



System-wide Effects of Avian Predation on Upper Columbia River Steelhead



Acknowledgments

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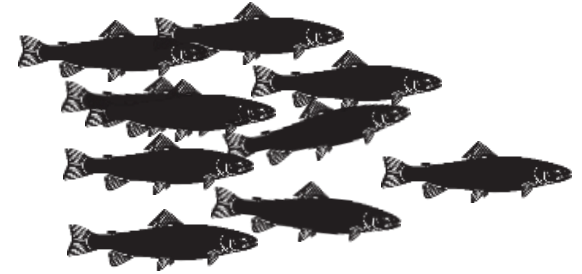


Background



- On-going management plans in CPR (terns) and CRE (terns, cormorants)
- Multiple piscivorous colonial waterbird species (terns, cormorants, gulls, pelicans) and colonies (managed and unmanaged) in CRB
- Several salmonid ESUs/DPSs migrate long-distances
- Avian predation is just one of many smolt mortality factors
 - Comparisons of avian predation to all sources of smolt mortality (1-survival)
 - Identify where and when predation occurs relative to other sources of mortality

Dataset

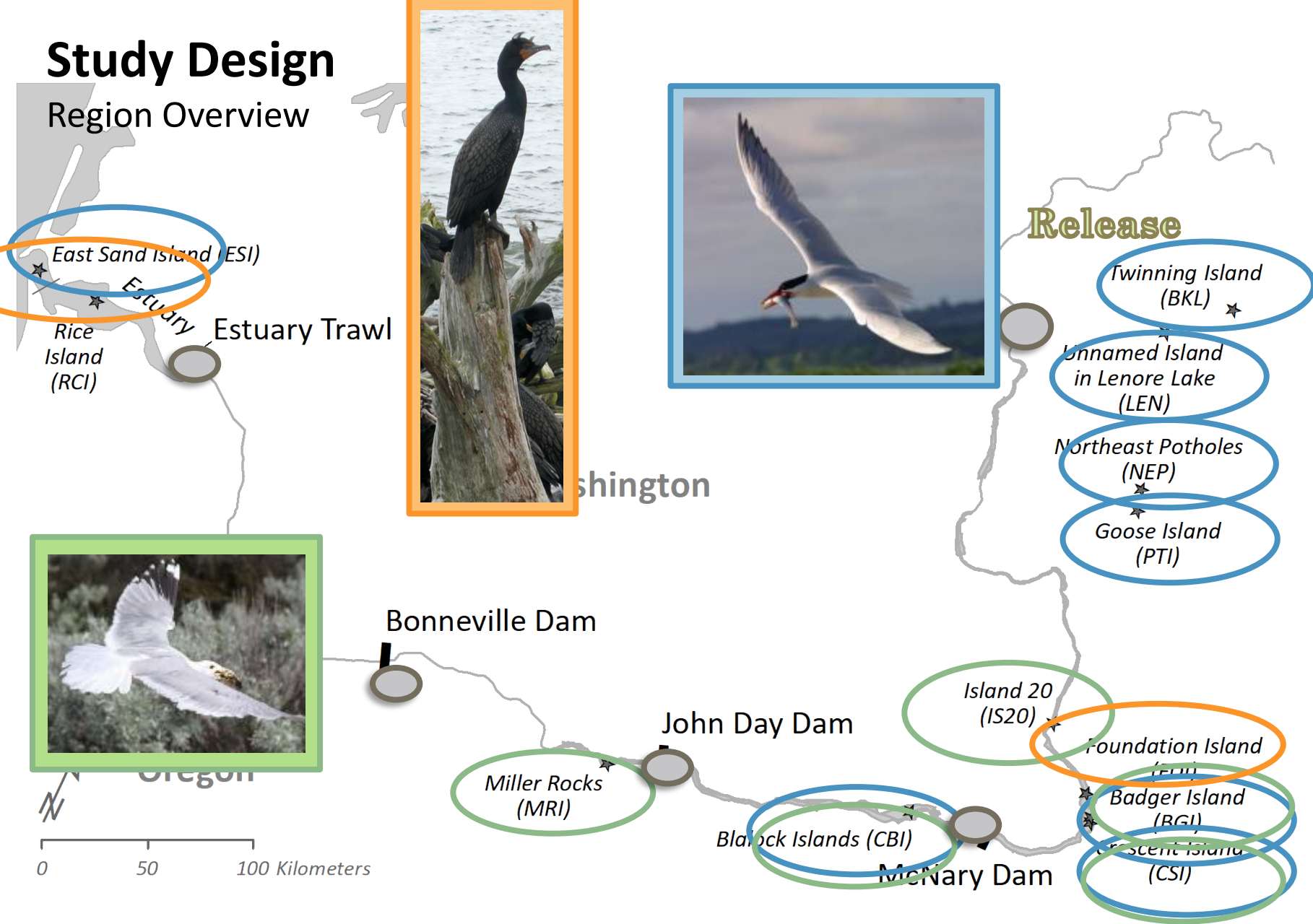


- Rock Island Dam Steelhead Tagging Project
 - ~ 7,000 steelhead tagged & released annually since 2008 (n=7,236 in 2021)
 - Fish selected at random, tagging in-concert with and in proportion to run at-large
 - Contains smolts from all UCR steelhead spawning tributaries
 - Location represents the upper-most extent of the foraging range of most colonies in CRB

