Caspian Tern Predation on Juvenile Salmonids in the Columbia River Basin: A Synopsis of PIT Tag Methods, Analyses, and Results from 2014

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Acknowledgements

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Background

- Recoveries of PIT tags on bird colonies can be used to determine predation rates (number consumed/number available)
  - Ø Estimates can be specific to salmonid ESU/DPS
  - Ø Provides a metric to evaluate which colonies pose the greatest risk to smolt survival
  - Ø Provides a metric to evaluate the efficacy of management efforts to reduce predation on ESA-listed salmonid populations
- Terns nesting on East Sand Island (estuary) and Goose Island (Potholes Reservoir) were dissuaded in 2014 as part of management plans
- Several other high-risk colony sites in CRB; sites were terns dissuaded from managed sites might relocate to

Presentation Goals

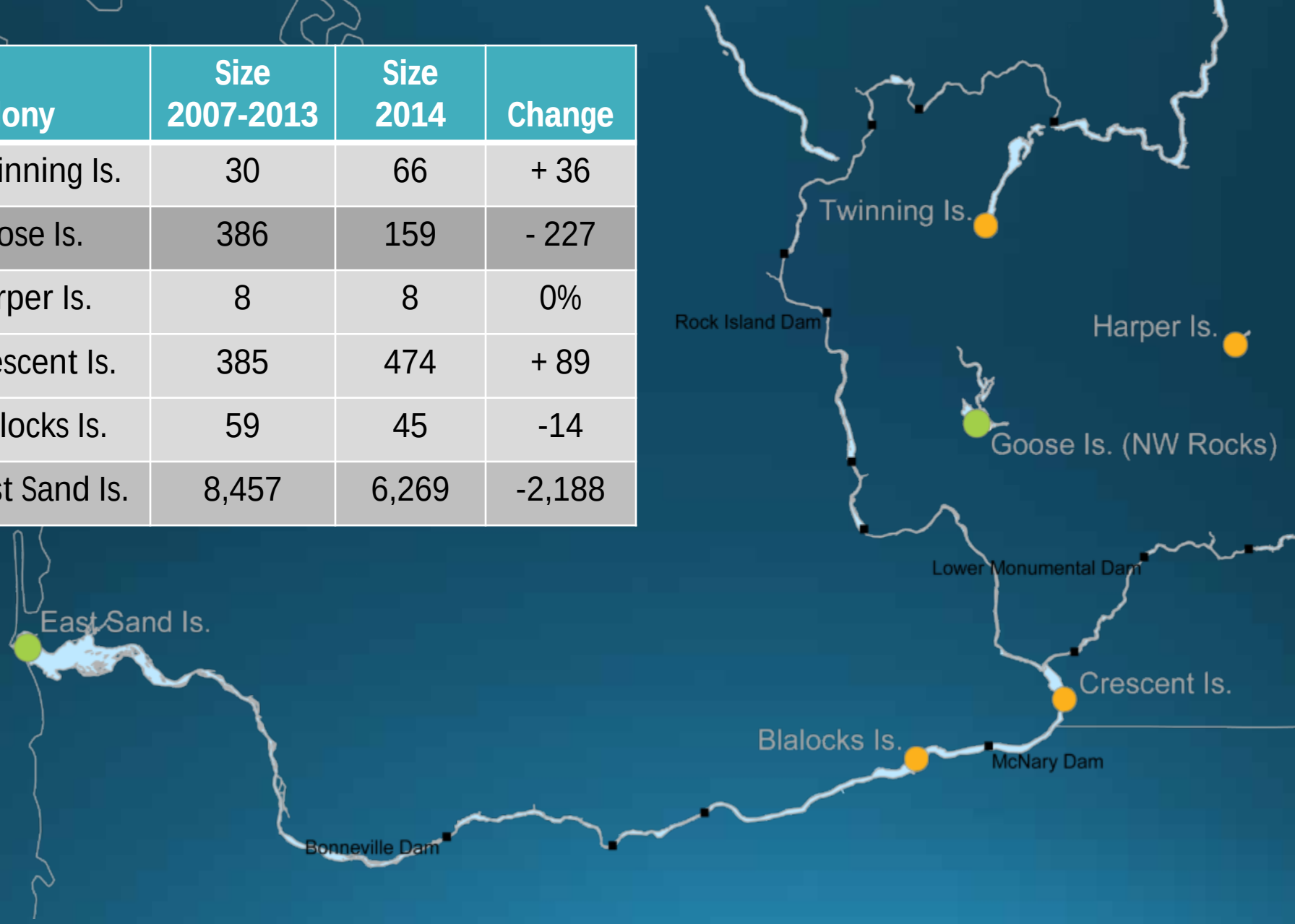
1) Over-view of PIT tag based predation rate methods

2) ESU/DPS-specific predation rates at managed and un-managed tern colonies in 2014

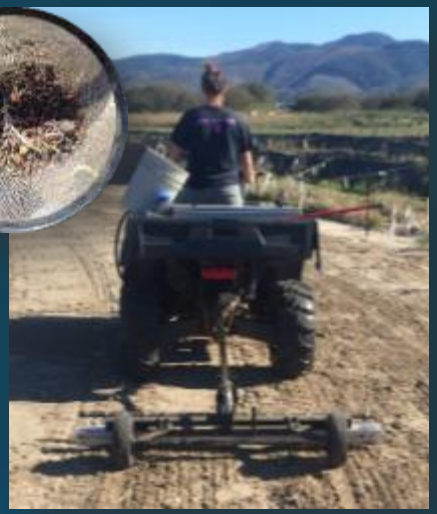
3) Changes in predation rates at managed and un-managed colonies

