Mercury Contamination Trends in Peregrine Falcon Feathers in Coastal Washington

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Washington

Ocean Shores
Grays Harbor
Grayland
Willapa Bay
Long Beach
Pacific Ocean
Columbia River

100 km
Methods: Field Effort

2001 – 2016
735 surveys

Year-round surveys
Primarily September – May
Falcons captured with European Starling or Rock Pigeon as lure
Banded for Identification
Aged Using Plumage Coloration

Hatch Year

Second Year

After Second Year
Peregrine Falcon
Cause: DDT
Biomagnifies through food webs
Peregrine Falcon: Indicator Species
Peregrine Falcon Sample Locations

113 blood samples also collected
Peregrine Falcon Blood Sample Analysis

Flame retardants
PCBs
DDT

Dr. Da Chen

Jinan University, Guangzhou, China
Mercury (Hg)

Hg biomagnifies through food webs

Largest source: coal combustion

Two-thirds of the human-caused total globally (Pacyna et al. 2006)
Hg and Health

1. Causes neurological problems in humans
2. Impacts nervous, circulatory, and endocrine systems in birds
3. Accumulates in feathers during feather growth (molt)
Assessment
Total Mercury (Hg) levels, feathers

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Methods: Feather Collection: outer 1.5 cm

Primarily 4th secondary feathers
Methods: Feather Processing

Analyzed Hg using thermal decomposition (750° C)

Detection limit = 2.5 ppb
Feathers Collected by Subspecies

- Peregrine total: 151
  - *Falco peregrinus pealei*: 123
  - *F. p. tundrius*: 6
  - *F. p. anatum*: 4
  - unclear: 18
Results: Subspecies

Likelihood ratio = 2.2, $P = 0.136$
Results: Age Class

Mean Hg $+95\%$ CI (ppm)

- Hatch Year: $n = 107$
- Second Year: $n = 25$
- After Second Year: $n = 27$

$F_{2,156} = 70.4, P < 0.001$
Results: Age Class & Sex

<table>
<thead>
<tr>
<th>Hatch Year</th>
<th>After Hatch Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male=35, Female=70</td>
<td>Male=11, Female=33</td>
</tr>
</tbody>
</table>

\[ F_{1,145} = 1.87, P = 0.17 \]
Results: Hatch Year Birds, 3 Time Periods

\[ F_{2,104} = 11.54, \ n = 107, \ P < 0.001 \]

ANOVA with Bonferroni post-hoc test
Summary

- Broad Hg exposure across age classes
- Significant Hg increase, Hatch Year to After Hatch Year
- Decrease in Hg, last 5 years of study (2012 – 2015)
Discussion

Hg levels increasing in north Pacific Ocean (Sunderland et al. 2009)
## Discussion

Our results compared with other studies

<table>
<thead>
<tr>
<th>Location</th>
<th>Years</th>
<th>Hatch Year in ug/g (n)</th>
<th>After Hatch Year in ug/g (n)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washington, USA</td>
<td>2001-2016</td>
<td>6.1 (105)</td>
<td>23.1 (44)</td>
<td>This study</td>
</tr>
<tr>
<td>Nevada, USA</td>
<td>2012-2013</td>
<td>3.8 (24)</td>
<td>12.2 (25)</td>
<td>Barnes &amp; Gretten. 2015</td>
</tr>
<tr>
<td>N Canada &amp; Alaska, USA</td>
<td>2009-2015</td>
<td>2.7 (120)</td>
<td>10.3 (105)</td>
<td>Barnes et al. 2018</td>
</tr>
<tr>
<td>Sweden</td>
<td>1971-1978</td>
<td>2.8 (7)</td>
<td>10.0 (9)</td>
<td>Lindberg &amp; Odsjo 1983</td>
</tr>
</tbody>
</table>
Peregrine Falcon: Indicator Species