

NWPCC Science and Policy Exchange
August 9, 2012

Summary of Predator-Prey Relationships between
Piscivorous Birds and Salmonids in the Columbia River Basin

USGS-Oregon Cooperative Fish
& Wildlife Research Unit

Oregon State University

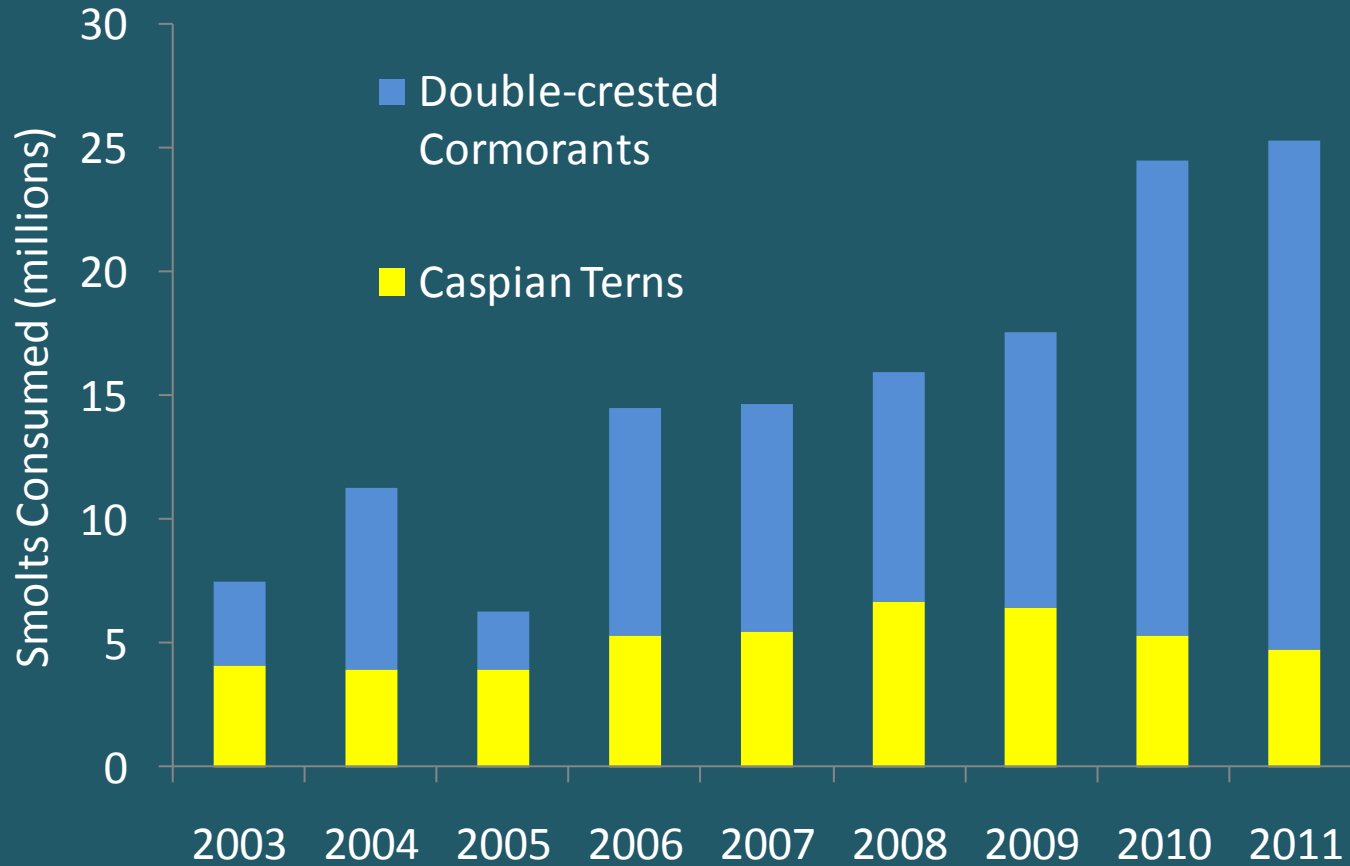
Real Time Research, Inc.





Perception #1: Salmonid smolt mortality due to avian predation is insignificant

Smolt Consumption by East Sand Island Caspian Terns and Double-crested Cormorants





