Apr 4th, 4:15 PM - 4:30 PM

Divergent trends in migration timing of shorebirds along the Pacific flyway

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**Speaker**
David Hope, Joseph Buchanan, Mary Anne Bishop, George Matz, Moira Lemon, and Mark Drever

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Divergent trends in migration timing of shorebirds along the Pacific flyway

David D. Hope, Mark C. Drever, Joseph B. Buchanan, Mary Anne Bishop, George Matz, and Moira J. F. Lemon
Northward migration along the Pacific Flyway

- Short time window
- Timing of arrival at breeding location must tradeoff with survival on migration
- Changes in conditions on migration and at breeding ground should result in changes in timing on migration
- Shorebirds can be counted easily at large stopover sites on migration

Source: Alaska Fish and Game
Project aims

Has the timing of migration changed along the flyway?
  - Climate change
  - Predator recovery

Is an observed change consistent across the flyway?
Western sandpipers and dunlin

*Calidris mauri*  
*Calidris alpina*  

[Images of Western sandpipers and dunlin]  

www.flickr.com/photos/katechka  

Birds of North America Online
Flyway sites with years and sample sizes

- Kachemak Bay
- Copper River Delta
- Tofino Mudflats
- Kennedy Creek
- Roberts Bank

Source: USDA, flickr.com/thedamian
Collaborators

- Joe Buchanan - Kennedy Creek, WA
- Mark Drever and Moira Lemon - Roberts Bank and Tofino Mudflats, BC
- Mary Anne Bishop - Copper River Delta, AK
- Environment for the Americas – Hartney Bay, AK
- George Matz and Kachemak Bay Birders - Kachemak Bay, AK
Quantifying passage through a stopover

Peak Passage Date (April 25)

Truncated Normal Distribution

Abundance counts

Western Sandpipers Roberts Bank, 2014
Timing of passage has changed in both species.
Role of Local Temperature

- Mean local minimum temperature affected passage dates
- Temperature did not explain interannual trend
Behavioural mechanisms

- Length of stay and arrival date influence peak passage estimate
- Small impact from number of birds and migratory strategies
- Winter resident population has strong impact
Divergent trends, divergent process?

- Western Sandpiper migratory passage now 3 days earlier in Salish Sea (0.085 days/year earlier)
- Passage shifted by 2 days later at northern sites
- Early arrival at southern sites
- Spending longer at northern sites
Non-breeding Dunlins

- More Dunlin at start of surveys
- Increased aggregation at large sites
- Predator and population impacts
Role of Wintering Dunlins

- More Dunlin at start of surveys
- Increased aggregation at large sites
- Predator and population impacts

Ydenberg et al. 2017 Oecologia
Conclusions

- Western Sandpipers appear to be arriving earlier to the Salish Sea each spring.
- Dunlins may be increasingly using large Salish Sea sites during winter.
- Long term monitoring can be useful when combined with simulation modelling.
Project affiliations and funding

Tofino Mudflats and Roberts Bank surveys funded by:
Environment and Climate Change Canada

Cascadia Research Collective
non-profit research and education since 1979

Environment and Climate Change Canada

Copper River Delta and Hartney Bay, 1992-95 funded by:

Hope et al. (In Press). Trends in timing of spring migration along the Pacific Flyway by Western Sandpipers and Dunlins. The Condor: Ornithological Applications
Model effects

- Migratory passage now 3 days earlier in Salish Sea (0.085 days/year earlier)
- Passage shifted by 2 days later at northern sites
- Strong effects in Dunlins
Model effects

\[ \mu_{ij} = \alpha_j + \beta_1 \cdot \text{year}_i + \beta_2 \cdot \varphi_j + \beta_3 \cdot \varphi_j \cdot \text{year}_i + \beta_4 \cdot \tau_{ij} \cdot \eta_j + \beta_5 \cdot \tau_{ij} + \beta_6 \cdot \eta_j + \varepsilon_{ij} \]

\[ \alpha_j = N(\mu_\alpha, \sigma_\alpha^2) \]
Power analysis
## Survey sites

<table>
<thead>
<tr>
<th>Site</th>
<th>Years (n)</th>
<th>Survey Days</th>
</tr>
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<tbody>
<tr>
<td>Kennedy Creek, WA</td>
<td>15</td>
<td>13.9 ± 0.9</td>
</tr>
<tr>
<td>Roberts Bank, BC</td>
<td>23</td>
<td>20.6 ± 1.3</td>
</tr>
<tr>
<td>Tofino Mudflats, BC</td>
<td>3</td>
<td>17.3 ± 4.1</td>
</tr>
<tr>
<td>Copper River Delta, AK</td>
<td>4</td>
<td>10.0 ± 0.9</td>
</tr>
<tr>
<td>Hartney Bay, AK</td>
<td>7</td>
<td>19.0 ± 2.5</td>
</tr>
<tr>
<td>Kachemak Bay, AK</td>
<td>15</td>
<td>20.5 ± 1.5</td>
</tr>
</tbody>
</table>