Tern Colony Locations and Sizes

Colony	Size 2007-2013	Size 2014	Change
Twinning Is.	30	66	+ 36
Goose Is.	386	159	- 227
Harper Is.	8	8	0%
Crescent Is.	385	474	+ 89
Blalocks Is.	59	45	-14
East Sand Is.	8,457	6,269	-2,188



Methods: Tern Colony PIT Tag Recovery



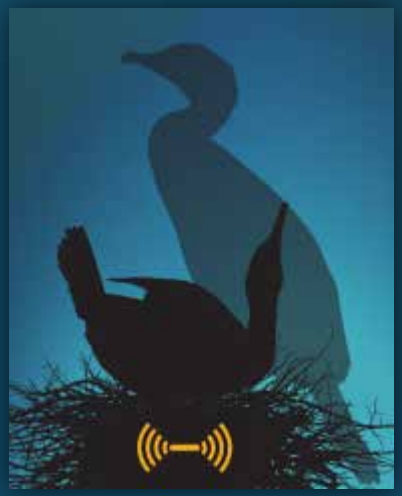
Electronic Detection

- Hand-held antennas used at sites with uneven terrain (rock, wood, etc.)
- Flat-plate antennas used at sites with even terrain (bare-sand)
- 4 - 12 complete passes (depending on colony size and tag density)
- > 150K tags, 36,725 unique (previously undetected) tags
- 22,475 MY 2014 tags detected

Physical Recovery

- Physical removal increases inter- and intra-annual detections were collision is a problem
- Physical recovery is also the only means to recover other tag types (AT, CWT)
- Hand-operated sweeper magnets & ATV-towed magnets
- ~ 20,000 functional tags removed in 2014

Methods: Predation Probabilities



Θ

Predation

Φ

Deposition

Ψ

Detection

Availability

By ESU/DPS (colony-specific)

Based on interrogations at upstream dams (RIS, LMN, MCN, BON)

Deposition probabilities

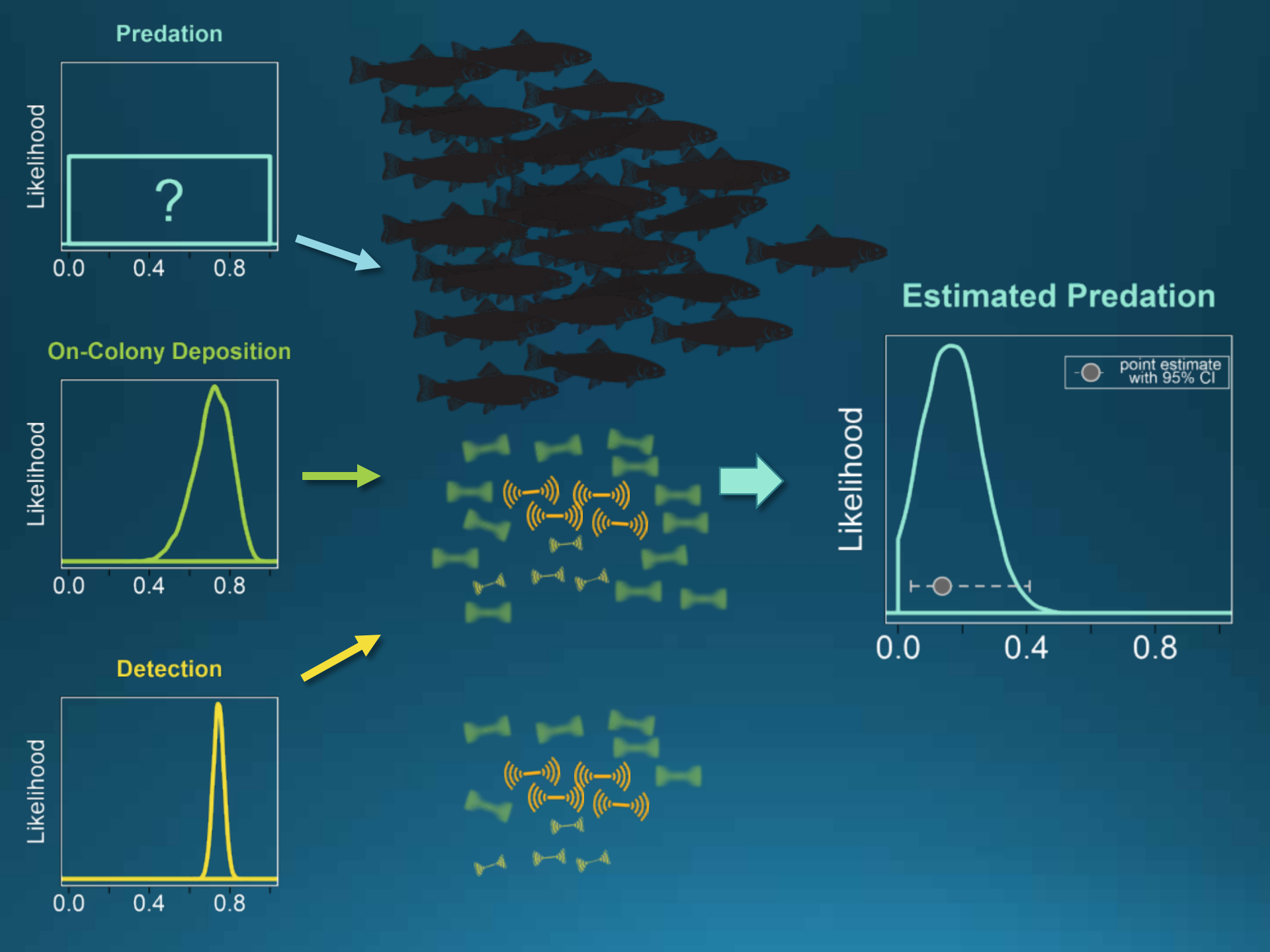
Annual 0.51 0.89 (all tern colonies)

