April 28, 2015

MEMORANDUM

TO: Council members

FROM: Jim Ruff

SUBJECT: Quantifying Avian Predation on Fish Populations presentation

BACKGROUND:

Presenters: Allen Evans, Fisheries Scientist with Real Time Research, Inc. and Dan Roby, Professor and Unit Leader of the Oregon Cooperative Fish and Wildlife Research Unit at Oregon State University.

Summary: Avian predation on ESA-listed fish populations is a concern among fisheries managers. To more accurately measure population-level impacts of predation, an integrated tag-recovery model was applied that accounts for the fraction of fish tags consumed by birds that are not subsequently deposited on their nesting colonies. Results indicate that predation rates (the percentage of tagged fish consumed) by Caspian terns, double-crested cormorants, and California gulls were higher than those calculated based solely on the proportion of fish tags deposited on-colony, especially when predation by gulls nesting in the Columbia Plateau region were considered. The methods improve the accuracy of tag recovery approaches to estimate predation impacts and the results have been incorporated into the most recent avian management and evaluation plans, including the U.S. Army Corps of Engineers’ Columbia River Estuary Double-crested Cormorant Environmental Impact Statement. These results, along with an update on the status of fish-eating waterbird colonies (size and locations) in the Columbia River Basin, will be presented.
Relevance: This information is relevant because preserving Fish and Wildlife Program effectiveness by supporting expanded management of predators, including avian predators, is a high priority identified in the Program. Management of predator birds is a key sub-strategy identified in the Program. A Program measure calls on the federal action agencies to continue to implement predator bird management actions in the Columbia Basin in coordination with state and federal fish and wildlife agencies and tribes.

Workplan: This presentation addresses Council work plan item 2.B, which promotes regional fish and wildlife recovery by prioritizing and implementing 2014 Fish and Wildlife Program actions.

Background: This presentation will summarize the findings from a recent scientific paper entitled, “Quantifying Avian Predation on Fish Populations: Integrating Deposition Probabilities in Tag Recovery Studies on Bird Colonies.” The authors of this paper are Nathan Hostetter, Allen Evans*, Bradley Cramer, Ken Collis, Donald Lyons and Daniel Roby*. The paper is available for review upon request.

More Info: None.
Quantifying Avian Predation on Fish Populations: Integrating Deposition Probabilities in Tag Recovery Studies on Bird Colonies

Briefing for the Northwest Power and Conservation Council  May 5, 2015
Acknowledgements

**Authors:** Nathan Hostetter, Allen Evans *, Bradley Cramer, Ken Collis, Donald Lyons, and Daniel Roby *

**Funding:** U.S. Army Corps Walla Walla District (Dave Trachtenbarg)  
U.S. Army Corps Portland District (Cindy Studebaker)  
Bonneville Power Administration (Dave Roberts, John Skidmore)  
Grant County PUD and Priest Rapids Coordinating Committee (Curt Dotson)

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US Fish and Wildlife (Lamont Glass)
PIT tags detected on bird colonies can be used to determine predation rates (number consumed/number available)
Advantages of Using PIT Tags

• Provides an accurate and precise measure of predation rates
• Estimates are population-specific (ESU/DPS)
• Can be used to identify which colonies pose the greatest risk to smolt survival
• Can be used to evaluate the efficacy of avian management plans
• Provides survival data to multiple RM&E programs basin-wide; over a million PIT tags detected on bird colonies since 1998; representing multiple fish families and species
Challenges of Using PIT Tags

- Some fraction of PIT tags consumed by birds are not deposited or detected on bird colonies; underestimating actual impacts.
Methods: Deposition Trials

Present PIT-tagged fish containing known tag codes to birds

- Five years of research (2004-2006; 2012-2013)
- Three bird species, seven different nesting colonies
- 2,696 tagged fish consumed

California Gull  Caspian Tern  Double-crested Cormorant
Methods: PIT Tag Scanning

- Scan colonies post-breeding season to recover PIT tags
  - Hand-held antennas on rocky or uneven substrate
  - Flat-plate antennas on sandy or smooth substrate
Results
Results: PIT Tag Deposition Rates

<table>
<thead>
<tr>
<th>Predator species</th>
<th>Tern</th>
<th>Cormorant</th>
<th>Gull</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deposition probability</td>
<td>0.00</td>
<td>0.25</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>0.75</td>
<td></td>
<td>1.00</td>
</tr>
</tbody>
</table>

Predator species

Deposition probability
Colony-specific Predation Rates on Snake River Steelhead (deposition uncorrected and corrected)

