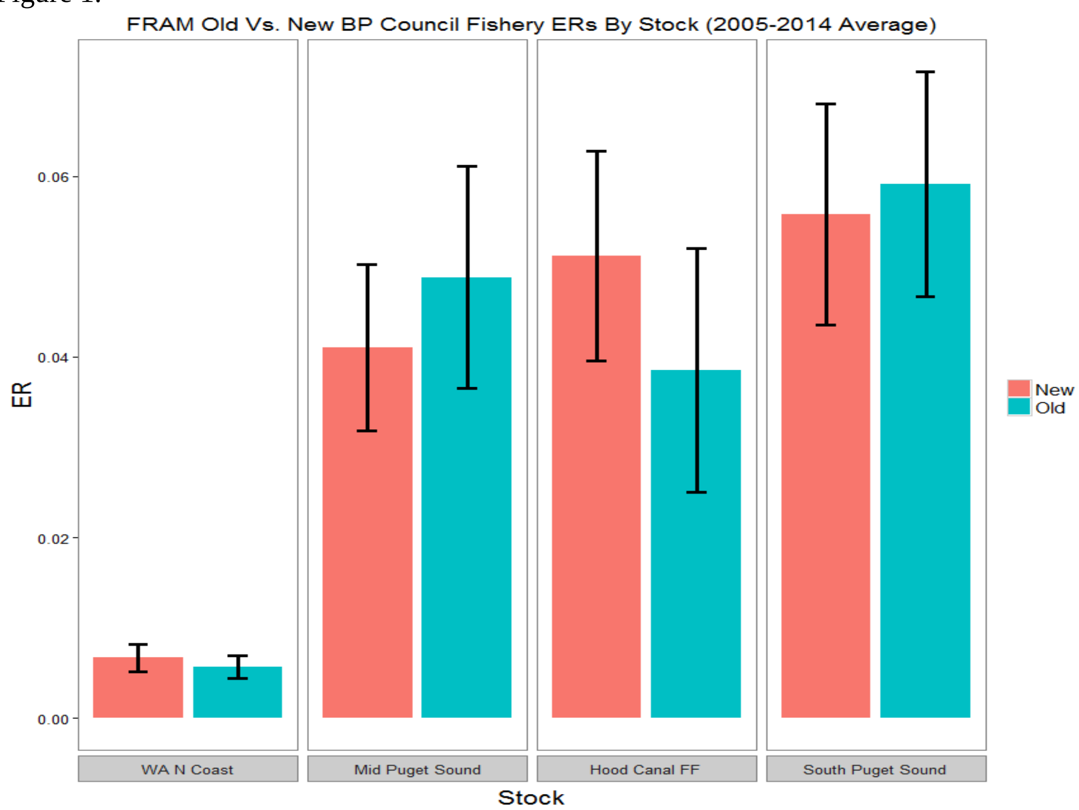
Year	Old Base Period	New Base Period
2005	0.52	0.48
2006	0.47	0.42
2007	0.51	0.44
2008	0.35	0.35
2009	0.38	0.35
2010	0.32	0.34
2011	0.39	0.39
2012	0.40	0.39
2013	0.32	0.31
2014	0.42	0.40
Average	**0.41**	**0.39**

Table 2. Average 2005-14 Lower Columbia AEQ Impact Distribution Old versus New Base Period by Fishery

Fishery	Old Base Period	New Base Period
SEAK	5.2%	6.7%
BC	41.6%	39.3%
PS&JDF	1.0%	0.8%
NoF		
Treaty Troll	10.6%	4.7%
Recreational	3.2%	7.0%
Non-Indian Troll	13.5%	10.9%
SoF		
Recreational:	0.2%	0.5%
Troll:	2.7%	6.5%
River	21.7%	23.8%
TOTAL	100.0%	100.0%

Exploitation Rate (ER) Comparison of Select Stocks in Council Fisheries

Figure 1.



Additional results presented as stock composition graphs for council fisheries are provided in Appendix A. Genetic Stock Information (GSI) data were obtained from Bellinger et al. (2015) and via personal correspondence with Dr. Paul Moran (NOAA NWFSC). While GSI data can provide a general perspective of stock contribution, differences to the new FRAM base period can be expected, because

GSI data stems from a shorter set of years (North of Falcon 2012-2014 , South of Falcon 2010) and exhibit fairly large inter-annual variability.

Appendix A.

Figures stem from Oct 3, 2016 review of base period output

Figures 1-2. Comparison of current base period (OldBP), new base period (NewBP), GSI (GSI_Avg) stock composition (2007-2013 post-season run average, 2012-2014 GSI study average). Time Step 2 is May-June.

Figure 1.

