Southern Oregon Northern California Coast coho Workgroup

Fishery harvest control rule risk assessment

SONCC coho Workgroup

- Established by the Council in April 2020
- Workgroup meetings held June, August, and October 2020
- November 2020 PFMC
  - Progress report
  - Supplemental Workgroup Report 2
- WG meetings January, March, and May 2021
- April 2021 PFMC
  - Progress report
- June 2021 PFMC
  - Range of Alternatives

Organization of the Workgroup report

Status of SONCC coho ESU

Fishery Description

Abundance Forecasting

Harvest Control Rules

Wild Population Risk Assessment

SONCC coho Status

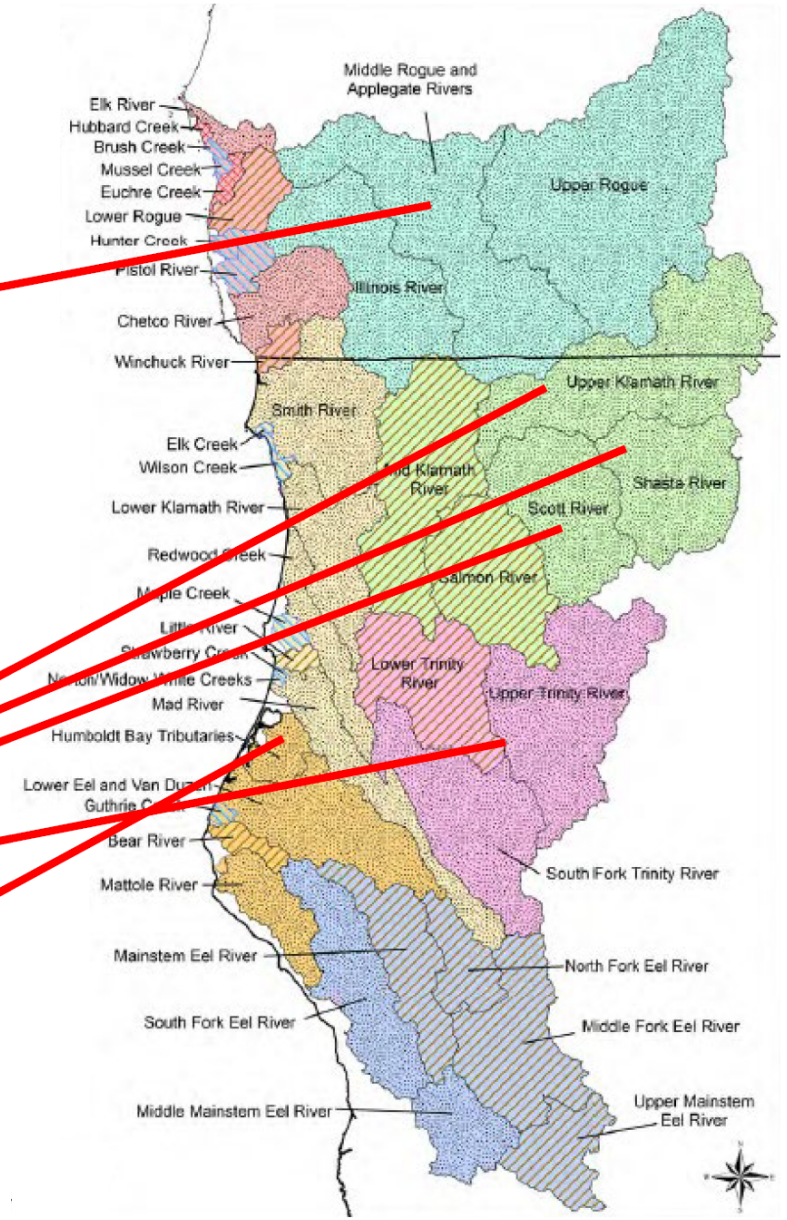
- ESA-listed: Threatened
  - Seven diversity strata
  - 40 populations

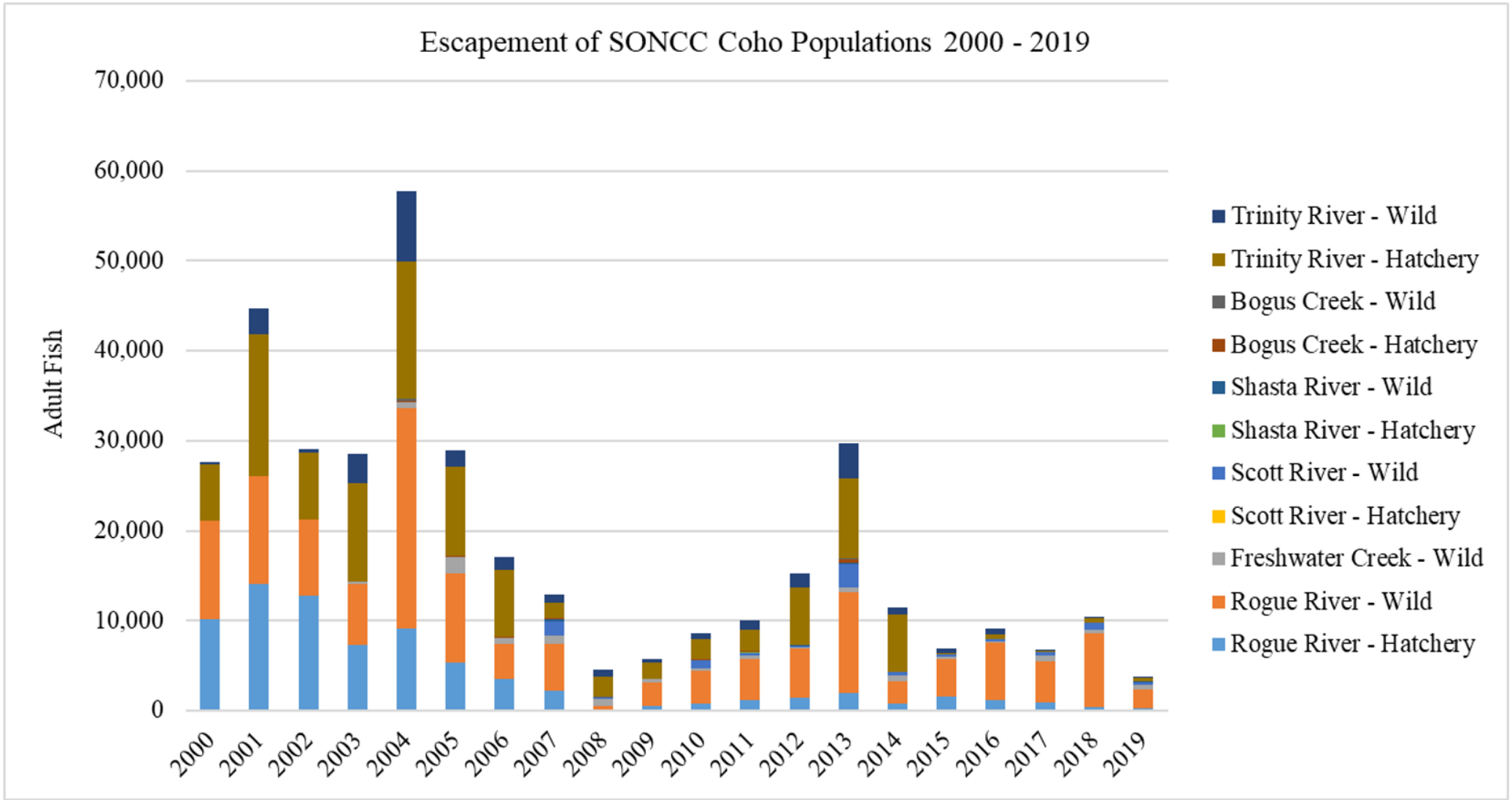
- Sufficient data for six ESU natural components:
  - Two populations (Shasta and Scott rivers)
  - Component of upper Klamath River population (Bogus Creek)
  - Component of Humboldt Bay Tributaries population (Freshwater Creek)
  - Two population aggregates (Trinity and Rogue rivers)

