

2024 CFNSC FCE & FPS

Cowlitz Annual Program Review and Science Conference
April 16, 2025

FCE/FPS basics

$$\hat{P}_{FCE} = \frac{n}{R}$$

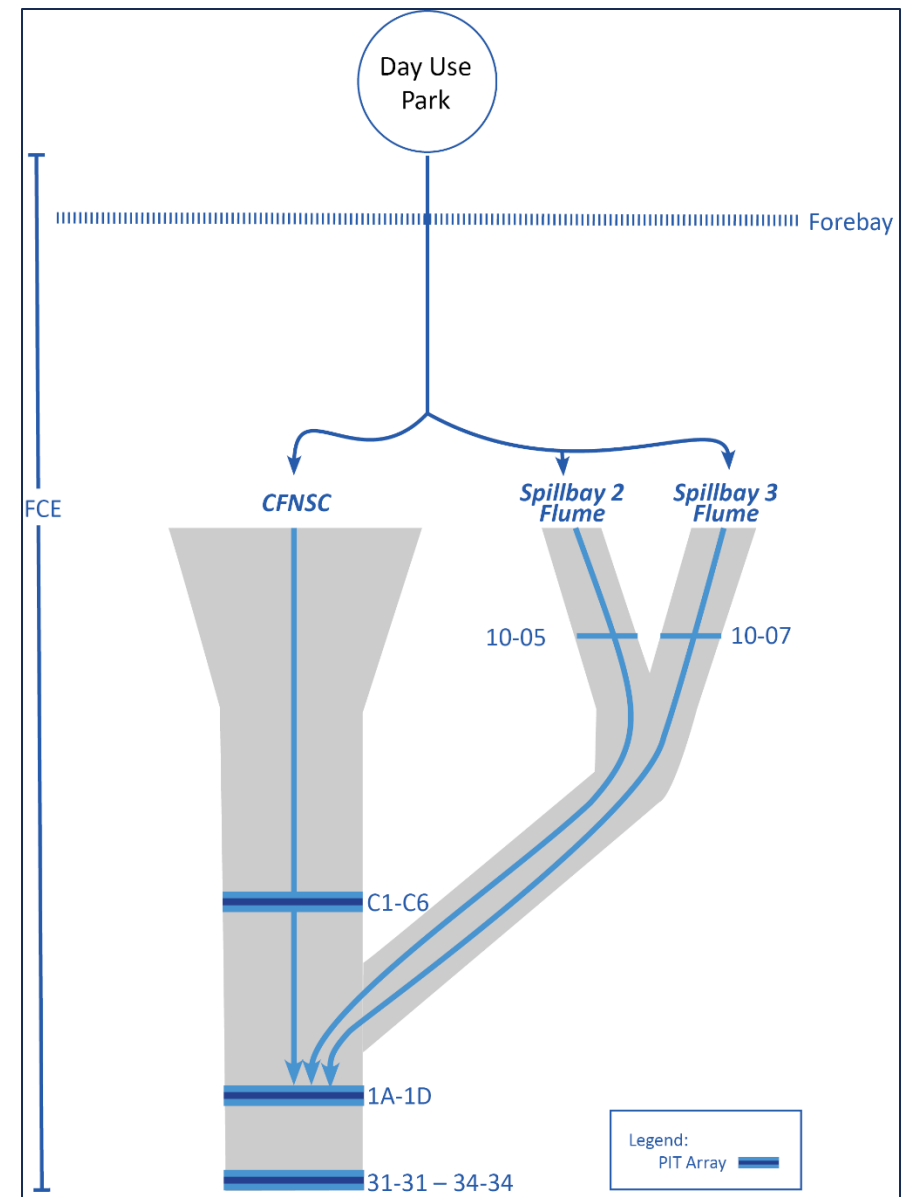
(1)

$$\hat{P}_{FCE} = \hat{\theta}[\hat{\psi}_1 \cdot \hat{\theta}_N + (1 - \hat{\psi}_1)s_F]\lambda$$

(2)

$$FPS = \left(\frac{\widehat{FCE}}{S_n} \right) S_t$$

(3)