Based previous studies (3 years, 2 colonies, 456 consumed PIT-tagged fish)

Detection probabilities

Weekly 0.16-0.98 (colony-specific)

Based on in-season sown tags (2-4 releases, 50 - 400 tags per-release)


Predation
Likelihood
?
0.0
0.4
0.8
On-Colony Deposition
Likelihood
0.0
0.4
0.8
Detection
Likelihood
0.0
0.4
0.8
Estimated Predation
point estimate with 95% CI
Likelihood
0.0
0.4
0.8

Methods: Per Capita (per bird) Predation Rates

$$\frac{\text{Estimated number of predated fish} \;/\; \text{Observed number available}}{\text{Observed maximum number of breeding pairs}}$$

Results: Predation by Goose Island Terns (managed)

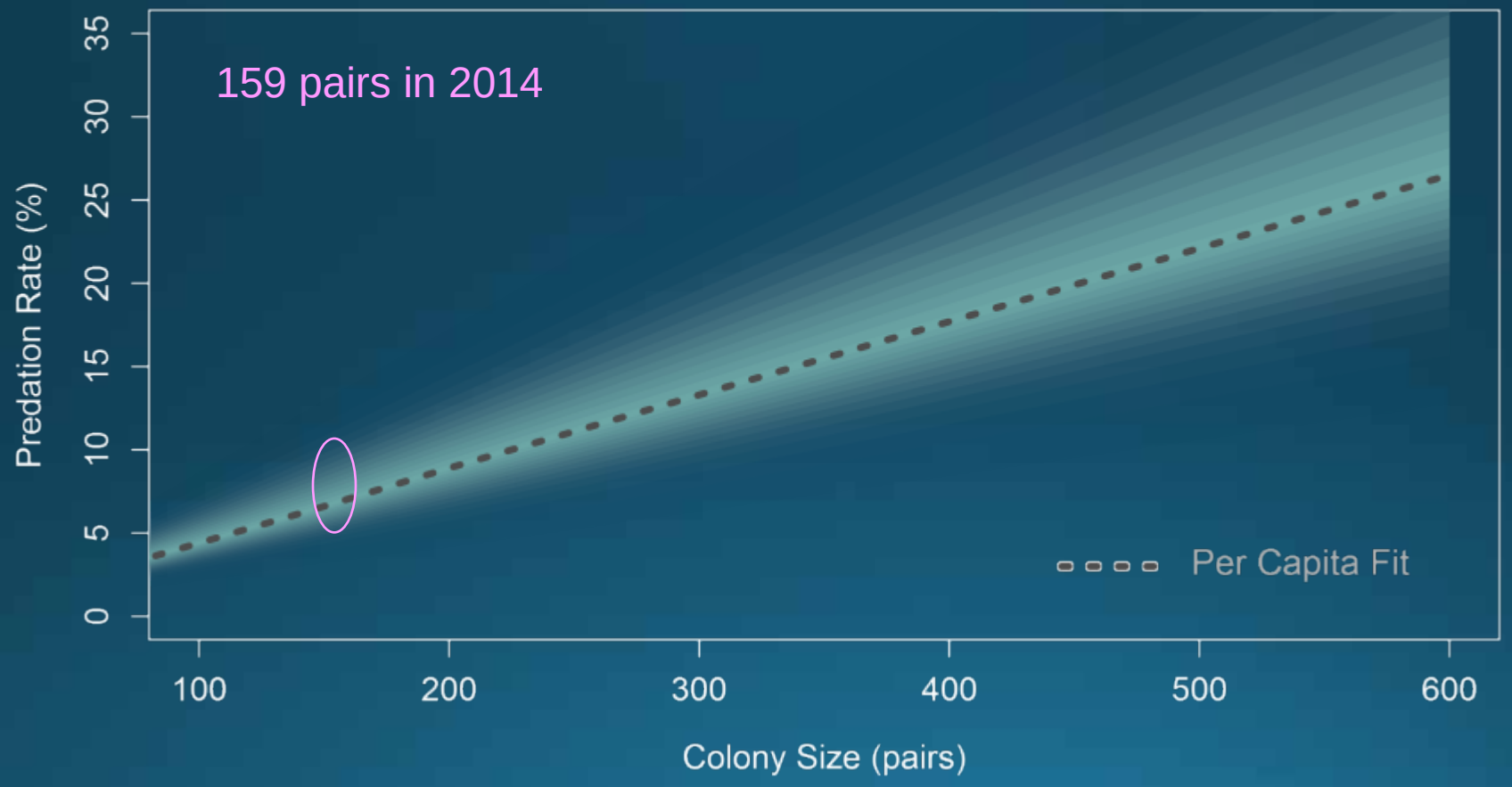
ESU/DPS	Pre-management 2007-2013	Post-management 2014	Change
UCR Spring Chinook	2.5% (1.7-3.6)	0.3 (0.1-0.7)	- 2.2 (1.6-2.9)
UCR Steelhead	15.7% (14.1-18.9)	2.9% (1.9-5.1)	- 12.7% (12.2-13.8)

Results: Predation by Twinning Island, Crescent Island, and Anvil Island Terns (un-managed)