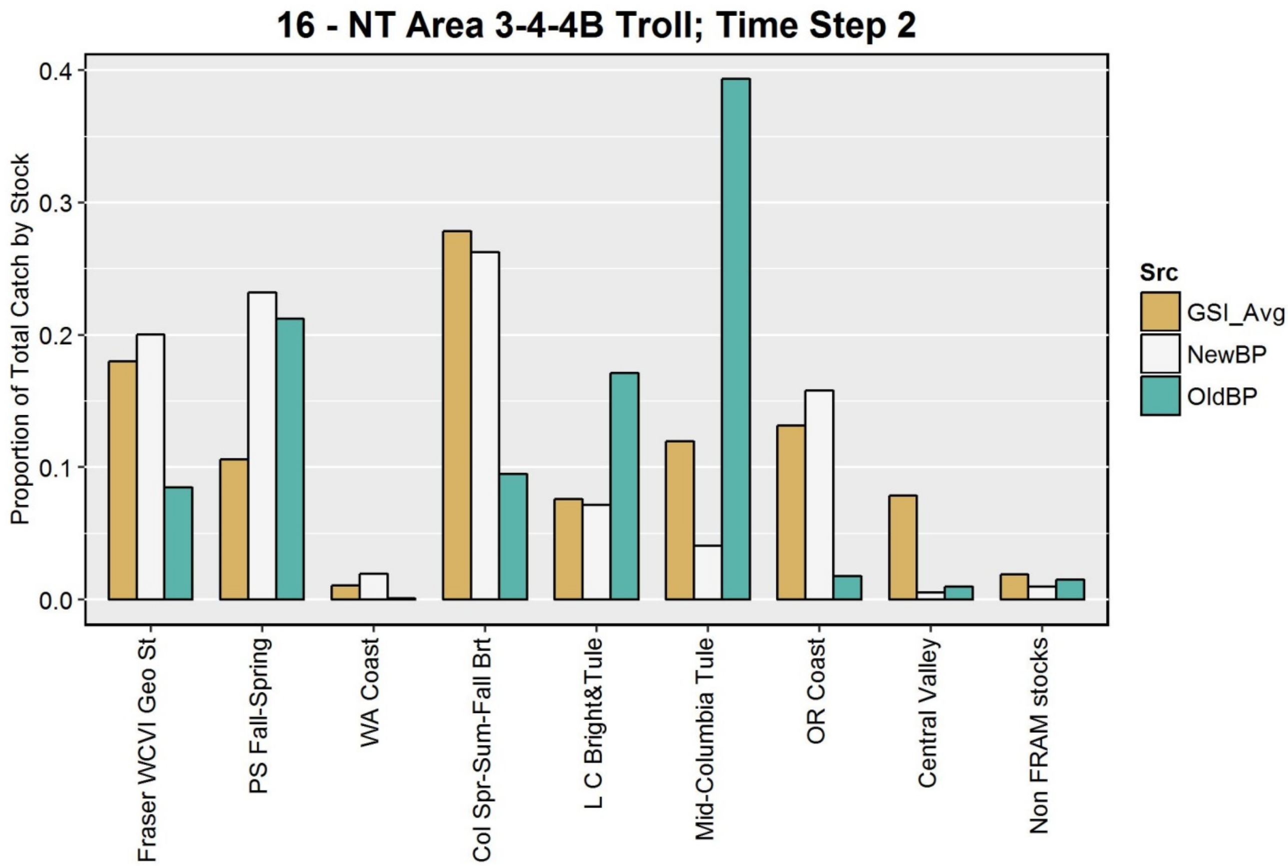


Figure 2.