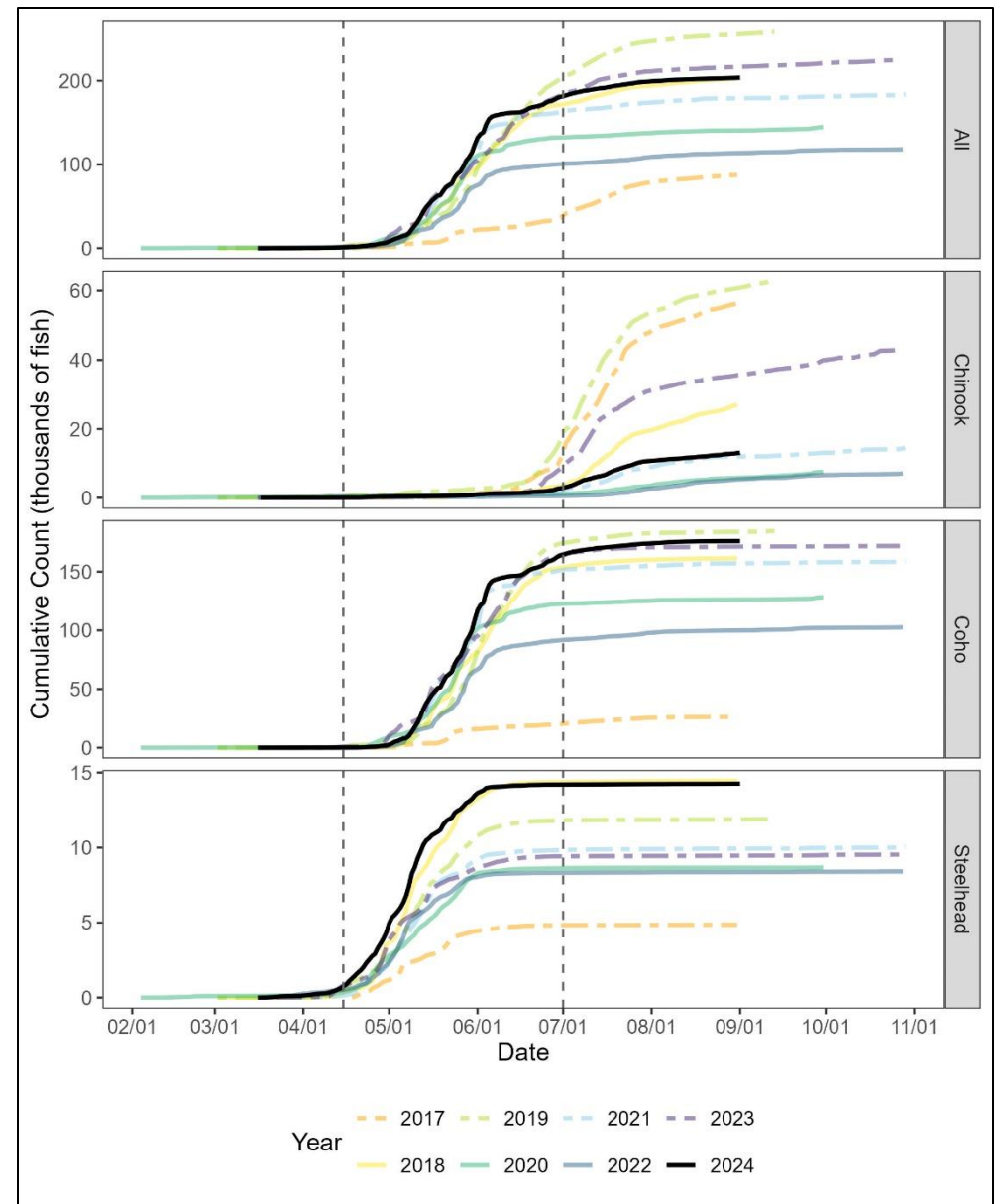
Traditional vs Supplemental

- Traditional = peak window tagging
- Supplemental = extended season tagging
 - Allows for wider inference into environmental and operational influences on FCE