- Data from three hatcheries
  - Cole Rivers (Rogue)
  - Iron Gate (Klamath)
  - Trinity River (Trinity)

Stratum	Populations	Risk status	Risk goal	Recovery role	Recovery criteria	Intrinsic potential (km)[a]	Analysis populations
Northern Coastal Basin	Elk R	High	Low	Core	2,400	62.6	--
	Brush Crk	High	Juveniles	Dependent	--	--	--
	Mussel Crk	High	Juveniles	Dependent	--	--	--
	Lower Rogue R	High	Moderate	Non-core 1	320	80.9	--
	Hunter Crk	High	Juveniles	Dependent	--	14.6	--
	Pistol Crk	High	Juveniles	Dependent	--	30.2	--
	Chetco R	High	Low	Core	4,500	135.2	--
	Winchuck R	High	Moderate	Non-core 1	230	56.5	--
Interior Rogue R	Illinois R	High	Low	Core	11,800	324.8	Rogue
	Middle Rogue/Applegate R	High	Moderate	Non-core 1	2,400	17.4	
	Upper Rogue R	Moderate	Low	Core	13,800	18.8	
Central Coastal Basin	Smith R	High	Low	Core	6,800	204.7	--
	Elk Crk	High	Juveniles	Dependent	--	151.0	--
	Wilson Crk	High	Juveniles	Dependent	--	18.8	--
	Lower Klamath R	High	Low	Core	5,900	34.2	--
	Redwood Crk	High	Low	Core	4,900	7.0	--
	Maple Crk/Big Lagoon	--	Juveniles	Dependent	--	9.9	--
	Little R	Moderate	Moderate	Non-core 1	140	136.5	--
	Strawberry Crk	--	Juveniles	Dependent	--	190.9	--
	Norton/Widow White Crk	--	Juveniles	Dependent	--	393.5	--
	Mad R	High	Moderate	Non-core 1	550	13.8	--
Interior Klamath	Middle Klamath R	Moderate	Moderate	Non-core 1	450	47.8	--
	Upper Klamath R	High	Low	Core	8,500	249.8	Bogus Crk
	Shasta R	High	Low	Core	4,700	589.7	Shasta R
	Scott R	Moderate	Low	Core	6,500	683.2	Scott R
	Salmon R	High	Moderate	Non-core 1	450	900.9	--
Interior Trinity	Lower Trinity R	High	Low	Core	3,600	113.5	Trinity R
	South Fork Trinity R	High	Moderate	Non-core 1	970	424.7	
	Upper Trinity R	Moderate	Low	Core	5,800	206.3	
Southern Coastal Basin	Humboldt Bay tributaries	Moderate	Low	Core	5,700	250.5	Freshwater Crk.
	Lower Eel/Van Duzen R	High	Low	Core	7,900	113.5	--
	Guthrie Crk	--	Juveniles	Dependent	--	102.1	--
	Bear R	High	Juveniles	Non-core 2	--	241.8	--
	Mattole R	High	Moderate	Non-core 1	1,000	365.0	--
Interior Eel	Mainstem Eel R	High	Low	Core	2,600	68.4	--
	Middle Mainstem Eel R	High	Low	Core	6,300	231.5	--
	Upper Mainstem Eel R	High	Juveniles	Non-core 2	--	--	--
	Middle Fork Eel R	High	Juveniles	Non-core 2	--	--	--
	South Fork Eel R	Moderate	Low	Core	9,300	463.7	--
	North Fork Eel R	High	Juveniles	Non-core 2	--	--	--

[a] *Equal to depensation threshold for population.*




Escapement of SONCC Coho Populations 2000 - 2019
Adult Fish
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Trinity River - Wild
Trinity River - Hatchery
Bogus Creek - Wild
Bogus Creek - Hatchery
Shasta River - Wild
Shasta River - Hatchery
Scott River - Wild
Scott River - Hatchery
Freshwater Creek - Wild
Rogue River - Wild
Rogue River - Hatchery

Status of SONCC coho ESU

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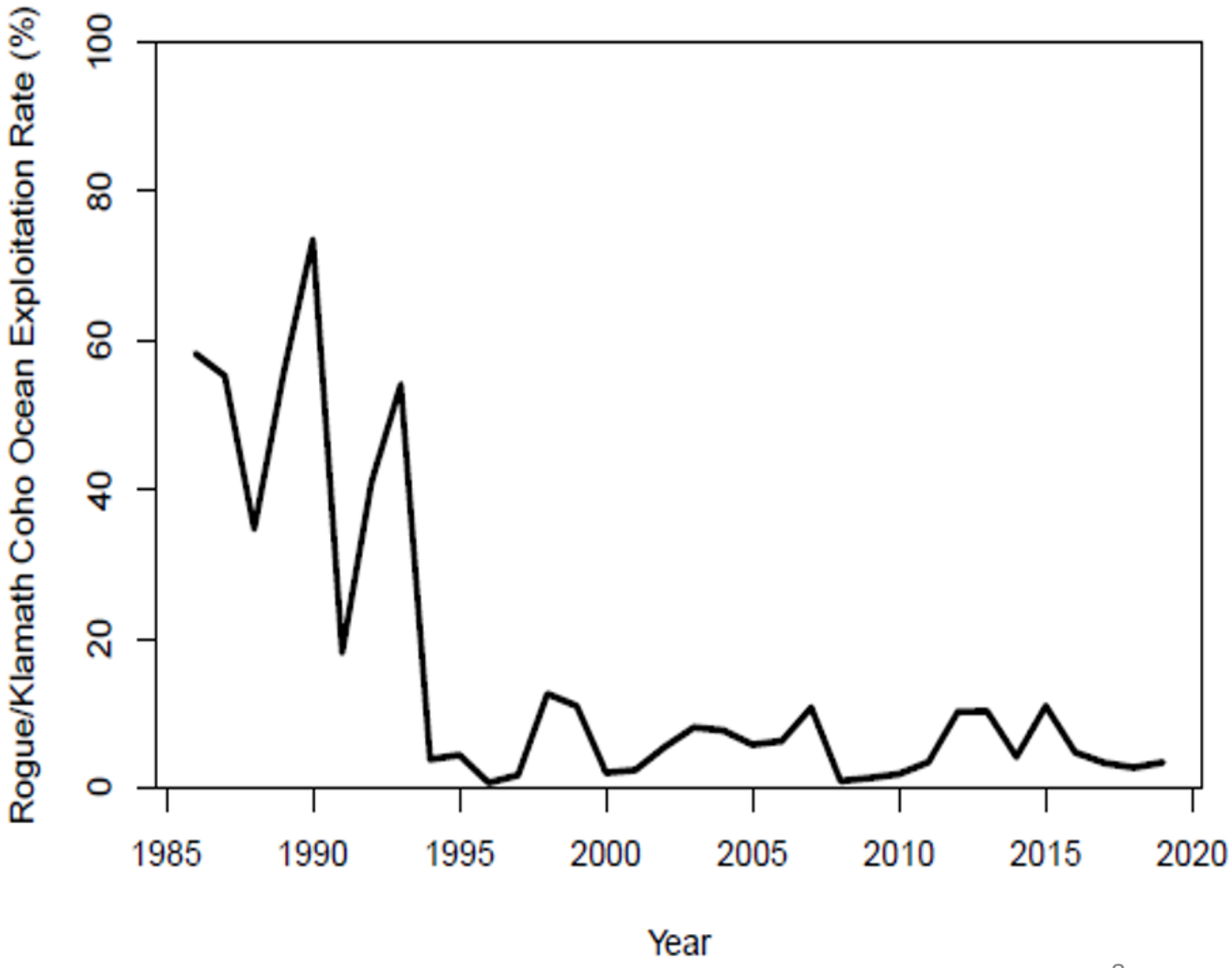
Wild Population Risk Assessment