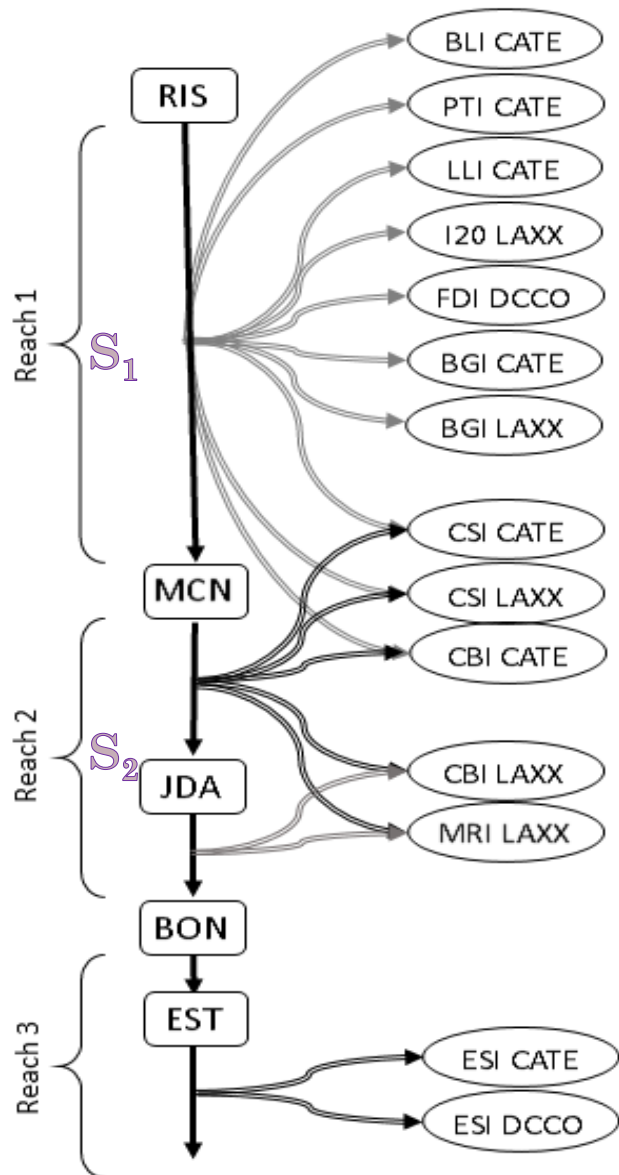
- Benefits of a long-term, standardized dataset:
 - Quantify relative changes in predation and survival across space and time
 - Quantify the relationship between predation and survival (i.e., additive effects)
 - Evaluate the efficacy of management actions to reduce predation

Study Design

Region Overview



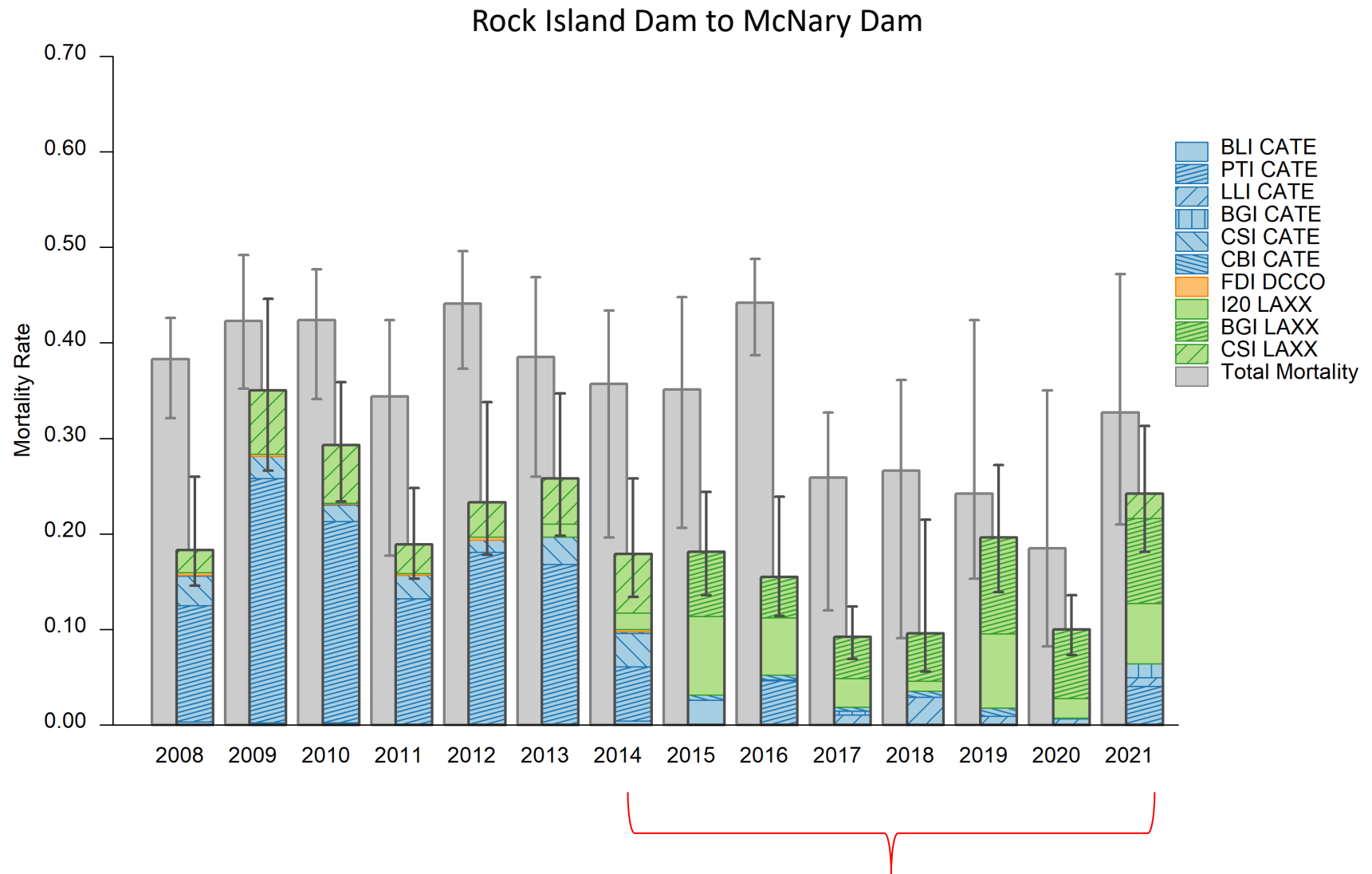
Methods: Joint Mortality and Survival (JMS) model



- Directly identify and measure cause-specific mortality rates
 - Exclusively looking at mortality due to colonial waterbird predation here
 - Can theoretically incorporate all sources of mortality
- Simultaneous estimation of **survival** and mortality
 - Aggregation among colonies and across segments
 - Relative comparisons of predation and survival
- Inclusion of tags on bird colonies increases the precision and accuracy of reach-specific survival estimates; formulas available in the published literature

