

# Feature extraction from insect wings (dragonfly example)

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14 April 2015

CSIRO Digital Productivity Flagship



# Overview

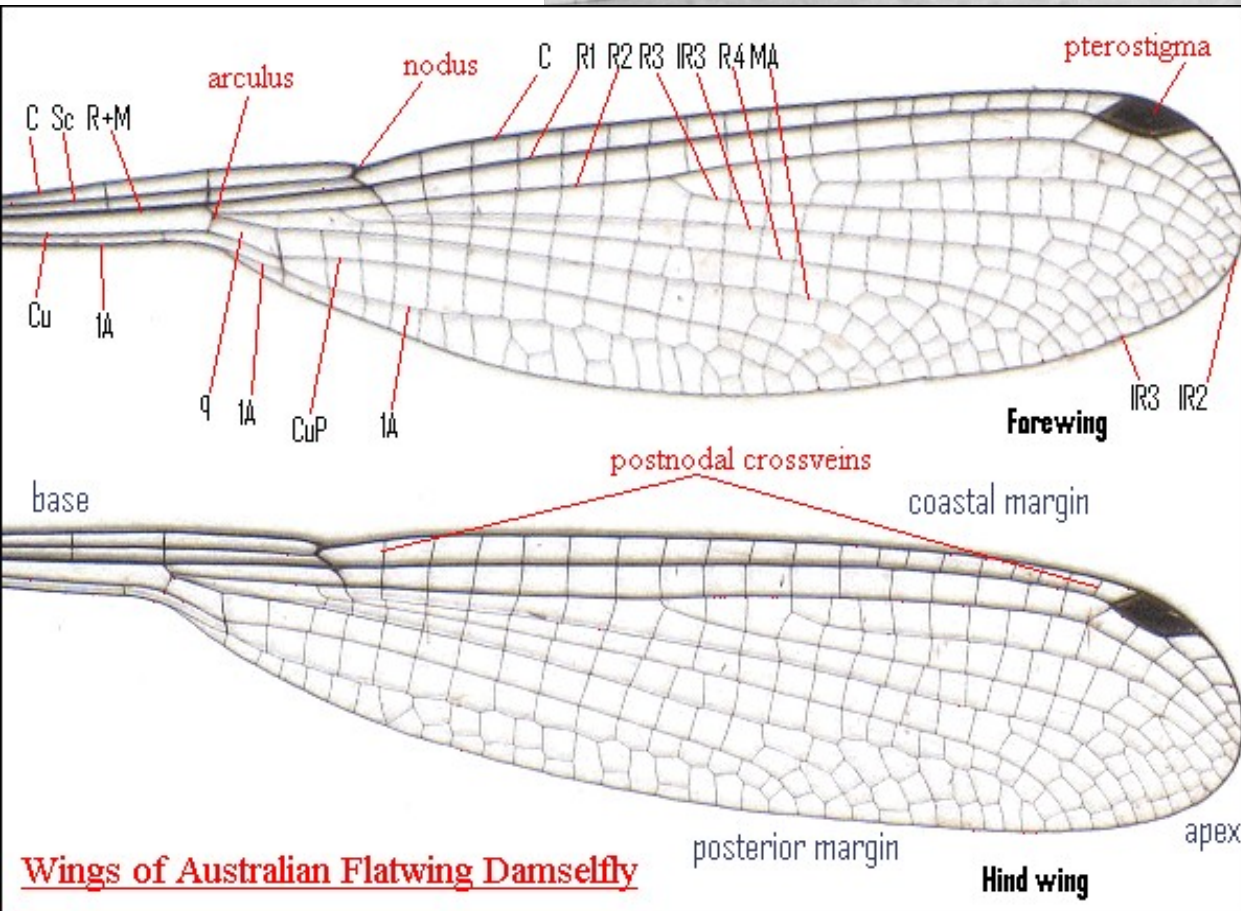
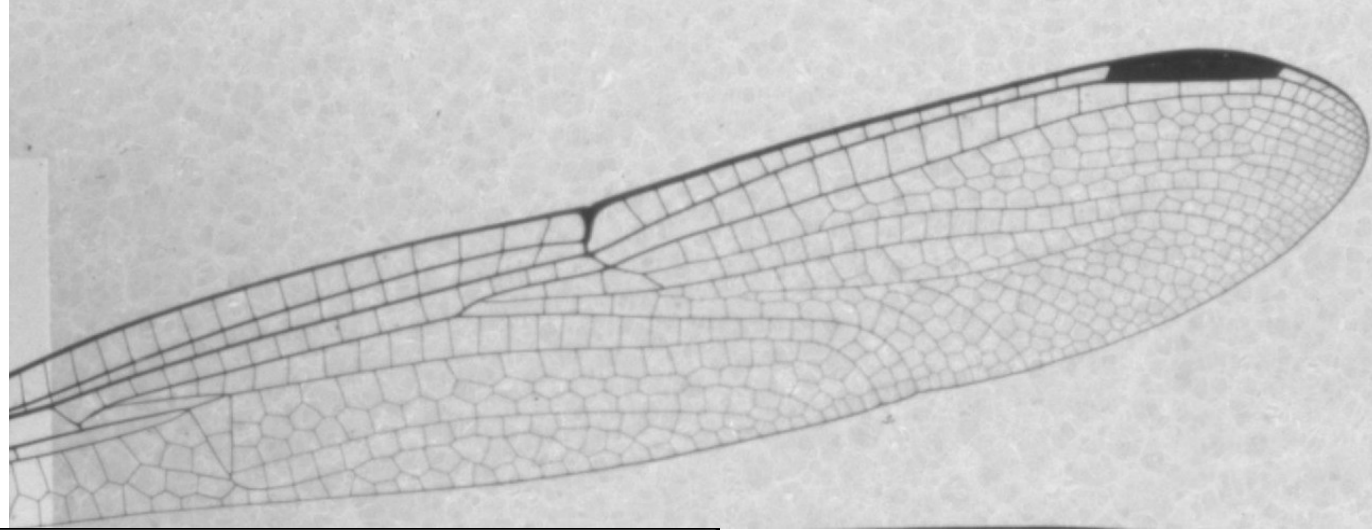
- Introduction
- Detection of some morphological features
- Summary

# Introduction

- Automated visual detection/measurement to increase throughput (for taxonomy, species discovery, collection management, etc)
- Current approaches (general purpose object recognition)
- Morphological feature extraction
- Population of character/feature matrix
- For classification/species discovery

