NOAA FISHERIES

Projecting impacts on Chinook salmon bycatch: potential transfer of exemptions to regulation, in two West Coast groundfish trawl fishery sectors

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Introduction

- Analyzed the current non-whiting trawl exempted fishing permit (tEFP)
- To evaluate potential impacts on Chinook salmon bycatch, of transferring tEFP conditions to regulation
- Focused on two current trawl exemptions in midwater rockfish (MWRF), and bottom trawl (BT) sectors
- Appears as March 2026 NMFS report

Purpose of the non-whiting trawl EFP

- Provide more flexibility in the use of trawl gear (in time and space) for participants in the groundfish trawl IFQ fishery
  - *2025 EFP application*
- And test whether removing certain gear, time, and area restrictions may impact the nature and extent of bycatch of prohibited species
  - *2025-2026 groundfish harvest specifications proposed rule*

Objectives of the analysis

- Compare total projected bycatch of Chinook per sector/exemption
- With vs without fishing under exempted conditions
- With varying levels of effort and distribution of effort
- ESU compositions

EFP timeline

- EFP began in 2017 as bottom trawl only
- In 2018 it was extended and several midwater trawl/multi-gear provisions were added.
- In 2019 the EFP was extended with focus on BiOp requirements, selected provisions were moved into regulation through trawl gear rule and dropped from EFP.
- By 2020 through 2025 the EFP was renewed with no major changes

Current exemptions

- Currently represents a continuation of the 2021-2022 and 2023-2024 Trawl Gear EFPs
- Participating groundfish trawl vessels are exempted from certain restrictions on gear, area, and time
- Table 1.a. summarizes the two key elements of the 2025 EFP the Council considered allowing in permanent regulation (March 2025 NMFS report) when we performed the analysis

Exemptions analyzed

Table 1a. Key elements of the 2025 trawl EFP analyzed, and under consideration for moving to permanent regulation.

Gear / Area	Participating **bottom trawl** vessels can use any legal small footrope trawl gear between 40º 10’ and 42º N. lat. and shoreward of the boundary line approximating the 100 fm depth contour (i.e., not restricted to SFFT only in that area)
Time	Participating **non-whiting midwater trawl** vessels can fish any time of year (not just after whiting season opens May 1)

Methods

- Made model-based projections of **total Chinook bycatch counts**
  - Predicted stratified distributions of counts under varying levels of effort, using a bootstrap simulation model
  - As in Matson and Erickson (2018) for the 2017 biological opinion
- Estimated proportional **ESU compositions**
  - via genetic mixture analysis
  - As in Moran & Anderson (2019; Moran et al. (2021), Van Doornik et al. (2024)

Three data sources

1) PacFIN
   - Landings per year, sector, month
   - Estimate annual effort per sector
2) Processed granular observer data (OBproc, WCGOP)
   - Haul-level, precise location
   - Estimate catch distribution by latitude, RCA line, gear type
3) Processed granular EM data (EMproc, FOS)
   - Similar attributes as observer data - distributed to haul-level
   - Estimate catch distribution by latitude, RCA line, gear type
   - IFQ hauls monitored by sum of observers and EM

Approach

- Modeled the potential future fishery over a range of likely conditions
- Established range of expected levels of groundfish effort (landings), combined w/ varying distributions of effort among temporal and spatial strata, to form alternatives for each sector (BT and MWRF)
- Varied total landings, and proportions of those landings caught under area/gear/season exemptions as inputs
- Summed stratified projections, for total sector projections of Chinook bycatch under range of future conditions

Approach

- Based the effort ranges on information from the relevant EFP period (2018 to most recent available data years)
- Assumption that effort during the EFP is likely representative of near-future interest (vessel caps not met)

Approach: range and distribution of potential year-sector-strata effort

MWRF (months)

