**Titrating the cost of plant toxins against predators: what’s the tipping point for foraging herbivores?**

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### Background: What influences foraging?

#### Model

- **Predation risk**
  - Lethal & Non-lethal
    - Abundance & population dynamics
    - Patch use:
      - Δ time allocation at safe vs risky
    - ↓ or ↑ in vigilance behavior

- **Plant Toxins**
  - Metabolism, Feeding, Foraging
    - Physiological/behavioral constraints:
      - ↓ intake
      - Δ meal size, duration, frequency
    - Eat a broad range of plants to limit toxin intake
    - Select plants with particular toxins

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### Concepts

- **Generalist herbivore**
  - Common brushtail possum (Trichosurus vulpecula)

- **Plant toxins**
  - Cineole (Eucalyptus oil)

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### Methods

Animals were offered a choice between non-toxic food at risky patches, paired against ↑ [toxin] at safe patches.

<table>
<thead>
<tr>
<th>Pair</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk</td>
<td>Safe + cineole g.gDM⁻¹</td>
</tr>
<tr>
<td>1</td>
<td>open, light, fox odor</td>
</tr>
<tr>
<td>2</td>
<td>(A) cover + No toxin</td>
</tr>
<tr>
<td>3</td>
<td>(B) cover + 0.01</td>
</tr>
<tr>
<td>4</td>
<td>(C) cover + 0.02</td>
</tr>
<tr>
<td>5</td>
<td>(D) cover + 0.05</td>
</tr>
<tr>
<td>6</td>
<td>(E) cover + 0.10</td>
</tr>
</tbody>
</table>

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### Results

- **Intake**
  - Using the experimental framework, we were able to establish the point – the tipping point – at which possums equated the cost of the toxin with the cost of fear induced by the predation cue.

- **Total time at patch**
  - Less time was spent at the safe patch as [toxin] ↑, concurrently ↑ time was spent at the risky patch. At 0.05 g gDM⁻¹ toxin, possums spent similar time between patches, until switching.

- **Time feeding**
  - As [toxin] ↑ in the safe patch, animals fed longer at the risky patch, and less at the cover patch. The point at which intake between treatments was most similar was at 0.05 g gDM⁻¹ toxin

- **Proportional vigilance**
  - In all instances, vigilance ↑ at the risky vs. the safe patch. As [toxin] ↑ in the safe patch, vigilance (absolute & proportional) also ↑. Thus, toxins - depending on their [ ]-modified vigilance.

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### References


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### Aims

1) Equate the cost of plant toxins and predation by titrating toxin concentration against perceived predation risk
2) Quantify the tipping point when animals move from safe but toxic food patches to risky non-toxic food patches

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### Conclusions

1) The tipping point occurred when food intake, time at patch and time feeding were most similar, ~ 0.05 g gDM⁻¹ toxin
2) Both plant toxins and predation risk were perceived as costs to foraging.
3) [Toxin] has a critical influence on the relative cost of predation risk.