Key questions for biodiversity accounting

• What are the units of account? (Genes, species, ecosystems?)
• Can indices of biodiversity be used as an input to ecosystem accounts?
• In what types of accounts would biodiversity by included?
  – Environmental (ecosystem) asset
  – Input to economic production
  – Input into ecosystem which generates ecosystem services
  – Indicator of ecosystem condition
  – Ecosystem service
• When assessing ecosystem condition, what reference points can be used?
Development of biodiversity accounting for the ACT using butterfly data

From Environmental-Economic Accounting for ACT State of the Environment Reporting Proof of Concept

Butterflies as indicators of biodiversity condition

• Useful indicator group of species:
  – Short lifespans
  – Generally limited dispersal ability
  – Larval food plant specialisation
  – Close reliance on weather and climate
  – Relatively well-documented for insects
  – Taxonomy relatively well-understood
  – Easy to recognise species
  – Information available on their ecology and life history
ACT Butterfly Research Project

• Materials and methods
  – Australian National Insect Collection (ANIC)
  – Published papers and books
  – Personal and citizen science observations
  – Field work
    • Modified Pollard (1977) walk
    • Fixed time and space
    • Transect surveys
    • Spring to autumn
    • Grassland, lowland woodland, dry forest, montane forest, wet forest, montane and subalpine woodland, wetlands, urban gardens, riparian habitat
ACT Butterfly Research Project

• Ongoing monitoring project since 2014 which collects reliable data on adult butterfly presence and abundance

• 176 survey sites in the ACT across a range of habitats.
### Butterflies of the World

Wallacea (between Wallace’s Line and Lydekker’s Line) important biogeographical transition zone separating Australian fauna from the rest of the world

<table>
<thead>
<tr>
<th></th>
<th>Number of species</th>
<th>Endemic to Australia</th>
<th>Introduced to Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>~18 000</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Australia</td>
<td>408*</td>
<td>200 (49%)</td>
<td>3</td>
</tr>
<tr>
<td>ACT</td>
<td>87</td>
<td>61 (70%)</td>
<td>2</td>
</tr>
</tbody>
</table>

* Represents continental Australia only (e.g. excluding Christmas, Norfolk and Lord Howe Islands)

Source: [https://www.learnaboutbutterflies.com/World%20Census.htm](https://www.learnaboutbutterflies.com/World%20Census.htm)
No threatened endemic species in ACT
Anticipated that the Small Ant-blue (Lycaenidae family) will be listed as threatened in ACT
Two introduced species – Cabbage White from the Pieridae and the Monarch from the Nymphalidae
## Snapshot of ACT butterfly species, breeding status and specialisation, 2018

<table>
<thead>
<tr>
<th>Breeding category</th>
<th>Breeding species*</th>
<th>Non-breeding species^</th>
<th>Generalists</th>
<th>Specialists</th>
<th>Total species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Papilionidae</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Hesperiidae</td>
<td>17</td>
<td>0</td>
<td>7</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td>Pieridae</td>
<td>3</td>
<td>8</td>
<td>3</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>Nymphalidae</td>
<td>18</td>
<td>6</td>
<td>9</td>
<td>9</td>
<td>24</td>
</tr>
<tr>
<td>Lycaenidae</td>
<td>26</td>
<td>3</td>
<td>9</td>
<td>17</td>
<td>29</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>67</strong></td>
<td><strong>20</strong></td>
<td><strong>31</strong></td>
<td><strong>36</strong></td>
<td><strong>87</strong></td>
</tr>
</tbody>
</table>

* Resident and regular migrant species

^ Migrants and vagrants; not included in classification of generalist/specialist breakdown

Specialists are species which rely on a particular habitat and hence can be linked to condition of these habitats (i.e. ecosystems)
• **Common Brown**  
  (*Heteronympha merope*)  
  • Widespread and abundant in every ACT ecosystem  
  • Cosmopolitan food plant preference (native and introduced plants)  
  • Adults live for several months  
  • Flexible strategies for surviving heat and drought

• **Alpine Sedge-skipper**  
  (*Oreisplanus munionga*)  
  • Restricted to swampy sub-alpine eucalypt woodland and grassland  
  • Food plant preference is one plant species  
  • Adults live for a few weeks  
  • Vulnerable to introduced herbivores, drought and heat
## Butterfly species account for the ACT, 1978 - 2018

<table>
<thead>
<tr>
<th></th>
<th>Native species</th>
<th>Introduced species</th>
<th>Specialisation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Endemic ACT</td>
<td>Endemic Australia</td>
<td>Non-endemic Australia</td>
</tr>
<tr>
<td><strong>Opening stock 1978</strong></td>
<td>0</td>
<td>56</td>
<td>19</td>
</tr>
<tr>
<td><strong>Additions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discovery of new species</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rediscovery of extinct species</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Addition of species</td>
<td>0</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Taxonomic reclassification</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td><strong>Reductions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extinction of species (Aust)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Loss of species (distribution)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Taxonomic reclassification</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Re-evaluation of records</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Closing stock 2018</strong></td>
<td>0</td>
<td>62</td>
<td>23</td>
</tr>
<tr>
<td><strong>Net change</strong></td>
<td>0</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

### Range extensions
- 3 vagrants or migrants
- 5 residents

### Taxonomic
- Golden Ant-blue was split from Copper Ant-blue (Lycaenidae)
Unexpected findings

• Complex taxonomic revisions over time
  – One new species,
  – Many scientific name changes

• Two points in time 40 years apart can miss significant disturbance events
  – 2003 bushfires
  – Reduced diversity at formerly productive sites
  – Two species lost for 14 years
  – Two species severely impacted and nearly lost
Final thoughts

• Systematic collection and assembly of species data a barrier to regular production of accounts
• Classification of species
  – Conservation status important but other classifications useful for understanding management needs of species
    • Generalists and specialists
    • Breeding and non-breeding
  – Which definitions should we use?
• Integration of species accounts with ecosystem accounts
  – Condition accounts
  – Cultural and recreation services (Bogong Moth example)
Questions for discussion

• What do you think of our table presentation? Is there a way to improve or change data presentation for greater clarity or impact?

• Have there been similar species accounts constructed for biodiversity?

• How could we best approach the future integration of this style of biodiversity species accounts with ecosystem accounts?