Whole-drawer imaging for management & curation of the ANIC

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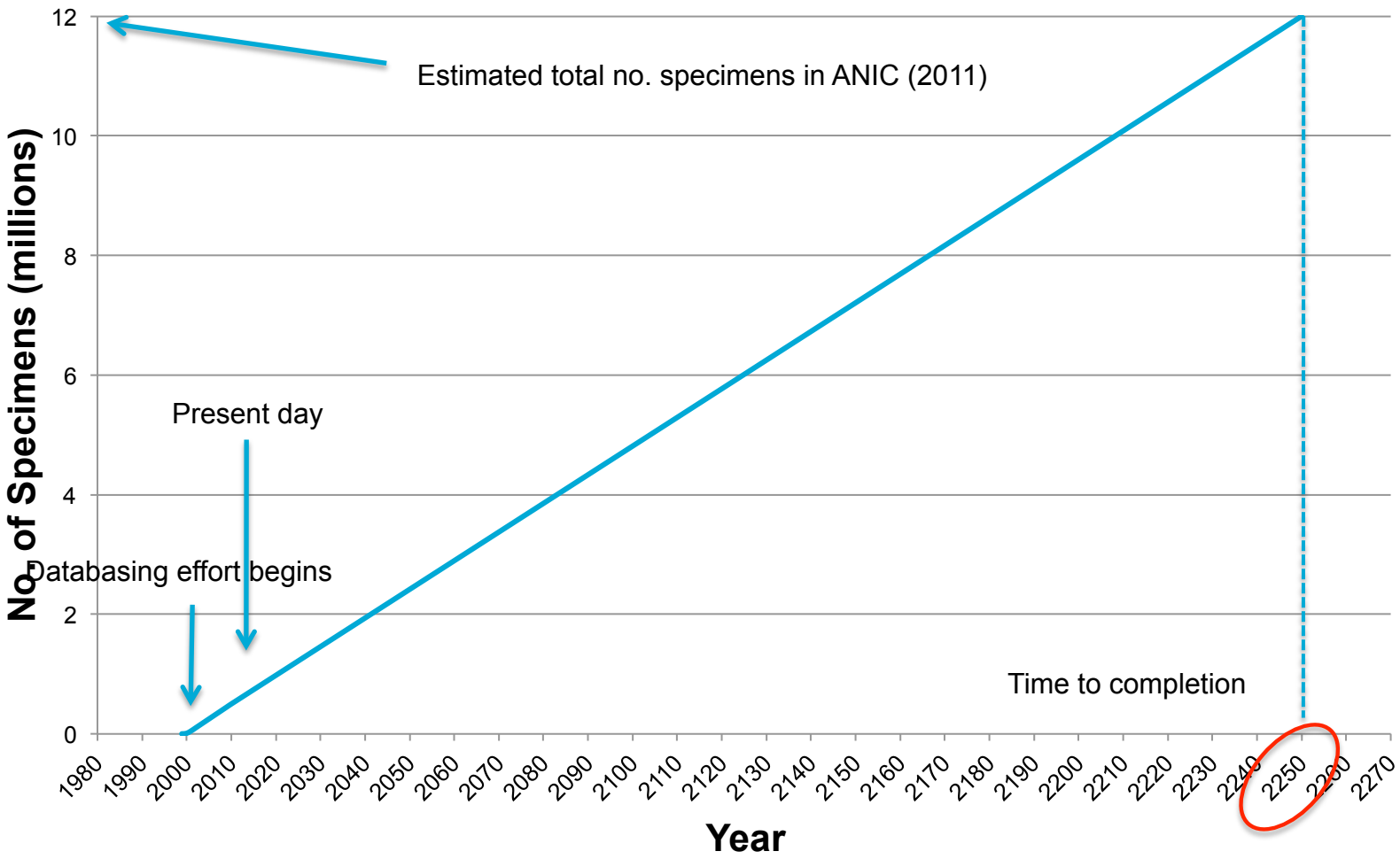
The taxonomic impediment