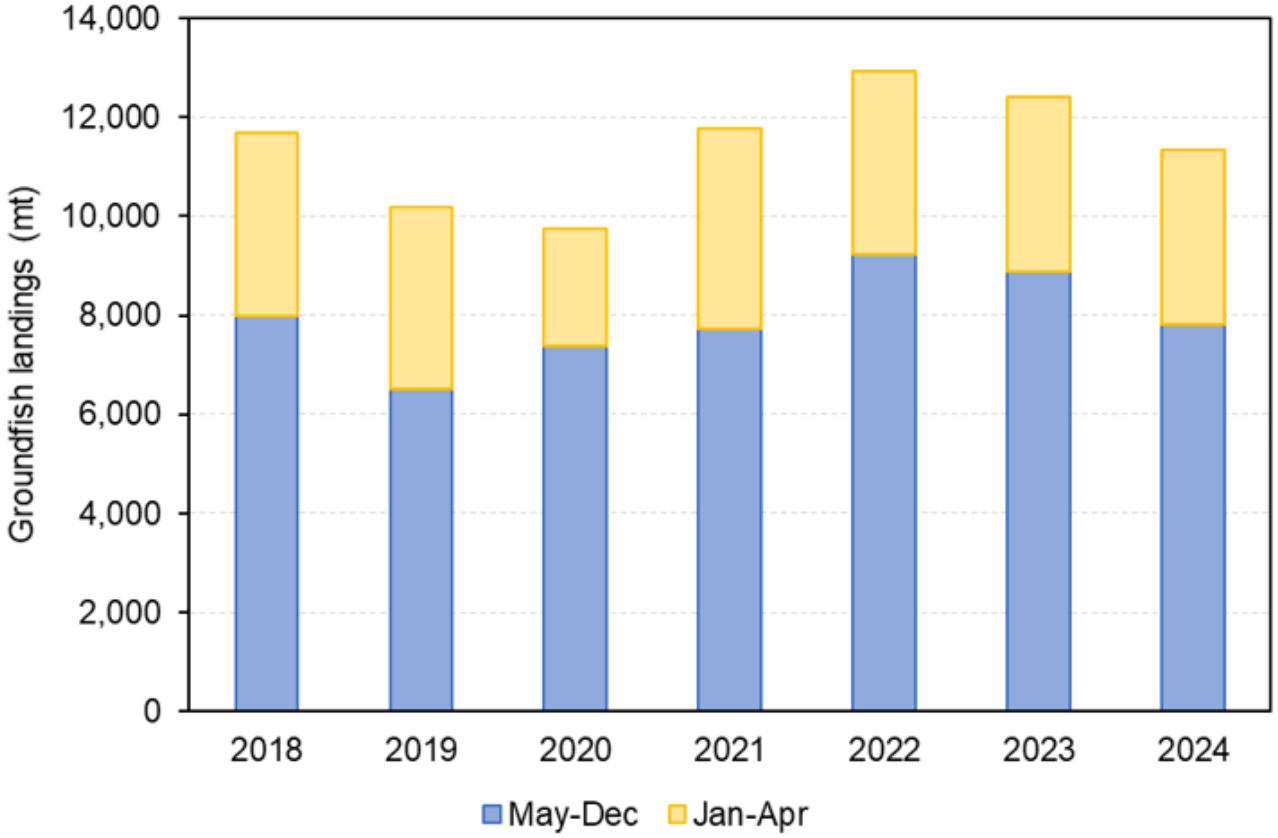


Figure 1, Table 2a

$\bar{x} = 0.306$

BT (area)

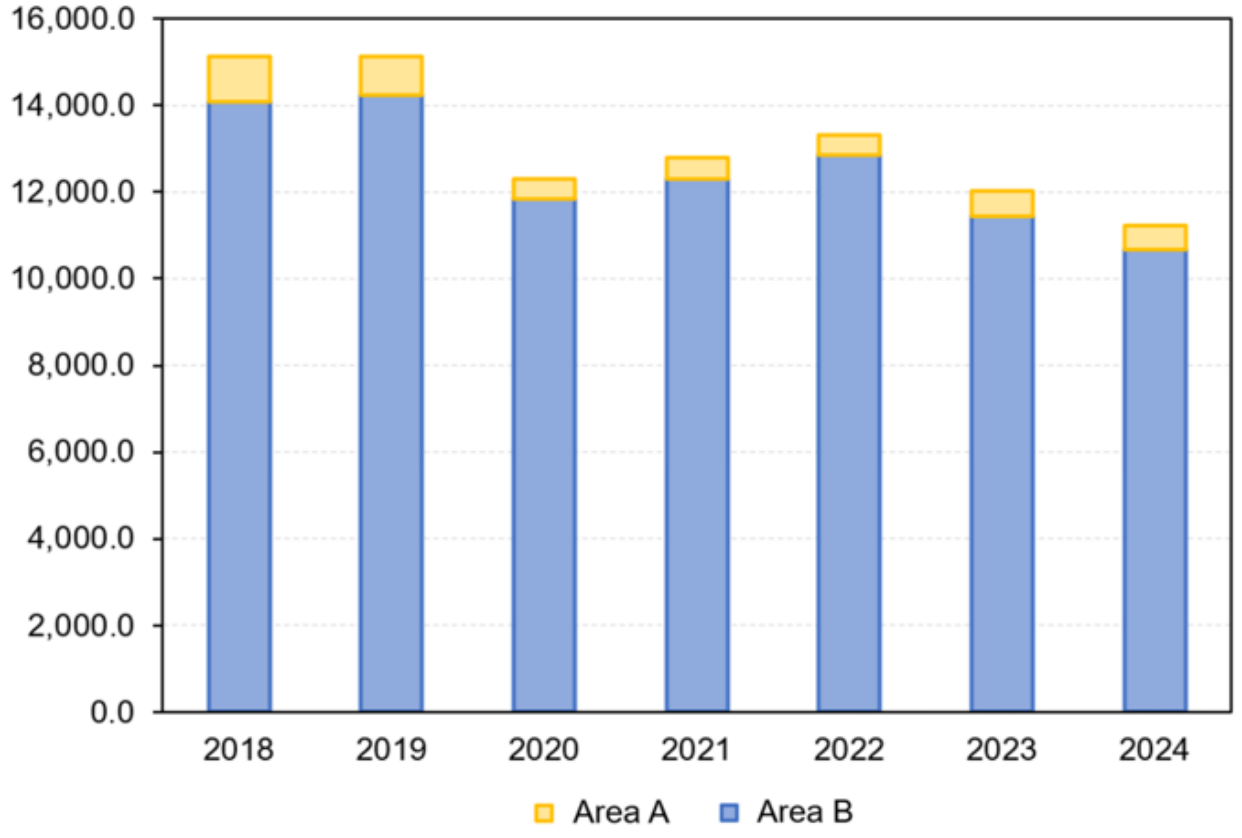


Figure 3, Table 2b

$\bar{x} = 0.048$

Approach (range of potential year-sector effort, ***MWRF***)

- Composed range of combination of annual effort, and distribution between strata
- Middle 80% of each distribution over relevant EFP period
- Combined high landings with high p(Jan-Apr), low with low, etc.
- Same approach for BT (area)

a. Modeled distributed seasonal landings (mt), January through April ("early").