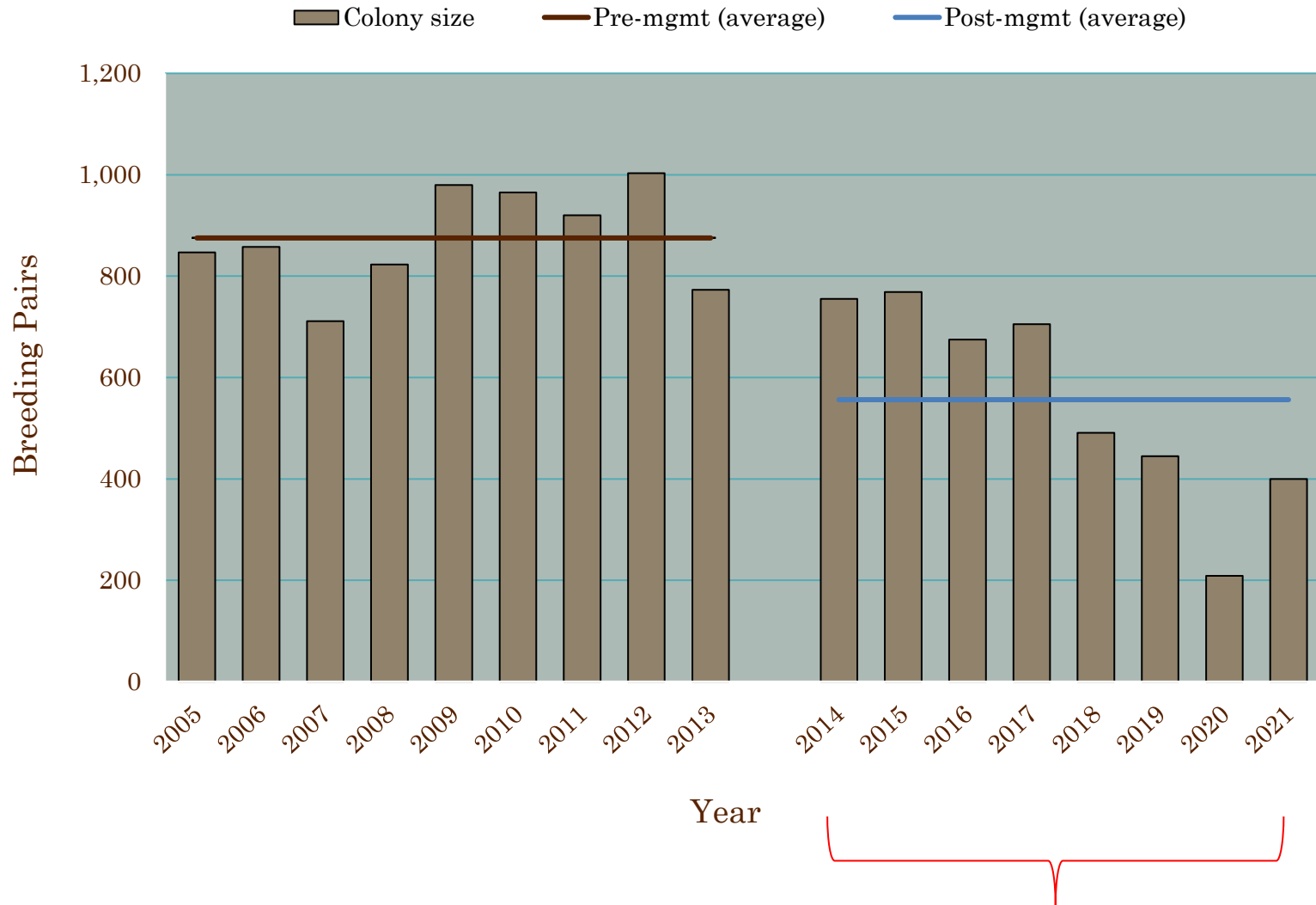
Payton et al. 2019

2021 Preliminary Results

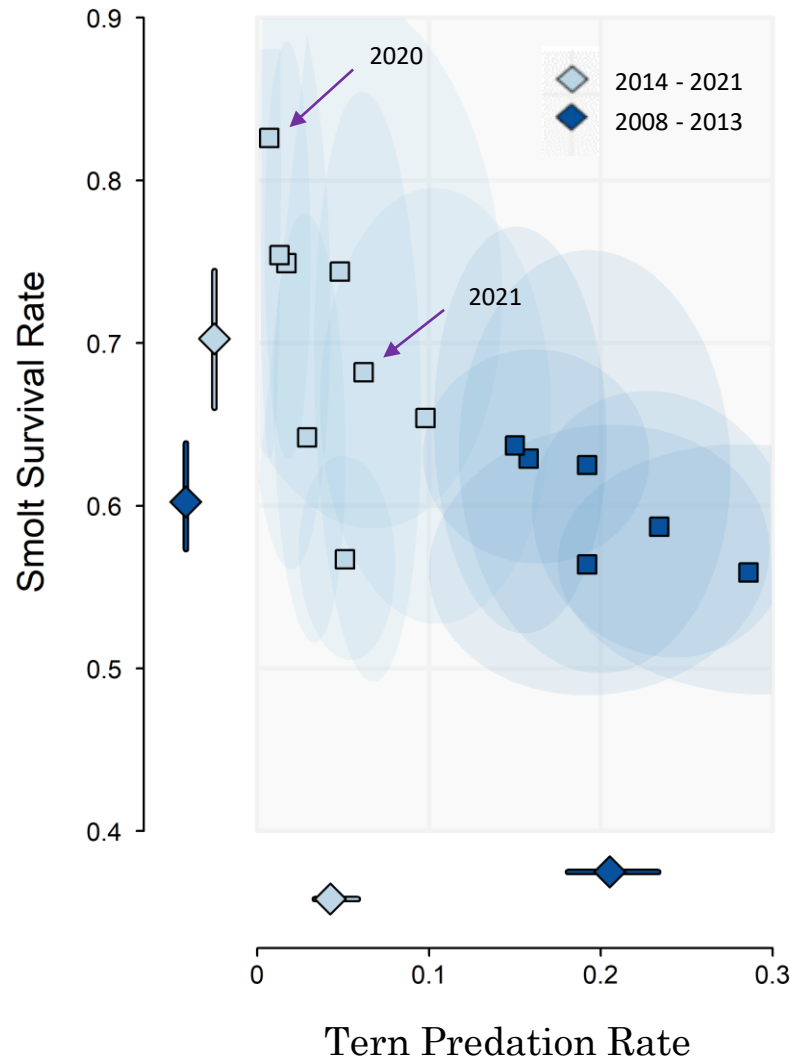


2021 Preliminary Results

Total Number of Tern Breeding Pairs in the CPR