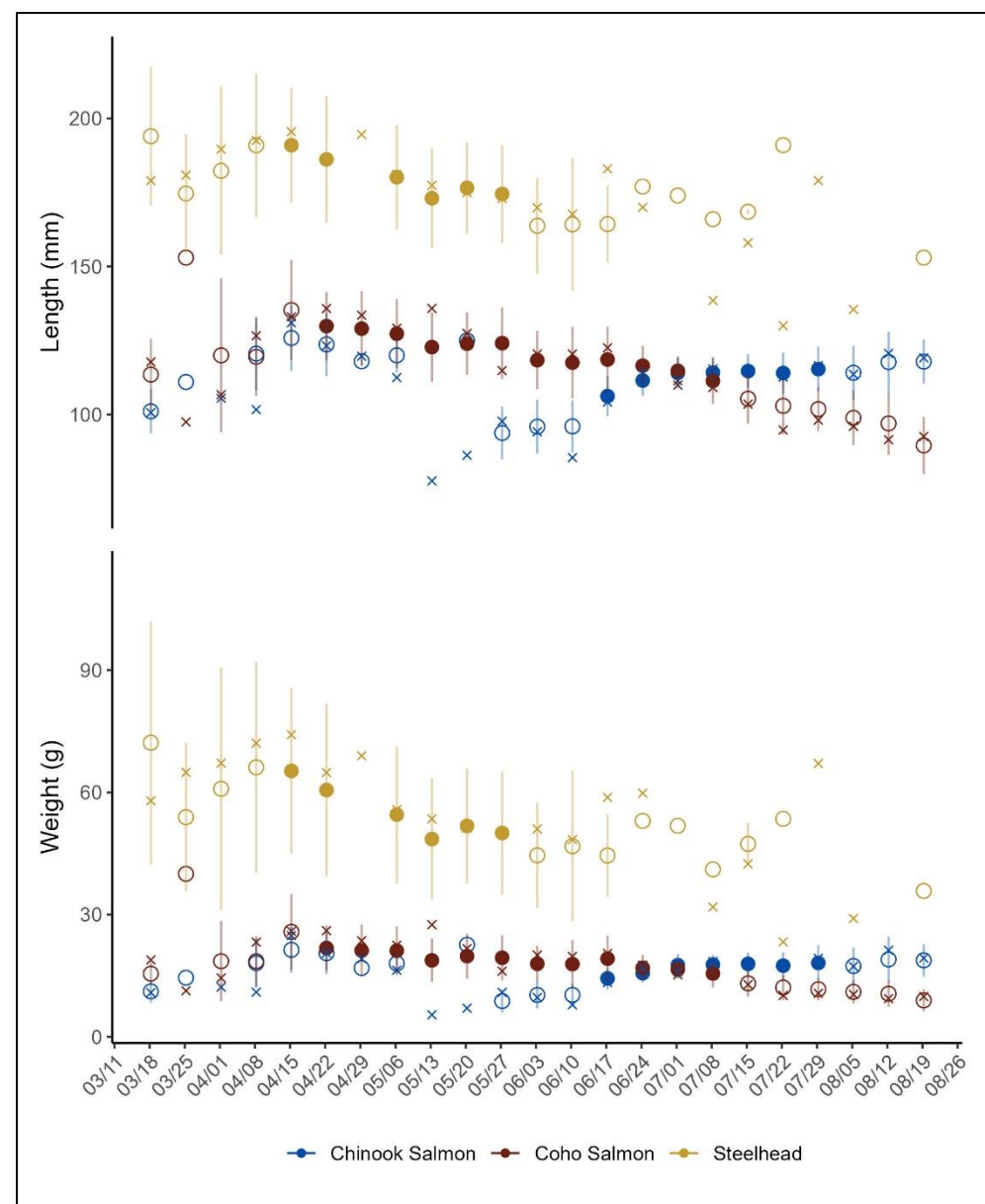
Collection totals

- 222,765 total juvenile target species
- 201,791 “active migrants” targets
- ↓ 9.4% relative to 2023
- ↑ 17.0% relative to 7-year (2017-2023) mean
- Chinook Salmon - ↓ 56.7% relative to 7-year mean
- Coho Salmon - ↑ 35.9% relative to 7-year mean
- Steelhead - ↑ 63.8% relative to 7-year mean