	Low, 10th land	Mean land	High, 90th land
High, 90th p(early)	3,504.7	4,005.3	**4,416.6**
Mean p(early)	3,065.0	**3,502.7**	3,862.4
Low, 10th p(early)	**2,674.6**	3,056.6	3,370.5

b. Modeled distributed seasonal landings (mt), May through December ("late").

	Low, 10th land	Mean land	High, 90th land
High, 1-90th p(early)	6,503.2	7,432.1	**8,195.3**
Mean, 1-p(early)	6,943.0	**7,934.6**	8,749.5
Low, 1-10th p(early)	**7,333.3**	8,380.8	9,241.4

c. Modeled potential range full year landings (mt).

	Sum 10th seasons	Sum means	Sum 90th seasons
Sum seasons	10,007.9	11,437.4	12,611.9
Sum seasons	10,007.9	11,437.4	12,611.9
Sum seasons	10,007.9	11,437.4	12,611.9

Table 3

Approach (range of potential year-sector effort, *BT*)

- Composed range of combination of annual effort, and distribution between strata
- Middle 80% of each distribution over relevant EFP period
- Combined high landings with high p(area), low with low, etc.

a. Modeled potential Area A landings.

	10th land	Mean land	90th land
90th p(area A)	734.0	822.8	**947.4**
mean p(area A)	558.5	**626.2**	721.0
10th p(area A)	**426.4**	478.0	550.4

b. Modeled potential Area B landings.

	10th land	Mean land	90th land
1-90th p(area A)	10,979.1	12,308.4	**14,171.8**
1-mean p(area A)	11,154.5	**12,505.1**	14,398.2
1-10th p(area A)	**11,286.7**	12,653.2	14,568.8

c. Sum modeled coastwide landings.

	Sum 10th	Sum mean	Sum 90th
Sum p()	11,713.0	13,131.2	15,119.2
Sum p()	11,713.0	13,131.2	15,119.2
Sum p()	11,713.0	13,131.2	15,119.2

Table 5

Approach (*BT*)

- Bottom trawl gear exemption area (shown right – red box)
- Between 40º10’ and 42º N. lat., shoreward of the 100 fm RCA line
- Determined using GIS and haul location