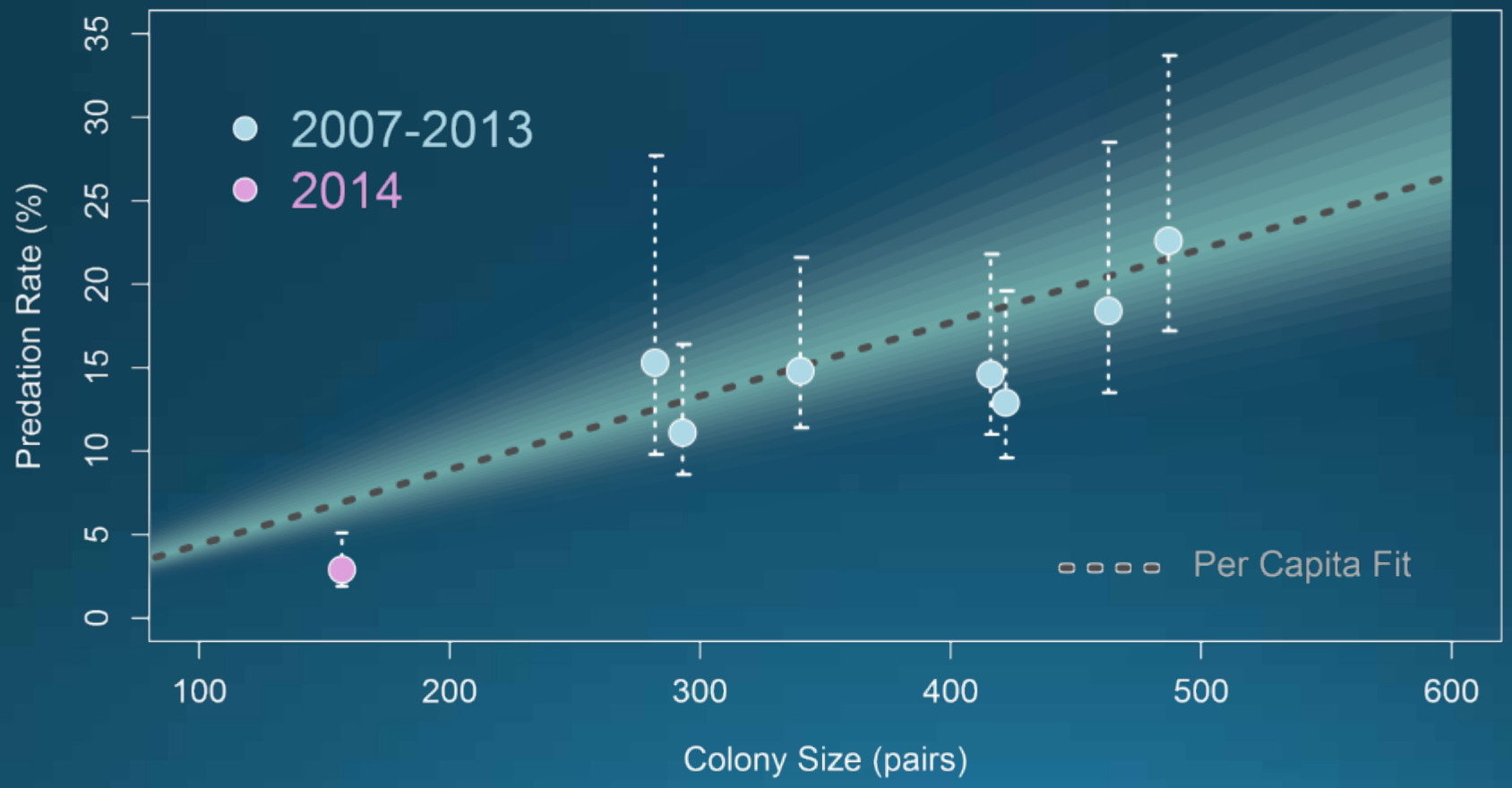
Colony	ESU/DPS	2007-2013	2014*	Change
Twinning Is.	UCR Steelhead	0.1% (<0.1-0.3)	1.1 (0.4-2.7)	+ 1.0 (0.4-2.4)
Crescent Is.		2.3% (2.0-2.7)	3.4% (2.5-4.9)	+ 1.1 (0.5-2.2)
Blalocks Is.		0.6% (0.4-0.8)	0.6% (0.3-1.2)	0 (-0.1-0.4)
Twinning Is.	SR Steelhead	<0.1%	< 0.1%	-
Crescent Is.		3.8% (3.4-4.6)	4.7% (3.7-6.9)	+ 0.9 (0.3-2.3)
Blalocks Is.		0.6% (0.5-0.7)	0.4% (0.2-0.7)	- 0.2 (0.3-0)
Twinning Is.	SR Sockeye	<0.1%	< 0.1%	-
Crescent Is.		1.1% (0.7-1.2)	0.7% (0.4-1.3)	- 0.4 (0.2-0.1)
Blalocks Is.		0.3% (0.1-0.4)	0.4 (0.1-1.1)	+ 0.1 (0-0.7)

**Preliminary estimate*

Results: Predicted Per Capita Predation Rates on Upper Columbia River Steelhead by Goose Island Terns (managed)



Results: Predicted (per capita) versus Actual Predation Rates on Upper Columbia River Steelhead by Goose Island Terns (managed)



Results: Predation by East Sand Island Terns (managed)

Summary of Findings

Methods

- A variety of techniques used to recover tags from tern colonies
- Physical recovery critical at colonies with high tag densities
- Detection & deposition probabilities highly influential
- Bayesian framework flexible and adaptive

Predation Results

- Predation by terns nesting on Goose Is. was significantly reduced in 2014 (post-management); results from East Sand Is. not available
- Increased predation on steelhead by un-managed tern colonies near Goose Is.
- Predicted per capita predation rates differed from actual (observed) predation rates