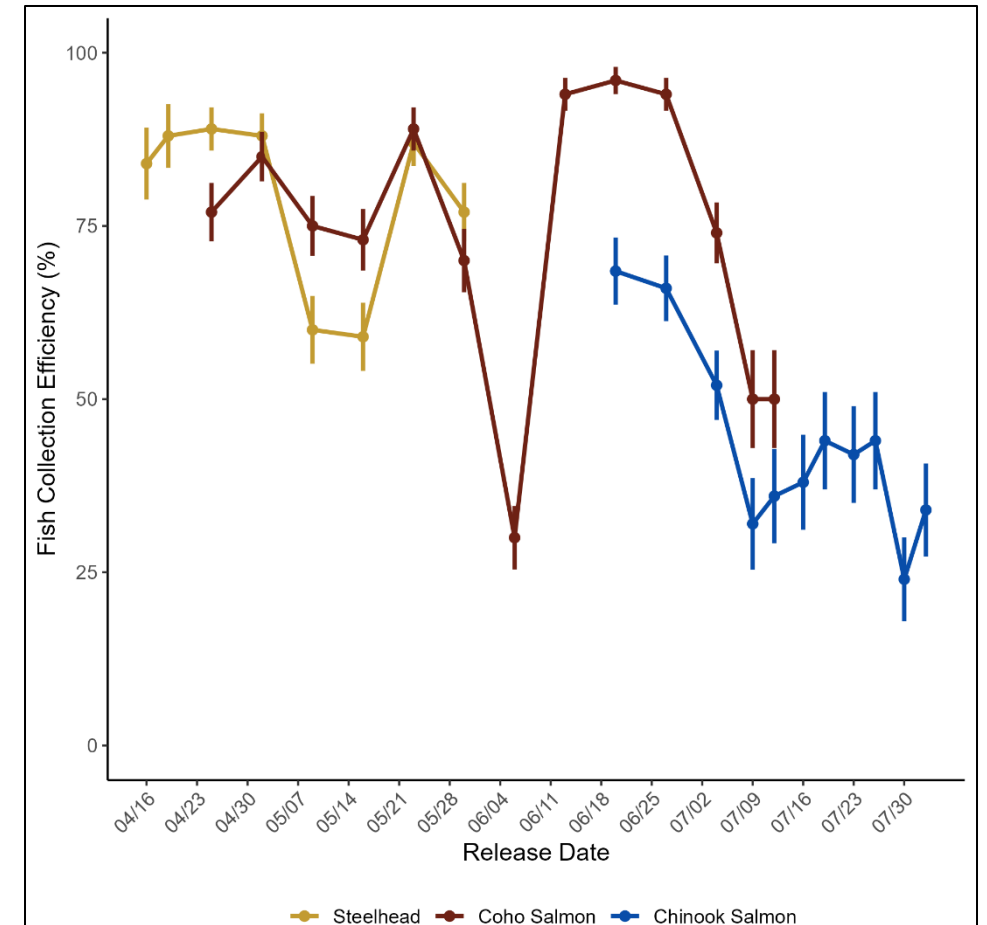
Study Fish

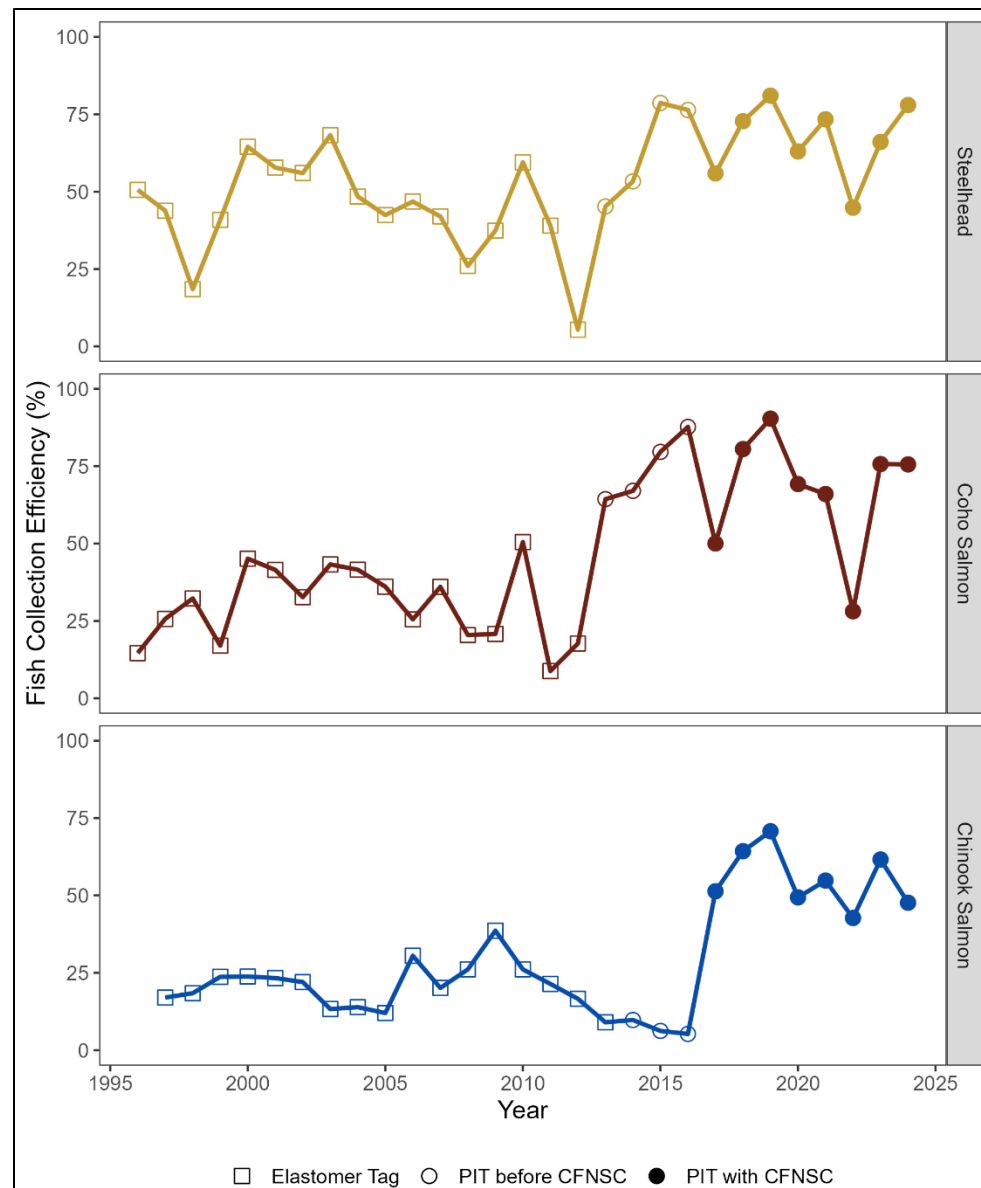
- Steelhead (n=700)
April 16th – May 30th
- Coho Salmon (n=1,200)
April 25th – July 12th
- Chinook Salmon (n=692)
June 20th – August 2nd



Fish collection efficiency

Release Date	Steelhead (%)	Coho Salmon (%)	Chinook Salmon (%)
16 April	84.0 (5.2)	.	.
19 April	88.0 (4.6)	.	.
25 April	89.0 (3.1)	77.0 (4.2)	.
2 May	88.0 (3.3)	85.0 (3.6)	.
9 May	60.0 (4.9)	75.0 (4.3)	.
16 May	59.0 (4.9)	73.0 (4.4)	.
23 May	87.0 (3.4)	89.0 (3.1)	.
30 May	77.0 (4.2)	70.0 (4.6)	.
6 June	.	30.0 (4.6)	.
13 June	.	94.0 (2.4)	.
20 June	.	96.0 (2.0)	68.5 (4.8)
27 June	.	94.0 (2.4)	66.0 (4.7)
4 July	.	74.0 (4.4)	52.0 (5.0)
9 July	.	50.0 (7.1)	32.0 (6.6)
12 July	.	50.0 (7.1)	36.0 (6.8)
16 July	.	.	38.0 (6.9)
19 July	.	.	44.0 (7.0)
23 July	.	.	42.0 (7.0)
26 July	.	.	44.0 (7.0)
30 July	.	.	24.0 (6.0)
2 August	.	.	34.0 (6.7)
Season-Wide Mean	78.0 (5.0)	75.6 (5.6)	47.6 (5.8)





Regression analysis

- Base model:
 - Relative migration timing, year, outflow, ZOI temperature, and fish length

Stepwise Regression Covariate	Definition
Unit 1&2 spillway flume flow (cfs)	Total flow through the flume gates
Capture velocity (fps)	Velocity through the NSC capture zone
Pumpback flow (cfs)	Cumulative volume pumped into the forebay
% unit-1 Q of total Q (cfs)	(unit-1 Q / total Q)
Dam spill (cfs)	Mean flow through spill routes
Differential pressure – unit 1&2 (in)	Hourly average
%NSC inflow of outflow (cfs)	(NSC inflow / project outflow)
CV _{Discharge}	CV of hourly flow (unit 1+2)

- Covariates are defined as release group-level averages

Regression relationships

- Model frameworks:

- FCE

- 2024, species combined
 - 2021-2024, species separated
 - 2018-2024, species separated