Perception #2: Managing avian predators can recover ESA-listed salmonids

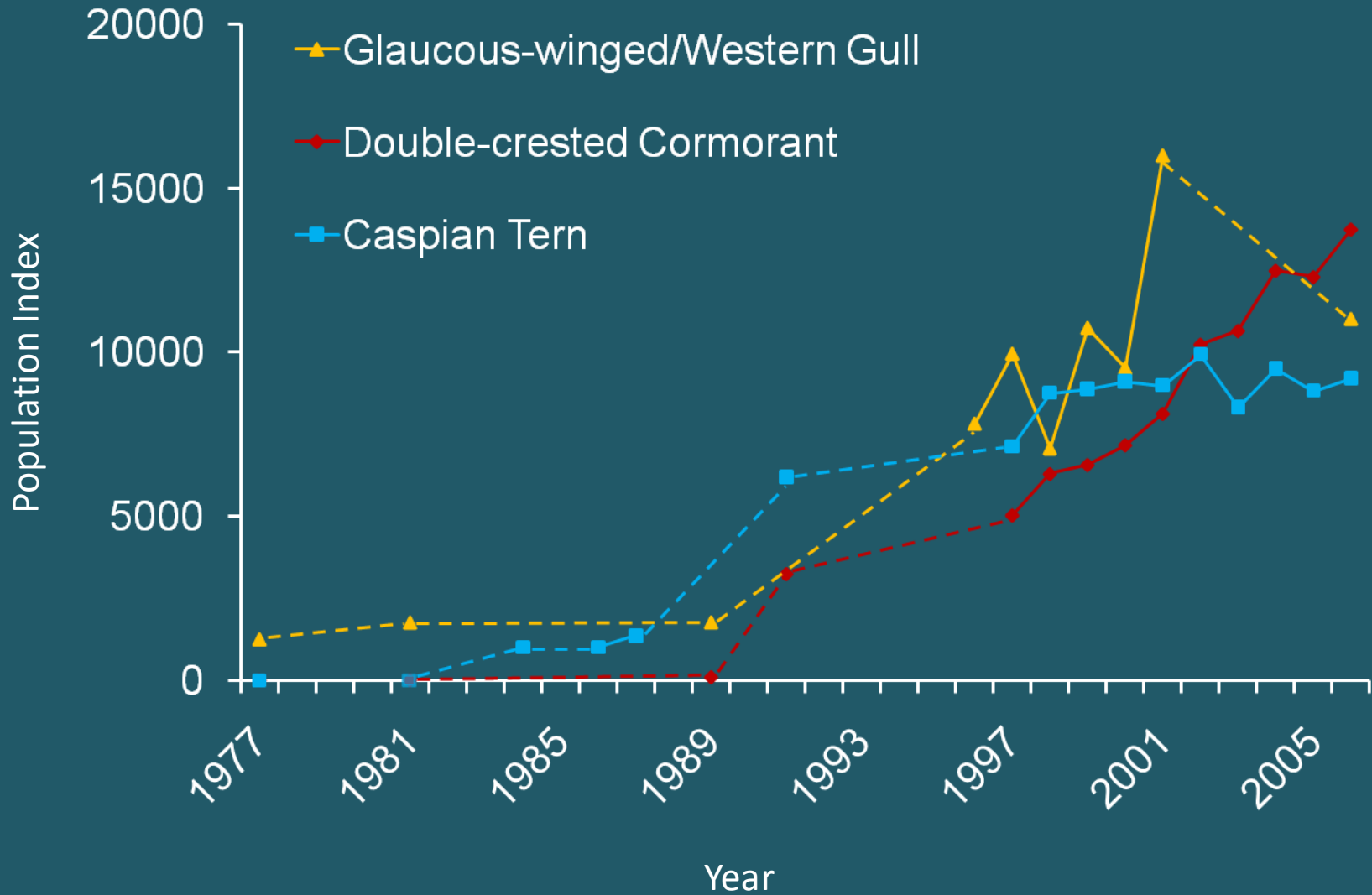
Potential changes in λ (%) for elimination of the double-crested cormorant colony on East Sand Island, assuming 0% compensation

Species	ESU/DPS	Estimated $\Delta\lambda$
Steelhead	Upper Columbia R.	1.9%
	Snake R.	2.4%
	Middle Columbia R.	2.5%
Chinook	Upper Columbia R.	0.9%
	Snake R. _{Spring/Summer}	1.2%
	Snake R. _{Fall}	1.0%
	Upper Willamette R.	0.6%
Sockeye	Snake R.	1.6%



Perception #3: Double-crested cormorants and Caspian terns are natural predators on salmonid smolts, which have evolved with these avian predators

Colonial Nesting Waterbirds in the Columbia River Estuary (1977-2006)





Perception #4: The only way to protect salmonids from overabundant avian predators is to lethally remove them by the thousands