# Dragonfly

- An example



# Character Matrix

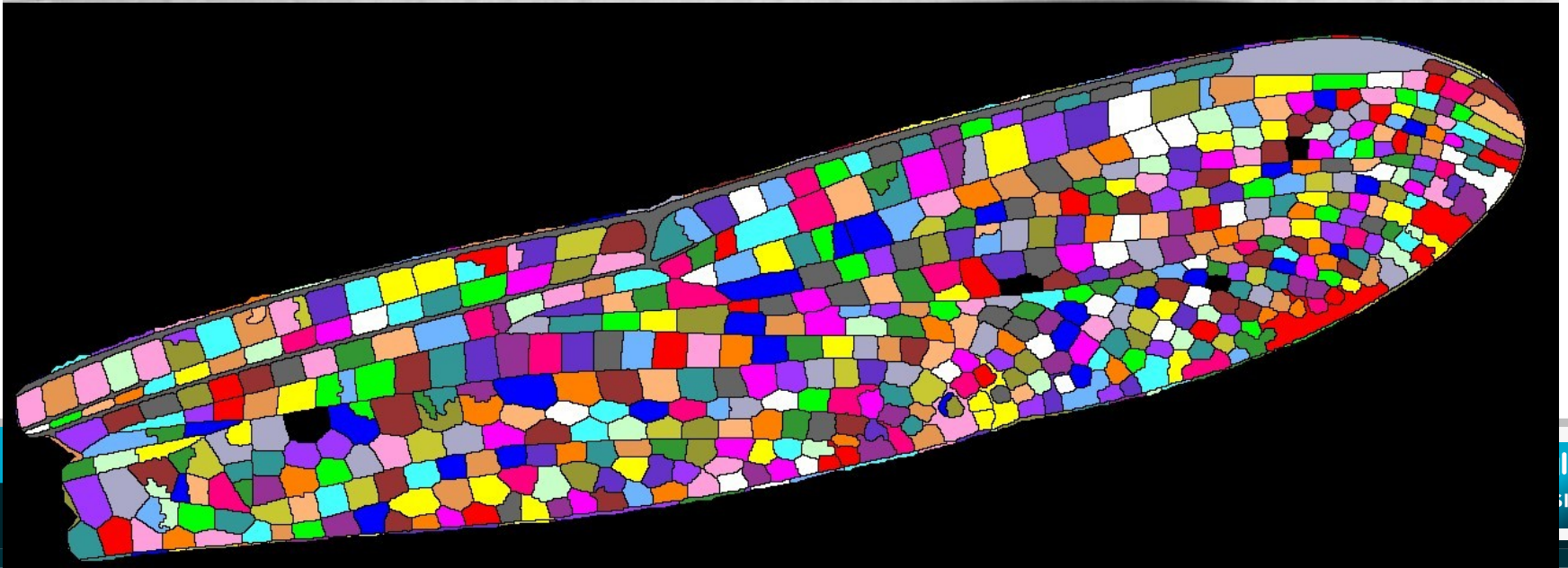
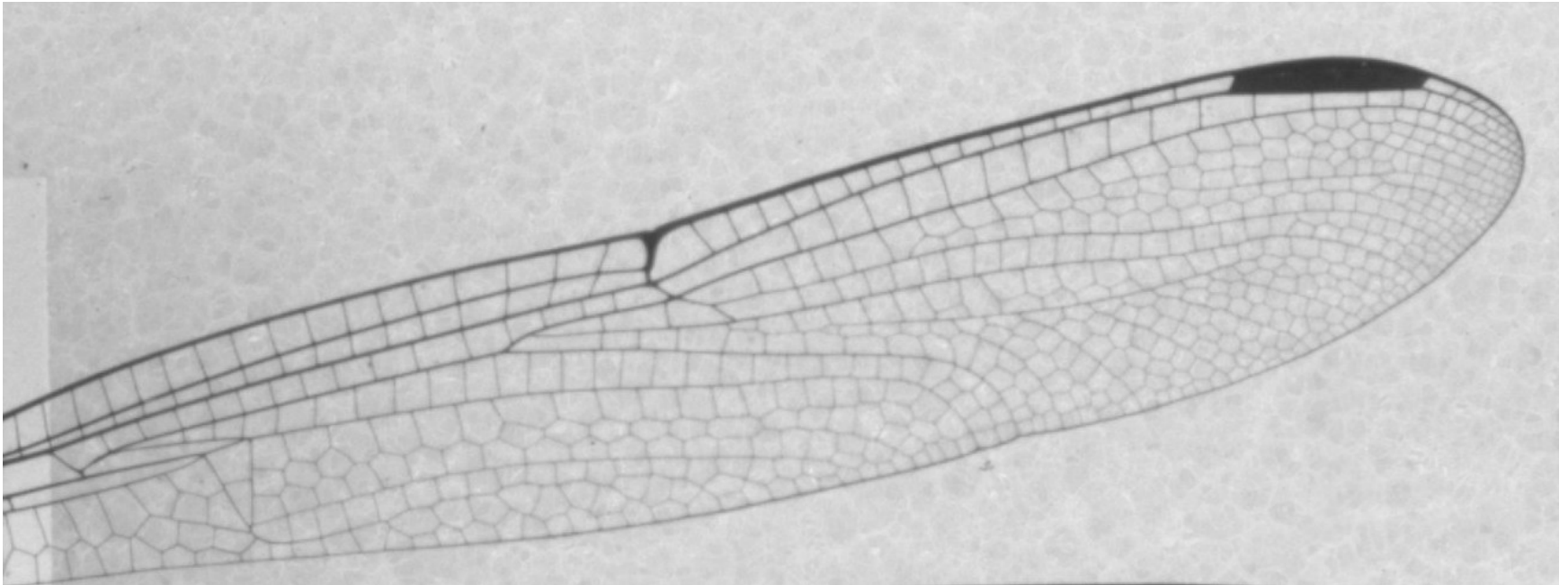
- Can be used with natural language descriptors
- Human understandable features, rather than blackbox features for classification
- Can be used for evolutionary relationship analysis