"Existing taxonomic processes have served us well for centuries but are clearly inadequate for the challenge at hand. The taxonomic community must rally around a common vision…

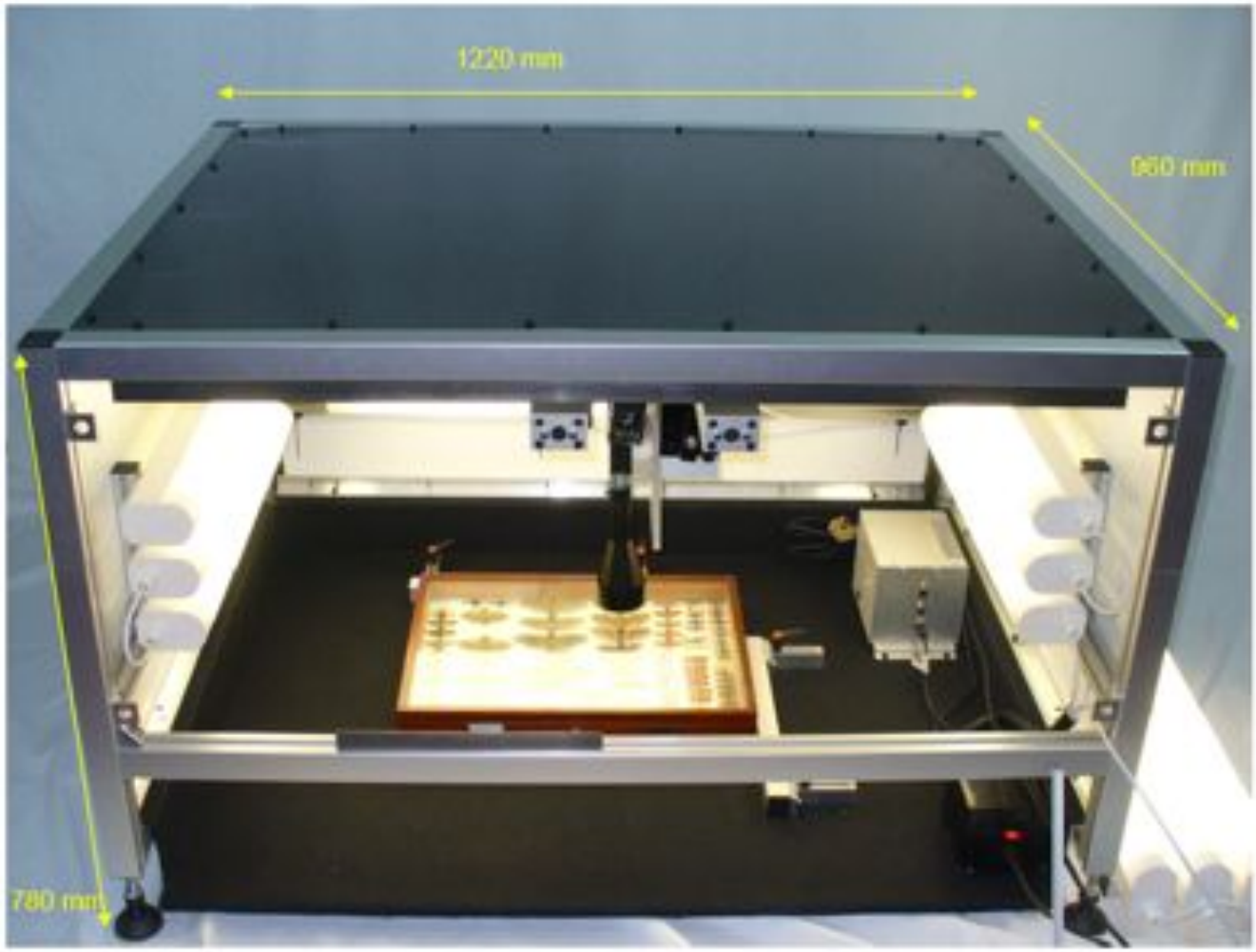
… It is time to approach taxonomy as a large-scale international science."