Ocean fisheries affecting SONCC coho

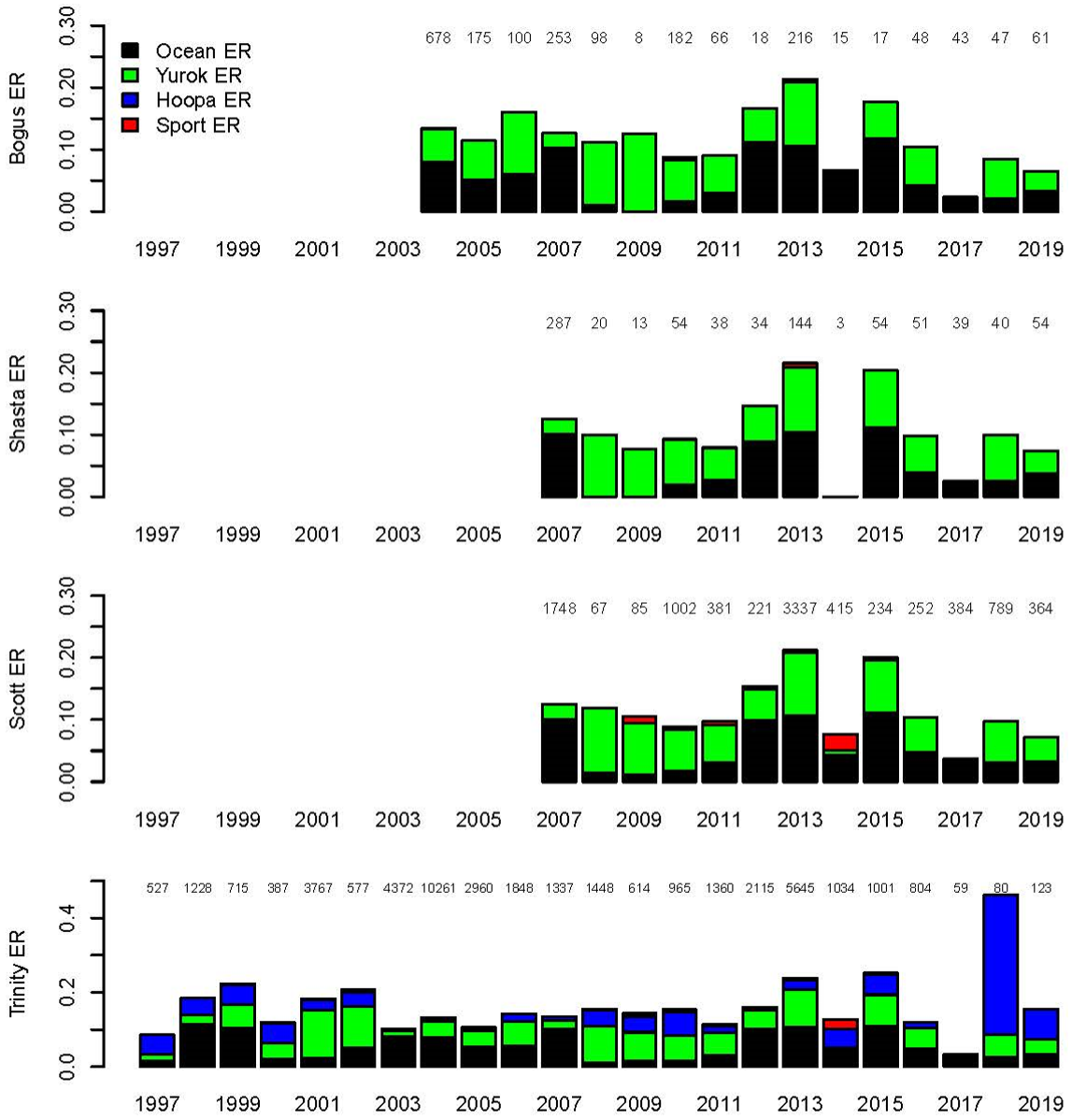
- Mostly non-retention impacts in commercial and recreational fisheries targeting Chinook

- Limited to a 13% ER



Freshwater fisheries

- Tribal
  - Yurok Tribe, Hoopa Valley Tribe
  - Manage fisheries for the benefit of its members and conservation of the resource
- Recreational
  - Retention of coho is prohibited in California
  - Small scale mark-selective fisheries in Oregon


Ocean ER
Yurok ER
Hoopa ER
Sport ER
Bogus ER
678 175 100 253 98 8 182 66 18 216 15 17 48 43 47 61
Shasta ER
287 20 13 54 38 34 144 3 54 51 39 40 54
Scott ER
1748 67 85 1002 381 221 3337 415 234 252 384 789 364
Trinity ER
527 1228 715 387 3767 577 4372 10261 2960 1848 1337 1448 614 965 1360 2115 5645 1034 1001 804 59 80 123
0.00 0.10 0.20 0.30
0.0 0.2 0.4
1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017 2019

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Natural-origin forecast feasibility

- Hatchery forecast made annually to facilitate management
- Currently no forecast for natural-origin fish
- Assessment of forecast potential for natural-origin fish
  - Data considerations
    - Abundance and escapement:1-2 decades
    - Smolt abundance: fewer years
  - Statistical considerations
  - Practical considerations

Statistical considerations

- 26 models fitted to six population units
- Two of 26 models had moderate to strong statistical relationships with potential forecast value

	Intercept (null) model					Sibling model					Outmigrant model					Parent-generation spawners model					3-year moving average model				
Population	***N***	**R^2**	***P***	**RMSE**	**ME**	***N***	**R^2**	***P***	**RMSE**	**ME**	***N***	**R^2**	***P***	**RMSE**	**ME**	***N***	**R^2**	***P***	**RMSE**	**ME**	***N***	**R^2**	***P***	**RMSE**	**ME**
Bogus Creek	16	*NA*	*NA*	1.237	0.000	15	0.03	0.560	1.175	0.025	*NA*	*NA*	*NA*	*NA*	*NA*	13	0.30	0.052	1.001	0.019	13	*NA*	*NA*	1.197	-0.176
Scott River	13	*NA*	*NA*	1.142	0.000	12	0.04	0.517	1.151	-0.048	12	0.61	0.003	0.870	0.062	10	0.14	0.282	0.995	-0.049	10	*NA*	*NA*	1.068	0.259
Shasta River	13	*NA*	*NA*	1.137	0.000	12	0.17	0.190	0.973	0.042	13	0.15	0.192	1.130	0.066	10	0.00	0.881	1.048	0.021	10	*NA*	*NA*	1.201	-0.216
Trinity River	23	*NA*	*NA*	1.301	0.000	22	0.24	0.019	1.217	-0.030	*NA*	*NA*	*NA*	*NA*	*NA*	20	0.25	0.026	1.270	-0.029	20	*NA*	*NA*	1.322	0.122
Freshwater Creek	20	*NA*	*NA*	0.703	0.000	*NA*	*NA*	*NA*	*NA*	*NA*	12	0.05	0.493	0.689	-0.009	17	0.02	0.617	0.639	0.014	17	*NA*	*NA*	0.415	-0.093
Rogue River	20	*NA*	*NA*	0.910	0.000	19	0.55	0.000	0.662	-0.021	*NA*	*NA*	*NA*	*NA*	*NA*	20	0.00	0.947	0.940	0.003	17	*NA*	*NA*	0.846	-0.024