# Characters to Extract

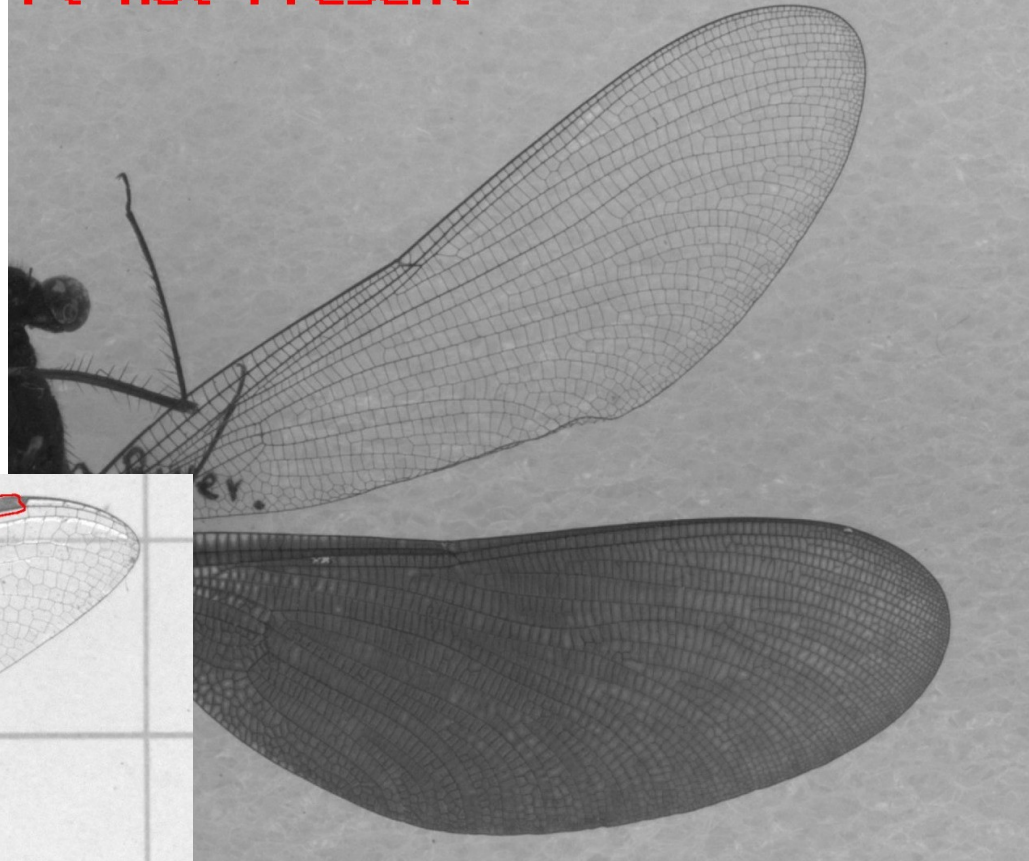
- Direct/low-level --- easier
  - Number of cross veins
  - Counting/measurement (after detection)
  - Colour of a region
- Direct/indirect/mid-level --- difficult
  - Wing shapes (fore/hind) comparison
  - Presence of anal loop
  - Identify vein names
  - Triangle orientations/shape
- Indirect/high-level --- more difficult
  - Eye detection, then eye separation/distance