Quentin Wheeler, Peter Raven & Edward O. Wilson
Science, 2004.

Current rate of digitisation at the ANIC



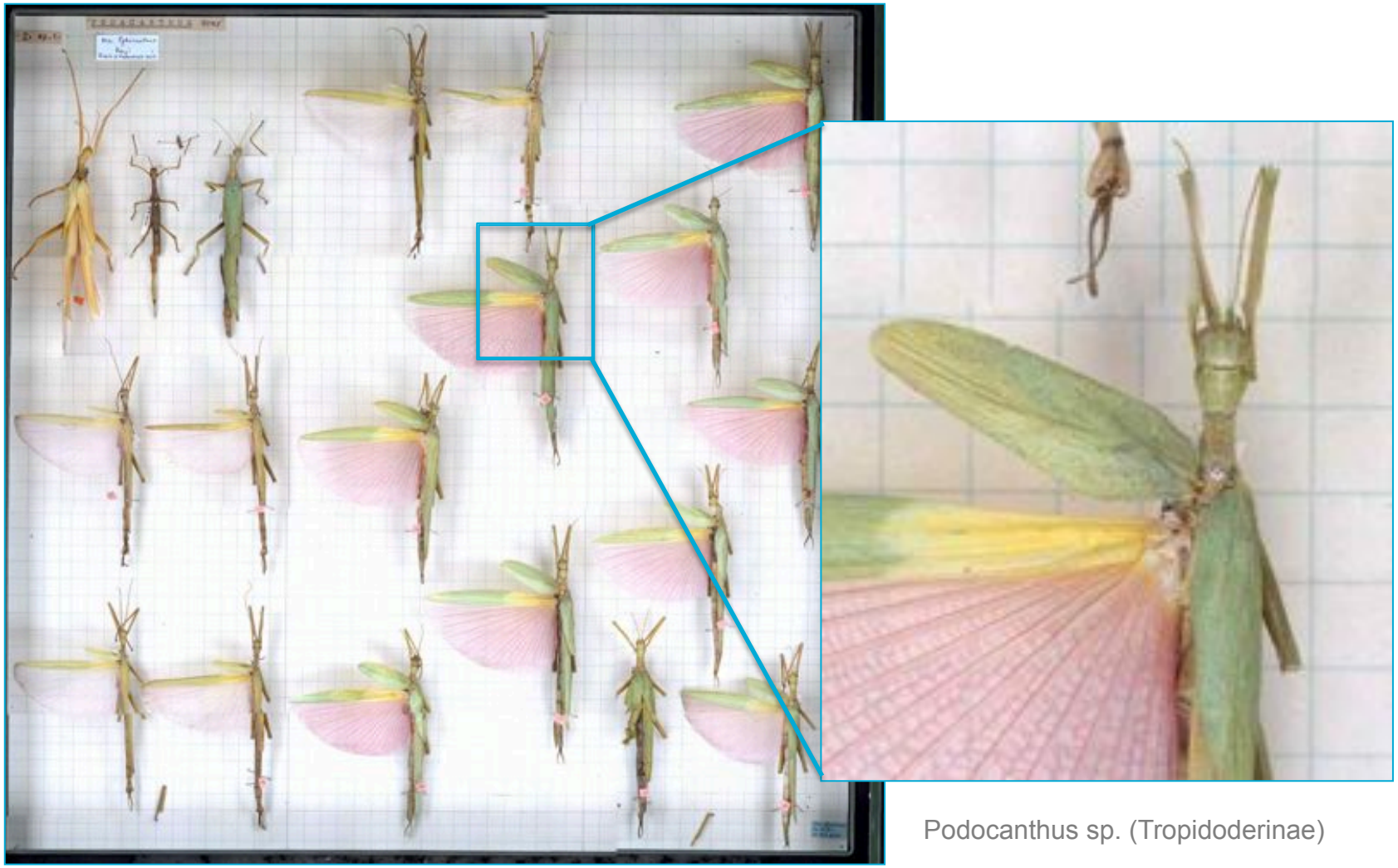