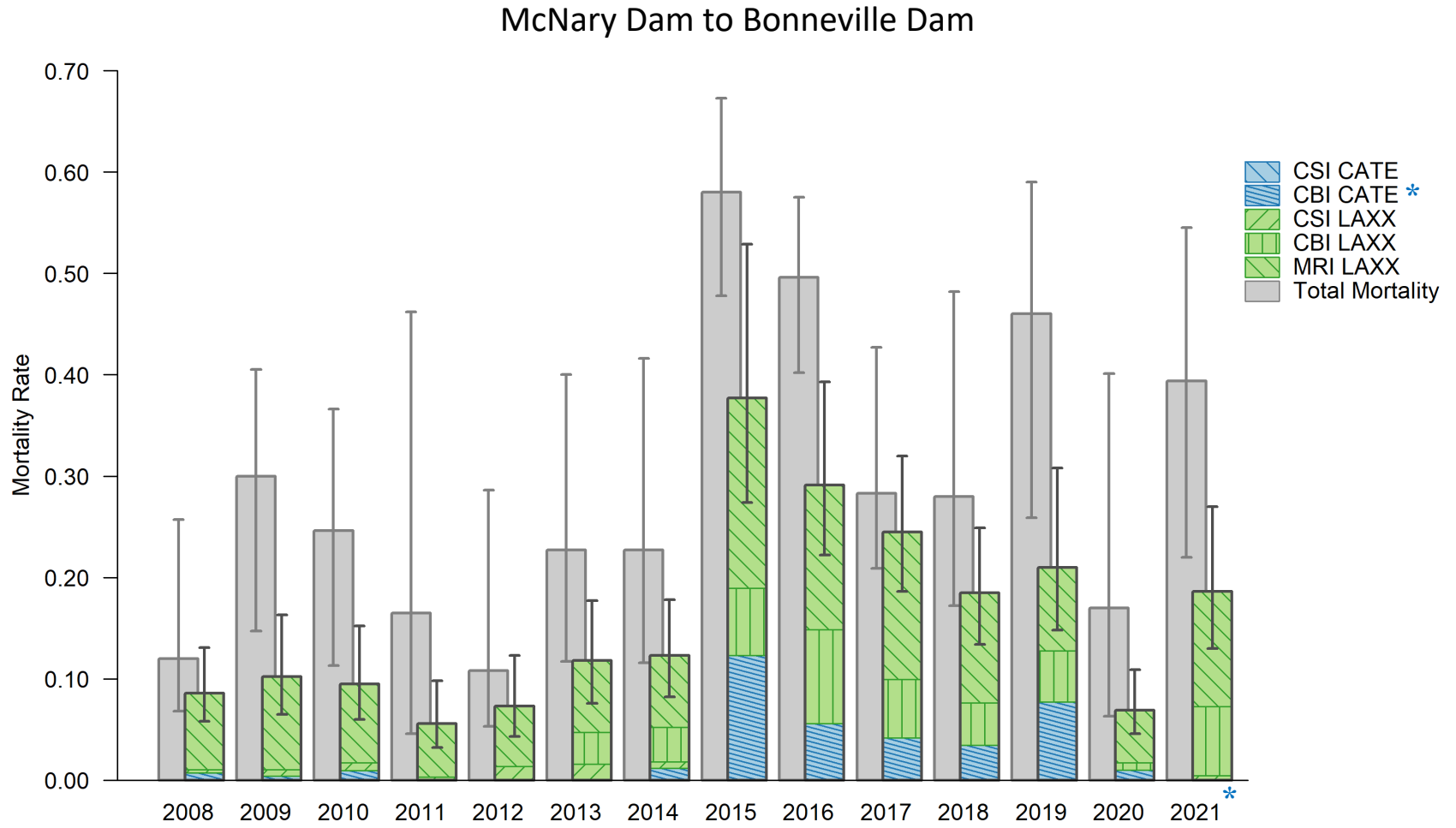


Predation Rates and Survival: Tern Management in CPR

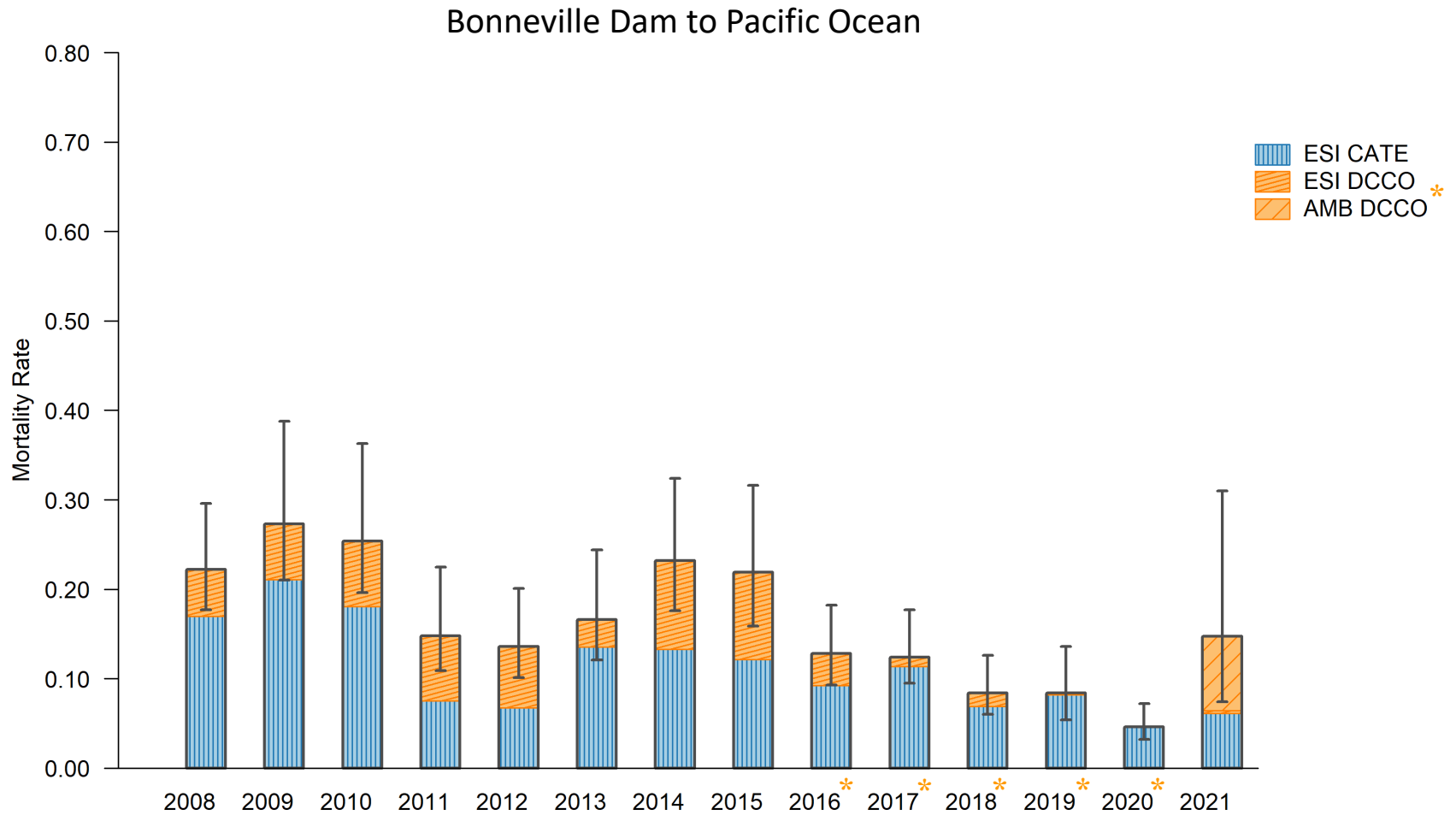


Modelled relationships based on weekly estimates within and across years (Payton et al. 2020)