# Initial Result for Insect Vein

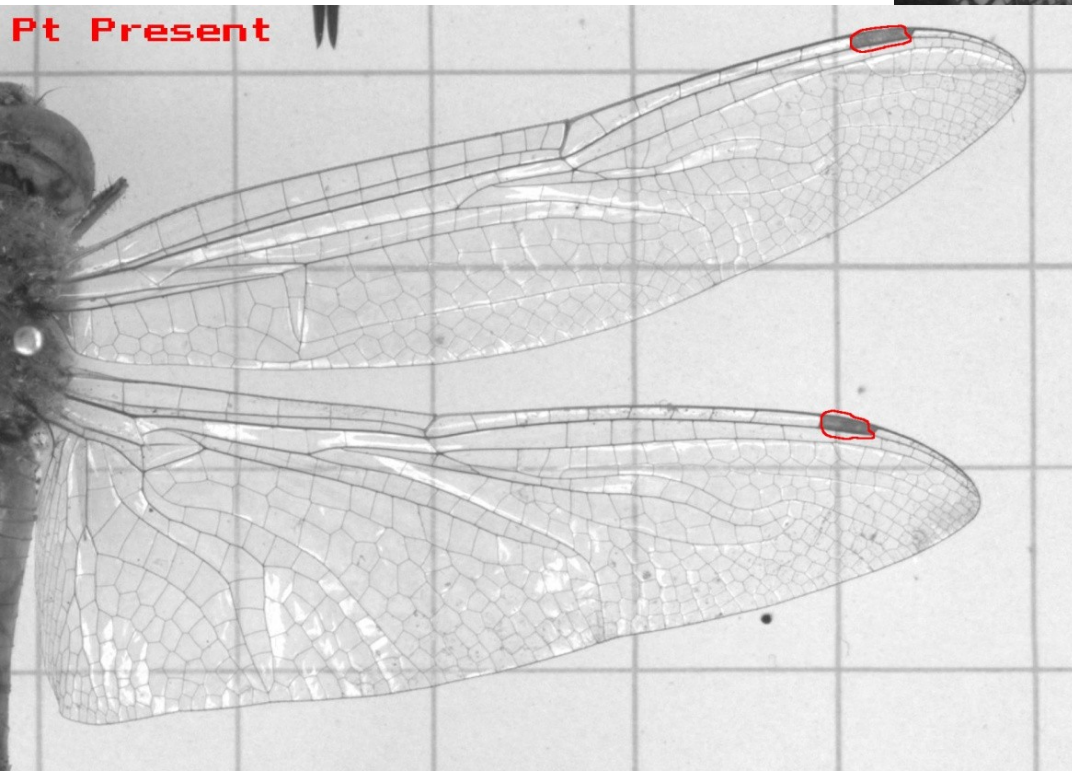


# Pterostigma Detection

Pt Not Present



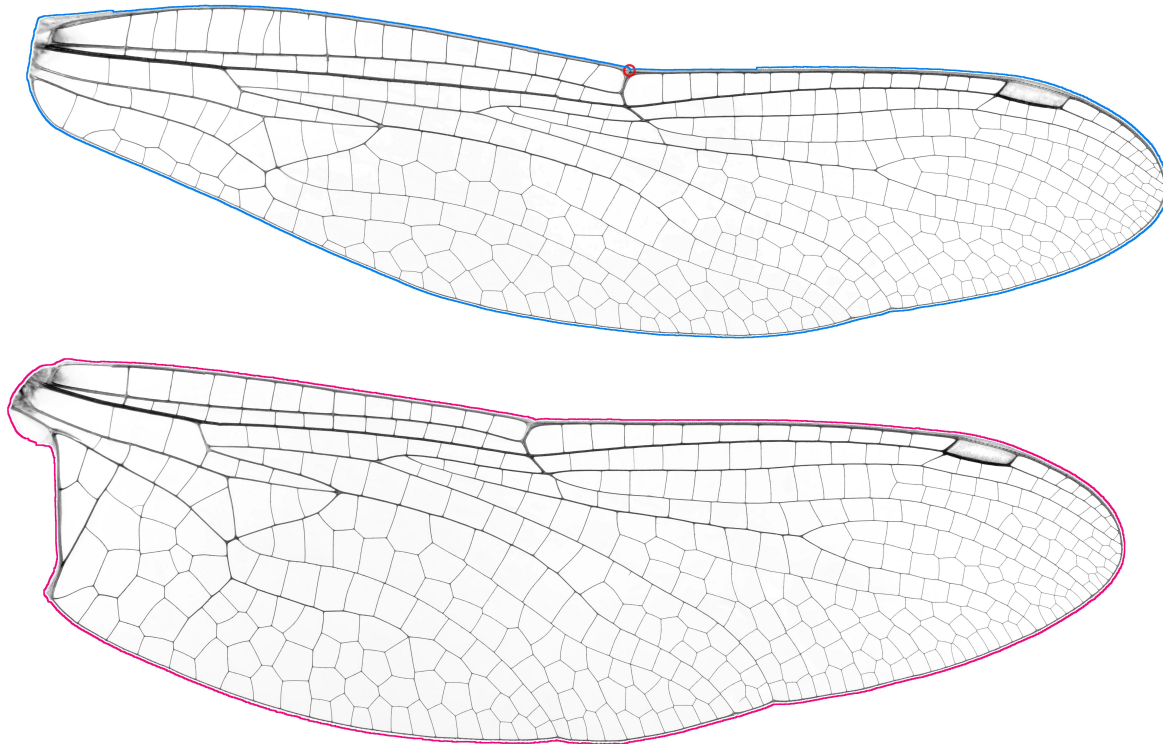
Pt Present





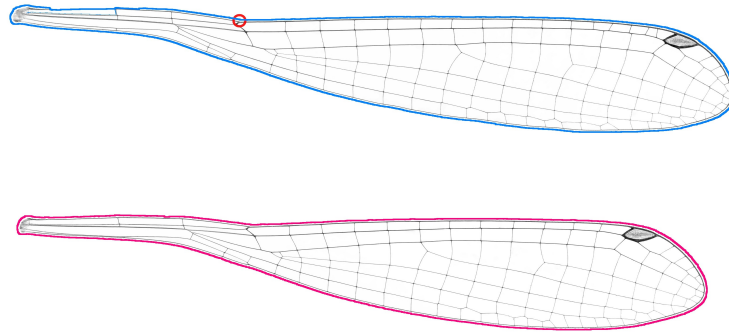
# Wing Shape Similarity (1)

- Fore wing and hind wing similarity = 0.788



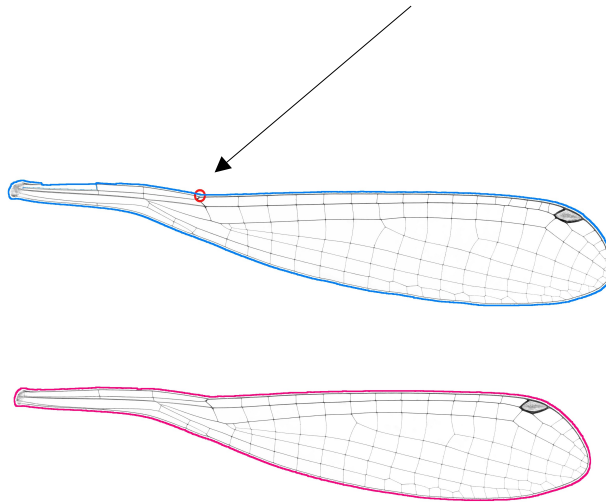
# Wing Shape Similarity (2)