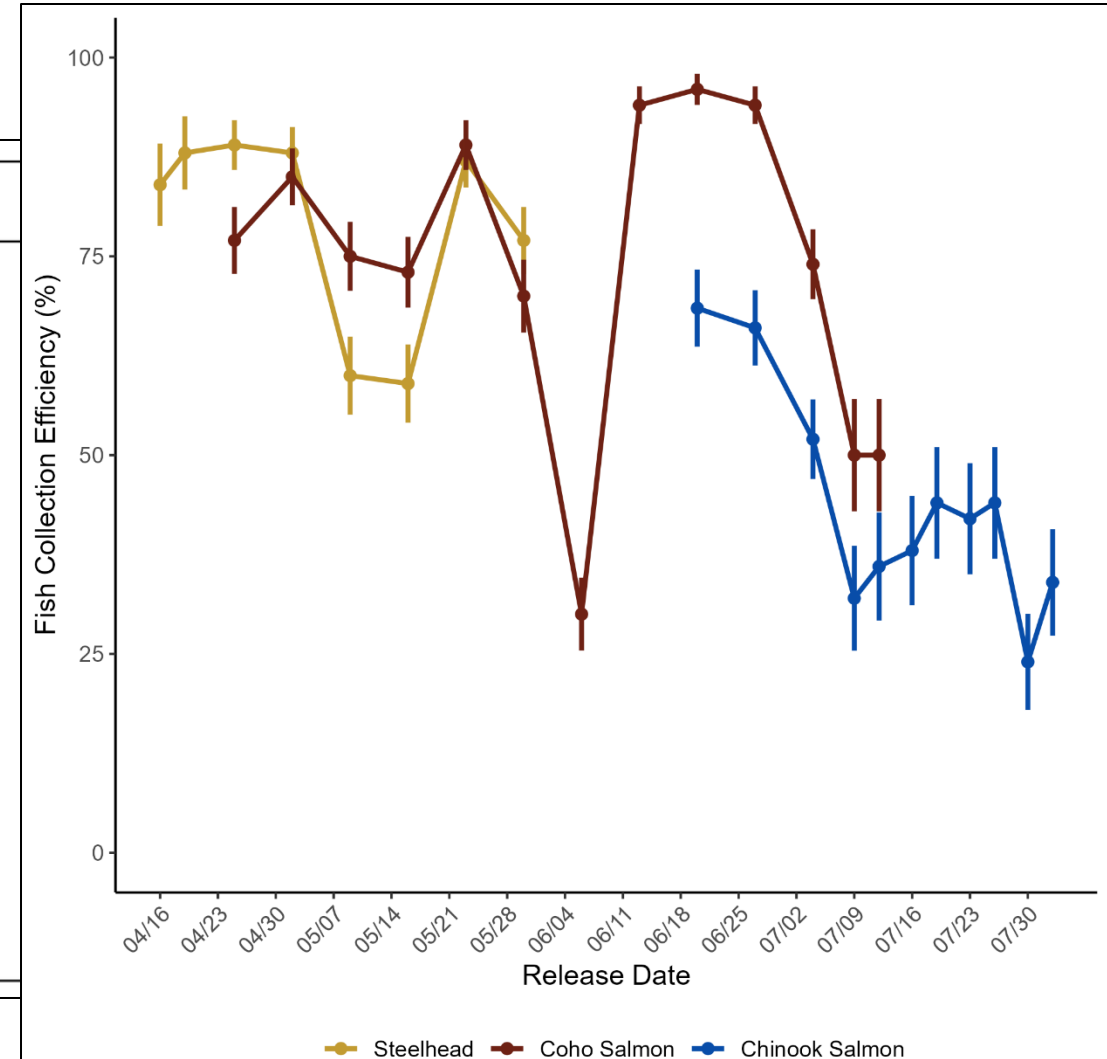
- Diversion probability

- 2024, species combined

Regression of 2024 data

Base model (FCE)

Coefficient	Estimate
Intercept	-0.5151
Species(Steelhead)	-3.9888
Species(Chinook)	1.9548
Migration.P	3.3432
Outflow	0.0619
Temperature	-0.0004
Fish length	-0.4072
Species(Steelhead):Migration.P	-1.6596
Species(Chinook):Migration.P	-4.7001



Regression of 2024 data

Stepwise model (FCE)

Covariate	<i>P</i> -value	Coefficient of partial determination	Sign
Base model			
+ Unit-1 spillway flume flow	0.1217	10.1%	+
+ Unit-2 spillway flume flow	0.5974	1.2%	+
+ Capture velocity	0.5257	1.8%	+
+ Pumpback flow	0.6152	1.1%	+
+ % Unit-1 of total discharge	0.4578	2.4%	--
+ Dam spill	0.6479	0.9%	--
+ Differential pressure-1	0.7144	0.6%	--
+ Differential pressure-2	0.0003	45.5%	--
+ % NSC inflow of outflow	0.0135	24.5%	--
+ CV _{discharge}	0.8270	0.2%	--