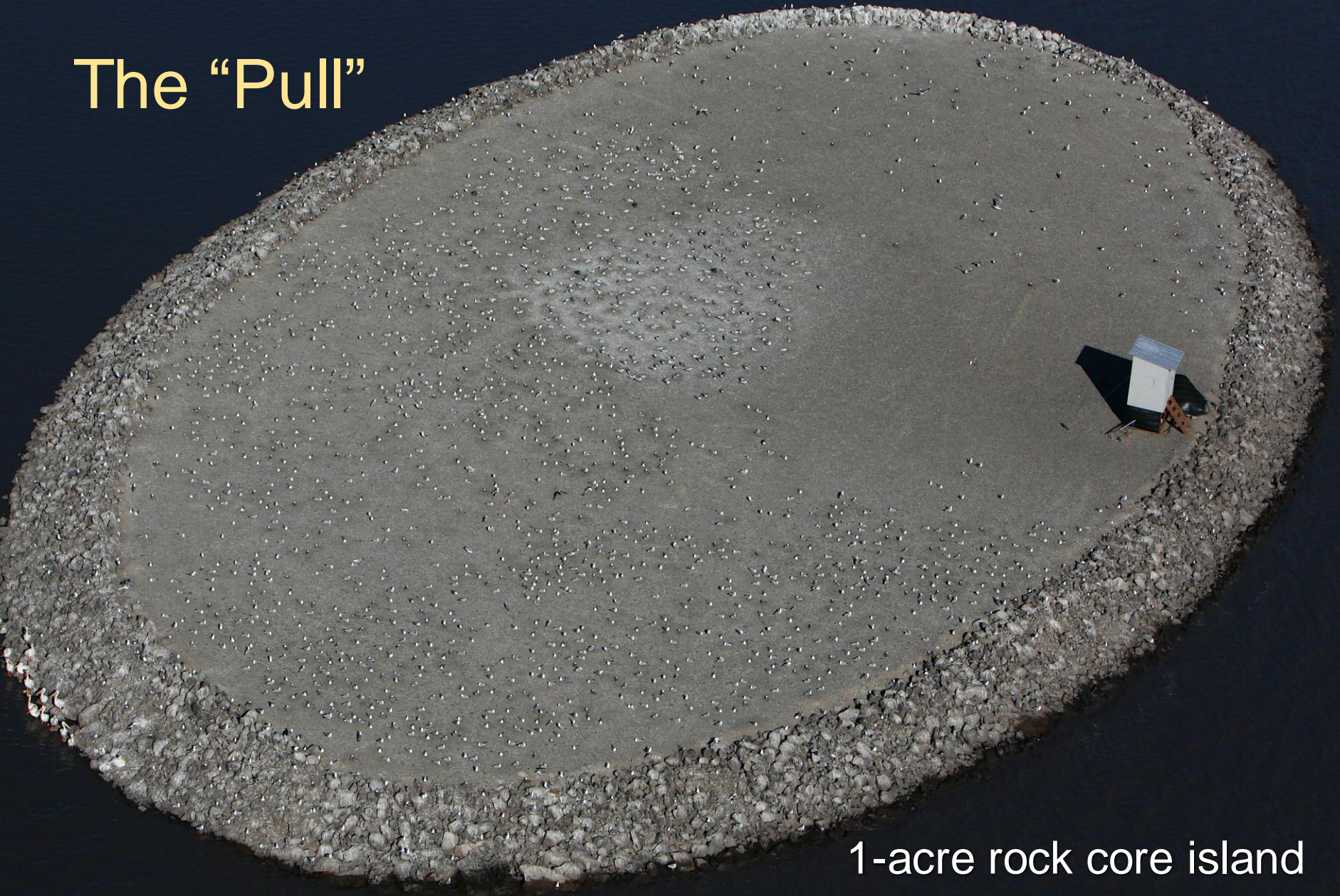
The “Push”



Limiting the access of Caspian terns to suitable nesting habitat on East Sand Island

Crump Lake tern island, Warner Valley, Oregon

The "Pull"



1-acre rock core island



Thank you

Questions?

ESA-Listed ESU/DPS-Specific PIT Tag Based Predation Rates

Species	ESU/DPS	Estimated Predation Rates
Steelhead	UCR	7.1%
	SR	13.0%
	MCR	11.0%
	UWR _{Winter}	No data available
	LCR	No data available
Chinook	UCR _{Spring}	3.6%
	SR _{Spring/Summer}	5.1%
	SR _{Fall}	3.7%
	UWR _{Spring}	2.7%
	LCR – Hatchery BB	47.0%
Sockeye	SR	4.8%
Coho	LCR – Hatchery BB	26.0%
Chum	CR	N/A

Caspian Tern Management Plan for the Columbia River Estuary



- Relocate colony from Rice Island to East Sand Island (near ocean)
- Develop alternative colony sites outside Columbia River Basin
- As alternative habitat becomes available, reduce habitat on East Sand Island to 1.0 acre (4.7 acres used in 2004)
- Expected long-term Caspian tern colony size at East Sand Island about 3,000 pairs, 1/3 current size

“Push – Pull”

Habitat Alteration, Social Attraction, and Nest Predator Control to Manage Colony Location

Desired Site:



East Sand Island

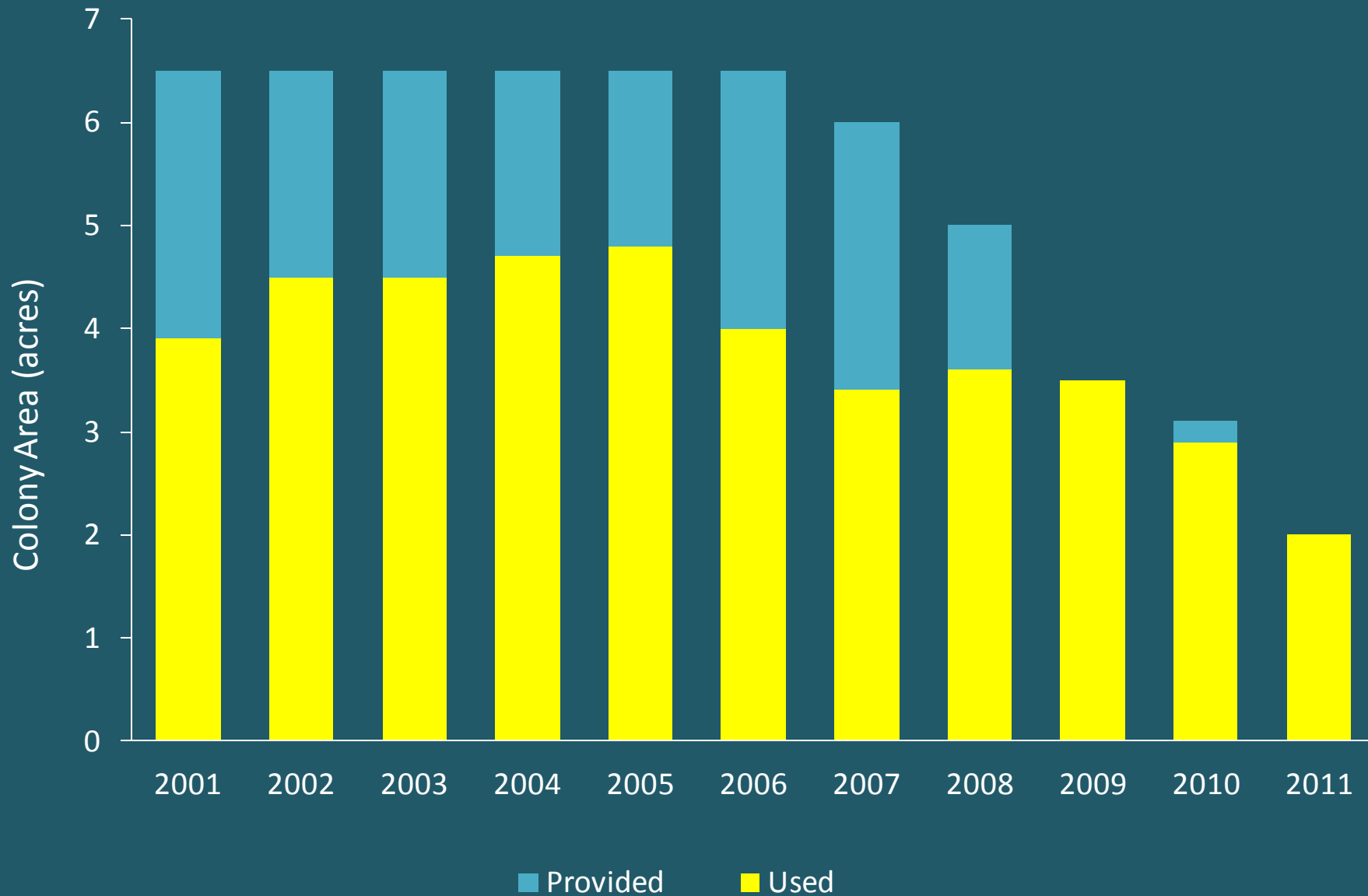
Undesired Site:



Rice Island

East Sand Island Caspian Tern Colony

Nesting Area Provided and Used



Alternative Caspian Tern Colony Sites Specified in the Management Plan

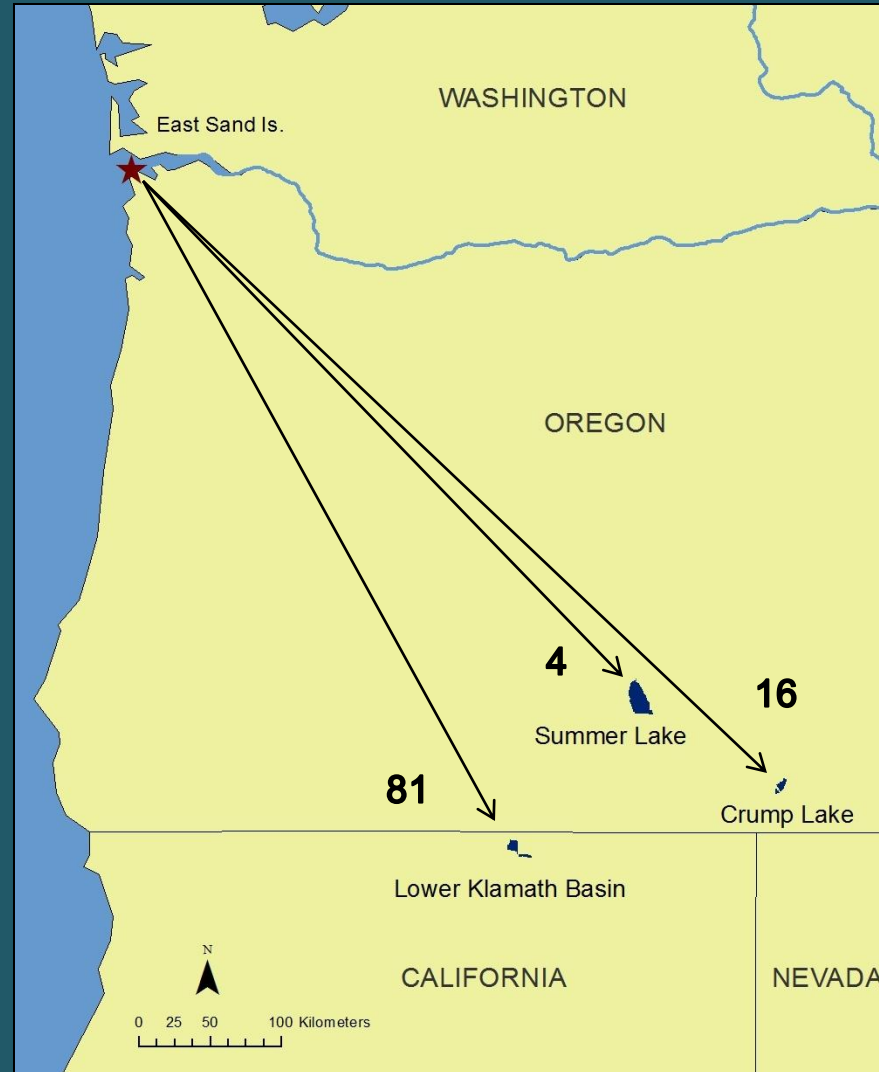


Re-sightings of Banded Caspian Terns

- Birds frequently recruit to colonies other than natal colony
- Adults also change breeding colonies
- Inter-colony movements can reach 2,000 mi
- One metapopulation on Pacific Coast of North America



Re-sightings of Caspian Terns Banded on East Sand Island in Interior Oregon and Upper Klamath Basin - 2011





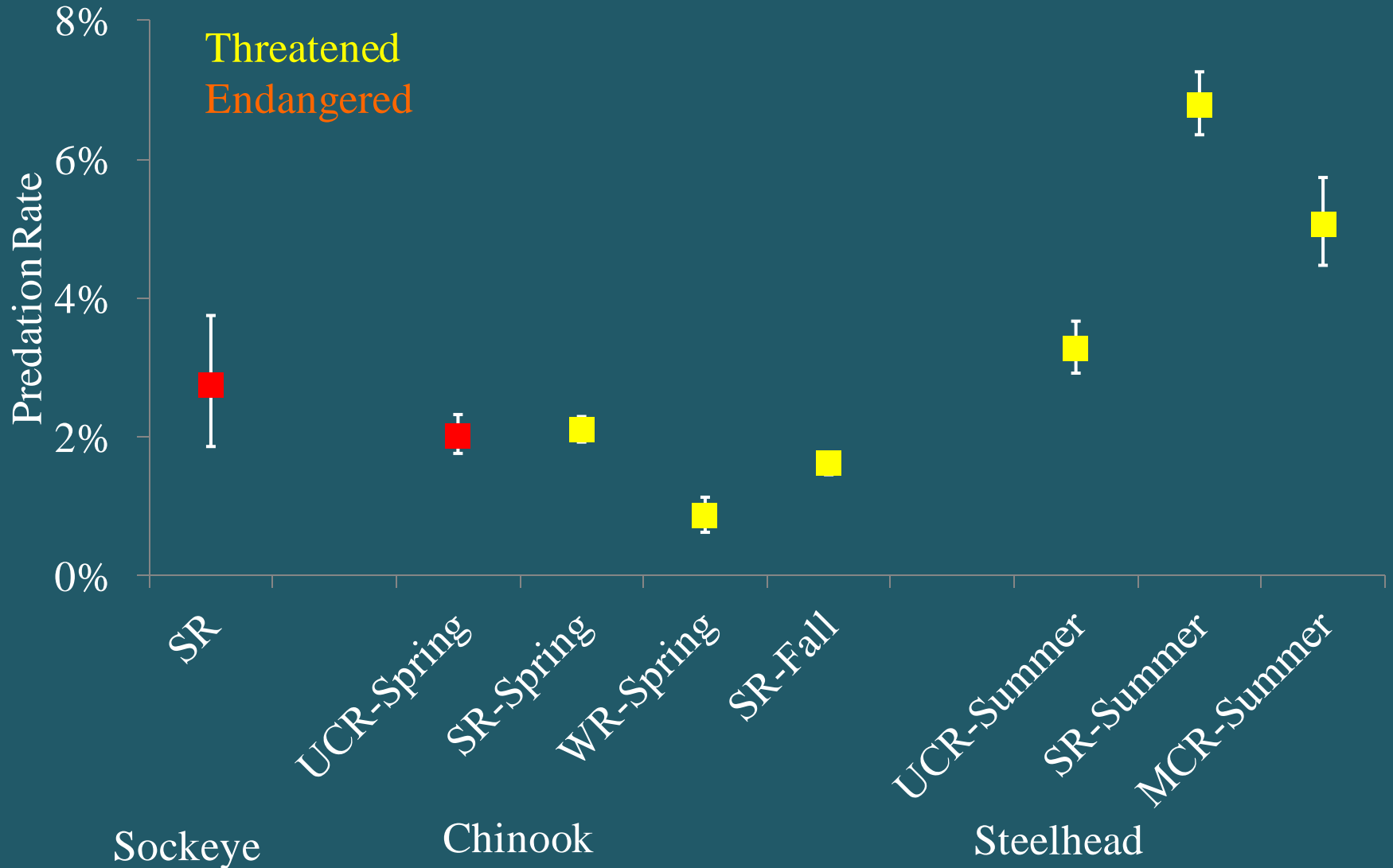
East Sand Island Cormorant Colony - 2012