Predation probability

Bird colony

2012 MCN
MCN-BON
ESTUARY

CSI Gull
CSI Tern
MRI Gull
ESI Tern
ESI Cormorant

Gull
Tern
Cormorant
### Salmonid Population-Specific Predation Rates, 2014* (deposition corrected)

<table>
<thead>
<tr>
<th>Salmonid Population</th>
<th>ESI Terns</th>
<th>ESI Corm</th>
<th>MRI Gulls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snake River Steelhead</td>
<td>8.6%</td>
<td>7.8%</td>
<td>5.3%</td>
</tr>
<tr>
<td>Upper Columbia Steelhead</td>
<td>11.4%</td>
<td>10.4%</td>
<td>6.1%</td>
</tr>
<tr>
<td>Middle Columbia Steelhead</td>
<td>9.5%</td>
<td>6.4%</td>
<td>-</td>
</tr>
<tr>
<td>Snake River Fall Chinook</td>
<td>1.0%</td>
<td>2.4%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Snake River Sp/Su Chinook</td>
<td>1.1%</td>
<td>8.5%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Upper Columbia Sp Chinook</td>
<td>1.4%</td>
<td>6.1%</td>
<td>2.3%</td>
</tr>
<tr>
<td>Upper Willamette Chinook</td>
<td>1.2%</td>
<td>1.8%</td>
<td>-</td>
</tr>
<tr>
<td>Snake River Sockeye</td>
<td>1.6%</td>
<td>4.5%</td>
<td>4.4%</td>
</tr>
</tbody>
</table>

* Preliminary
## Cumulative Predation Rates on Upper Columbia Steelhead, 2014*

*(deposition corrected)*

<table>
<thead>
<tr>
<th>Location</th>
<th>Colony</th>
<th>Predation Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twinning Is.</td>
<td></td>
<td>1.1%</td>
</tr>
<tr>
<td>Goose Is.</td>
<td></td>
<td>2.9%</td>
</tr>
<tr>
<td>Crescent Is.</td>
<td>Tern</td>
<td>3.4%</td>
</tr>
<tr>
<td>Blalock Is.</td>
<td></td>
<td>0.8%</td>
</tr>
<tr>
<td>East Sand Is.</td>
<td></td>
<td>6.6%</td>
</tr>
<tr>
<td>Island 20</td>
<td></td>
<td>1.6%</td>
</tr>
<tr>
<td>Crescent Is.</td>
<td></td>
<td>6.8%</td>
</tr>
<tr>
<td>Anvil Is.</td>
<td>Gull</td>
<td>1.6%</td>
</tr>
<tr>
<td>Straight Six Is.</td>
<td></td>
<td>0.4%</td>
</tr>
<tr>
<td>Miller Rocks</td>
<td></td>
<td>4.6%</td>
</tr>
<tr>
<td>Foundation Is.</td>
<td></td>
<td>0.2%</td>
</tr>
<tr>
<td>East Sand Is.</td>
<td>Corm</td>
<td>4.6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>35%</strong></td>
</tr>
</tbody>
</table>

*Preliminary*
Summary of PIT Tag Study Results

- Deposition rates influence PIT tag detections on bird colonies
- Updated methods are more accurate and allow for comparisons across colonies, salmonid populations, and years
- Predation rates vary by colony, salmonid population, and year; not all colonies have an equal impact on smolt survival
- Cumulative losses on salmonid smolts can be substantial
Back Up Slides
Methods: Predation Rate Models

Estimated Predation

θ

φ

ψ

Likelihood

point estimate with 95% CI
Results: Colony-specific PIT Tag Deposition Rates

Deposition probability

Week (April) (July)

Tern
Results: PIT Tag Deposition Rates

Deposition probability

Week (April) (July)

Cormorant
Results: PIT Tag Deposition Rates

Deposition probability

Gull

Week (April) (July)
Status of Caspian Tern Breeding Colonies at Managed and Un-managed Sites in the Columbia Basin and at Corps-constructed Islands

Briefing for the Northwest Power and Conservation Council
May 5, 2015

Oregon State University
Real Time Research, Inc.
USGS-Oregon Cooperative Fish & Wildlife Research Unit
Acknowledgments

**Co-authors:** Ken Collis (Co-PI), Don Lyons, Allen Evans, Pete Loschl, Tim Lawes, Yasuko Suzuki, Brad Cramer, Kirsten Bixler, Alexa Piggott, Cheryl Horton, and Mike Hawbecker

**Collaborators:**
- U.S. Bureau of Reclamation
- NOAA Fisheries
- Oregon Department of Fish and Wildlife
- Washington Department of Fish and Wildlife
- U.S. Fish & Wildlife Service
- Northwest Power and Conservation Council
- Pacific States Marine Fisheries Commission