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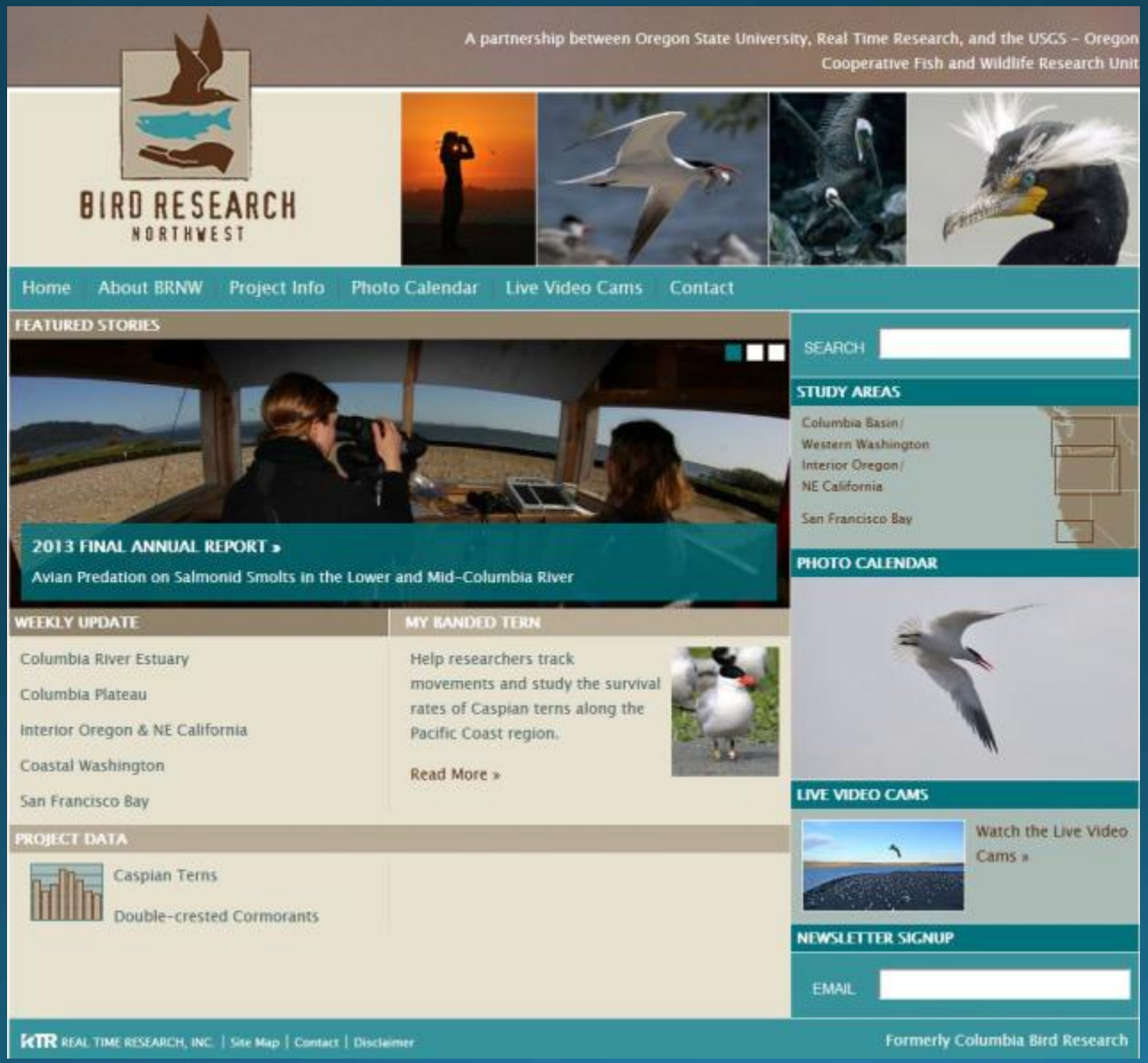
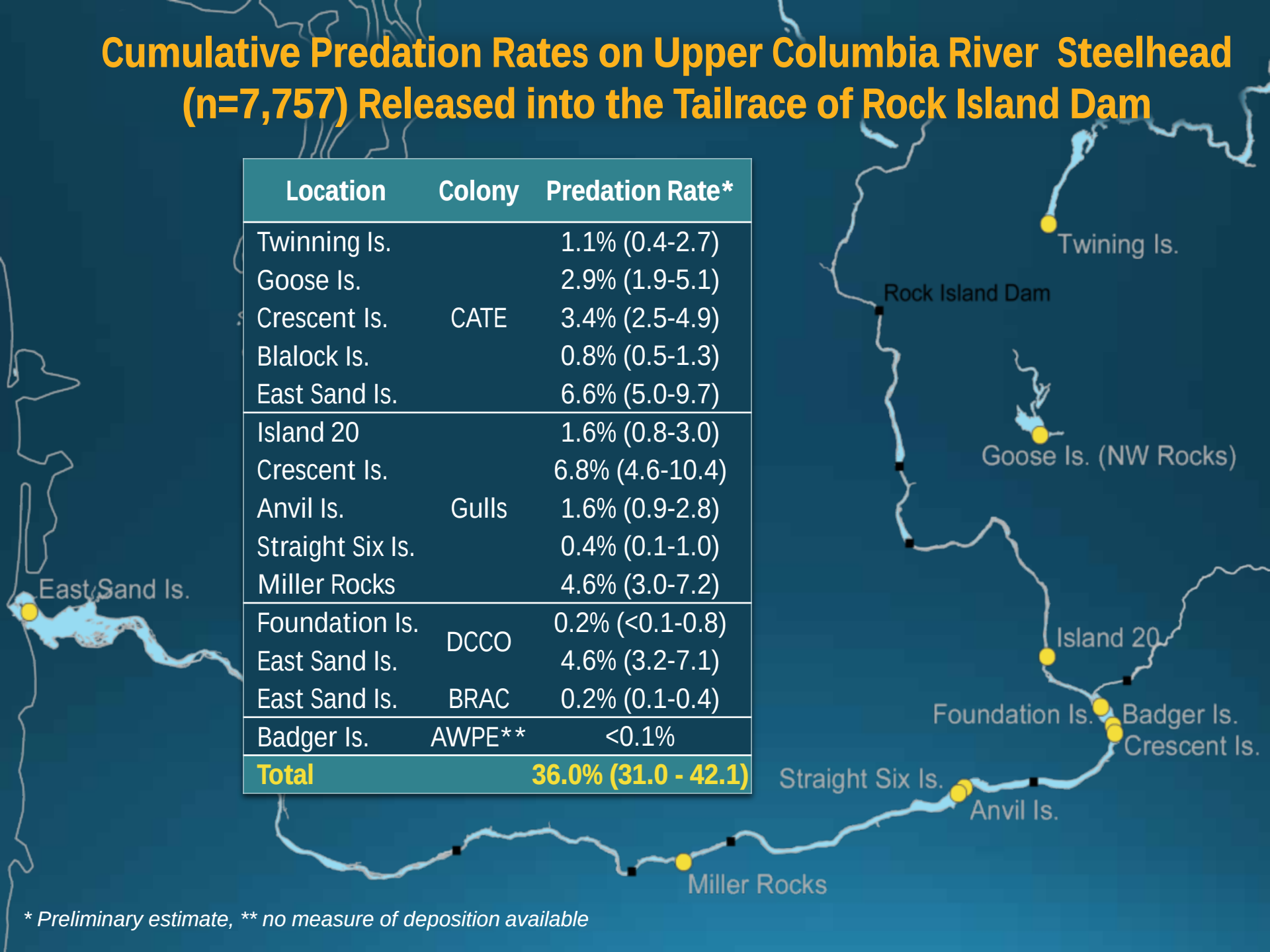