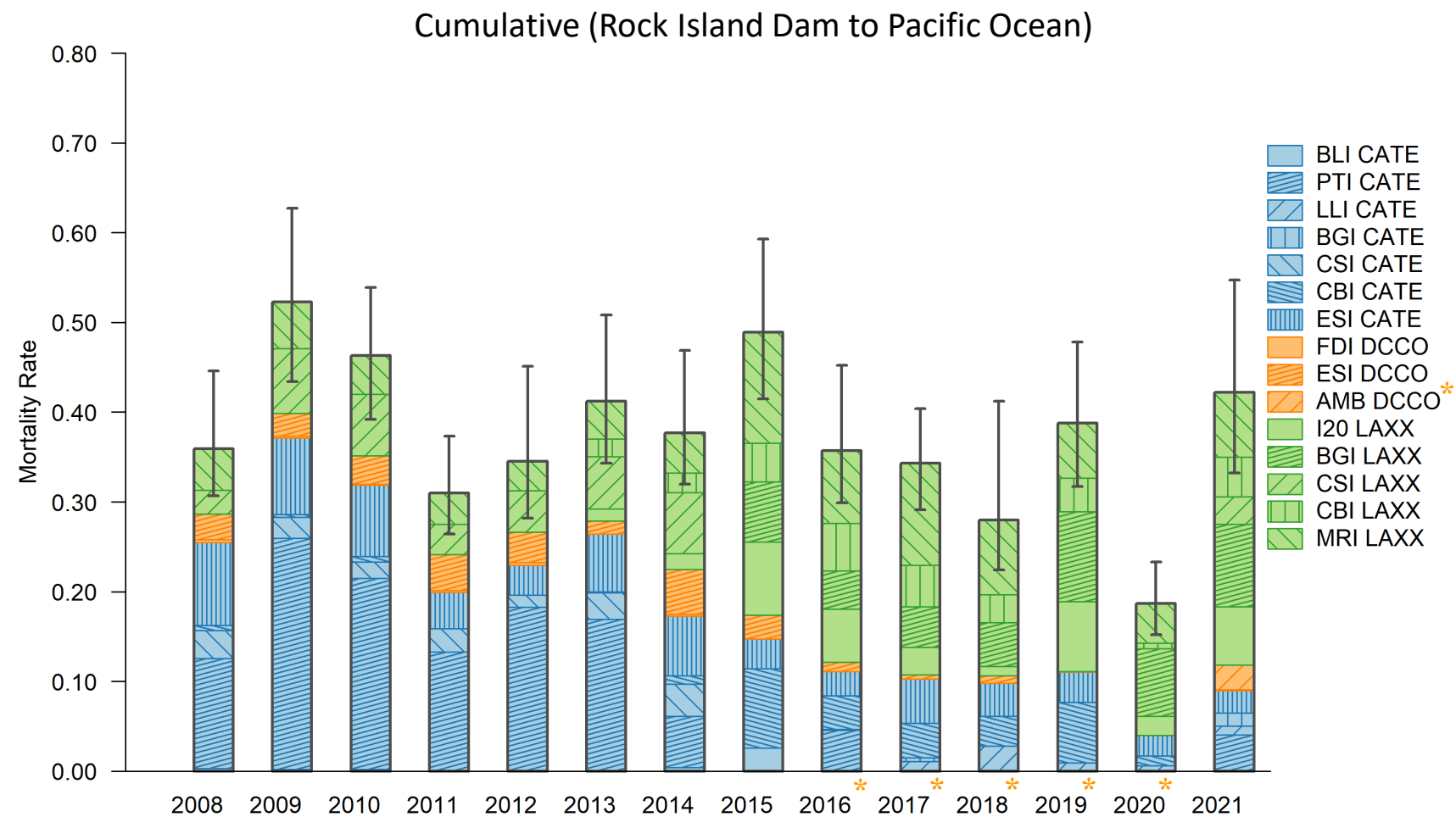
2021 Preliminary Results



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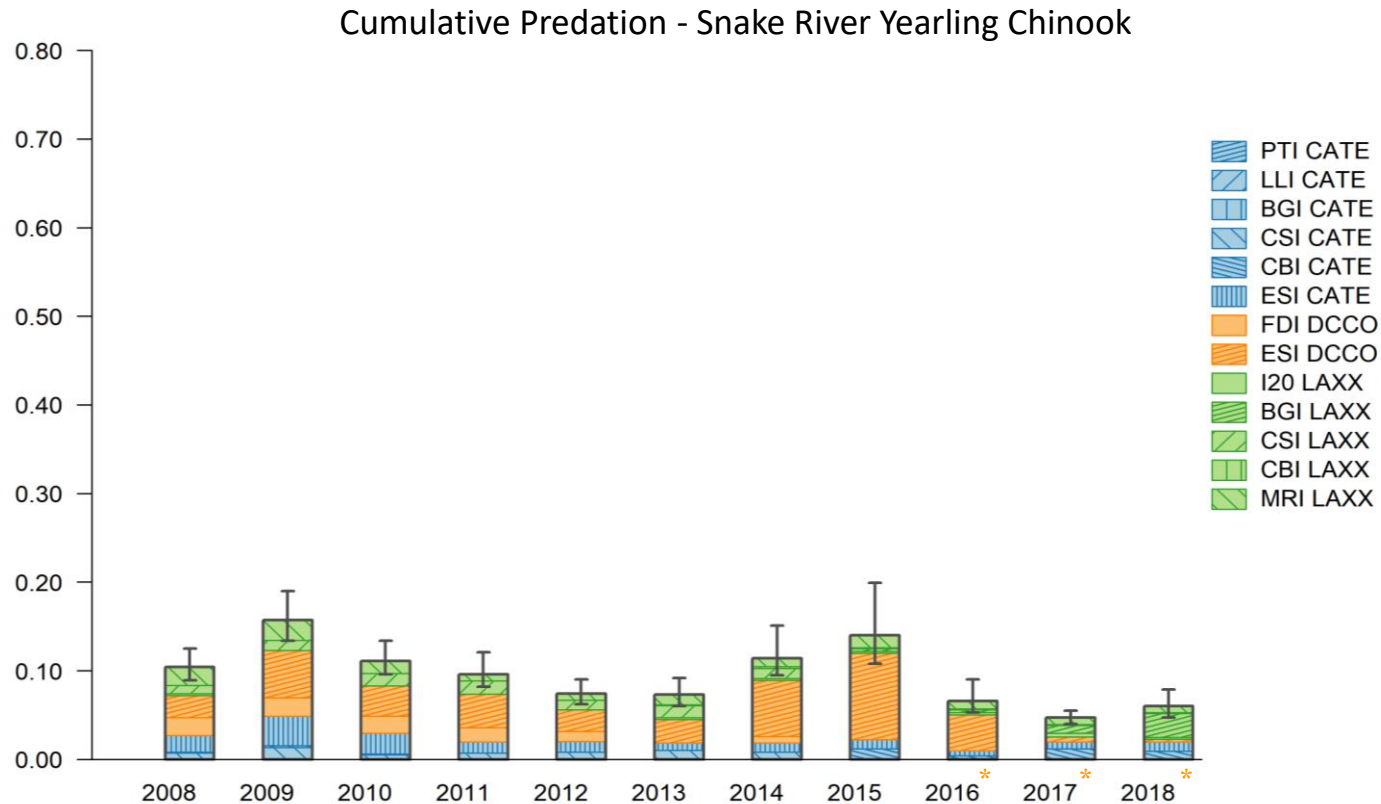
Summary of Results

- Predation on UCR steelhead smolts was substantial
 - Accounted for > 50% of all smolt mortality in most years
 - Estimates in 2021 were the third highest since 2008
 - Decreases in tern predation in CPR commensurate with increases in survival & vice versa (i.e. additive)
- Gull consumption surprisingly high
 - Highest estimates from colonies near dams
 - Gull consume dead fish & steal fish from other predators
- Cormorant impacts highest in the estuary
 - But were not fully quantified during 2016-2020 until 2021 AMB study
- If ignored, predation impacts could confound or mask the influence of other, non-avian management actions on smolt survival



Additional Considerations

- Steelhead are particularly susceptible to avian predation, especially tern and gull predation/consumption
 - Result here are from only one salmonid species, from one ESU/DPS
 - Predation on other salmonid species can be very different (see Synthesis Report)



Additional Considerations

- Steelhead are particularly susceptible to avian predation, especially tern predation
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- Additional research is warranted to:
 - Investigate the additive effects of gull predation
 - Investigate the additive effects of predation with covariates
 - Spill, WTT, temperature, turbidity
 - Ocean conditions
 - Individual fish characteristics (size, rearing-type)
 - Other factors