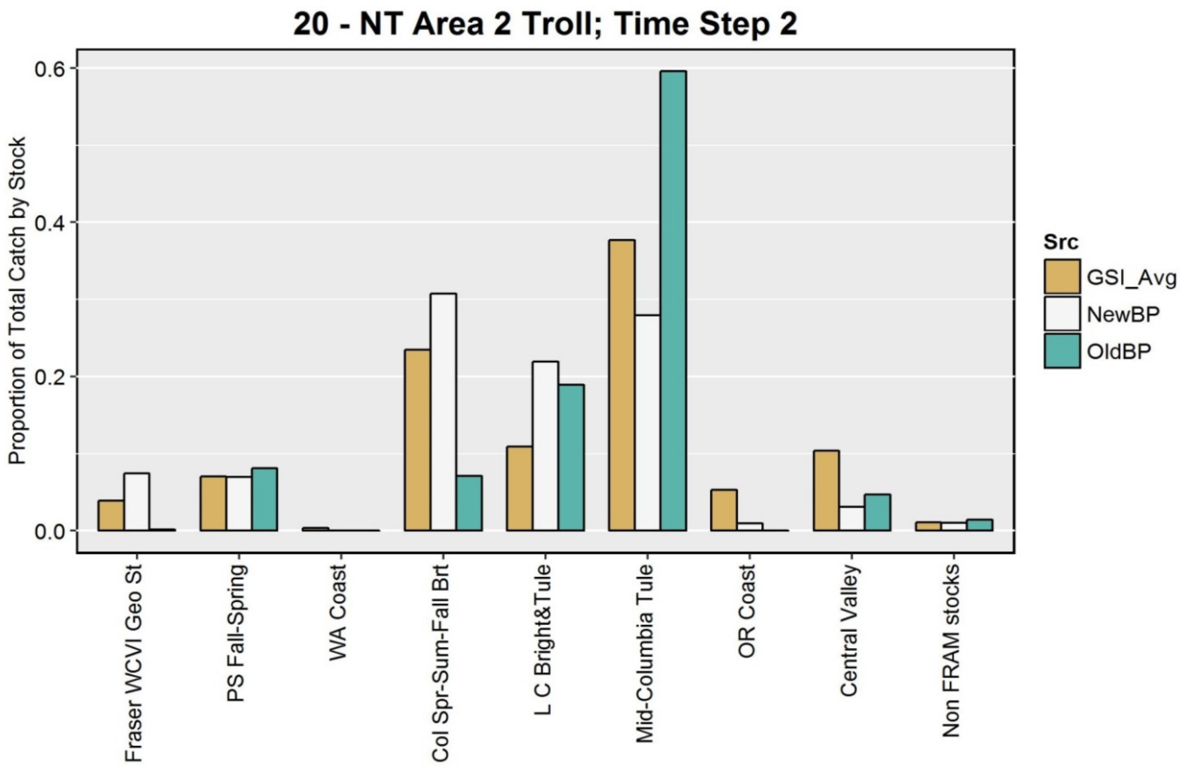


Figure 3-4. Comparison of current base period (OldBP), new base period (NewBP), Central Oregon GSI (GSI_CO), and Northern Oregon GSI (GSI_NO) stock composition (2007-2013 post-season run average, 2010 GSI study). Time Step 2 is May-June.

Figure 3.

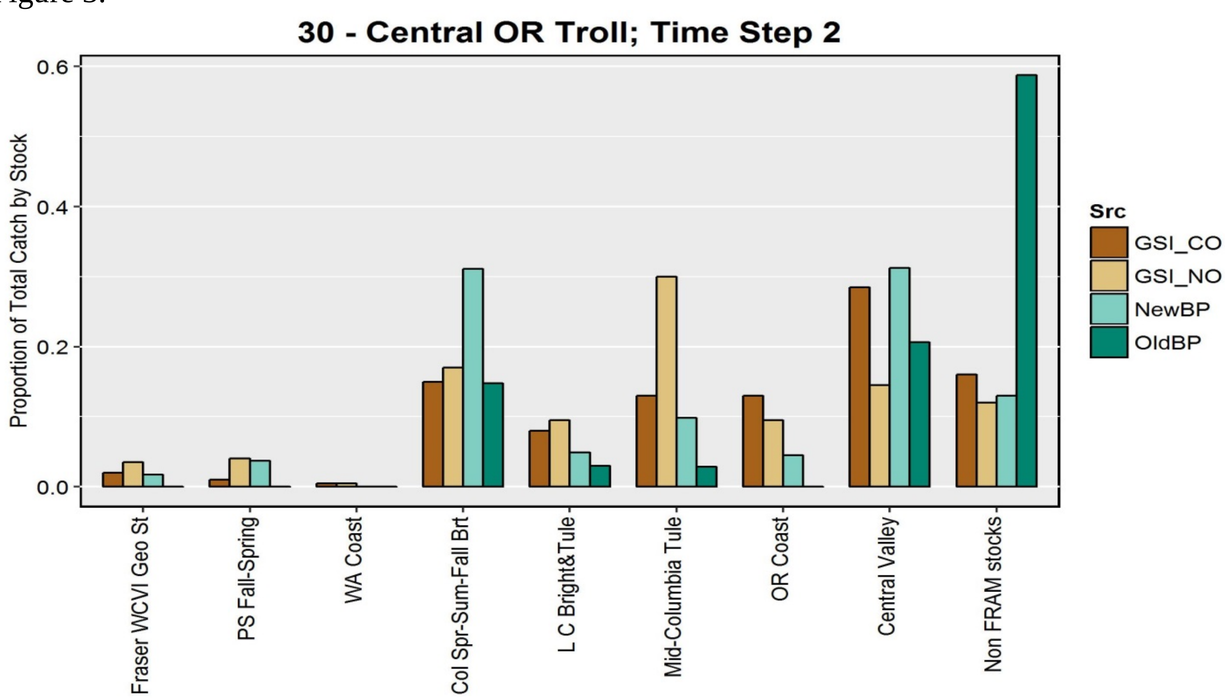


Figure 4. Comparison of current base period (OldBP), new base period (NewBP), California Klamath North GSI (GSI_KC-n), and Oregon Klamath GSI (GSI_KO) stock composition (2007-2013 post-season run average, 2010 GSI study). Time Step 2 is May-June.

Figure 4.