Questions ?

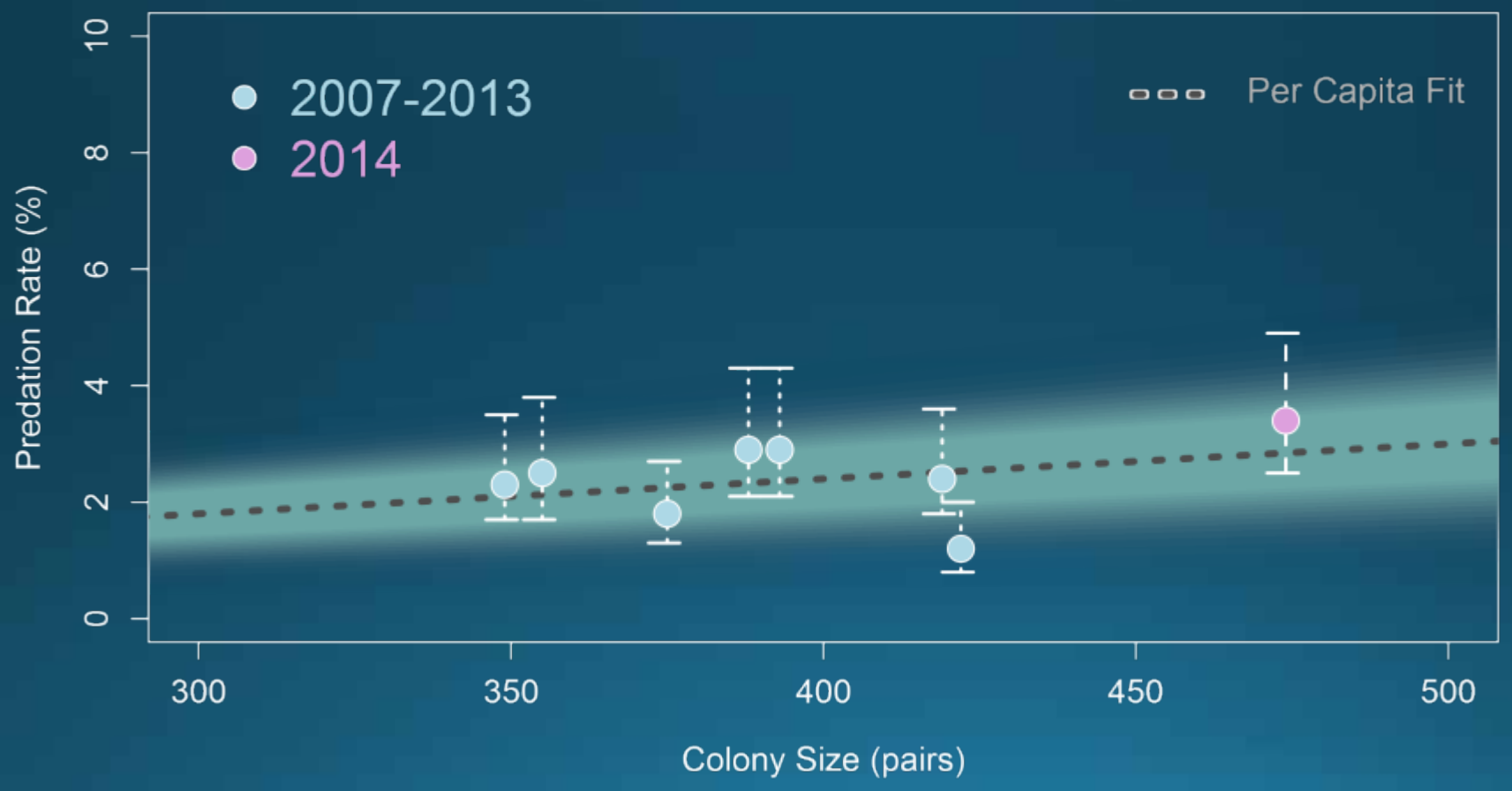
Cumulative Predation Rates on Upper Columbia River Steelhead (n=7,757) Released into the Tailrace of Rock Island Dam