- Fore wing and hind wing similarity = 0.998



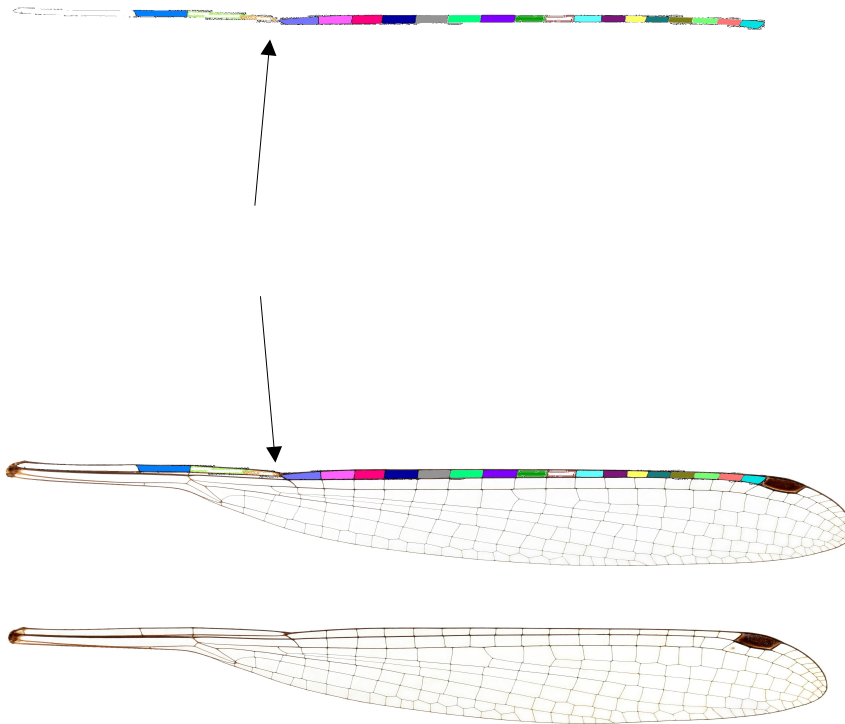
# Nodus Point

- A key point on the wing



# Number of Cross Veins

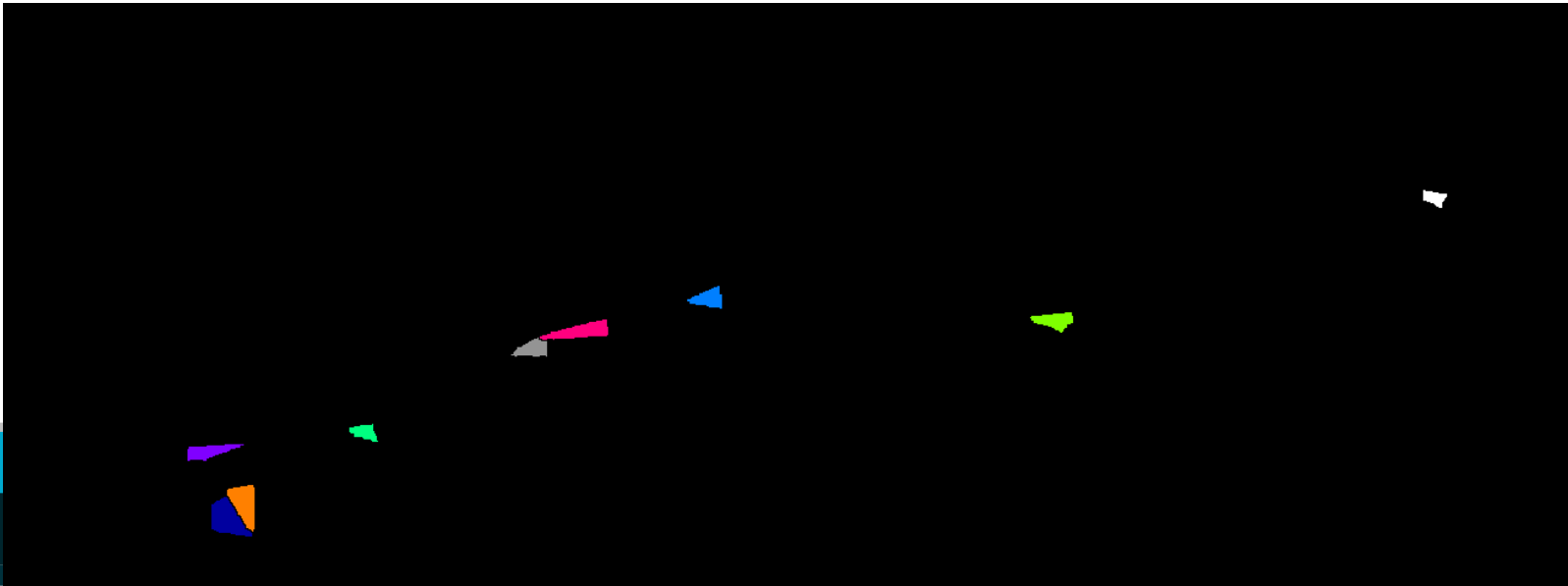
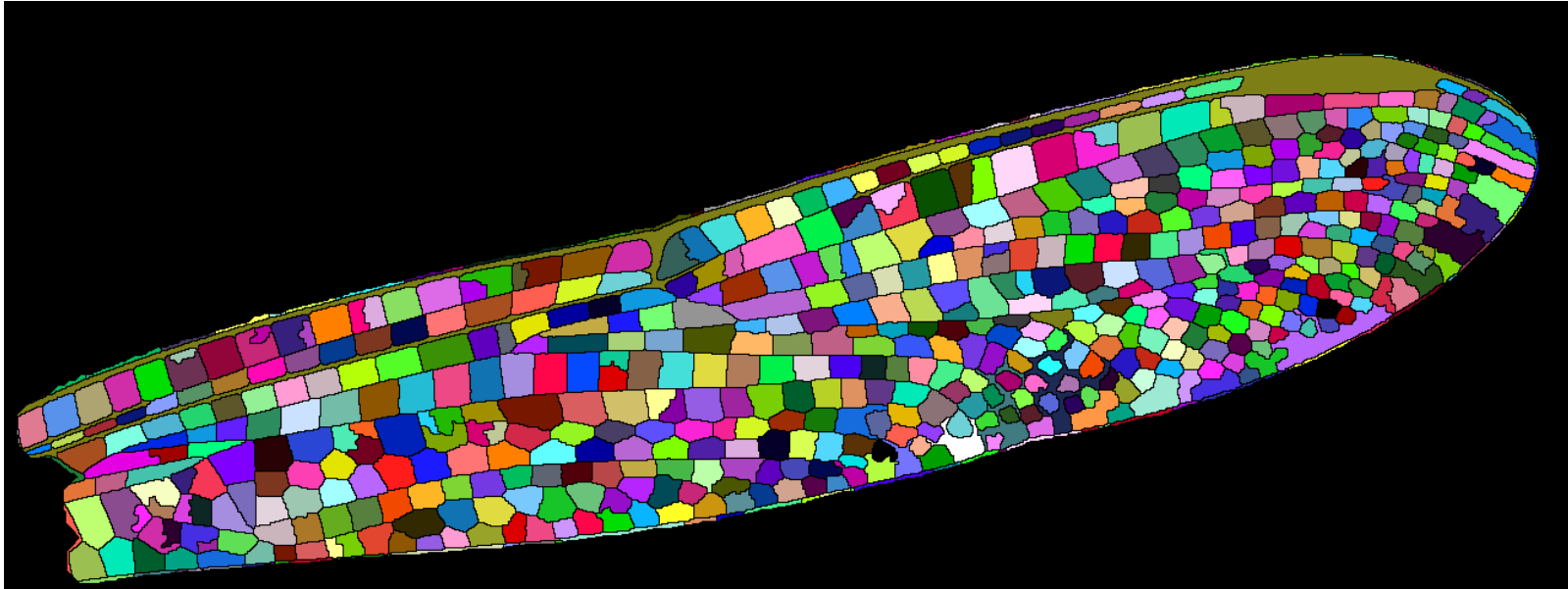
- Number of antenodal cross veins=3
- Number of postnodal cross veins=16





# Triangles Detection

- Initial results



# Character Matrix

- Collection of morphometric features
- (Linking matrix with species)

|   | ImageName                                   | Ptx  | Pty  | nAx | nPx | Nodu | Nodu | Sim   | Length | ... |
|---|---|------|------|-----|-----|------|------|-------|--------|-----|
| 2 | ../images/John_Tann/Zygoptera_no_text/Synle | 5559 | 1876 | 3   | 16  | 3208 | 1789 | 0.997 | 3681   | ... |
| 3 | ../images/John_Tann/Zygoptera_no_text/Teino | 4645 | 1984 | 2   | 10  | 2897 | 1871 | 0.998 | 2687   | ... |
| 4 | ../images/John_Tann/Zygoptera_no_text/Calia | 5148 | 1857 | 2   | 12  | 3268 | 1724 | 0.997 | 3375   | ... |
| 5 | ../images/John_Tann/Zygoptera_no_text/Grise | 4795 | 2875 | 2   | 10  | 3007 | 1827 | 0.998 | 3000   | ... |
| 6 | ../images/John_Tann/Epiprocta_no_text/Tonyo | 5815 | 1425 | 14  | 7   | 4433 | 1360 | 0.492 | 4579   | ... |
| 7 | ../images/John_Tann/Epiprocta_no_text/Micro | 5188 | 1603 | 10  | 6   | 3959 | 1510 | 0.633 | 3716   | ... |

# Summary

- Morphological feature extraction
- Feature extracted:
  - Pterostigma; Wing similarity; Nodus points; Ante nodal cross veins; Post nodal cross veins; Triangular shapes
- To build feature matrix for species discovery/identification/etc

# Acknowledgements

- John La Salle (ALA)
- John Tann (AM)
- Nicole Fisher (ANIC)
- Dadong Wang (DPF)
- Paul Flemons (AM)