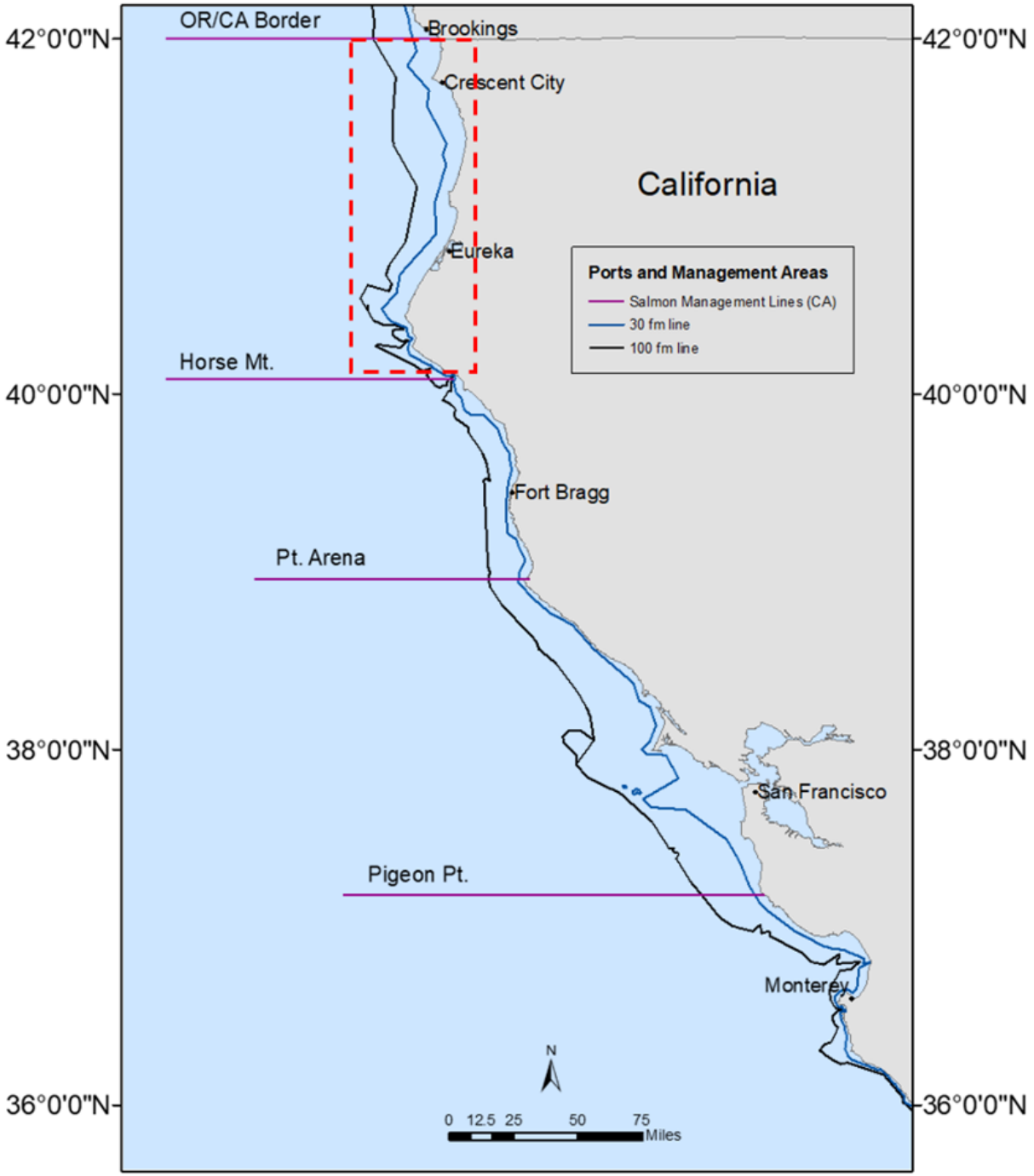


Figure 2

Approach

- Compared projections of full-year bycatch
- Projected complete years **with vs without** fishing at varying effort x effort distribution levels under exemption

Results (**MWRF**)

- MWRF results showed little difference in projected bycatch for a fishing year which included the exemption, vs without the exemption

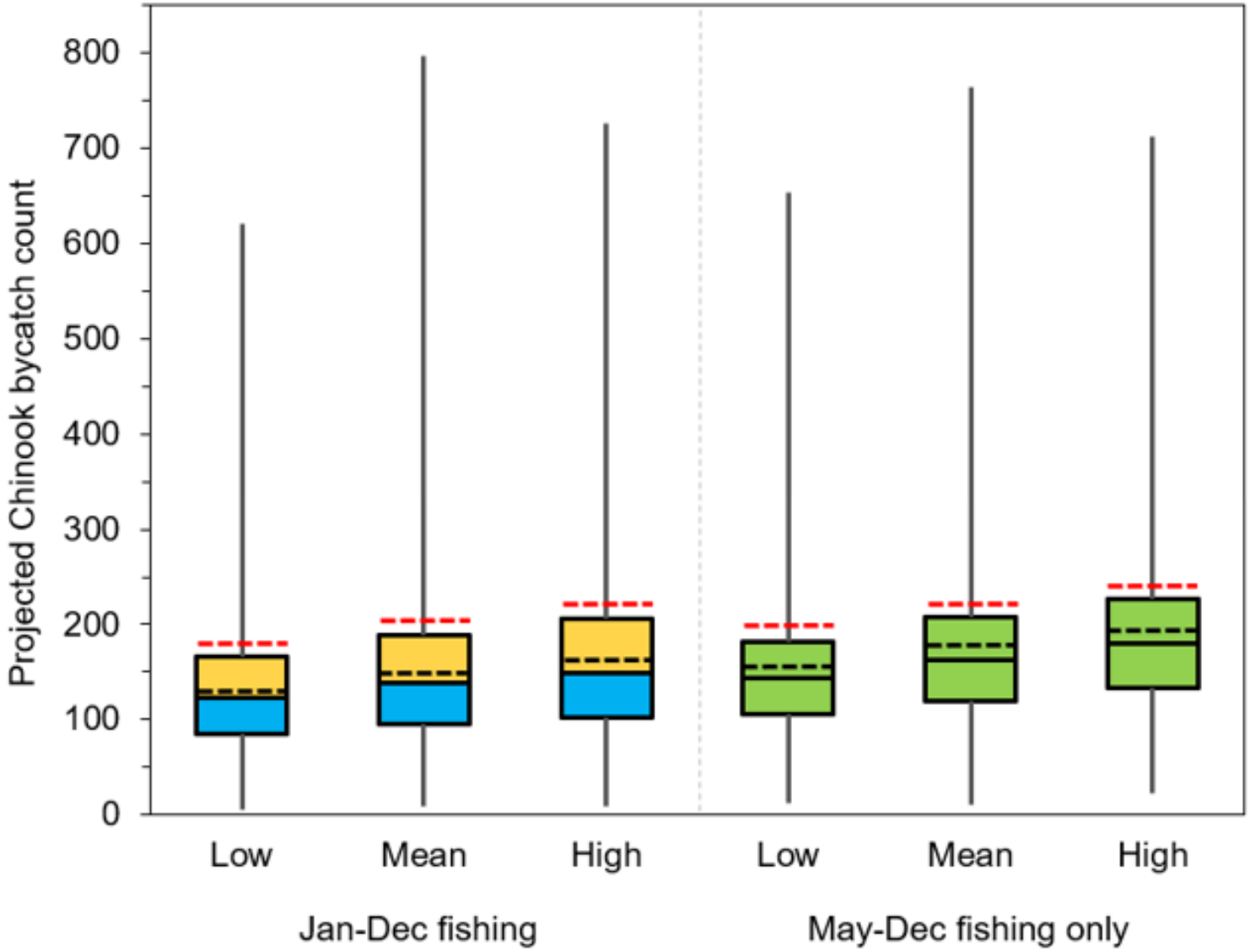


Figure 4

Results (**MWRF**) add table

- MWRF results showed little difference in projected bycatch for a fishing year which included the exemption, vs without the exemption