Location	Colony	Predation Rate*
Twinning Is.		1.1% (0.4-2.7)
Goose Is.		2.9% (1.9-5.1)
Crescent Is.	CATE	3.4% (2.5-4.9)
Blalock Is.		0.8% (0.5-1.3)
East Sand Is.		6.6% (5.0-9.7)
Island 20		1.6% (0.8-3.0)
Crescent Is.		6.8% (4.6-10.4)
Anvil Is.	Gulls	1.6% (0.9-2.8)
Straight Six Is.		0.4% (0.1-1.0)
Miller Rocks		4.6% (3.0-7.2)
Foundation Is.	DCCO	0.2% (<0.1-0.8)
East Sand Is.		4.6% (3.2-7.1)
East Sand Is.	BRAC	0.2% (0.1-0.4)
Badger Is.	AWPE**	<0.1%
Total		**36.0% (31.0 - 42.1)**

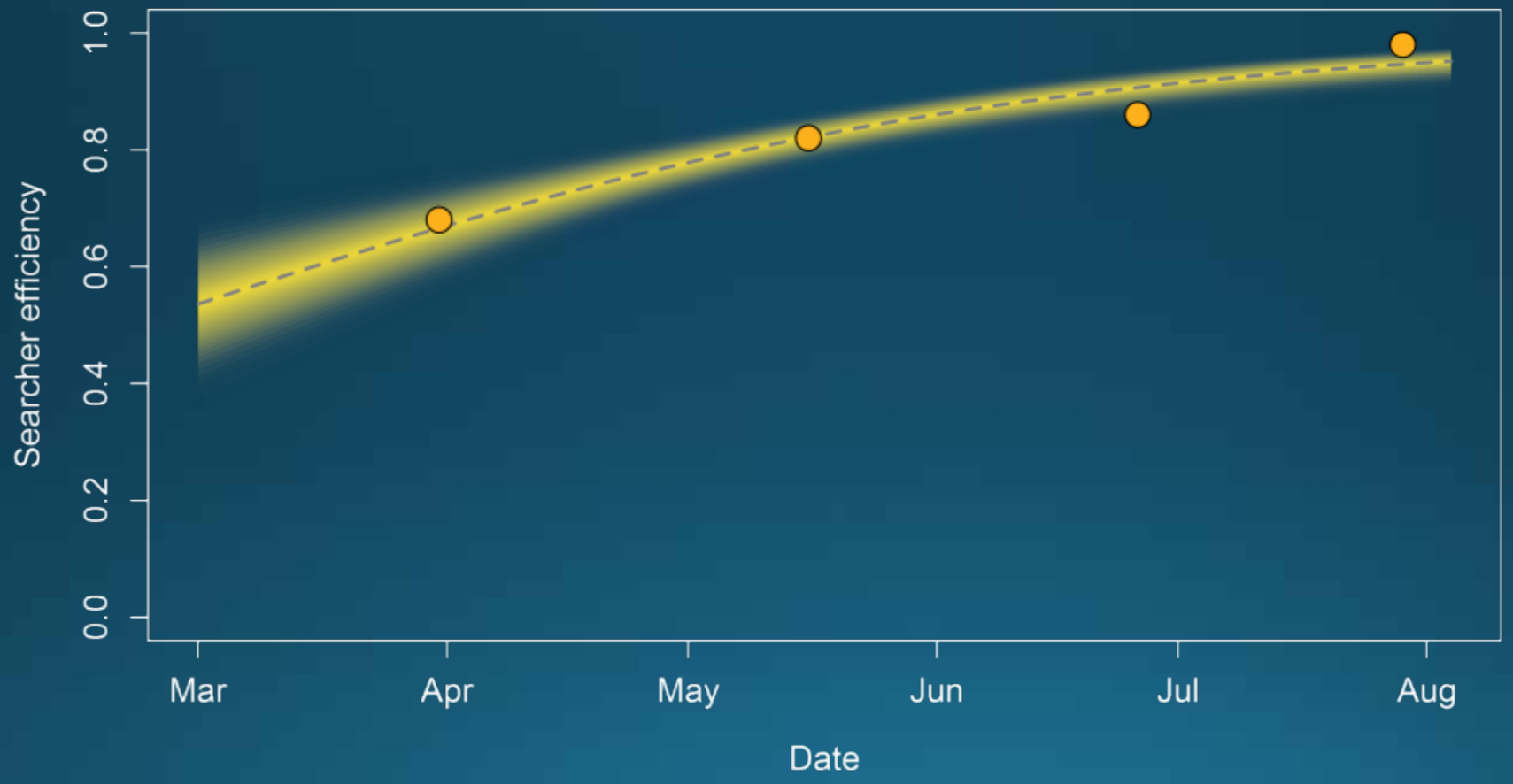


** Preliminary estimate, ** no measure of deposition available*

Results: Predicted (per capita) versus Actual Predation Rates on Upper Columbia River Steelhead by Crescent Island Terns (un-managed)



