Assessment of climate trends and projections and their associated impacts on the Pacific coast of Canada

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Fisheries and Oceans Canada
ACCASP stands for Aquatic Climate Change Adaptation Services Program

This is the Fisheries and Oceans Canada contribution to a government-wide effort to address climate change adaptation.

This is a Science program developed in close coordination with other 'sectors' (Policy, Fisheries Management, Fisheries Protection Program) of the Department.

Science participants included "Trends and projections" and "Impacts, vulnerabilities and opportunities" teams for each of four Large Aquatic Basins.
Pacific LAB subdomains

GOA

WCVI

SoG

NC

Gulf of Alaska

Depth (m)
100
200
2000
A trend is based on past observations, and the length of the observational records varies.

A projection is estimated from climate model output based on assumptions about future anthropogenic greenhouse gas emissions. We make projections only for the 50 year timescale.

In the North Pacific, climate variability is large relative to anthropogenic trends. Climate model projections have no predictive skill on the 10-year time scale. Trends based on less than 20-30 years of data can not be assumed to represent long-term trends.
What is unique about Pacific LAB?

- no sea ice
- very large interdecadal variability
- very shallow OMZ and ASH
- dominant role for anadromous fish
- adjacent ocean is HNLC
What is unique about Pacific LAB?

- no sea ice
- very large interdecadal variability
- very shallow OMZ and ASH
- dominant role for anadromous fish
- adjacent ocean is HNLC
Projections require **downscaling** for all sub-basins except the open Gulf of Alaska.
Domain of regional downscaling model (Masson, Morrison, Foreman, Callendar, Pena)
CanRCM grid (45 km)
## Coastal temperature time series

<table>
<thead>
<tr>
<th>Location</th>
<th>Duration (years)</th>
<th>Trend (°C / 100 y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphitrite Point</td>
<td>76</td>
<td>0.77 ± 0.60</td>
</tr>
<tr>
<td>Kains Island</td>
<td>76</td>
<td>0.57 ± 0.74</td>
</tr>
<tr>
<td>Entrance Island</td>
<td>74</td>
<td>1.48 ± 0.53</td>
</tr>
<tr>
<td>Race Rocks</td>
<td>69</td>
<td>1.52 ± 0.57</td>
</tr>
<tr>
<td>Pine Island</td>
<td>74</td>
<td>0.86 ± 0.80</td>
</tr>
<tr>
<td>Langara Island</td>
<td>71</td>
<td>0.85 ± 0.75</td>
</tr>
<tr>
<td>Bonilla Island</td>
<td>51</td>
<td>0.86 ± 1.05</td>
</tr>
<tr>
<td>Chrome Island</td>
<td>48</td>
<td>3.60 ± 1.86</td>
</tr>
</tbody>
</table>

Cummins and Masson 2014 Prog Oceanogr 120: 279
Projections of aragonite saturation (Gulf of Alaska)
Projections of dissolved oxygen (Gulf of Alaska)
Historic temperatures and projected changes over land
Frequency of occurrence of temperatures >18°C in northern and southern salmon-bearing rivers

- Tahltan
- Meziadin
- Docee

- Cowichan
- Somass
- Okanagan

Mean No. POT18°C Dates per Year

Decade

Month | Jul | Aug | Sep | Oct
--- | --- | --- | --- | ---


Ranking the Risks

Climate Change Risk Exposure
Pacific LAB in 10 years (IRM)

2. Changes in Biological Resources
3. Species Reorganization and Displacement
1. Ecosystem and Fisheries Degradation and Damage
5. Infrastructure Damage
4. Increased Demand to Provide Emergency Response
6. Changes in Access and Navigability of Waterways

Risk Index (Risk Exposure)

Climate Change Risk Exposure
Pacific LAB in 50 years (IRM)

3. Species Reorganization and Displacement
2. Changes in Biological Resources
1. Ecosystem and Fisheries Degradation and Damage
5. Infrastructure Damage
4. Increased Demand to Provide Emergency Response
6. Changes in Access and Navigability of Waterways

Risk Index (Risk Exposure)
# Risk index - all LABs

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Arctic LAB</th>
<th>Atlantic LAB</th>
<th>Freshwater LAB</th>
<th>Pacific LAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ecosystem and Fisheries Degradation and Damage</td>
<td>20.16</td>
<td>13.48</td>
<td>17.1</td>
<td>17.16</td>
</tr>
<tr>
<td>2. Changes in Biological Resources</td>
<td>18.24</td>
<td>15.08</td>
<td>13.76</td>
<td>18.4</td>
</tr>
<tr>
<td>3. Species Reorganization and Displacement</td>
<td>14.52</td>
<td>13.82</td>
<td>21.12</td>
<td>18.86</td>
</tr>
<tr>
<td>4. Increased Demand to Provide Emergency Response</td>
<td>20.16</td>
<td>12.94</td>
<td>11.1</td>
<td>7.83</td>
</tr>
<tr>
<td>5. Infrastructure Damage</td>
<td>17.1</td>
<td>18.32</td>
<td>14.96</td>
<td>14.76</td>
</tr>
</tbody>
</table>
The Integrated Risk Management Heat Map

Pacific IRM 10 yrs

Pacific IRM 50 yrs
The Integrated Risk Management Heat Map

Pacific IRM 10 yrs

Pacific IRM 50 yrs
The Integrated Risk Management Heat Map
Parting thoughts

- steep learning curve regarding climate variability and climate projections
- differences among LABs in how relative risks are perceived
- heat-map methodology needs work
- $O_2$, OA and river T risks need more thorough evaluation
Climate Trends and Projections for the Pacific Large Aquatic Basin

Editors
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