**Funding:**
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- U.S. Army Corps of Engineers, Walla Walla District (David Trachtenbarg)
- U.S. Army Corps of Engineers, Portland District (Cindy Studebaker)
- Grant Co. Public Utility District & Priest Rapids Coordinating Committee (Curt Dotson)
- Bureau of Reclamation (Mike Lesky & Ann Haynes)
Caspian Tern Colony on East Sand Island
The “Push”

Limiting Caspian terns to 1 acre of suitable nesting habitat in the Columbia Estuary
East Sand Island Caspian Terns
Colony Area Provided and Used

Colony Area (acres)
East Sand Island Caspian Terns
Colony Size

Breeding Pairs


Average (pre-management)
The “Pull”
Corps-constructed Tern Islands as Alternative Colony Sites

Malheur Lake Tern Island, Malheur National Wildlife Refuge, OR
Corps-constructed Tern Islands monitored in 2014

- Crump Lake
- Warner Valley
- Summer Lake Wildlife Area
  - East Link Impoundment
- Summer Lake Wildlife Area
  - Gold Dike Impoundment
- Malheur Lake
- Malheur NWR
- Sheepy Lake
- Lower Klamath NWR
- Tule Lake Sump 1B
- Tule Lake NWR
Corps-constructed Tern Islands
Caspian Tern Nesting

Breeding Pairs

2008 2009 2010 2011 2012 2013 2014
Corps-constructed Tern Islands monitored in 2015

- Malheur Lake
- East Sand Island
- Summer Lake Wildlife Area (2)
- Sheepy Lake
- Tule Lake
- South Link Impoundment
- Sheepy Lake Wildlife Area
- East Link Impoundment
- Gold Dike Impoundment
- Malheur NWR
- Lower Klamath NWR
- Tule Lake Sump 1B
- Tule Lake NWR
New Corps-constructed Caspian tern islands in Don Edwards National Wildlife Refuge, south San Francisco Bay

Pond SF2 New Tern Islands

Pond A16 New Tern Islands
Caspian Tern Colonies in the Columbia Plateau Region
Goose Island Tern Colony, Potholes Reservoir

More “Push”

- Former Caspian tern colony of 400-500 breeding pairs
- Much larger gull colony shares the island
- Management to reduce tern colony size initiated in 2014
Goose Island Passive and Active Dissuasion 2014

- Successful in preventing Caspian terns from nesting on Goose Island proper
- Some Caspian terns dissuaded from Goose Island nested on Northwest Rocks
- Action agencies decided not to haze terns at Northwest Rocks
- 159 Caspian tern pairs nested on Northwest Rocks; 46 young terns fledged
Goose Island, Potholes Reservoir - 2015

• Tern dissuasion installed on virtually the entire island plus Northwest Rocks

• Caspian tern colony has so far been prevented from forming due to hazing & dissuasion
Crescent Island Tern Colony, McNary Pool, Mid-Columbia River
More “Push”

• Former Caspian tern colony of 400-500 breeding pairs
• Much larger California gull colony shares the island
• Management to reduce tern colony size initiated in 2015
No Caspian terns have attempted to nest on Crescent Island so far this year.
Summary of Key Findings in 2014

- Caspian tern colony at East Sand Island in Columbia River estuary was slightly smaller and smolt consumption slightly lower than in 2013.

- Despite management that prevented all nesting by Caspian terns on Goose Island – Potholes Reservoir, some terns nested on small islet nearby.

- Severe drought in the basins where Corps-constructed tern islands are located led to reduced colony size at most islands; combined breeding pairs declined 33% compared to 2013.

- Total number of breeding Caspian terns at all colonies in the Pacific Northwest was somewhat lower in 2014 compared to 2013.
Thanks! Questions?
Backup Slides
East Sand Island Double-crested Cormorant Colony Size

Breeding Pairs

- 2000: 8,000 ± 1,000
- 2001: 9,000 ± 1,000
- 2002: 10,000 ± 1,000
- 2003: 11,000 ± 1,000
- 2004: 12,000 ± 1,000
- 2005: 13,000 ± 1,000
- 2006: 14,000 ± 1,000
- 2007: 15,000 ± 1,000
- 2008: 16,000 ± 1,000
- 2009: 14,500 ± 1,000
- 2010: 15,000 ± 1,000
- 2011: 15,500 ± 1,000
- 2012: 16,000 ± 1,000
- 2013: 16,500 ± 1,000
- 2014: 17,000 ± 1,000