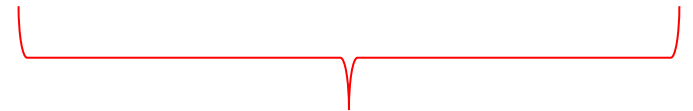




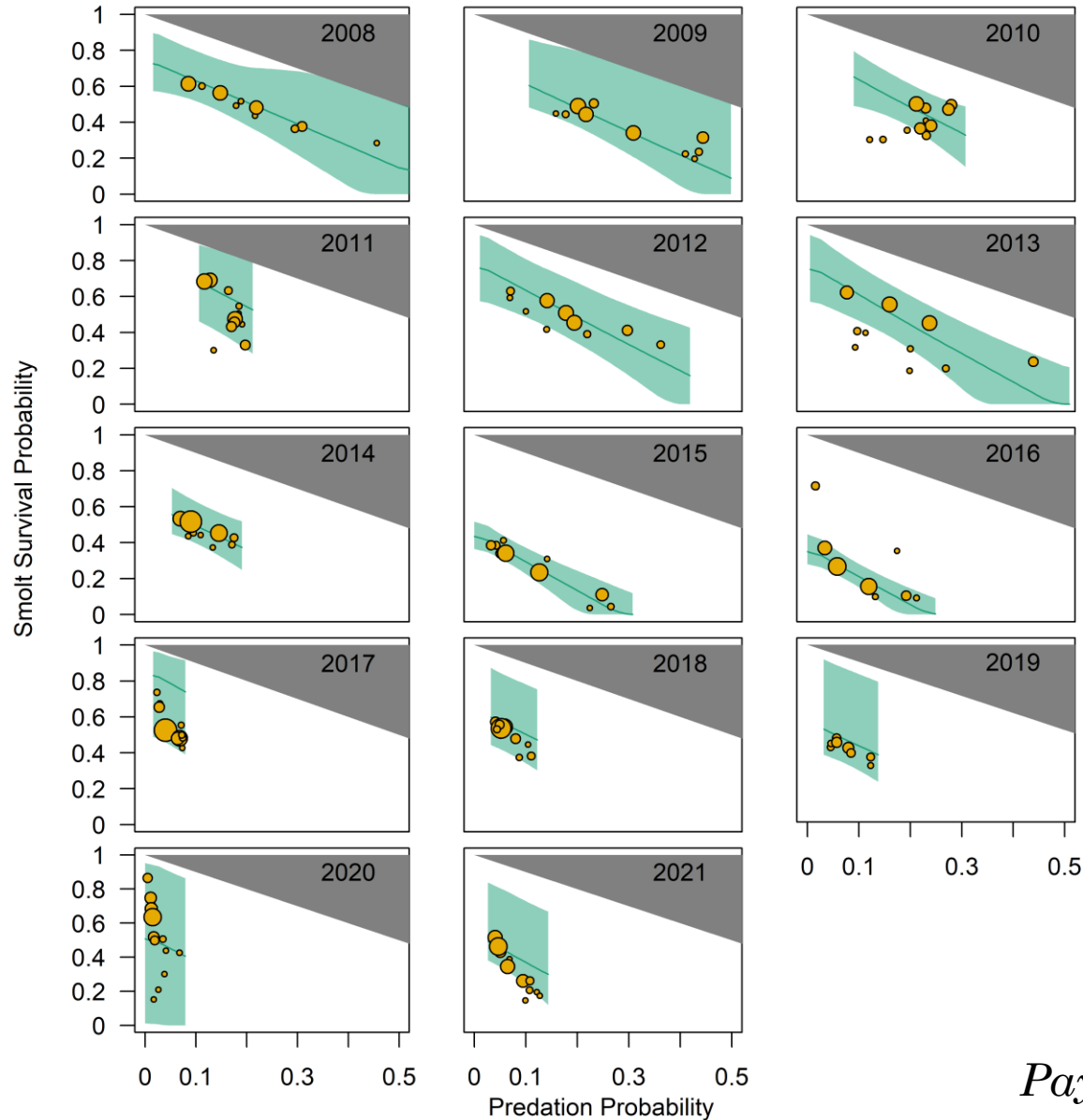
Questions?

CPR Tern Colony Sizes

	Year																
Colony	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Goose Is.	325	273	282	293	487	416	422	463	340	159	2	0	0	0	0	6	22
Crescent Is.	476	448	355	388	349	375	419	422	393	474	0	0	0	0	0	0	1
Blalock Is.	6	110	43	104	79	136	20	6	26	45	677	483	449	313	379	150	0
Badger Is.	0	0	0	0	0	0	33	60	0	0	0	0	41	8	0	0	231
Twinning Is.	13	23	31	27	61	34	19	22	13	67	64	6	0	0	0	0	0
Harper Is.	7	7	0	11	4	4	4	30	1	8	10	3	92	79	18	0	85
N. Rocks & Shoal	0	0	0	0	0	0	0	0	0	0	0	0	123	91	48	53	61
Total	827	861	711	823	980	965	917	1003	773	755	769	675	705	491	445	209	400