Practical considerations (Table 15)

- Stability of current monitoring programs
  - Moderate for many Klamath Basin programs
  - Moderate/High for Rogue and Trinity
- Data timing
  - CA populations: early-mid March
  - Rogue: early-mid February
- Comanager processes
  - E.g., data QA/QC, analysis, and documentation
  - Factored in to data availability timelines

Status of SONCC coho ESU

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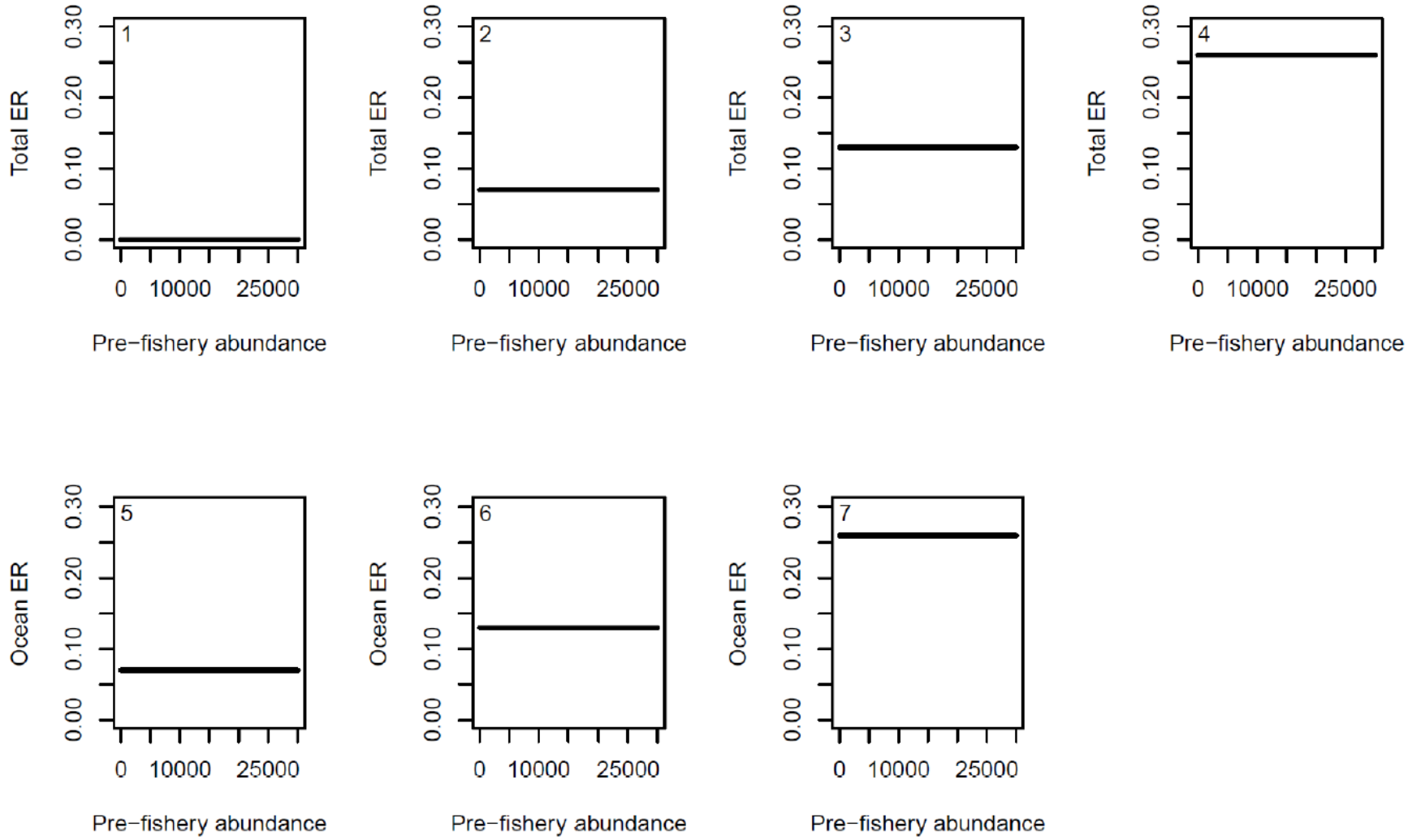
Harvest Control Rules

Wild Population Risk Assessment

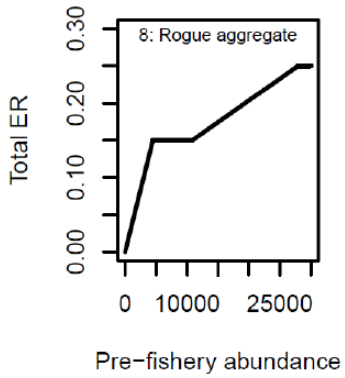
Control rules considered

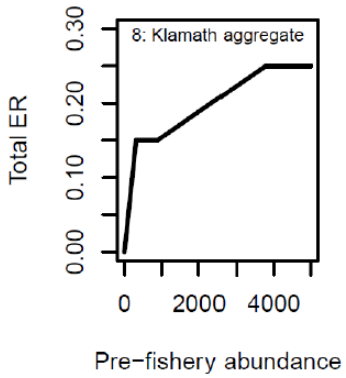
- Constant ER control rules
- Abundance-based control rules
- Matrix control rule (preliminary)