Smolt PIT Tag Recoveries On-colony

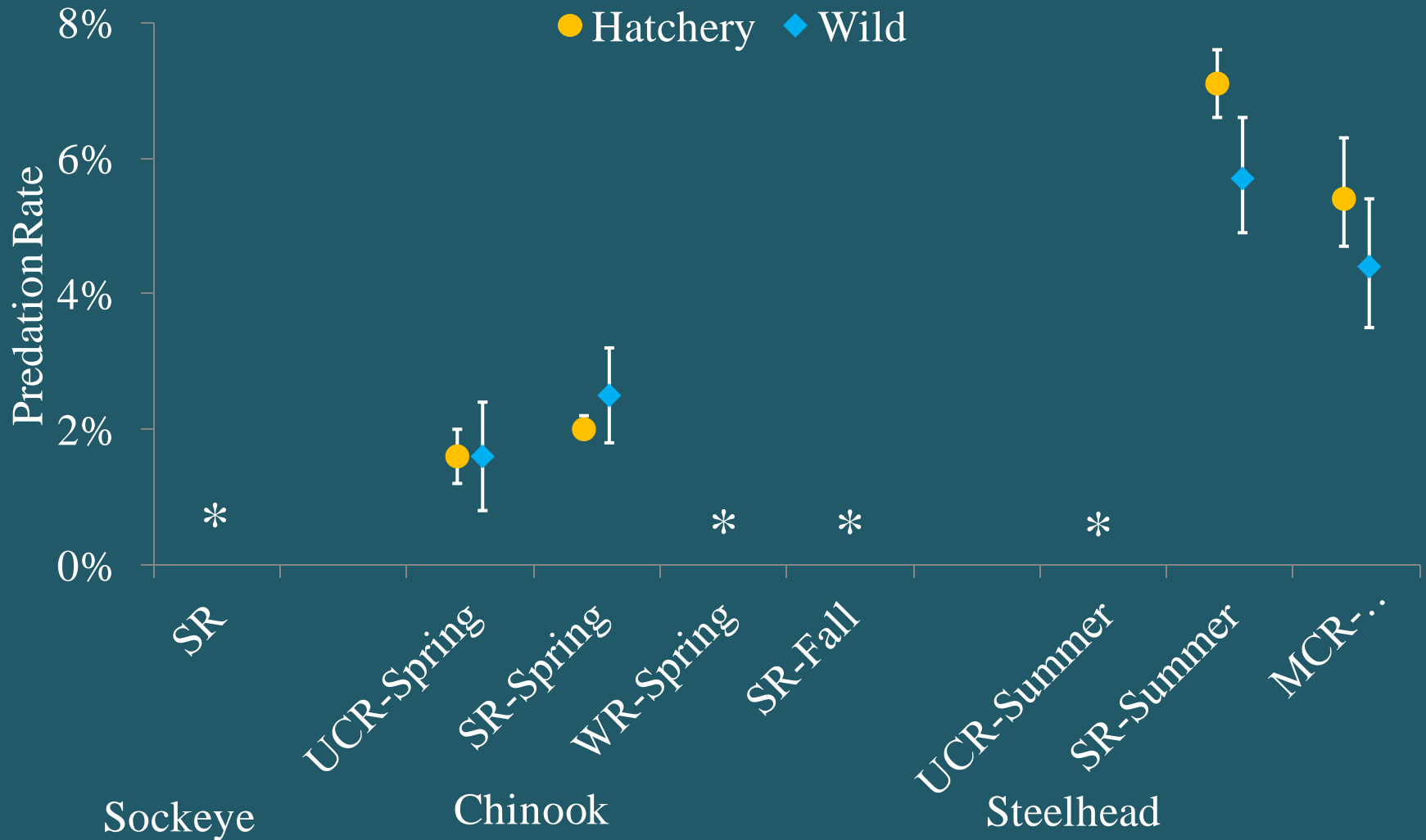
- Portion of consumed PIT tags regurgitated on-colony
- On-colony PIT tag recoveries relative to in-river interrogations yields minimum predation rates
- NOAA Fisheries - Collaborator



Predation Rates on PIT-tagged ESA-listed Smolts by Double-crested Cormorants on East Sand Island by stock, 2004-2009