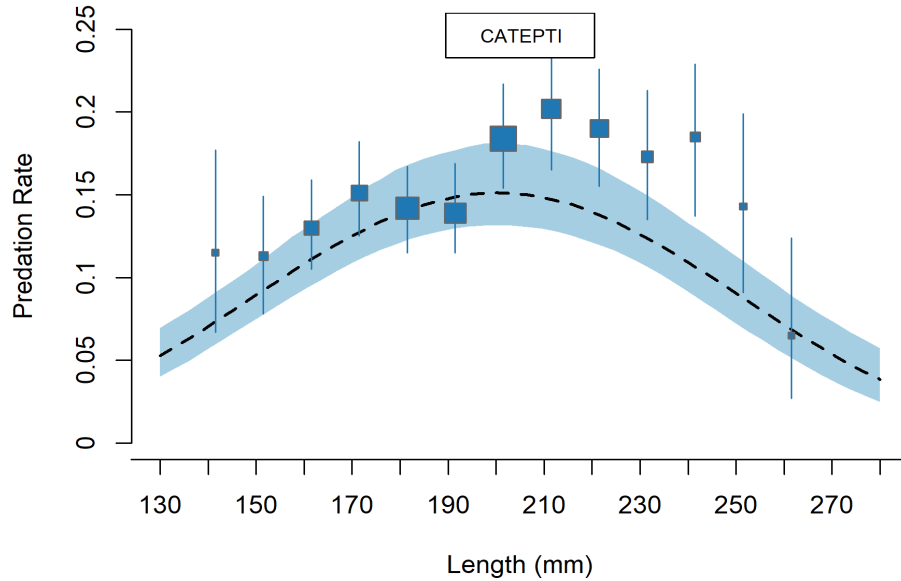
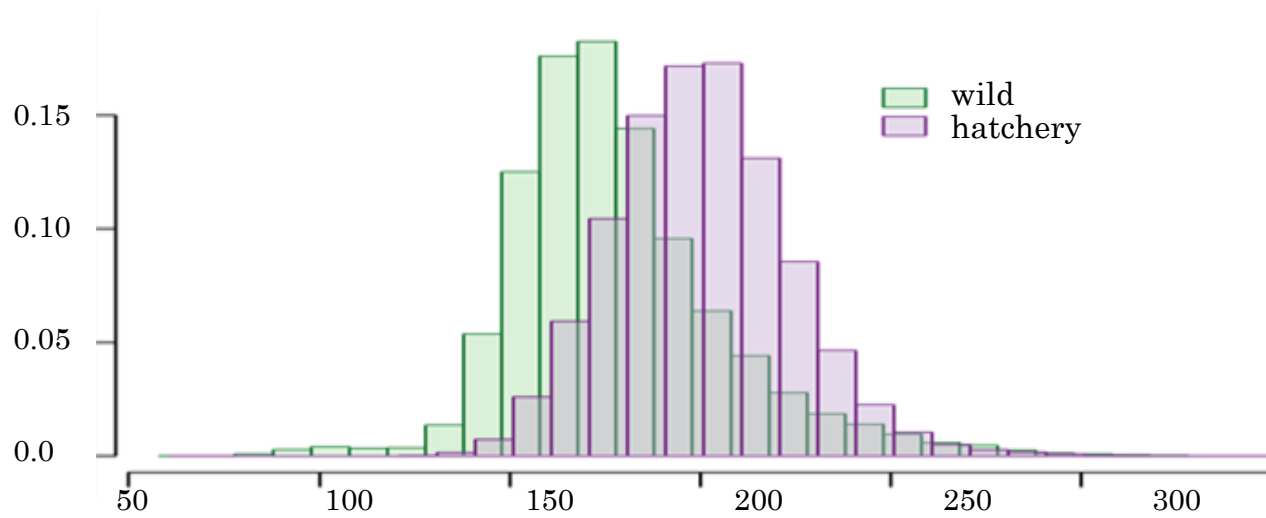


Predation Rates and Survival: CPR Tern Management

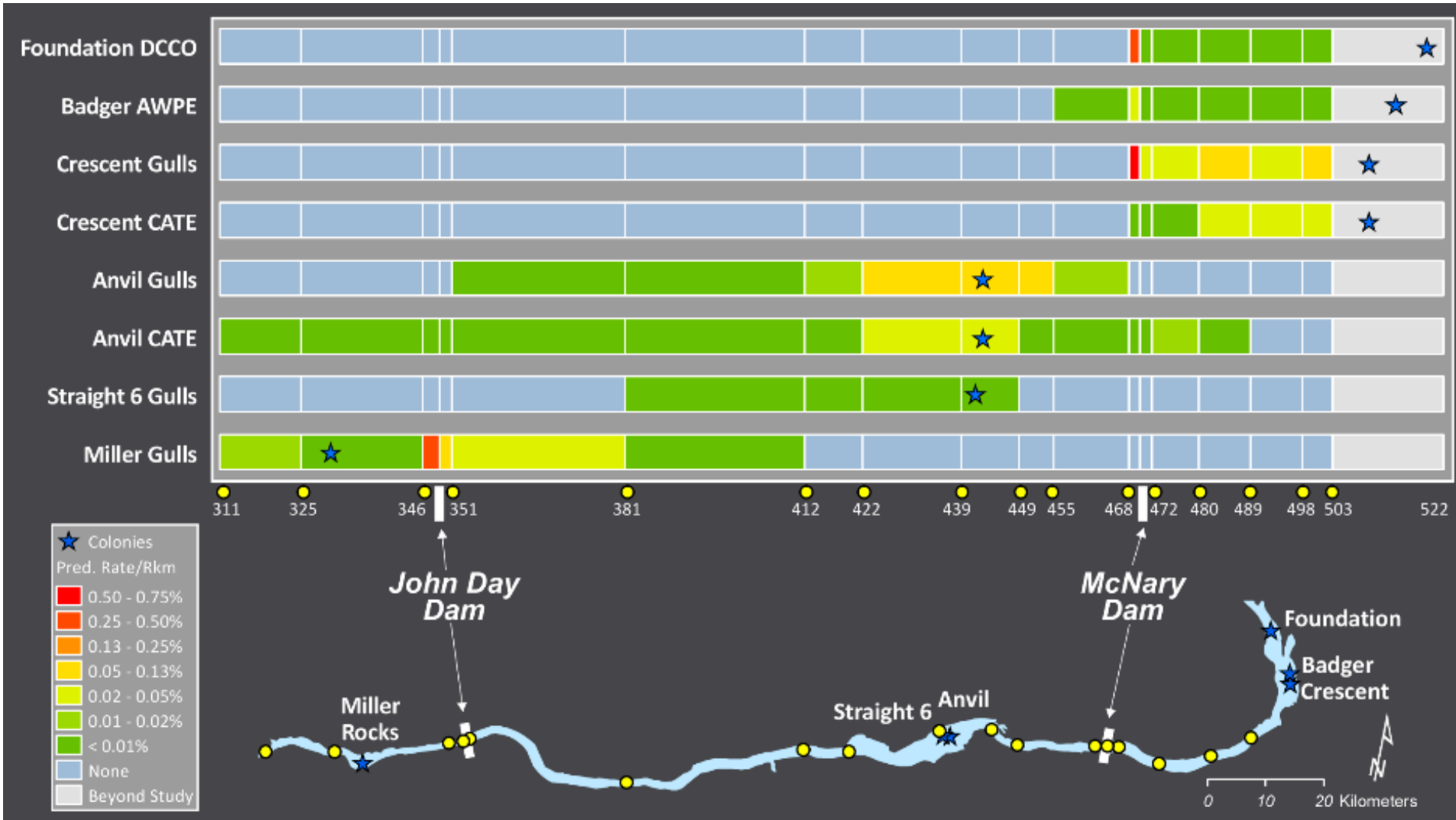


Payton et al. 2020

Size Selectivity



Hotspots of Predation



Evans et al. 2016