# Thank you

**CSIRO Digital Productivity Flagship**

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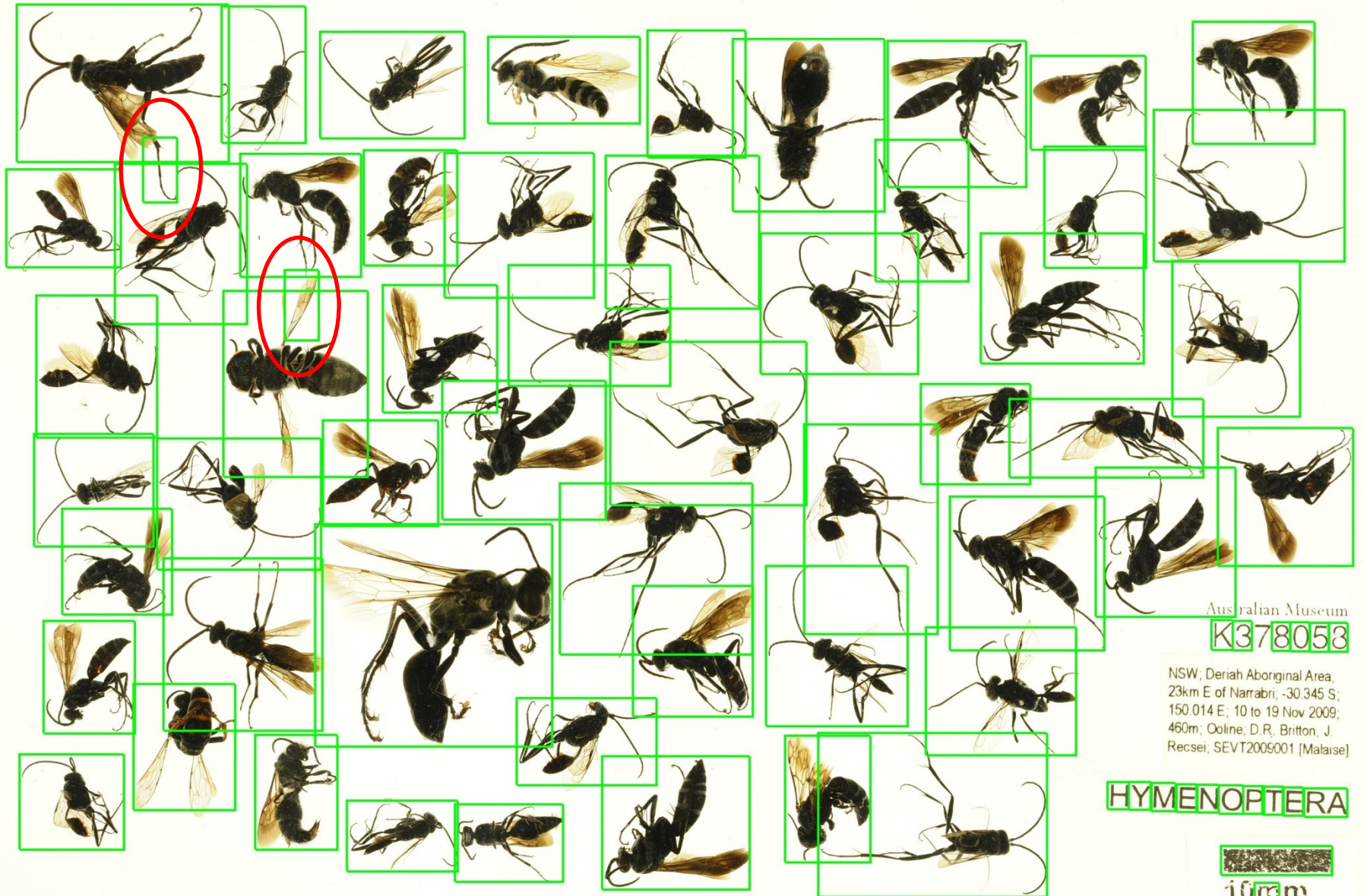
CSIRO digital productivity flagship



CSIRO

# Insect Soup

- Initial results



Australian Museum

K378053

NSW, Deriah Aboriginal Area,  
23km E of Narrabri, -30.345 S;  
150.014 E; 10 to 19 Nov 2009;  
460m; Ooline, D.R. Britton, J.  
Receci; SEVT2005001 [Malaise]