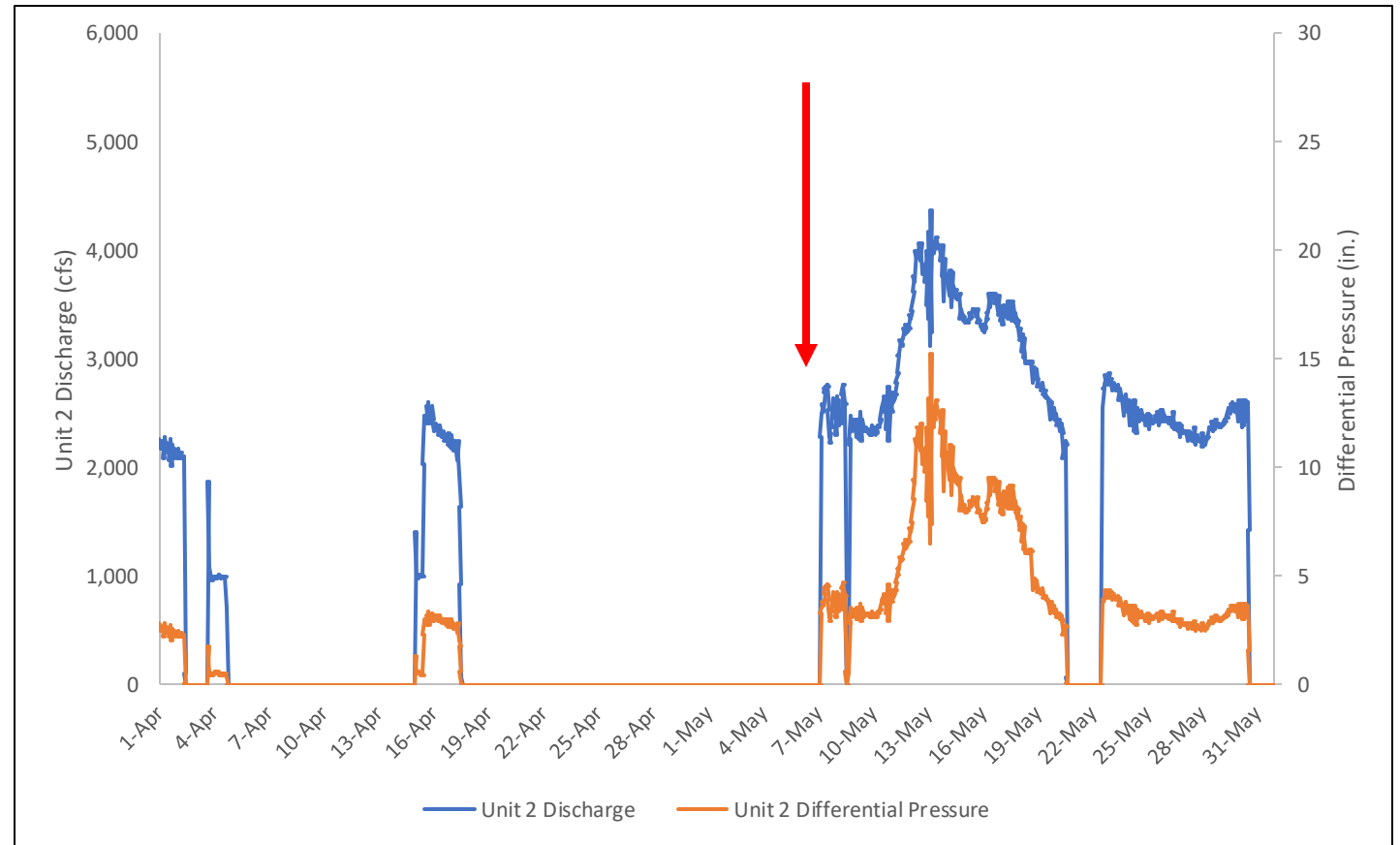
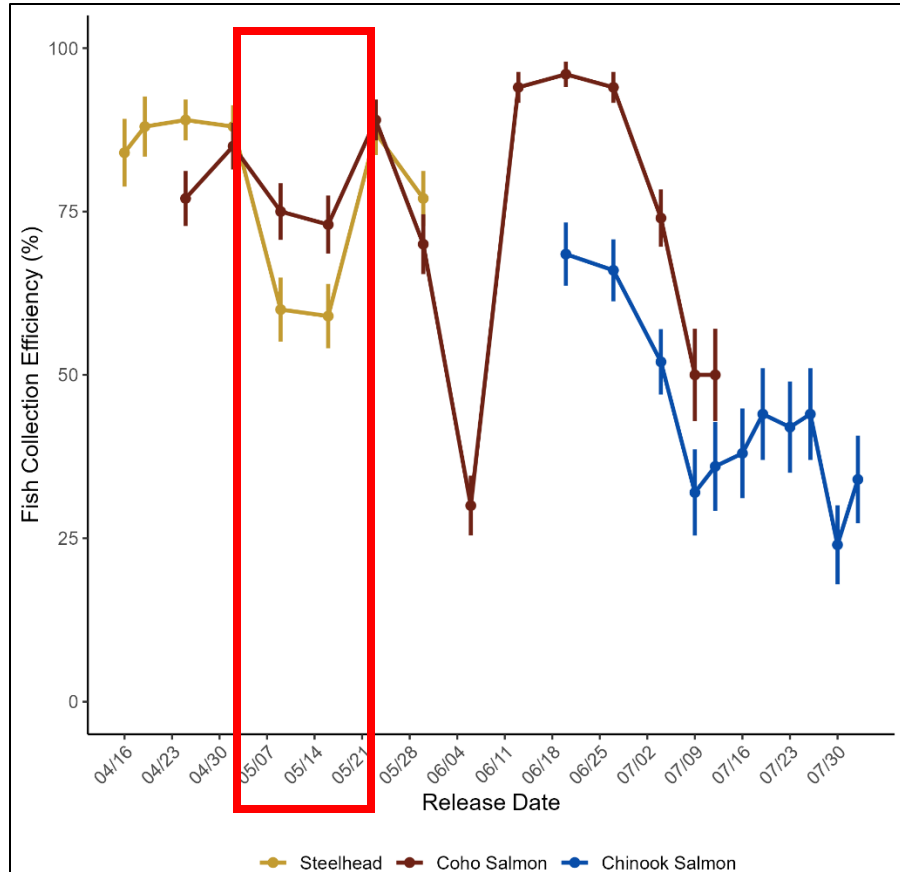
Species specific regression

Steelhead (FCE, 2021-2024)

	Coefficient	Estimate	SE	<i>t</i>	<i>P</i> (> <i>t</i>)
	Steelhead				
Base model	Intercept	-1.7018	2.2820	-0.7458	0.4645
	Year (2022)	-0.3953	0.4764	-0.8297	0.4165
	Year (2023)	-0.2982	0.2982	-1.0001	0.3292
	Year (2024)	0.3874	0.4395	0.8815	0.3885
	Migration.P	0.3869	0.5306	0.7291	0.4744
	Fish length	0.0132	0.0101	1.3044	0.2069
	Outflow	< 0.0001	0.0001	-0.5191	0.6094
	Temperature	0.1139	0.1318	0.8643	0.3977
	Differential pressure-2	-0.1744	0.0659	-2.6444	0.0156