Exemption / season	(1) Jan-Dec fishing (w/ exemption to regulations)			(2) May-Dec fishing only (status quo regulations)		
Quantiles / effort levels	Low	Mean	High	Low	Mean	High
0	6.1	8.8	9.6	12.7	10.4	22.9
0.01	34.7	40.8	44.2	55.6	68.9	79.1
0.05	51.8	57.9	61.2	73.9	85.8	95.4
0.25	85.0	96.0	102.9	105.8	119.4	133.3
0.50	**122.4**	**138.3**	**149.8**	**143.3**	**162.1**	**179.6**
0.75	166.5	188.3	206.1	182.4	207.2	227.1
0.80	**178.8**	**200.9**	**220.1**	**193.4**	**218.4**	**240.3**
0.95	253.9	282.9	303.6	277.2	304.6	331.9
0.99	365.1	393.7	421.5	394.5	427.2	459.1
1	620.7	797.2	726.6	653.0	764.2	712.2
Mean	**133.3**	**149.4**	**161.9**	**153.0**	**172.4**	**190.0**

Table 6

Results (**BT**)

- BT results showed little difference in projected bycatch for a fishing year which included the exemption, vs without the exemption

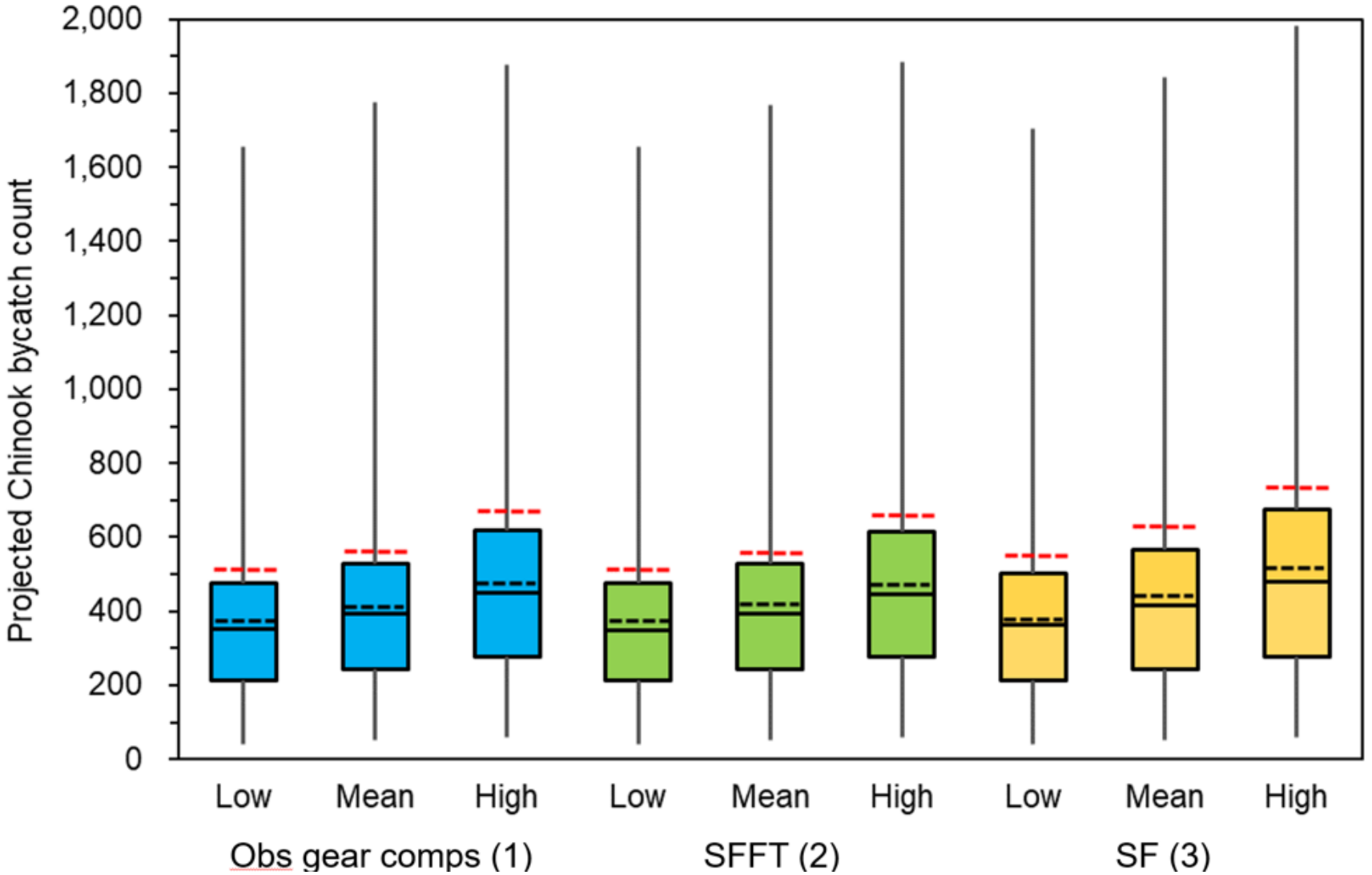


Figure 4

Results (**BT**)