HYMENOPTERA

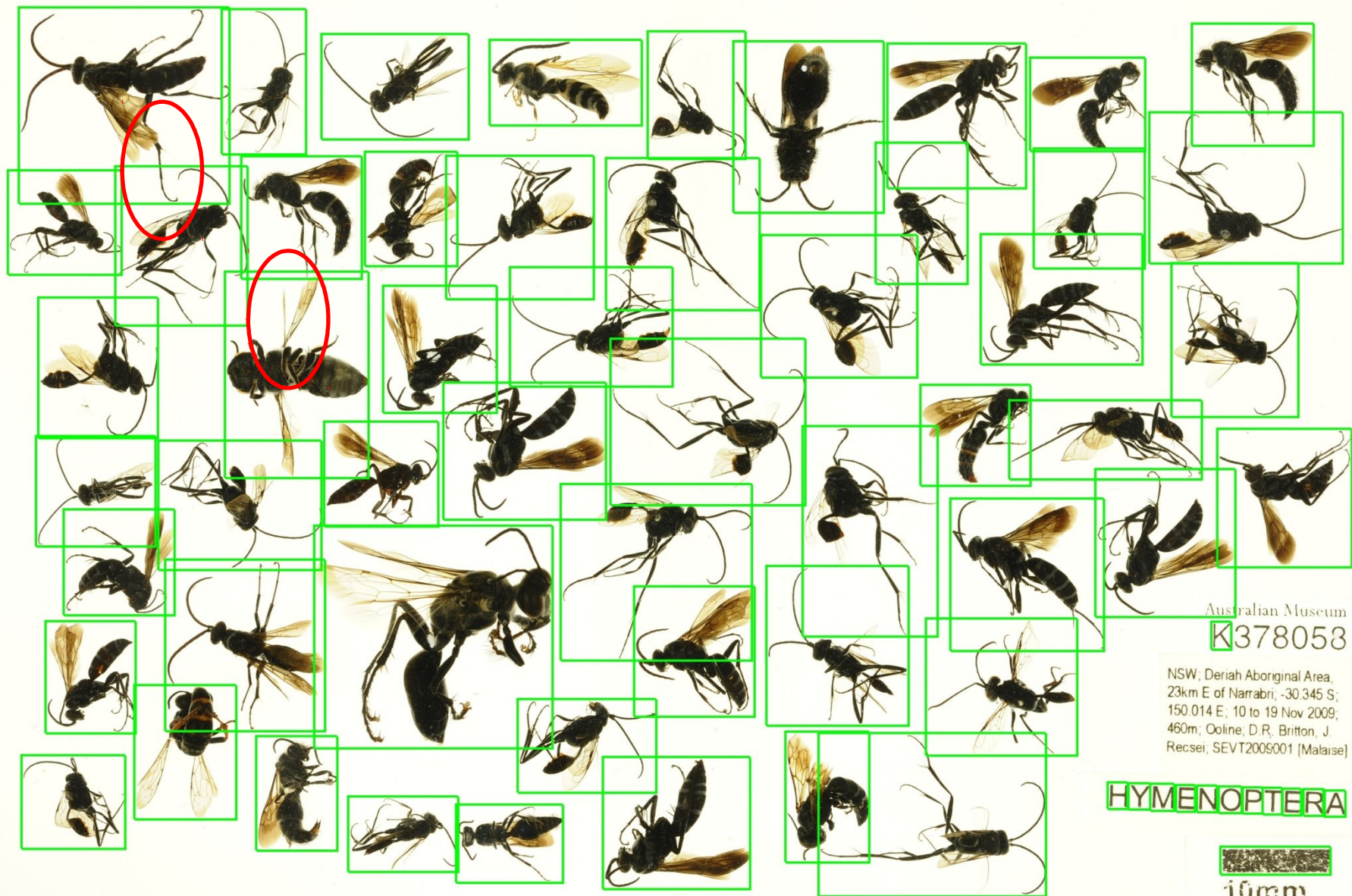


10mm



# Insect Soup

- Improvements





# Insect Drawer

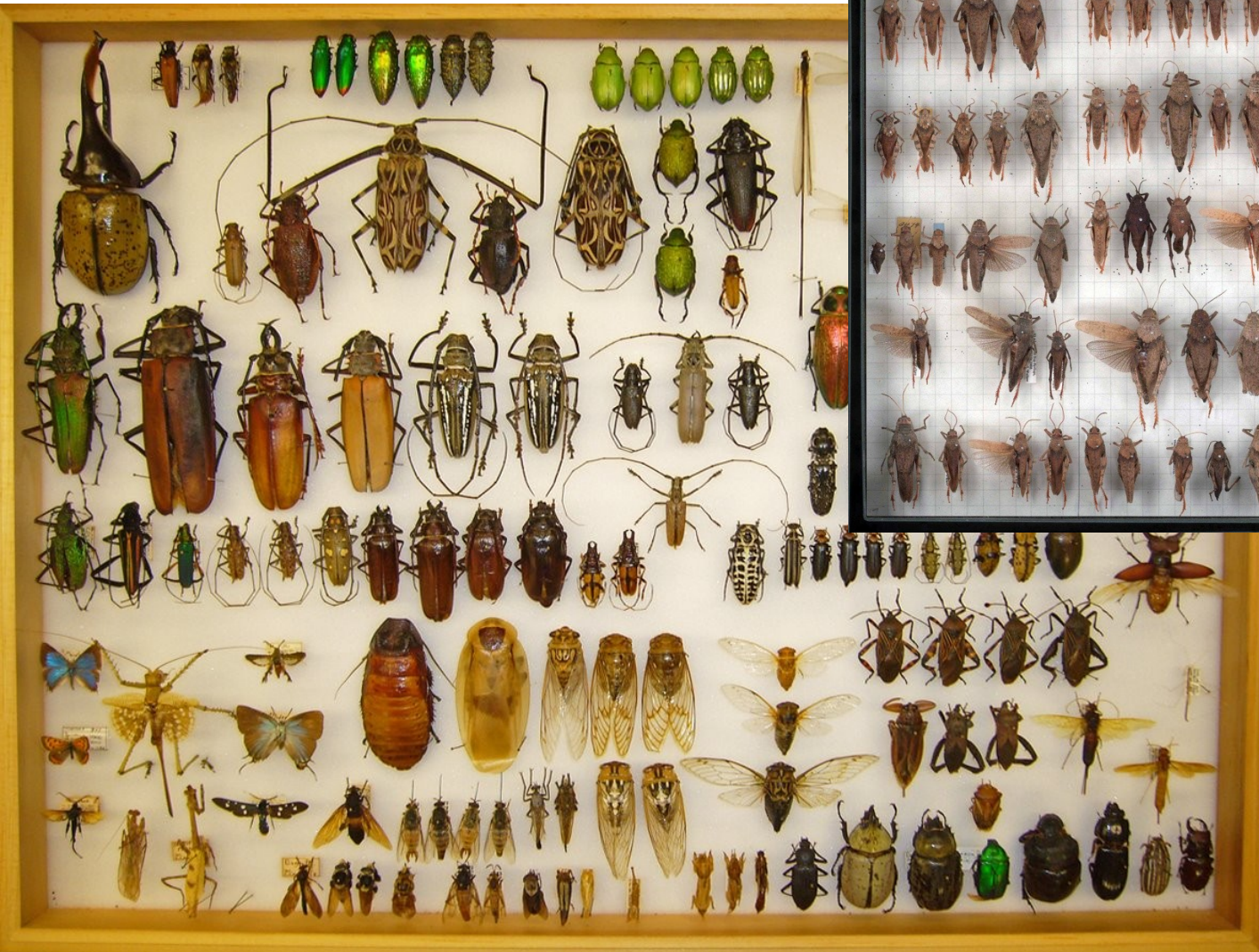
- Initial results





# Insect Drawers

- ANIC
- SatScan??
- A new method?





# Insect Soup, Pest

- Insect classification initial result (Katarina Mele)
- Australian Museum
- ARC Discovery Grant (Gao, Blumenstein, Sun, La Salle)