Species specific regression

Steelhead (FCE, 2021-2024)



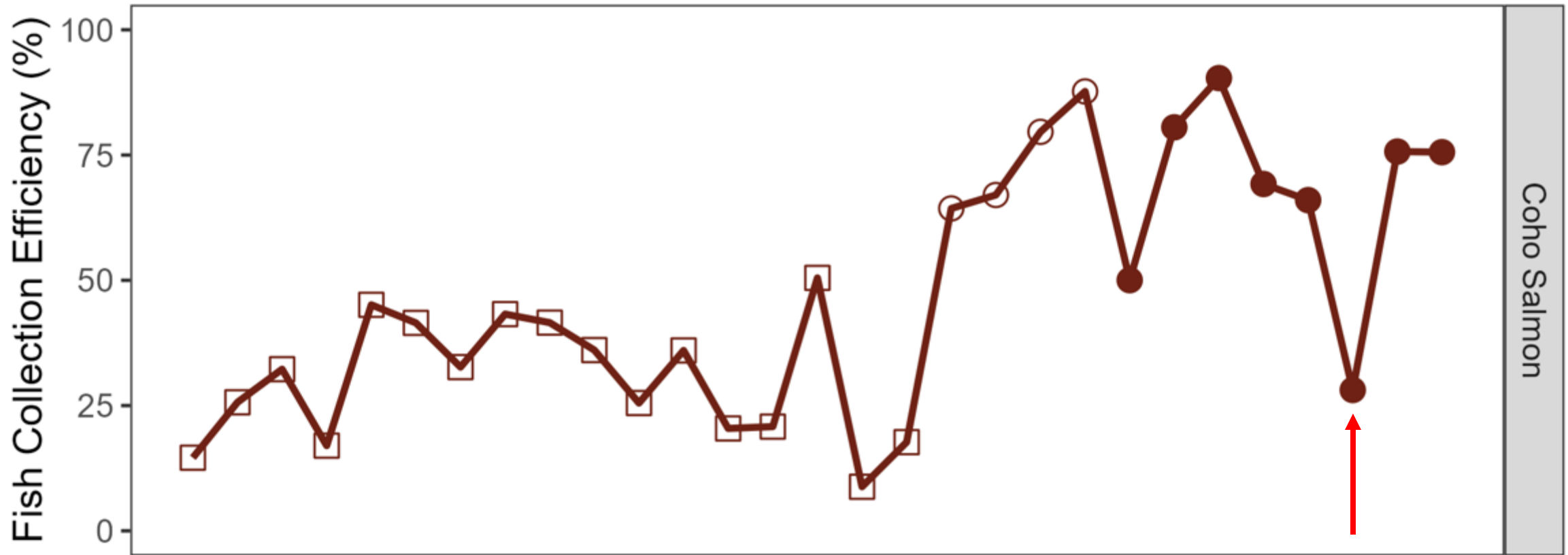
Species specific regression

Coho (FCE, 2021-2024)

	Coefficient	Estimate	SE	<i>t</i>	<i>P</i> (> <i>t</i>)
	Coho salmon				
Base model	Intercept	7.8944	2.0932	3.7714	0.0006
	Year (2022)	-1.5917	0.4664	-3.4123	0.0017
	Year (2023)	0.5186	0.4118	1.2594	0.2165
	Year (2024)	-0.1545	0.3867	-0.3996	0.6119
	Migration.P	0.5130	1.2556	0.4086	0.6854
	Fish length	-0.0148	0.0095	-1.5606	0.1279
	Outflow	-0.0004	0.0001	-4.3669	0.0001
	Temperature	-0.2539	0.1485	-1.7094	0.0965