Predation Rates on PIT-tagged ESA-listed Smolts by Double-crested Cormorants on East Sand Island by stock and rear-type, 2004-2009



*No comparisons, too few PIT-tagged wild smolts

Estimating Benefits from Reduced Cormorant Predation

- NOAA's deterministic, age-structured salmon population growth model (Kareiva et al. 2000, McClure et al. 2003)

- Key measure: average annual population growth rate (λ)

- Population Trajectory
- $\lambda > 1$ growth
- $\lambda = 1$ stability
- $\lambda < 1$ decline

$$D / = \left[\left(\frac{S_a}{S_b} \right)^{1/G} - 1 \right] \cdot 100\%$$

- Analysis input:

- Current survival (1 – current predation rate)
- Future survival (1 – future predation rate)
- Generational time

- Analysis output:

- % increase in λ ($\Delta\lambda$) for a given reduction in cormorant predation
- Range of $\Delta\lambda$ reflecting different assumptions about unknowns

Analysis Context

- Use ESU/DPS-specific estimates of predation rate:
 - Based on PIT-tagged samples of particular ESU/DPSs
 - Pool of available smolts enumerated at upstream interrogation or release site
 - Tag recoveries at ESI DCCO colony used to quantify predation
 - Corrected for detection efficiency
 - Corrected for off-colony deposition rate



Modeling Framework Assumptions

- Assume mortality is not density dependent
 - If smolt abundance changes dramatically, re-analysis may be warranted
 - e.g., if dramatic change occurs in smolt transportation, hatchery production, or in-river survival
- Mortality at different life history stages is independent
 - Levels of compensation for reductions in avian predation is unknown



Status of Western Population of Double-crested Cormorants

- Current Western Population \approx 31,500 breeding pairs
- Western Population has been increasing by about 3% per year
- Western Population still an order of magnitude smaller than population in interior & eastern North America
- Limited connectivity between Western Population and populations east of the Continental Divide

Incomplete Science

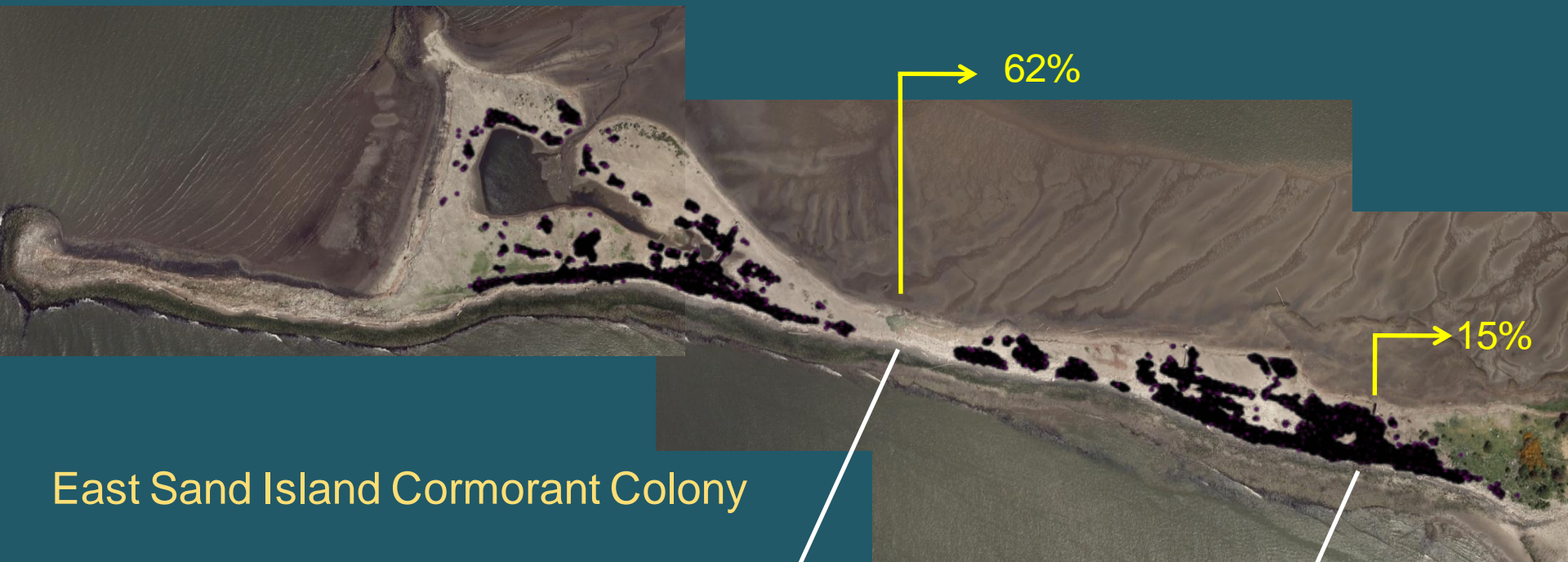


- Can usually estimate:
 - Numbers of salmonids consumed
 - Juvenile salmonid mortality rates
- Can not measure:
 - Impact to adult (breeding) salmonid populations
 - Many confounding effects
(climate/ocean conditions, delayed mortality from dams, etc.)
- Models helpful, but controversial:
 - Additive/compensatory mortality?
 - Indirect species interactions (impacts to salmonid competitors, predators)?
- Usual conclusion: Managing avian predators won't recover salmonids, but may benefit some salmonid Evolutionarily Significant Units as much as expensive recovery actions



Pilot study of cormorant dissuasion – 2011 & 2012

The Push?