- BT results showed little difference in projected bycatch for a fishing year which included the exemption, vs without the exemption

Alternative/ condition	Actual gear compositions			SFFT only in exempt area			SF only in exempt area		
quantiles	low	mean	high	low	mean	high	low	mean	high
0	41.0	53.0	58.0	41.0	53.0	58.0	41.0	53.0	58.0
0.01	68.0	76.0	91.0	68.0	76.0	91.0	68.0	76.0	91.0
0.05	89.0	100.0	116.0	89.0	100.0	116.0	89.0	100.0	116.0
0.25	212.0	242.0	278.0	212.0	242.0	278.0	212.0	242.0	278.0
0.5	**350.0**	**395.0**	**449.5**	**349.0**	**394.0**	**447.5**	**363.0**	**415.0**	**478.5**
0.75	476.3	529.0	617.3	474.3	527.0	613.3	501.3	566.0	676.3
0.8	**520.0**	**585.0**	**674.0**	**518.0**	**582.0**	**670.0**	**548.0**	**625.0**	**737.0**
0.95	815.0	918.0	1028.1	814.0	917.0	1027.1	851.0	968.0	1102.1
0.99	1071.0	1173.0	1314.0	1071.0	1172.0	1315.0	1108.0	1225.0	1393.0
1	1655.0	1775.0	1876.0	1655.0	1769.0	1884.0	1705.0	1843.0	1980.0
mean	374.0	420.2	479.5	373.1	419.0	477.8	388.4	440.6	510.9

Table 8a

Validation (MWRF)

- As coarse validation, to identify any potential bias, and temper expectations
- Compared projected MWRF bycatch results under mean effort and mean seasonal effort distribution, vs mean actual bycatch estimates over years informing the analysis
- Projection was nearly equal to actual estimated levels
- Mean actual = 151 fish per year vs projected mean = 149

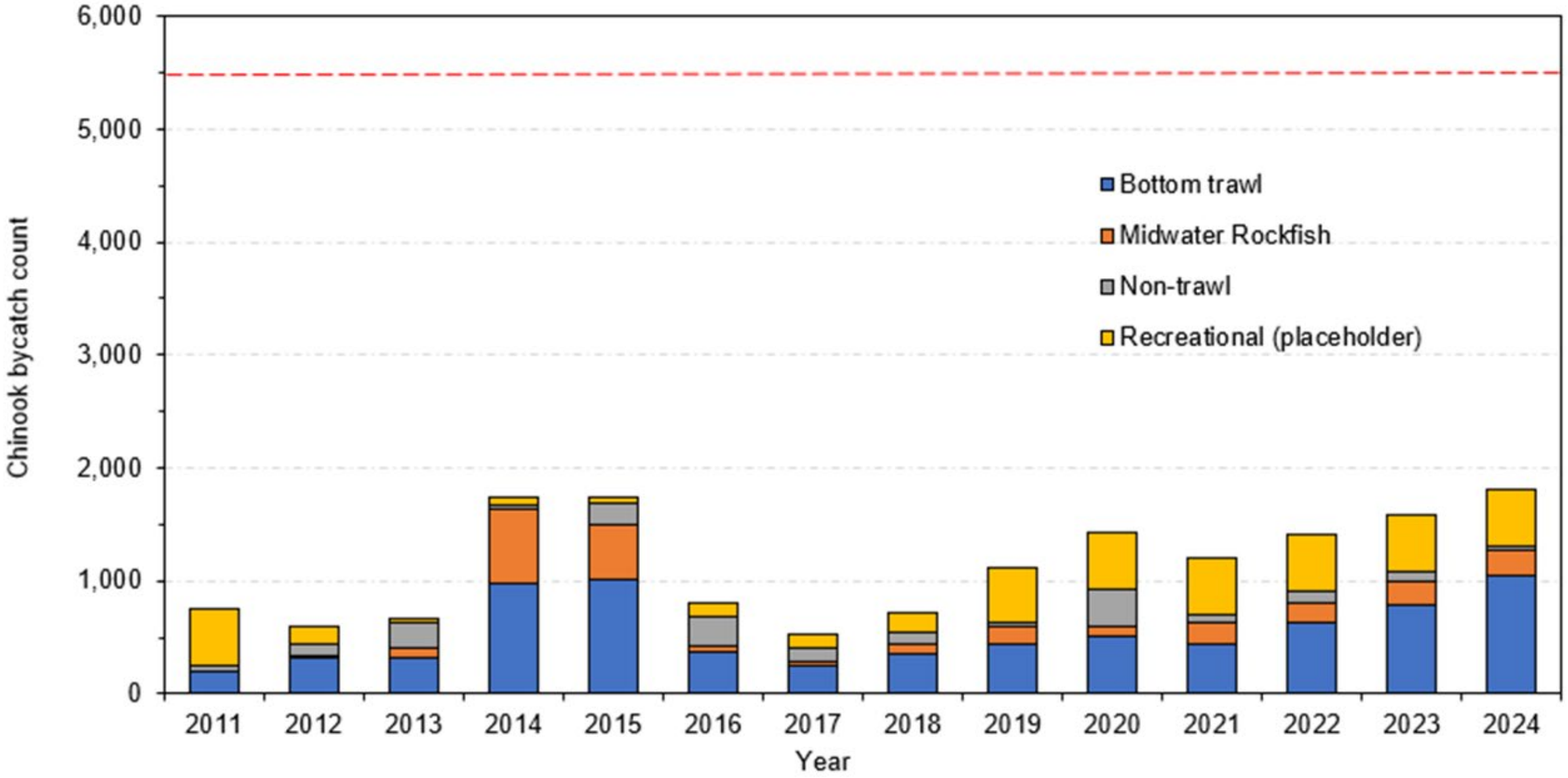
Validation (BT)