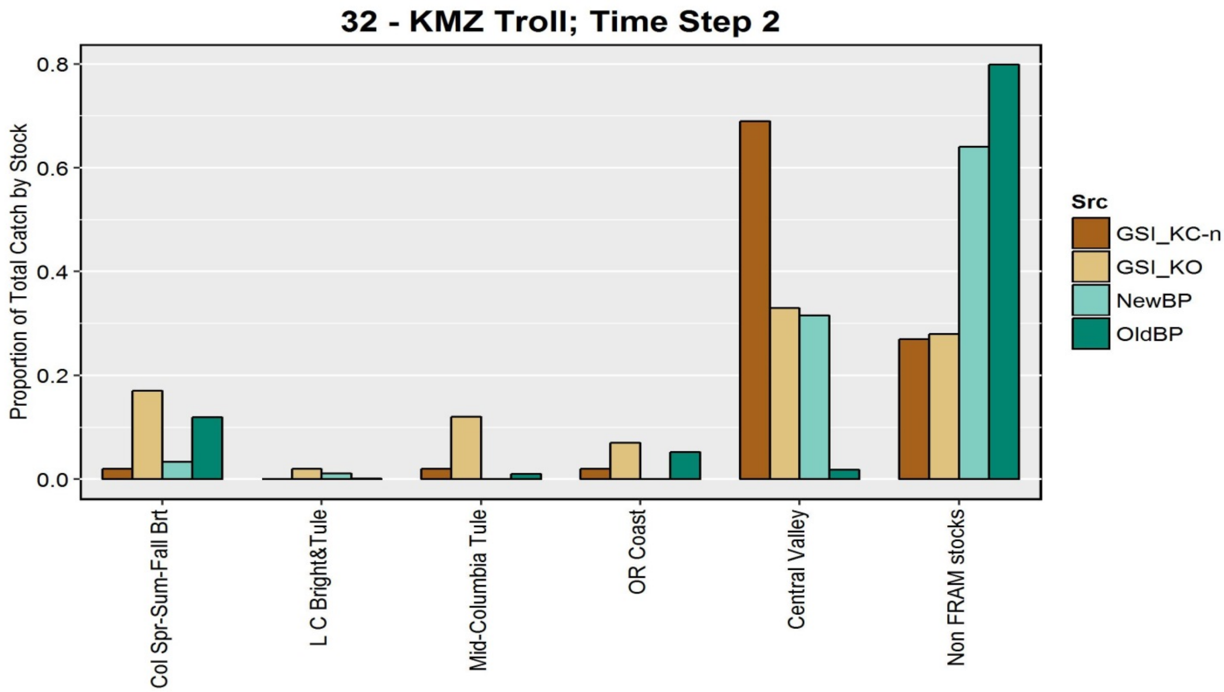
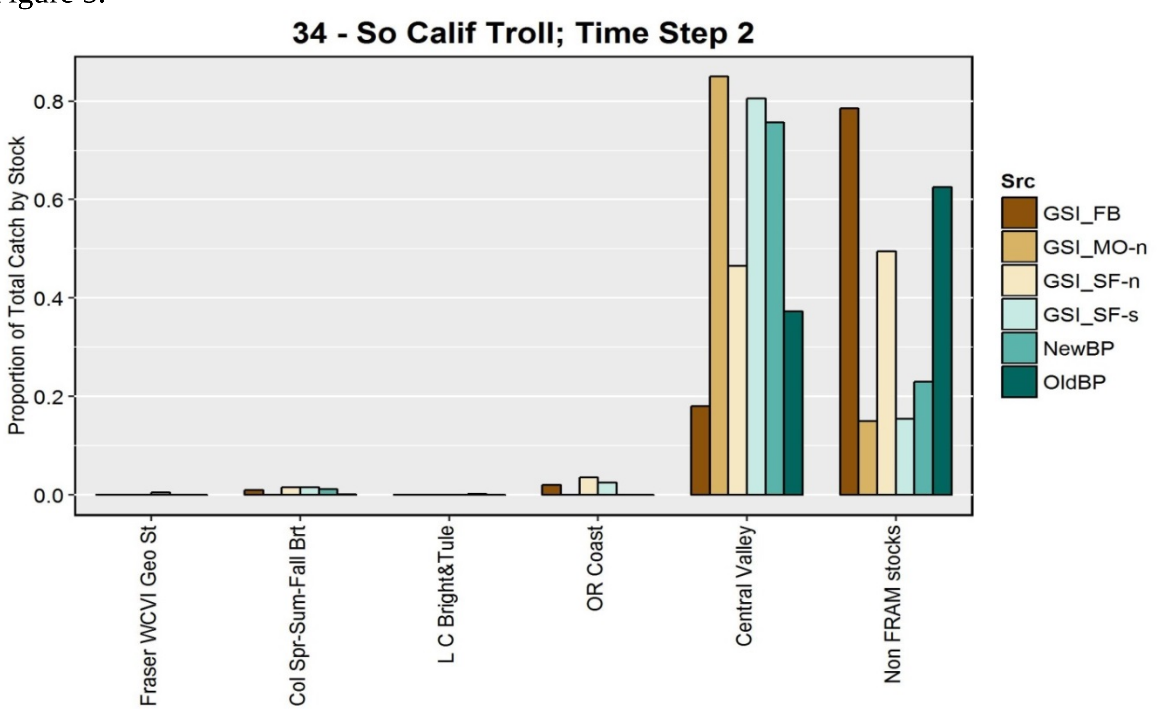


Figure 5. Comparison of current base period (OldBP), new base period (NewBP), Fort Bragg GSI (GSI_FB), Monterey North GSI (GSI_MO_n), San Francisco North GSI (GSI_SF_n), and San Francisco South GSI (GSI_SF_s) stock composition (2007-2013 post-season run average, 2010 GSI study), Time Step 2 is May-June.

Figure 5.



Figures 6-12. Comparison of fishery stock composition using current base period (OldBP) and new base period (NewBP) (2007-2013 post-season run average)

Figure 6.