East Sand Island Cormorant Colony

Proposed Privacy Fence 2012

Privacy Fence 2011

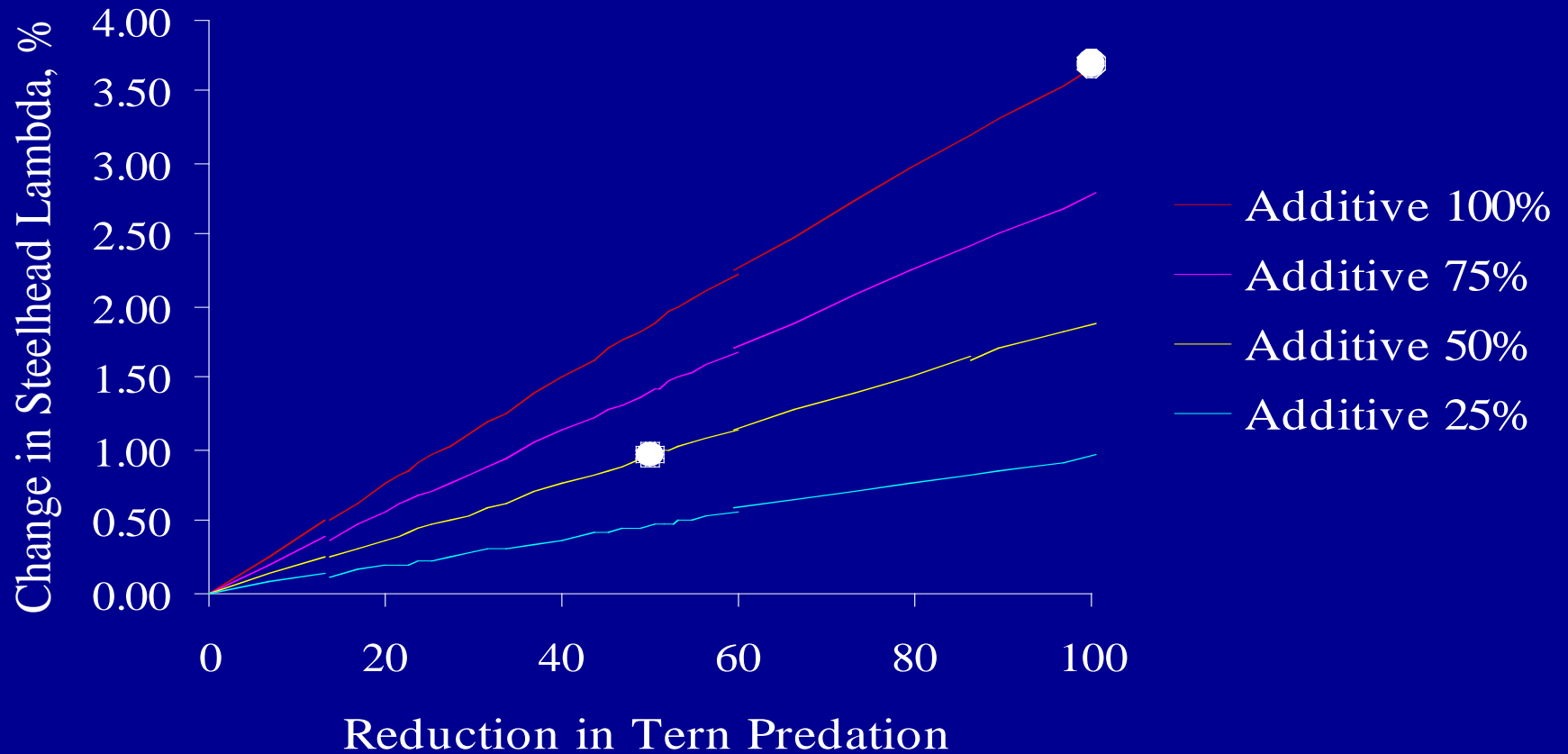


2012 Privacy Fence – East Sand Island Cormorant Colony

Avian Predation in the Columbia River Estuary

- Combined losses of juvenile salmonids to predation by Caspian terns and double-crested cormorants in the Columbia River estuary were about 25 million smolts in 2011
- Total smolt losses to double-crested cormorants were about 4 times greater than smolt losses to Caspian terns in 2011
- Habitat for Caspian terns on East Sand Island was reduced by 70% from former area; Caspian terns colony about half its former size
- A Draft Environmental Impact Statement for managing the East Sand Island cormorant colony is in preparation

Potential Improvements in Steelhead λ From Reductions in Tern Predation



Caspian Tern Colonies on the Columbia Plateau