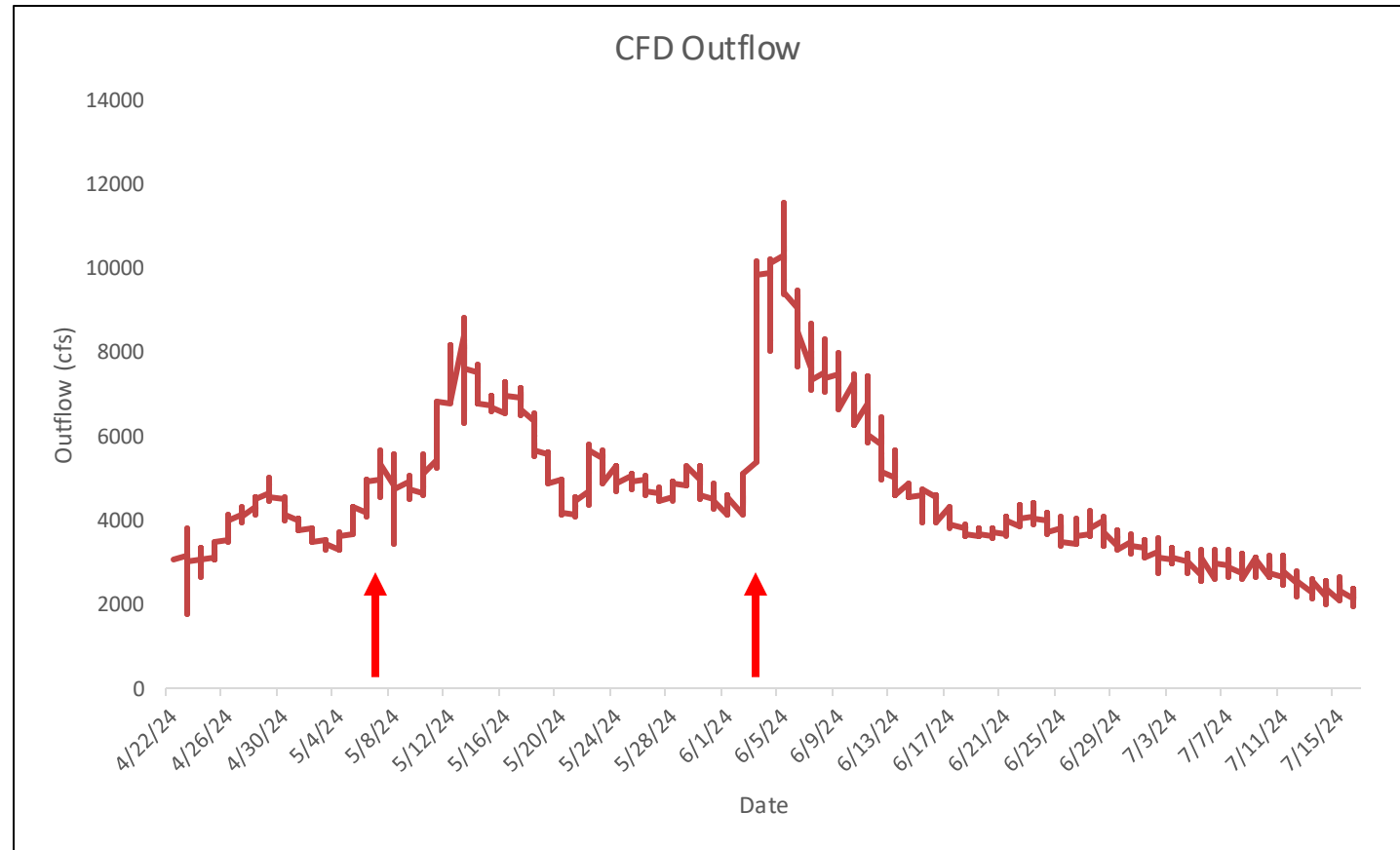
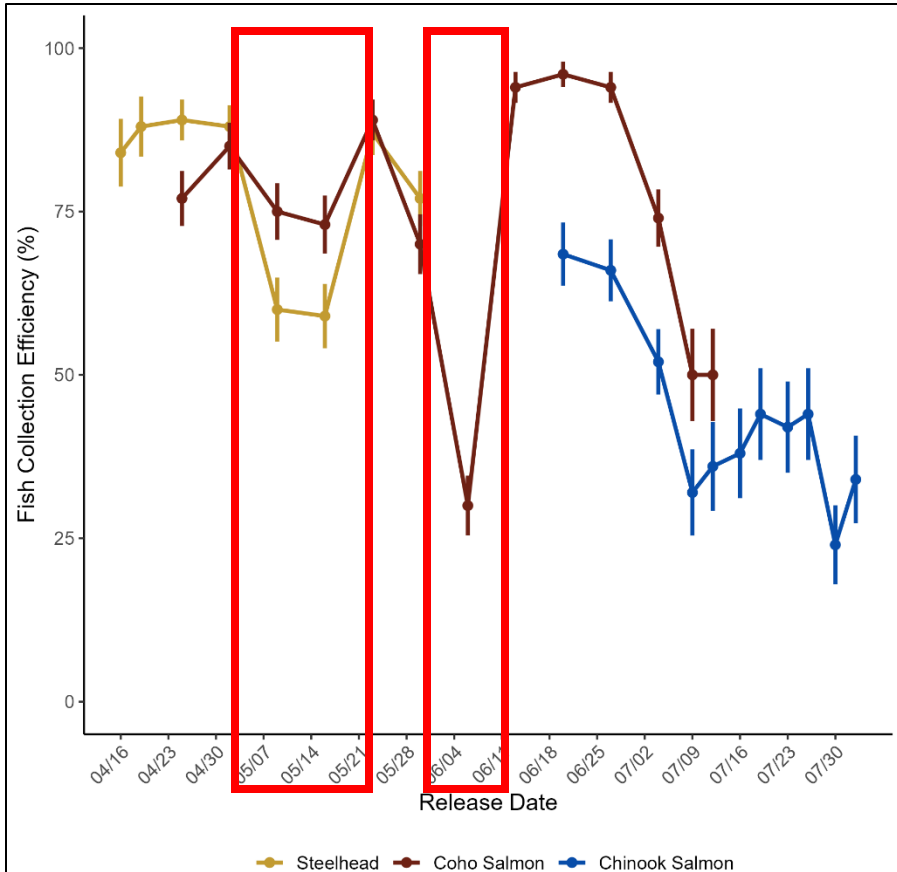
Species specific regression

Coho (FCE, 2021-2024)



Species specific regression

Coho (FCE, 2021-2024)



Species specific regression

Chinook (FCE, 2021-2024)

Coefficient		Estimate	SE	<i>t</i>	<i>P</i> (> <i>t</i>)
Subyearling Chinook salmon					
Base model	Intercept	20.2331	3.1891	6.3445	<0.0001
	Year (2022)	0.1410	0.3120	0.4519	0.6558
	Year (2023)	0.0384	0.4014	0.0957	0.9246
	Year (2024)	-0.2309	0.3552	-0.6499	0.5225
	Migration.P	-0.5303	0.3658	-1.4498	0.1612
	Fish length	-0.0988	0.0290	-3.4097	0.0025
	Outflow	-0.0008	0.0003	-2.5257	0.0193
	Temperature	-0.3430	0.1133	-3.0260	0.0062
	Dam Spill	0.0719	0.0202	3.5648	0.0017
	% NSC inflow of outflow	-3.2089	1.1789	-2.7219	0.0125