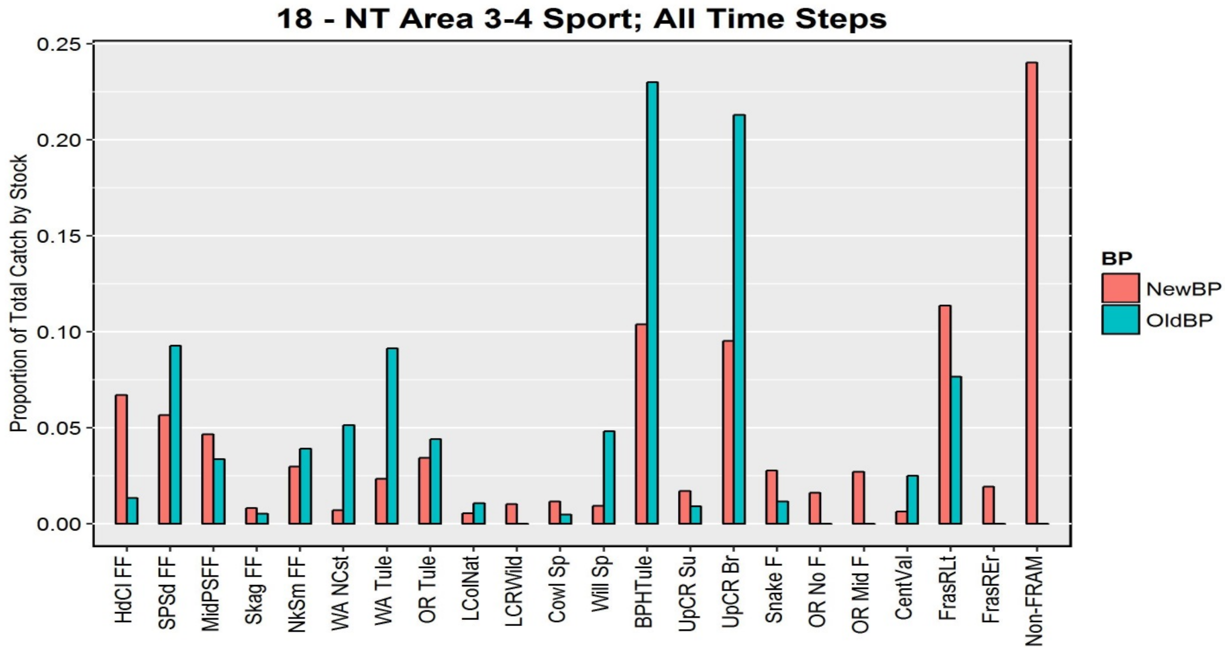


Figure 7.

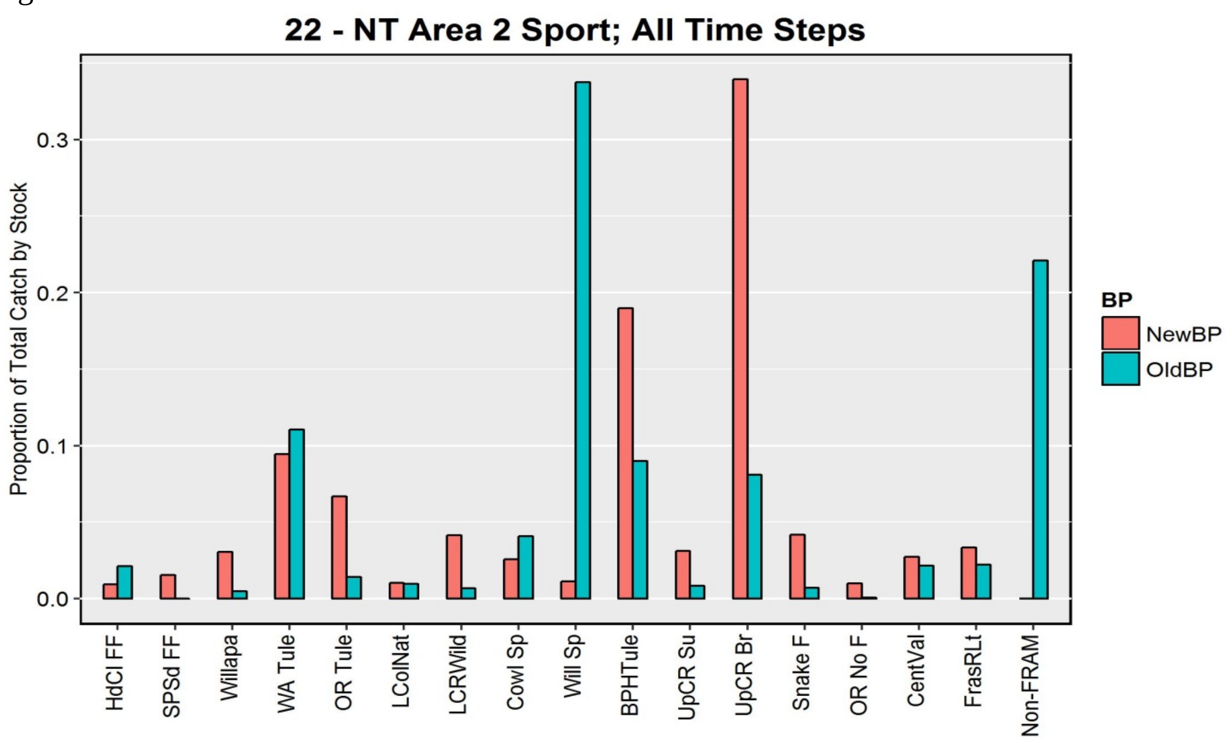
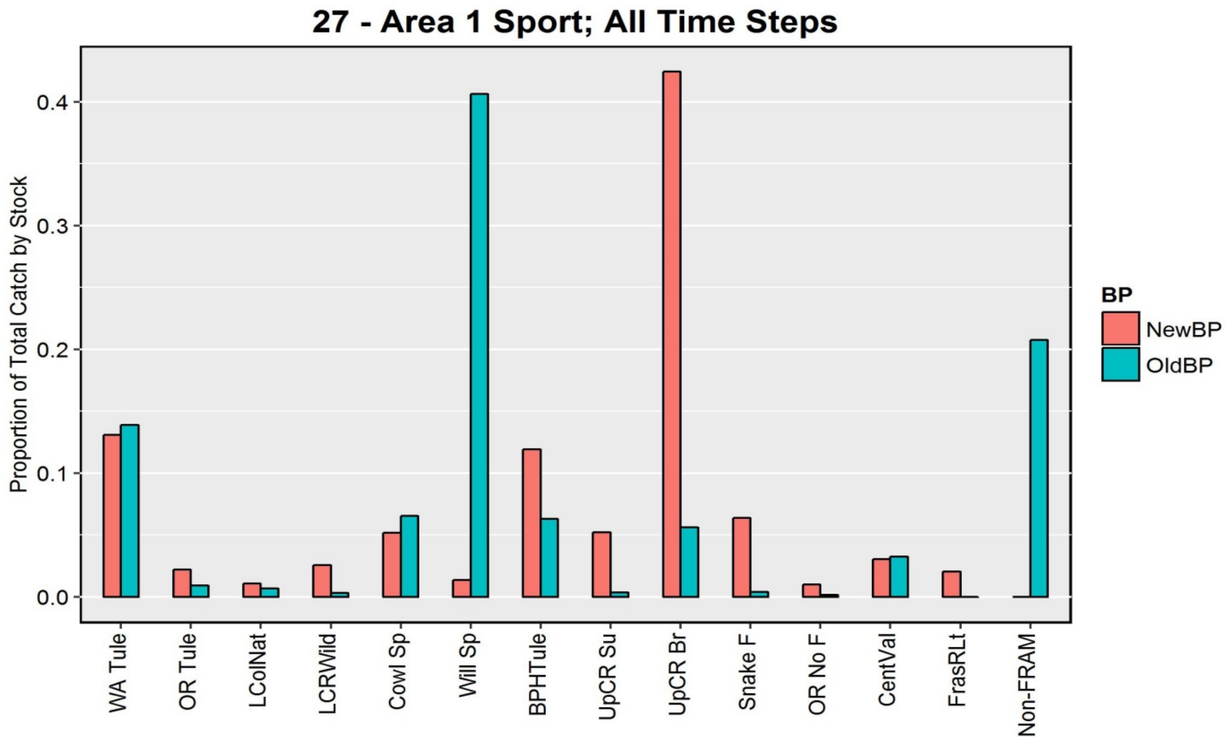