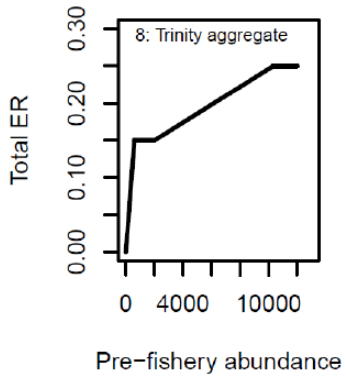
Constant ER control rules

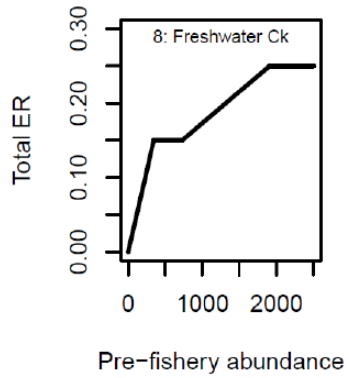


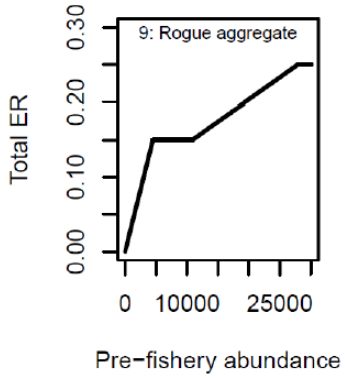
Abundance-based ER control rules

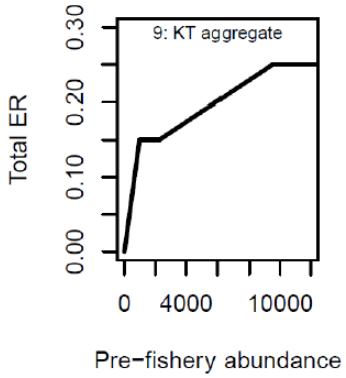


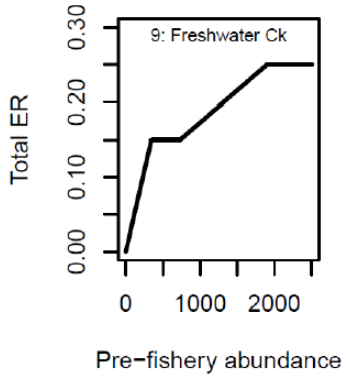


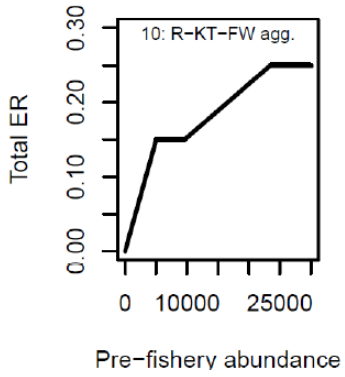


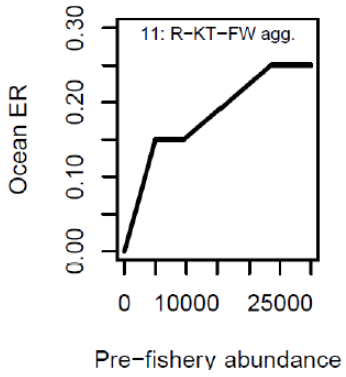










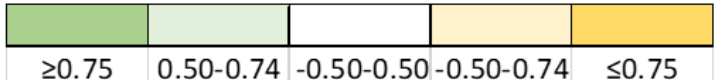


Further considerations for abundance-based CRs

Are SONCC populations correlated?

- Generally yes, but see Freshwater Creek

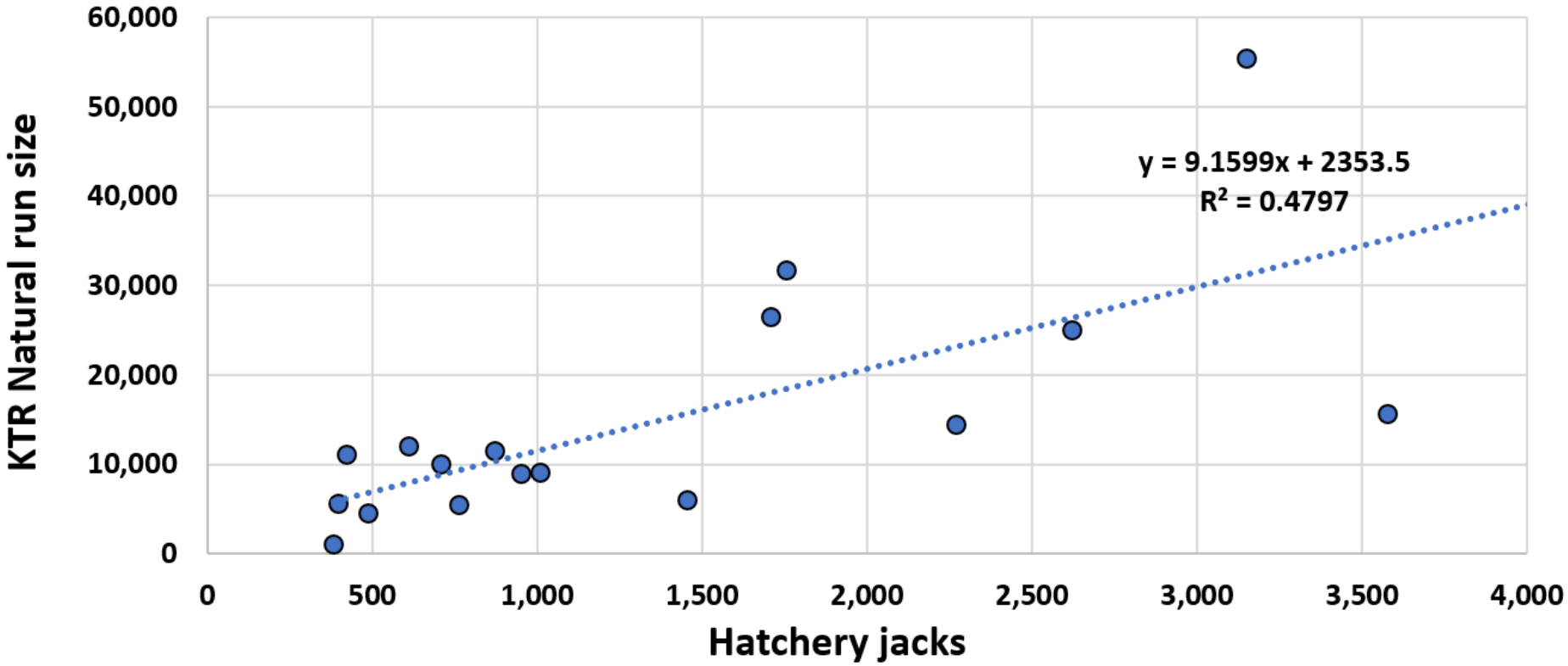
	Run size						
	Shasta	Scott	Trinity	Freshwater	Rogue	K-T total	KTR total
Bogus	0.910	0.944	0.652	-0.414	0.566	0.715	0.735
Shasta		0.809	0.719	-0.792	0.748	0.775	0.820
Scott	--		0.665	-0.552	0.762	0.755	0.819
Trinity	--	--		0.513	0.793	0.994	0.961
Freshwater	--	--	--		0.503	0.468	0.517
Rogue	--	--	--	--		0.817	0.937
K-T total	--	--	--	--	--		0.968
KTR total	--	--	--	--	--	--	
Trinity Hat	--	--	--	--	--	--	--
IG Hat	--	--	--	--	--	--	--
CR Hat	--	--	--	--	--	--	--
TrH SAR	--	--	--	--	--	--	--
IG SAR	--	--	--	--	--	--	--
CR SAR	--	--	--	--	--	--	--
TrH jk-1	--	--	--	--	--	--	--
IGH jk-1	--	--	--	--	--	--	--
CRH jk-1	--	--	--	--	--	--	--
all H jk-1	--	--	--	--	--	--	--
TrH j/sm -1	--	--	--	--	--	--	--
IG j/sm -1	--	--	--	--	--	--	--
CR jk/sm -1	--	--	--	--	--	--	--



Further considerations for abundance-based CRs

Can SONCC populations be adequately forecast?

- Hatchery data may be useful as a proxy for natural run size



Potential matrix control rule

Natural Seeding level[2]	Marine Survival Index[1] ≤33 percentile	33-67 percentile	>67 percentile
> capacity	15%	20%	25%
CRT - Capacity	10%	15%	20%
≤ Critical Risk Threshold	5%	10%	15%

[1]Marine survival Index based on brood year jacks-per-smolt for Cole Rivers and Trinity Hatcheries. (Iron Gate not included)

[2]Natural seeding level based on brood year average for index populations.