# Images with Labels?

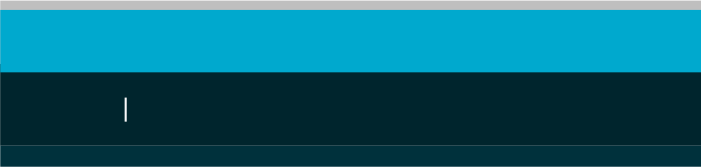
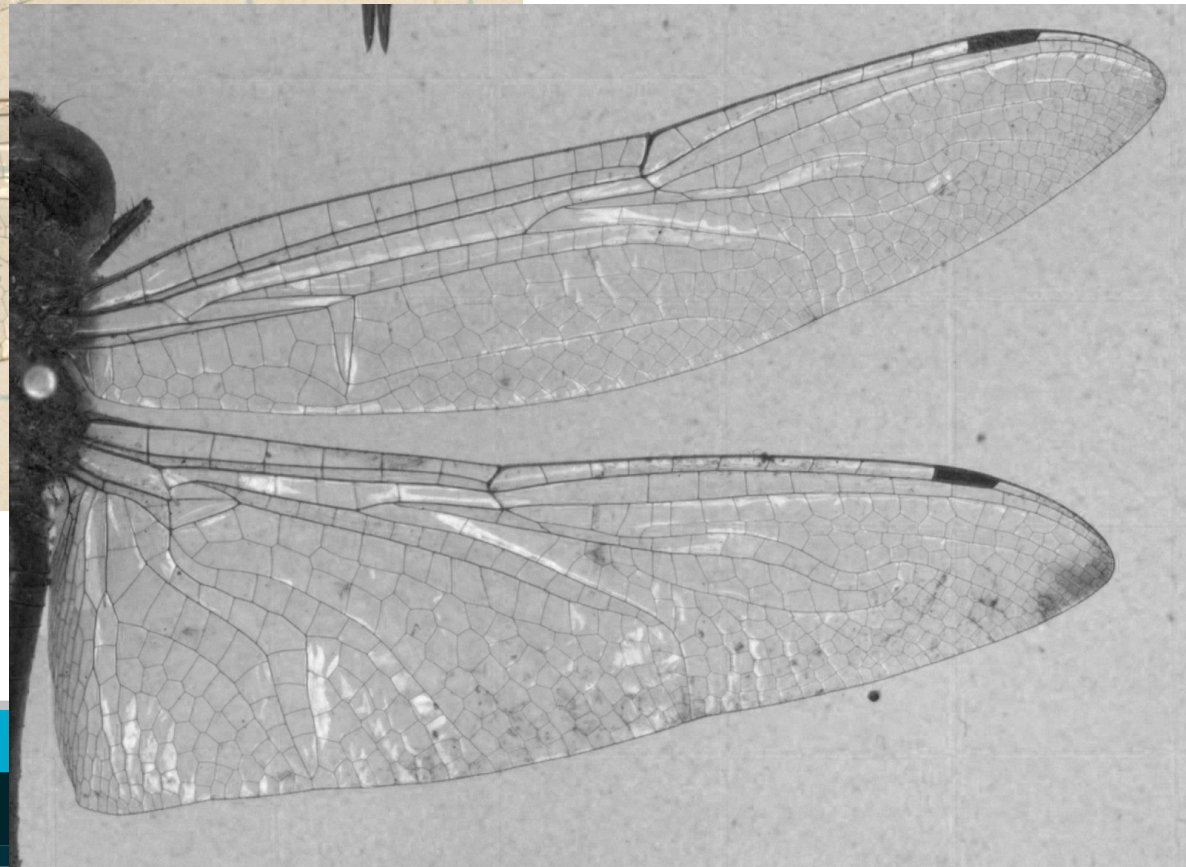
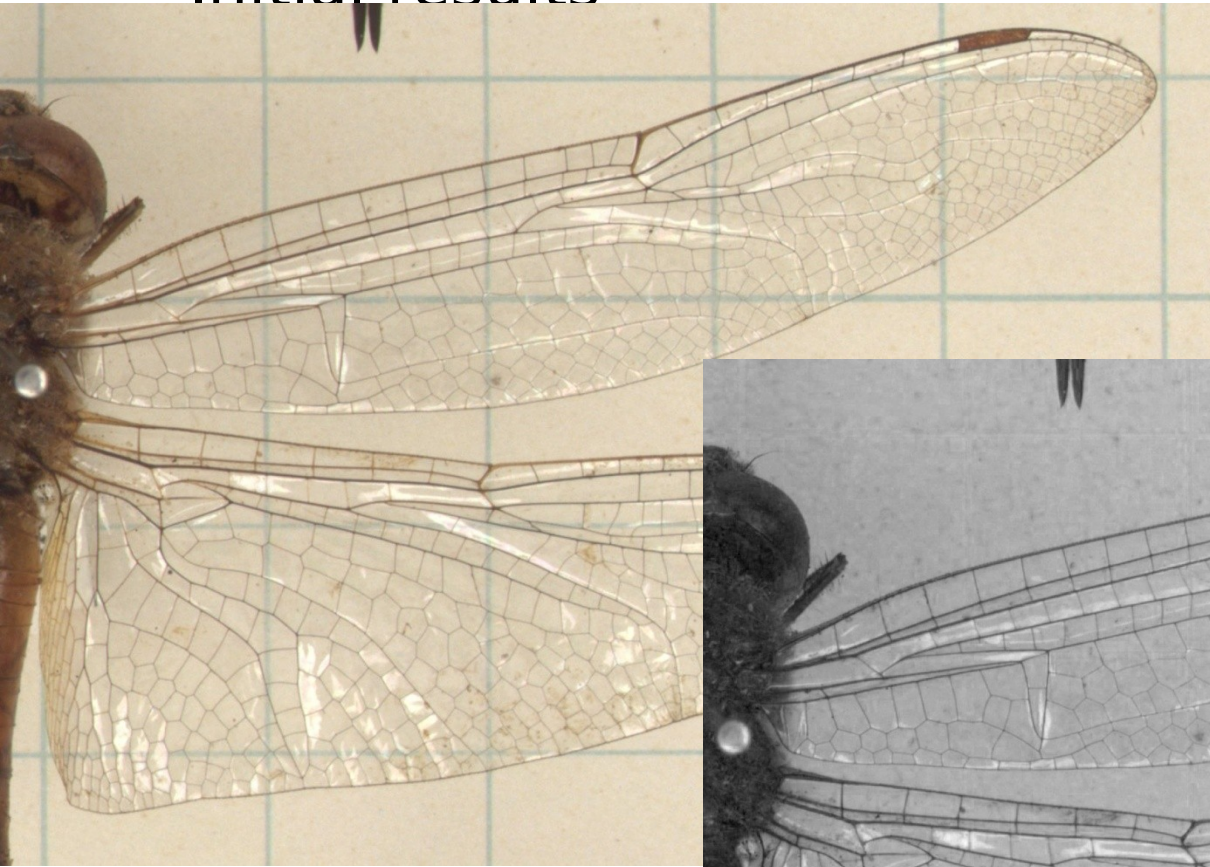
- Working with existing draw images?
  - With labels.
- Collect new images?
  - With/without labels?





# Blue Grid Removal

- Initial results



# Possible Steps for Image Analysis

- Images/data collections (50 specimens?)
- Availability of ground truth (species?)
- Linear feature/junction enhancement
- Individual insect segmentation from whole draw image?
- Label removal if necessary
- Wing segmentation (see initial result in previous slide)
- Finding characters
- Filling character matrix
- Recognition/classification