Figure 8.



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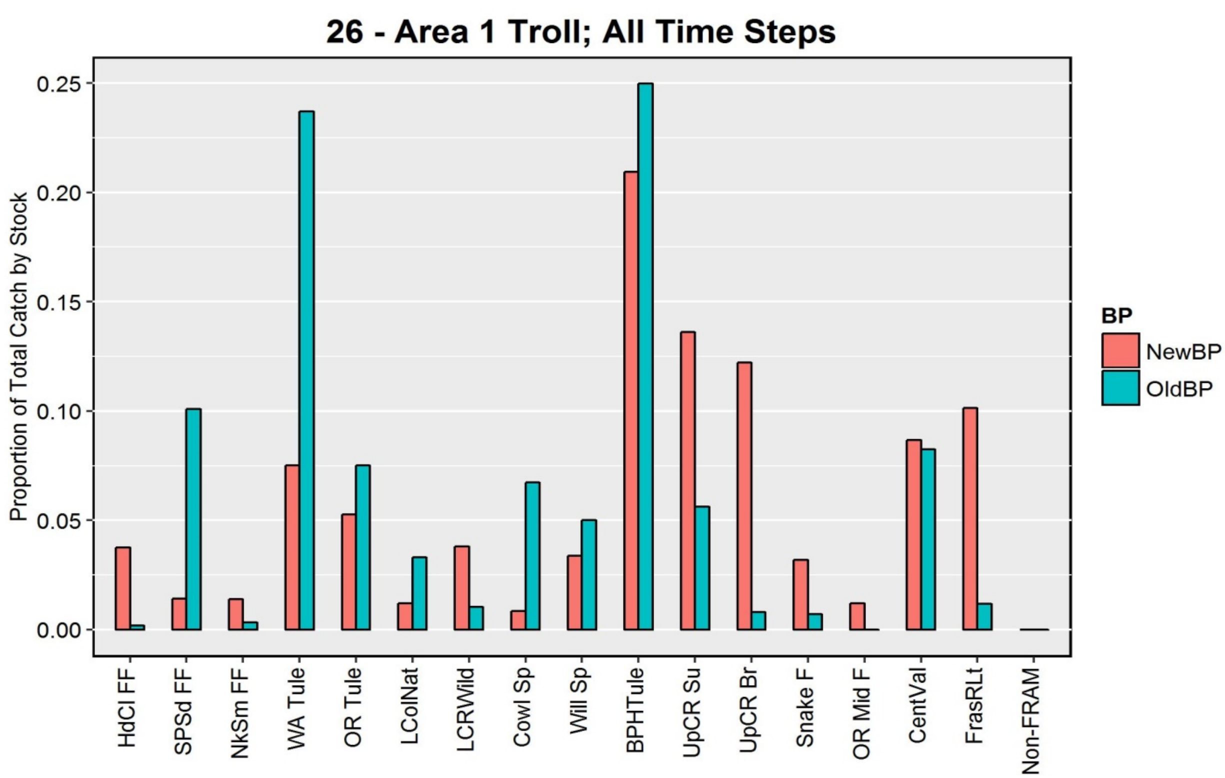


Figure 10.