Status of SONCC coho ESU

Fishery Description

Abundance Forecasting

Harvest Control Rules

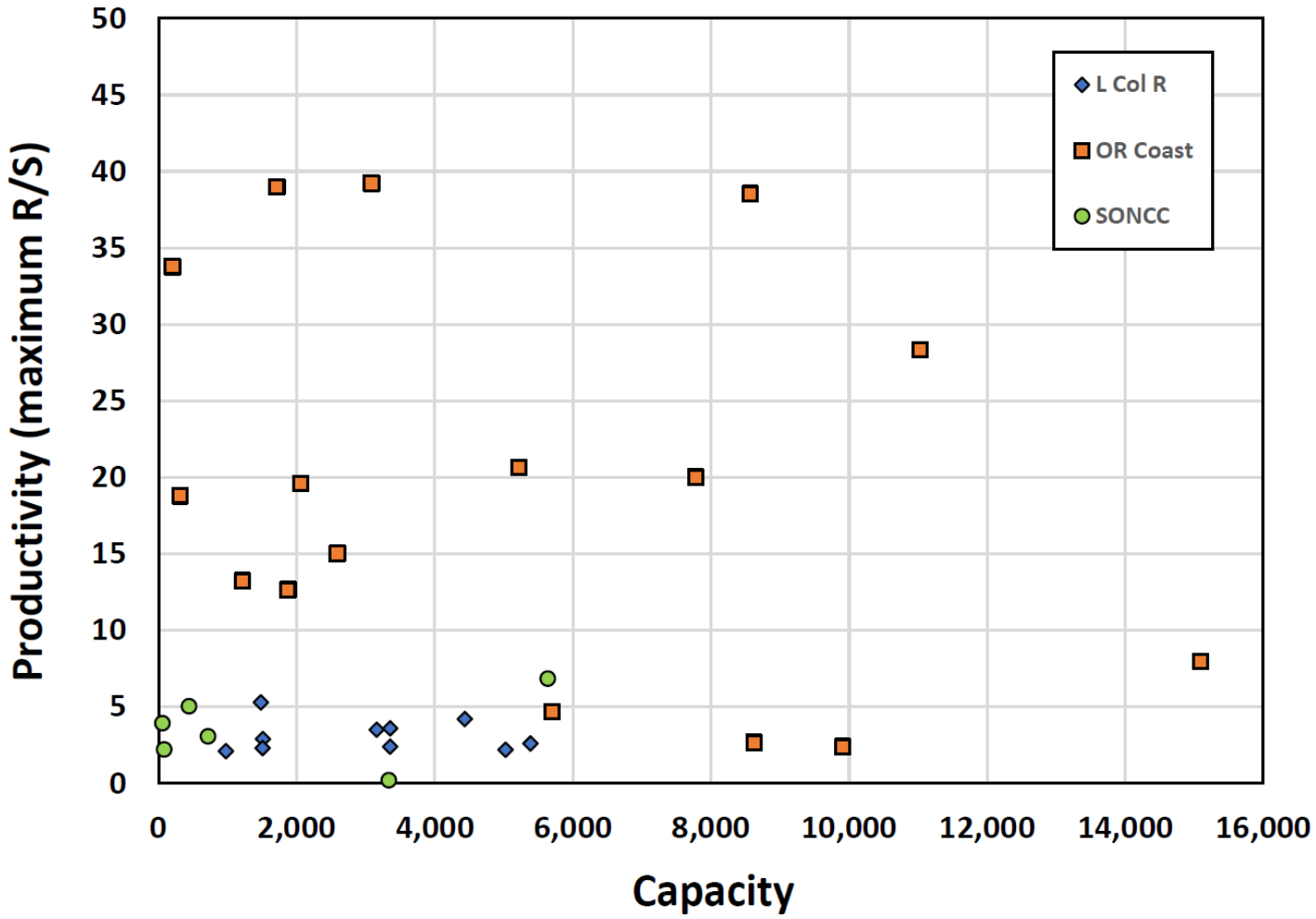
Wild Population Risk Assessment

Risk assessment components

- Estimation of productivity and capacity (spawner-recruit analyses)
- Risk assessment model
  - Assess conservation costs, fisheries benefits
- Sensitivity analyses