Average (2004-2013): 15,000 ± 1,000
Caspian Tern Nesting Density

Nesting Density (nests/m²)

Colony Location

- East Sand Is.
- Tacoma Barge
- Brooks Is.
- Eden Landing
- Crescent Is.
- Rice Is. (97-98)
- Rice Is. (99)
- Stevens Creek
East Sand Island Caspian Terns
Nesting Success

Young Raised/Breeding Pair

![Graph showing nesting success from 2000 to 2014.](image-url)
## Corps-constructed Islands
### 2014 Results

<table>
<thead>
<tr>
<th>Location</th>
<th>Size (acres)</th>
<th>Colony Size (breeding pairs)</th>
<th>Produced fledglings (limiting factor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malheur NWR, OR</td>
<td>1</td>
<td>134</td>
<td>Yes</td>
</tr>
<tr>
<td>Lower Klamath NWR, CA (Sheepy Lake)</td>
<td>0.8</td>
<td>520</td>
<td>Yes</td>
</tr>
<tr>
<td>Crump Lake, OR</td>
<td>1</td>
<td>1</td>
<td>No (no water)</td>
</tr>
<tr>
<td>Tule Lake NWR, CA</td>
<td>2</td>
<td>109</td>
<td>Yes</td>
</tr>
<tr>
<td>Summer Lake, OR (East Link)</td>
<td>0.5</td>
<td>22</td>
<td>Yes</td>
</tr>
<tr>
<td>Summer Lake, OR (Gold Dike)</td>
<td>0.5</td>
<td>0</td>
<td>No (mink, raccoon)</td>
</tr>
<tr>
<td>Lower Klamath NWR, CA (Orems Unit)</td>
<td>1</td>
<td>0</td>
<td>No (no water)</td>
</tr>
<tr>
<td>Fern Ridge, OR</td>
<td>1</td>
<td>0</td>
<td>No (unknown)</td>
</tr>
</tbody>
</table>

**TOTAL**

7.8 acres

786 pairs
Corps-constructed Tern Islands
2014 Caspian Tern Colony Sizes

- Crump Lake Island
- East Link Island
- Gold Dike Island
- Tule Lake Sump 1B Island
- Sheepy Lake Island
- Malheur Lake New Tern Island
- All Interior CATE Colonies

Arrows indicate change from 2013
Net numbers of Caspian terns that moved between colonies (2013-2014)

- East Sand Island: 133
- Crescent Island: 126
- Goose Island: 106
- Oregon:
  - 50
  - 40
  - 42
- California:
  - 4
  - 0
Goose Island Passive and Active Dissuasion

- Dissuasion materials delivered to Goose Island via helicopter (25 February)
- Passive dissuasion constructed with pier blocks, rebar, PVC tubing, polypropylene rope, and caution tape
- 2.38 acres of tern nesting habitat covered with passive dissuasion
- Active hazing of gulls and terns initiated in late March
• Successful in preventing Caspian terns from nesting on Goose Island proper

• 3 pairs of Caspian terns attempted to nest

• 3 Caspian tern eggs were removed from nests by researchers soon after laying
Goose Island Archipelago
Potholes Reservoir
Columbia Plateau Region
2014 Caspian Tern Colony Sizes

Arrows indicate change from 2013
Caspian Tern Breeding Population Size on the Columbia Plateau

Average (2005-2013)
Predation Rates by Goose Island Terns on ESA-listed Salmonid Populations (managed)

<table>
<thead>
<tr>
<th>ESU/DPS</th>
<th>Pre-management 2007-2013</th>
<th>Post-management 2014</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCR Spring Chinook</td>
<td>2.5% (1.7 - 3.6%)</td>
<td>0.3% (0.1 - 0.7%)</td>
<td>-2.2% (-1.6 - -2.9%)</td>
</tr>
<tr>
<td>UCR Steelhead</td>
<td>15.7% (14.1 - 18.9%)</td>
<td>2.9% (1.9 - 5.1%)</td>
<td>-12.7% (-12.2 - -13.8)</td>
</tr>
</tbody>
</table>
Tern Tagging Study: Methods

- Satellite tags deployed on 28 Caspian terns caught on former colony site at Goose Island, Potholes Reservoir during April 2-11, 2014
- Location data available on 28 hour cycle (6 hours on, 22 hours off)
- All tags collected data through the end of May
- 23 tags still functional and collecting data through May 1, 2015
Tagged birds displayed three general categories of response to displacement and habitat reduction:

• Stay and compete for reduced habitat
• Move and attempt to nest at other colony; return if nesting fails
• Nomadic wandering without sustained colony association