- Made same comparisons for **BT**, projected (mean effort/distribution) vs mean actual
- BT projection was somewhat low, vs actual mean actual estimates
- Projected mean (420 fish) vs actual mean (524 fish)
- Implies a low *overall* projection bias, affecting all BT projections, not only the treatment
- Should not compromise the comparison of *exempted* vs *non-exempted*, all other things equal
- One potential contributor is that only observer (not EM) data could be used to inform effort distribution, for specific haul-level gear description information

In context

- Risks of implementation appear low in terms of total Chinook bycatch by these sectors considering :
- Results of this analysis
  - Little difference in projected Chinook bycatch, over reasonable ranges of potential effort, and distribution of that effort over season, area, and/or gear
- Recent historical bycatch of these sectors (Fig 11)
  - The non-whiting sectors taken together, have historically, since the inception of the IFQ fishery in 2011, taken a small proportion of the 5,500 fish non-whiting limit on Chinook bycatch

In context


6,000
5,000
4,000
3,000
2,000
1,000
0
Chinook bycatch count
Bottom trawl
Midwater Rockfish
Non-trawl
Recreational (placeholder)
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Year

ESU compositions

- Estimated proportional ESU compositions directly from fishery samples via genetic mixture analysis, for 2023 and 2024
- In the **MWRF**, comparable amounts of variation in composition between years (2023 vs 2024) as there was between seasons (Jan-Apr vs May-Dec)
- Scale of the variation between seasons also fits w/in 95 percent credible intervals for most ESUs
- Implies a lack of meaningful difference attributable to seasons

