Modelling optimal responses and fitness consequences in a changing Arctic

Reimer, JR, Mangel, M, Lewis, MA, & Derocher, AE
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A female polar bear lives in a world of tradeoffs:

**Should she hunt in the riskier active ice...**

- Prey are abundant, but cubs are at risk of infanticide, or having to swim long distances.

**...or in the safer fast ice?**

- Prey are less abundant, but cubs face less risk.

**Should she continue investing in a reproductive attempt or save her energy for next year?**

How might the answers to these questions change if the sea ice breaks up earlier, shortening the important spring feeding period?
We explored these tradeoffs using **stochastic dynamic programming**, a type of mathematical model.

We found that:

- **earlier ice breakup** leads to increased use of riskier habitat and shifts in reproductive thresholds, resulting in fewer cubs produced over the lifetime of a female polar bear.

<table>
<thead>
<tr>
<th>historical date</th>
<th>1 week earlier</th>
<th>3 weeks earlier</th>
</tr>
</thead>
<tbody>
<tr>
<td>fast ice</td>
<td></td>
<td>active ice</td>
</tr>
</tbody>
</table>

- female's stored energy

  - attempt below this line
  - abandon a reproductive attempt
  - 2830 MJ
  - 3260 MJ
  - 3480 MJ