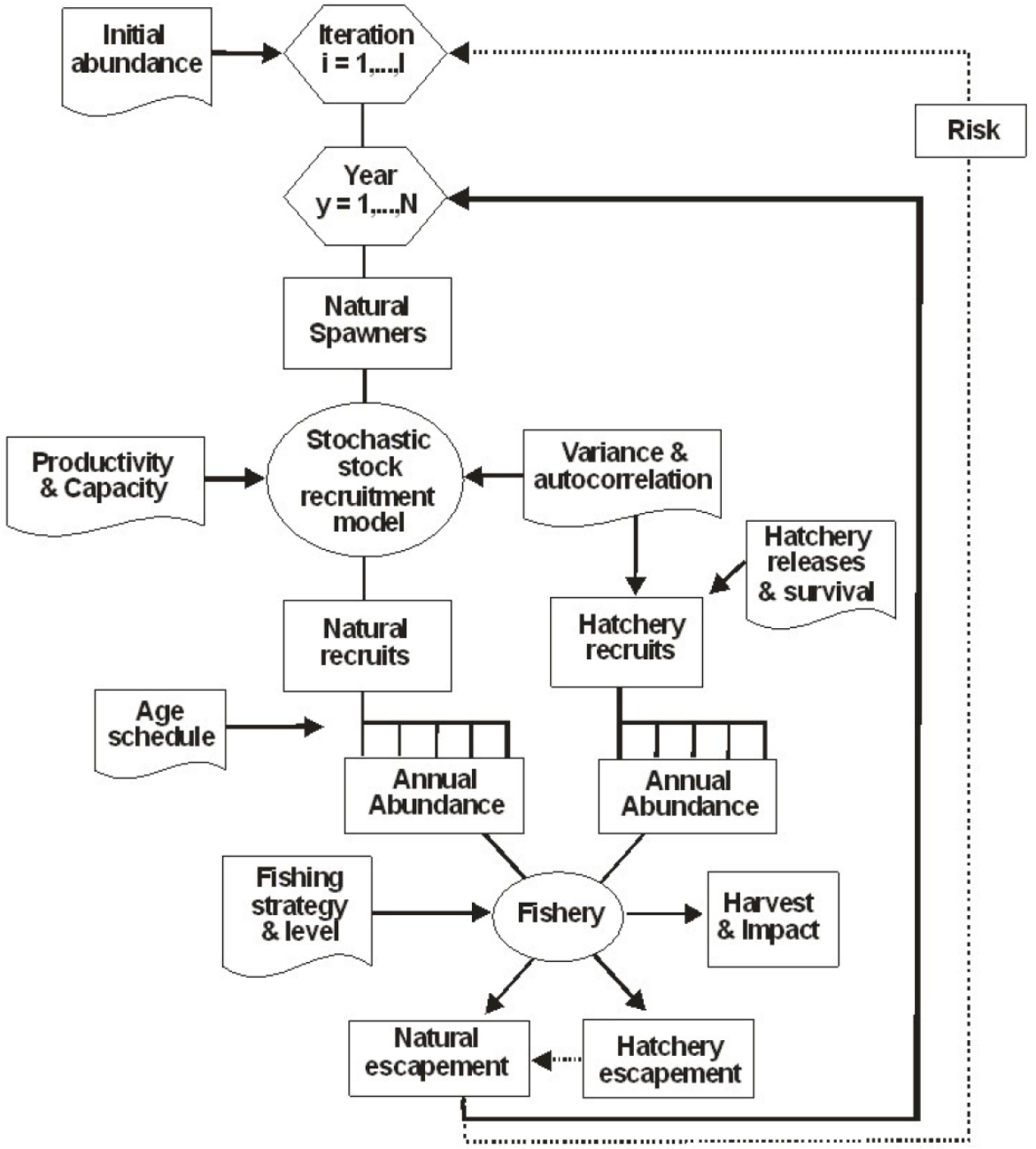
Productivity and Capacity

- Necessary model inputs
- Generally low productivity
- Low to moderate capacity

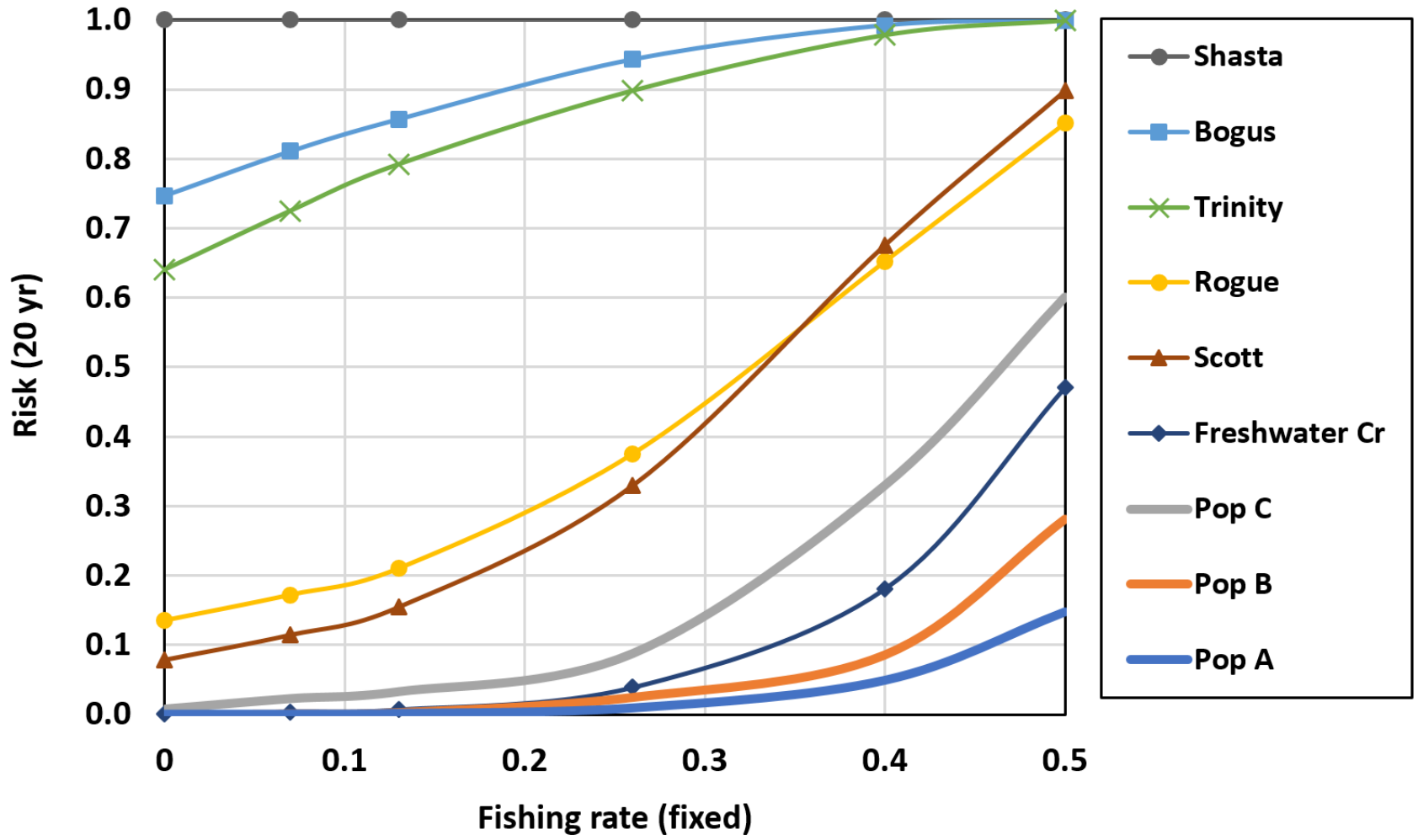


Model structure

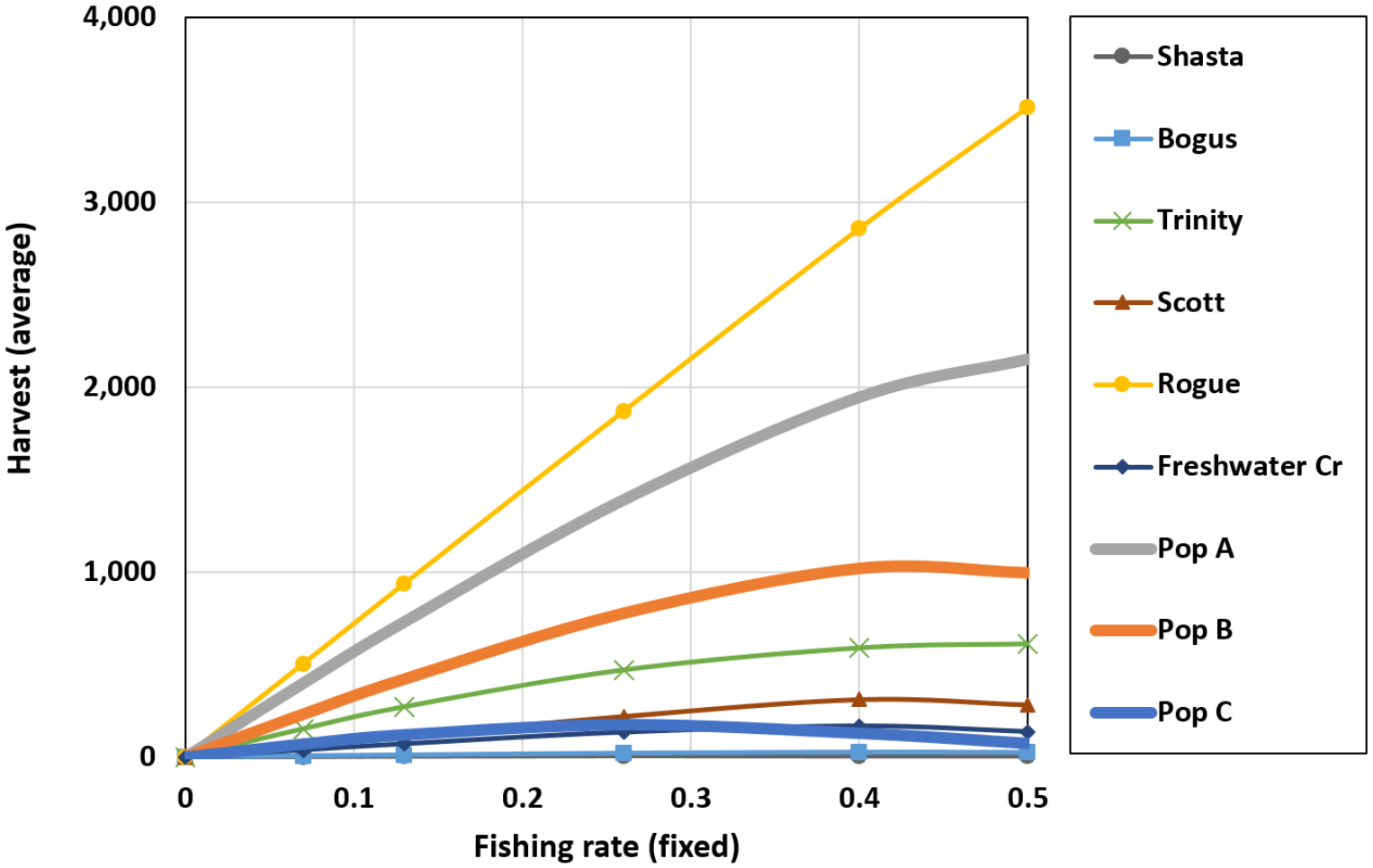
- Centered around stock-recruitment models
- Stochastic
- Accounts for autocorrelation in survival and productivity
- Accounts for depensation at low abundance
- Accounts for annual variability in ERs