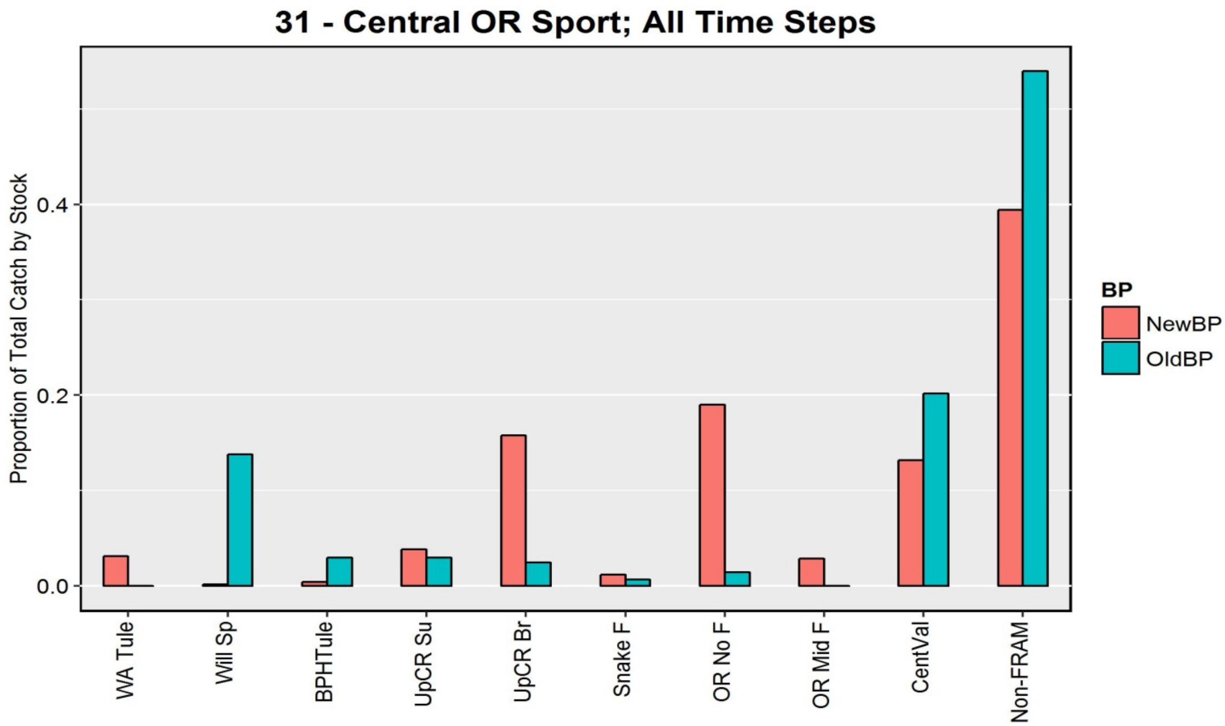


Figure 11.