ESU compositions
MWRF x season

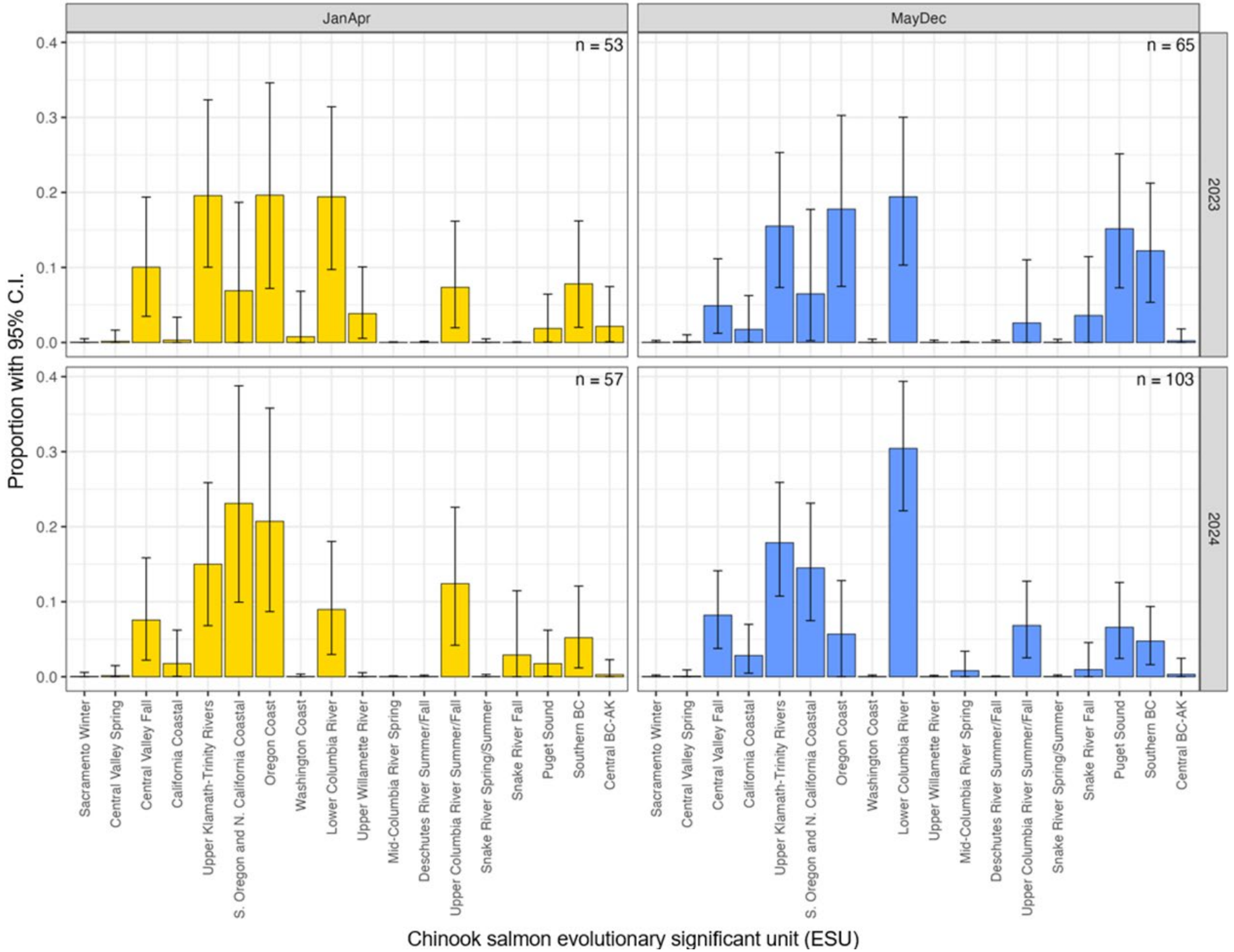


Figure 9

ESU compositions

- Estimated proportional ESU compositions directly from fishery samples via genetic mixture analysis, for 2023 and 2024
- With the EFP included, random sampling w/in sector
- For the **BT**, we were able to estimate compositions for the sector as a whole
- Few to estimate composition for the specific area/gear/depth combination (40°10” N. to 42° N. x other SF x <100 fm)

ESU compositions
MWRF & BT

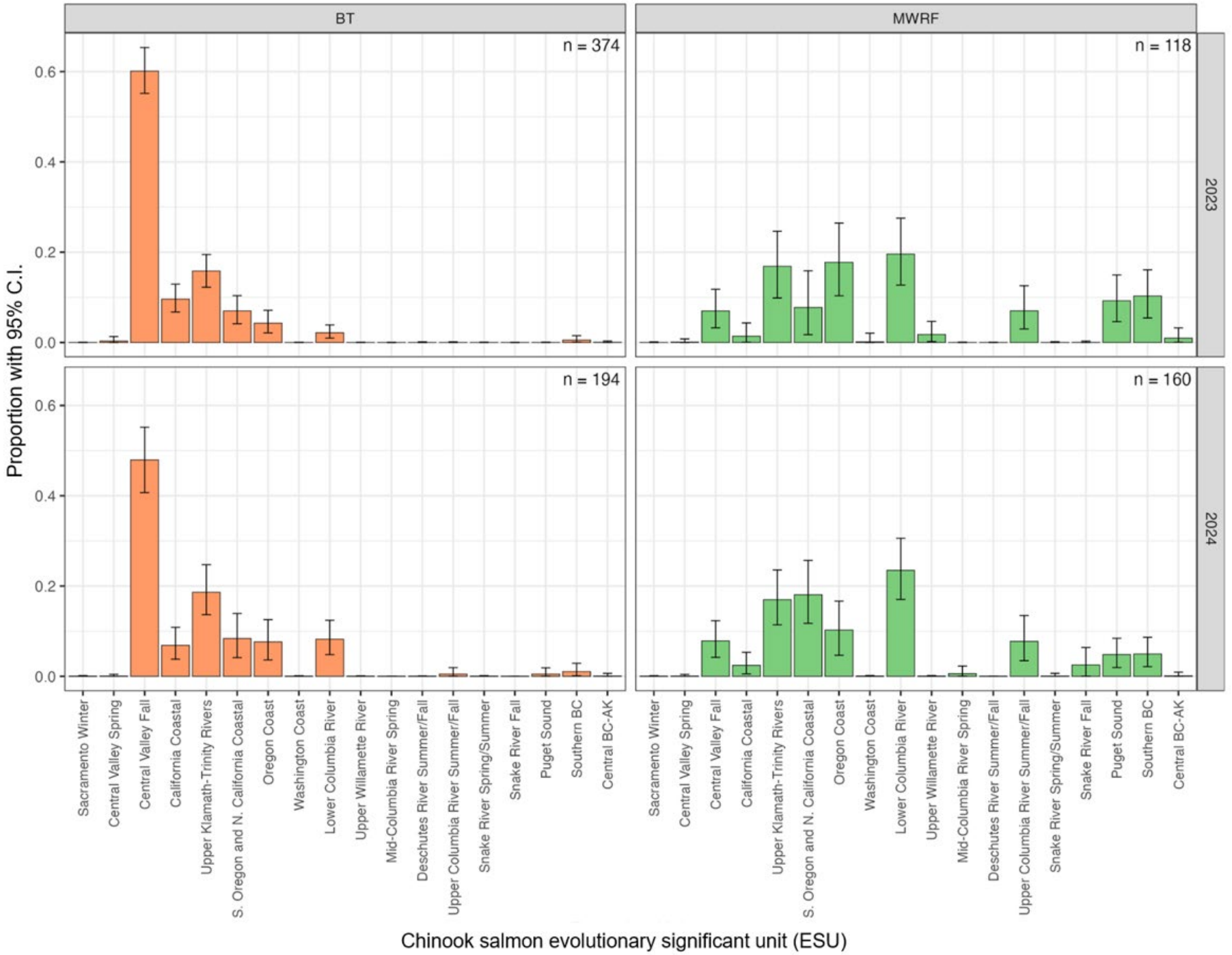


Figure 10

Acknowledgements

- Big thanks to **Dr. Paul Moran**
- Recently retired
- Long-time collaborator on these projects
- Large body of work on salmon genetics
- Insightful and creative work on salmon ESU compositional analysis
- Developed predictive modeling approaches for predicting salmon bycatch composition that we continue to use

Photo: Megan Crabtree, National Marine Sanctuary Foundation; https://marinesanctuary.org/blog/sea-wonder-copper-rockfish/