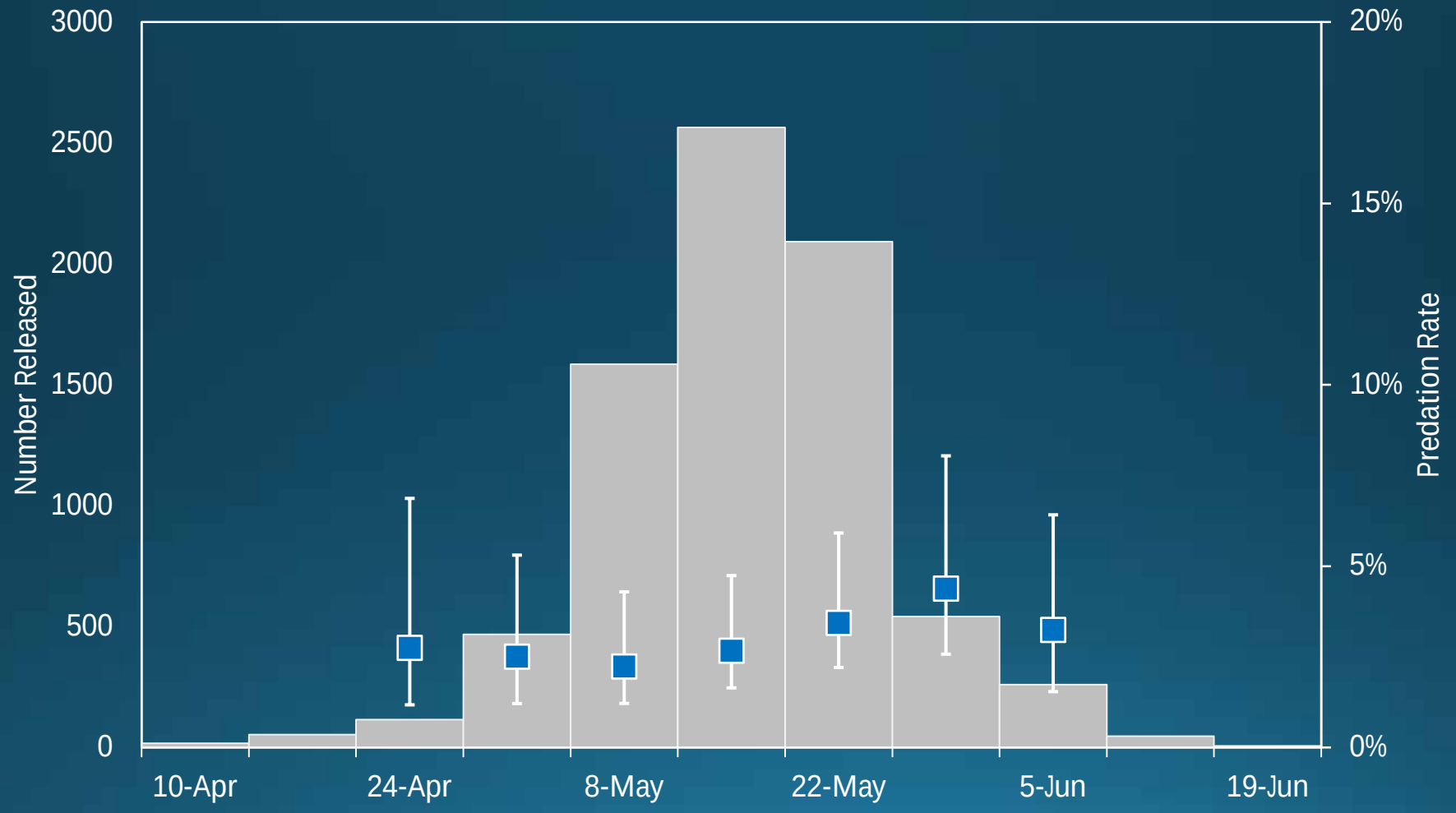
Results: Detection Efficiency at the Crescent Island Tern Colony in 2014



Predicted Per Capita Versus Actual Predation Rates at Un-managed Tern Colonies in 2014

Predation by Crescent Island Caspian Terns (n=474) in McNary Reservoir			
ESU/DPS	2014 Predicted	2014 Actual*	Difference
UCR Steelhead	2.8% (1.2-4.7)	3.4% (2.5-4.9)	**+ 0.6%**
SR Steelhead	5.1% (2.6-8.8)	4.7% (3.7-6.9)	**- 0.4%**
Spring Chinook	0.6% (0-2.0)	0.7% (0.2-2.1)	**- 0.1%**
SR Spr/Sum Chinook	1.0% (0.4-2.4)	0.5% (0.3-0.7)	**- 0.6%**
SR Fall Chinook	1.2% (0.5-2.4)	0.5% (0.3-0.8)	**- 0.7%**
SR Sockeye	1.4% (0.4-3.6)	0.7% (0.4-1.3)	**- 0.7%**

Predation by Anvil Island Caspian Terns (n=45) in John Day Reservoir			
ESU/DPS	2014 Predicted	2014 Actual*	Difference
UCR Steelhead	0.4% (0.1-1.4)	0.6% (0.3-1.2)	**+ 0.2%**
SR Steelhead	0.4% (0.1-1.2)	0.4% (0.2-0.7)	**-**
Spring Chinook	0.1% (0-0.3)	0.2% (0.1-0.4)	**+ 0.1%**
SR Spr/Sum Chinook	0.1% (0-0.2)	0.1% (0-0.2)	**-**
SR Fall Chinook	0.1% (0-0.3)	0.3% (0.2-0.5)	**+ 0.2%**
SR Sockeye	0.3% (0-1.4)	0.4% (0.1-1.1)	**+ 0.1%**

**Preliminary estimate*

Caspian Tern Predation on Steelhead at Goose Island Relative to Run-timing, 2014