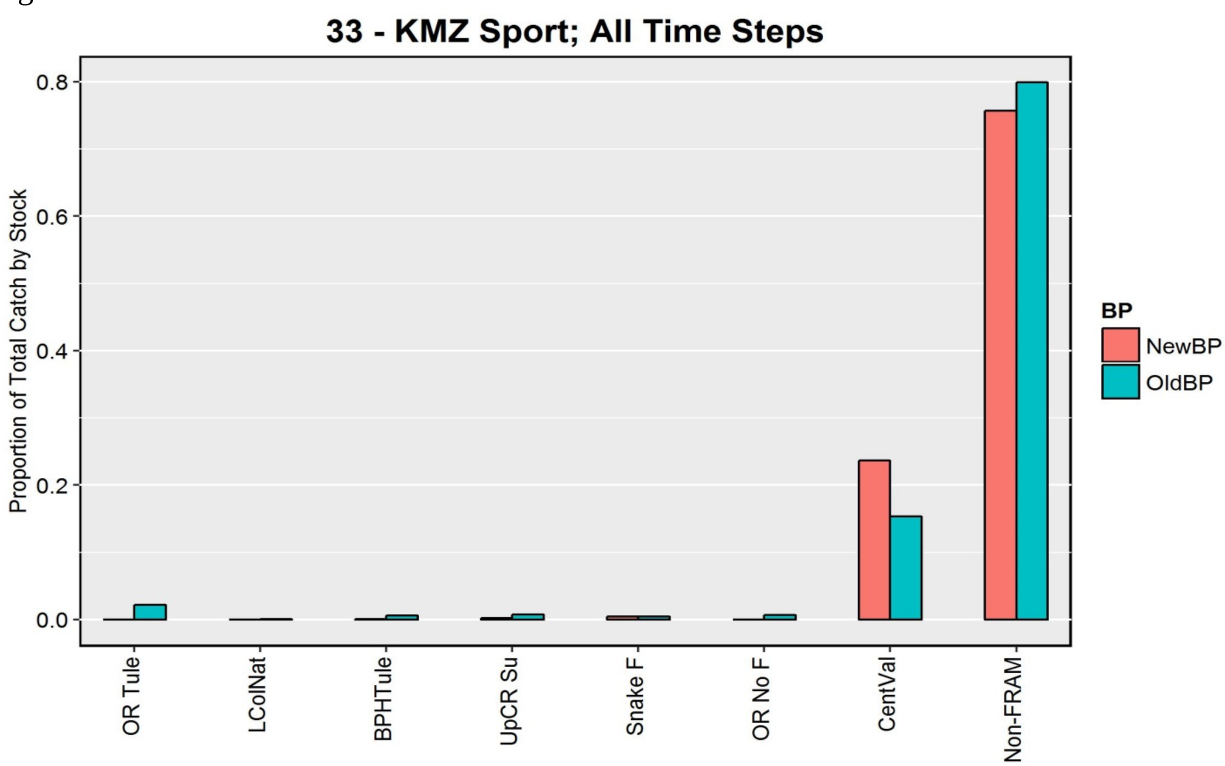
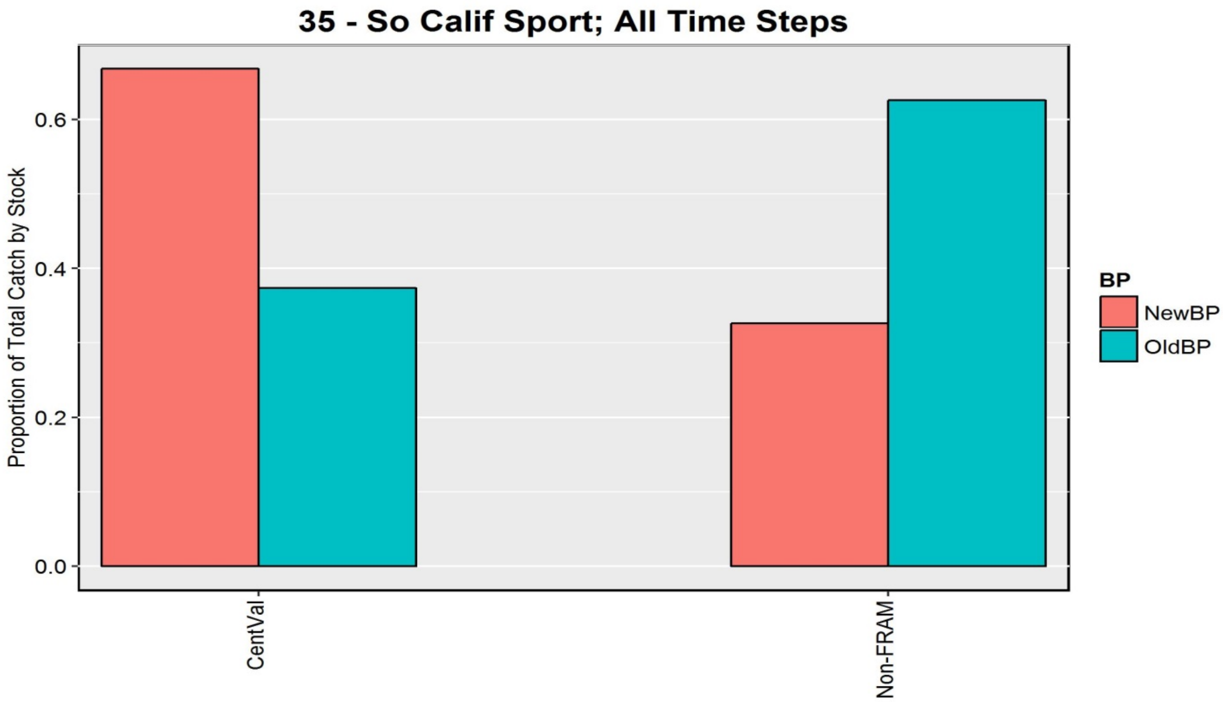


Figure 12.


35 - So Calif Sport; All Time Steps
Proportion of Total Catch by Stock
0.6
0.4
0.2
0.0
CentVal
Non-FRAM
BP
NewBP
OldBP

References

Bellinger, M.R., Banks, M., Bates, S., Crandall, E., Garza, C., Sylvia, G., Lawson, P. (2015). Geo-Referenced, Abundance Calibrated Ocean Distribution of Chinook Salmon (*Oncorhynchus tshawytscha*) Stocks across the West Coast of North America. PLoS ONE 10(7): e0131276. doi:10.1371/journal.pone.0131276.

Johnson, G., Hagen-Breaux, A., McHugh, P., Carey J., LaVoy, L. (2015). Chinook FRAM Base Period Documentation: Sublegal Stock and Age Assignments. Pacific Fishery Management Council Briefing Book, November 2015, Agenda Item D.2. Attachment 3.

McHugh, P., Johnson, G., Schaffler, J. (2015). Chinook FRAM Base Period Documentation: Growth Functions. Pacific Fishery Management Council Briefing Book, November 2015, Agenda Item D.2. Attachment 2.