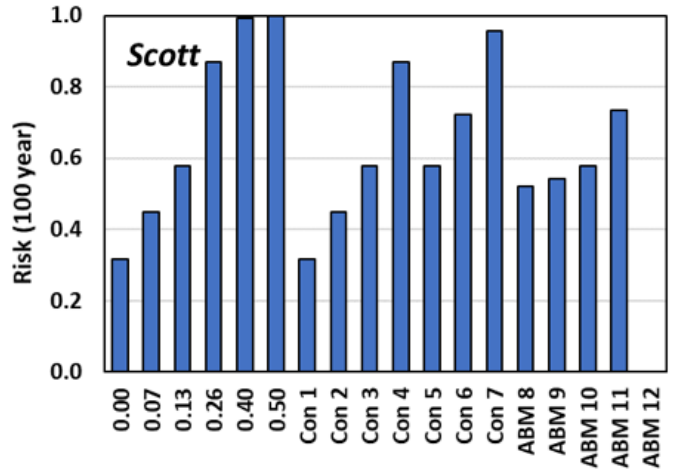
Results: extinction risk under fixed ERs

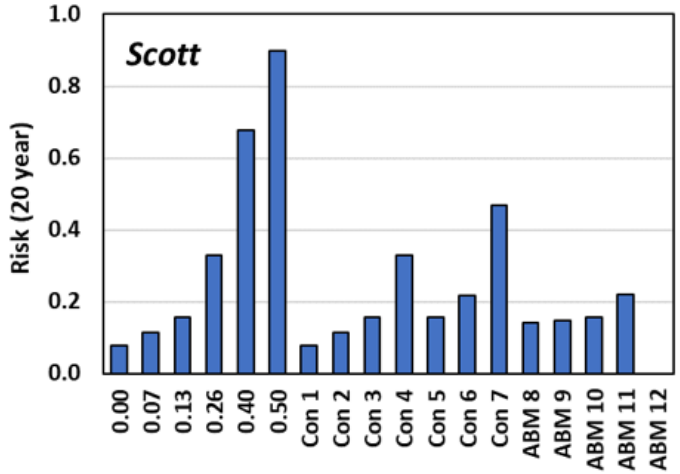


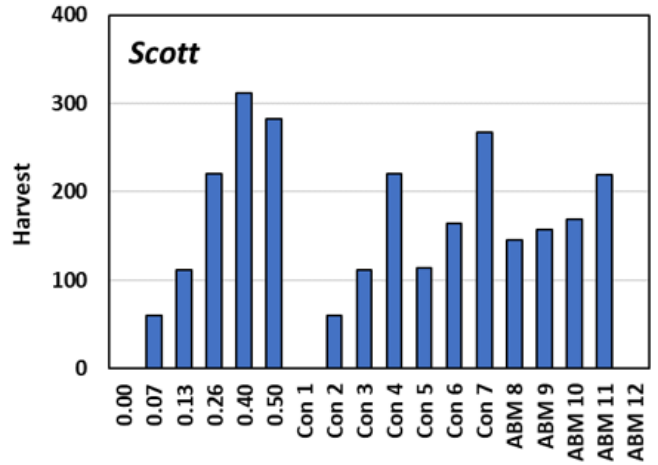
Results: harvest impacts under fixed ERs

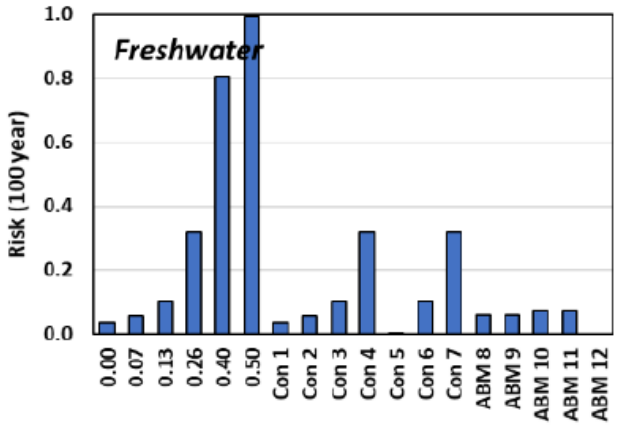


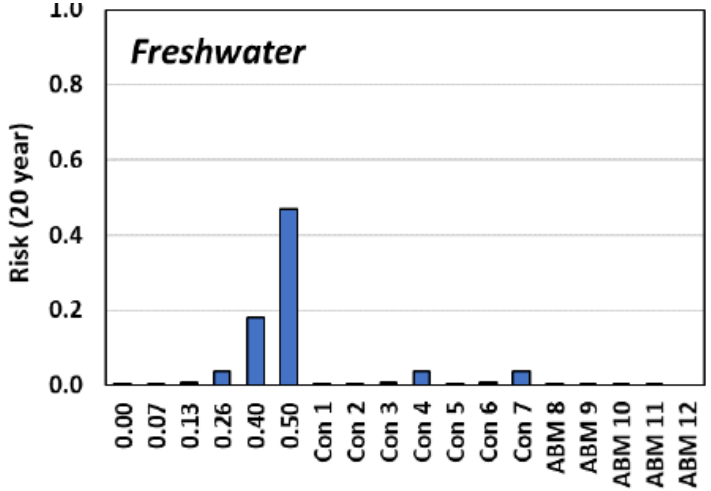
Extinction risk and harvest impacts

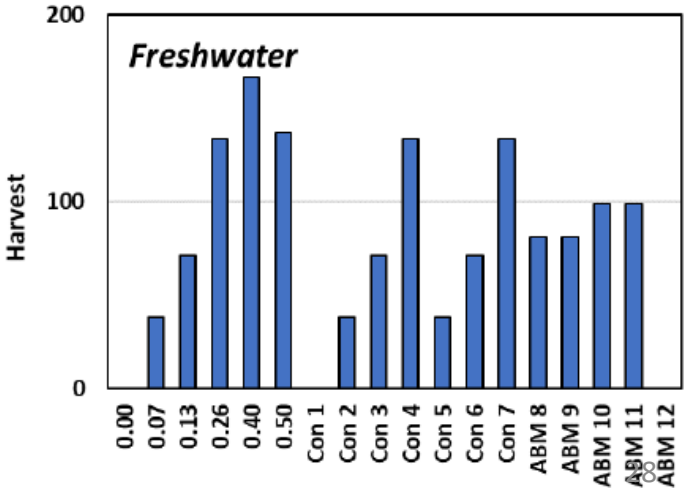












Sensitivity analyses

- Effects of hatchery strays
  - Little effect on risk for SONCC populations
- Fishery implementation error
  - Conservation risks minimally sensitive
- Forecast and implementation error (for abundance based control rules)
  - Conservation risks minimally sensitive
- Effects of alternative stock-recruit parameters
  - Little difference in risk for parameters estimated here, and from a Trinity HGMP
- Alternative implementation of abundance-based control rules
  - Analysis suggests that results for abundance-based control rules may be sensitive to whether populations are modeled simultaneously or separately
    - Workgroup task to resolve this technical issue following this meeting

Summary

- Preliminary analysis of 11 control rules
  - Analysis of matrix-based control rule is being developed

- The analysis considered performance measures for:
  - conservation (spawning escapement, and extinction risks)
  - fishery performance (exploitation rate and harvest of SONCC coho)

- Range of risks across SONCC ESU
  - High for Shasta, Bogus, and Trinity regardless of fishing
  - Relatively low for Freshwater Creek
  - Intermediate for Rogue and Scott

Summary (continued)

- Abundance-based control rules
  - May produce increased fishery benefits at similar risk levels
  - This result will continue to be investigated by the Workgroup using alternative model formulations
  - Few strong statistical associations between abundance and predictor variables
  - The assessment of abundance forecasting feasibility noted uncertainty about the future dependability and annual timing of data availability

- RA requires total ERs to assess conservation and fishery effects
  - Total ER control rules: freshwater and ocean ERs managed to ER cap
  - Ocean ER control rules: freshwater ERs set to recent-year averages
  - If these rates are not representative of future freshwater ERs, the population and fishery effects could be quite different than analyzed here