The SatScan™ by SmartDrive Ltd



Using SatScan™

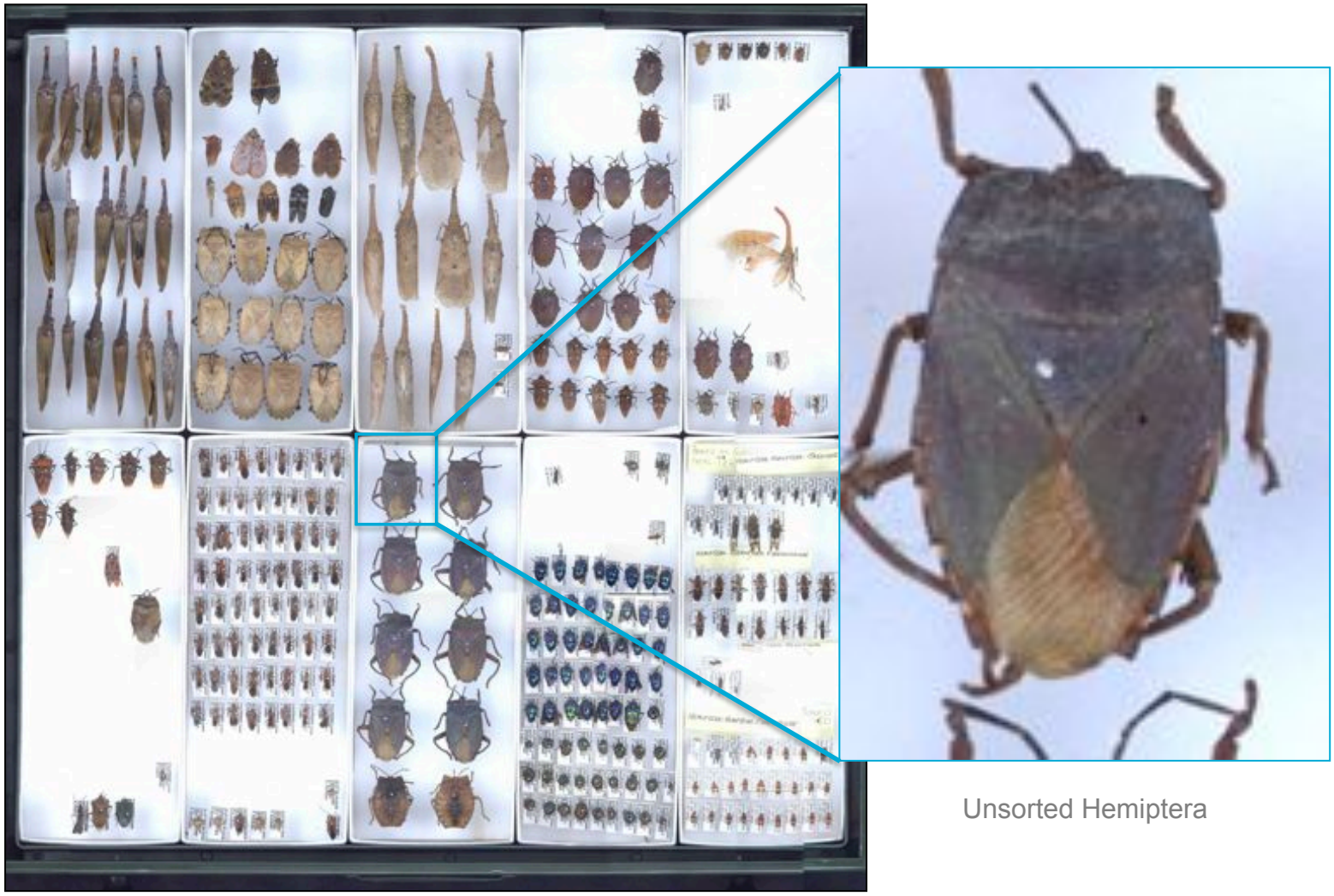
http://www.youtube.com/watch?v=ogpiqzDqa4A

Examples – Large specimens



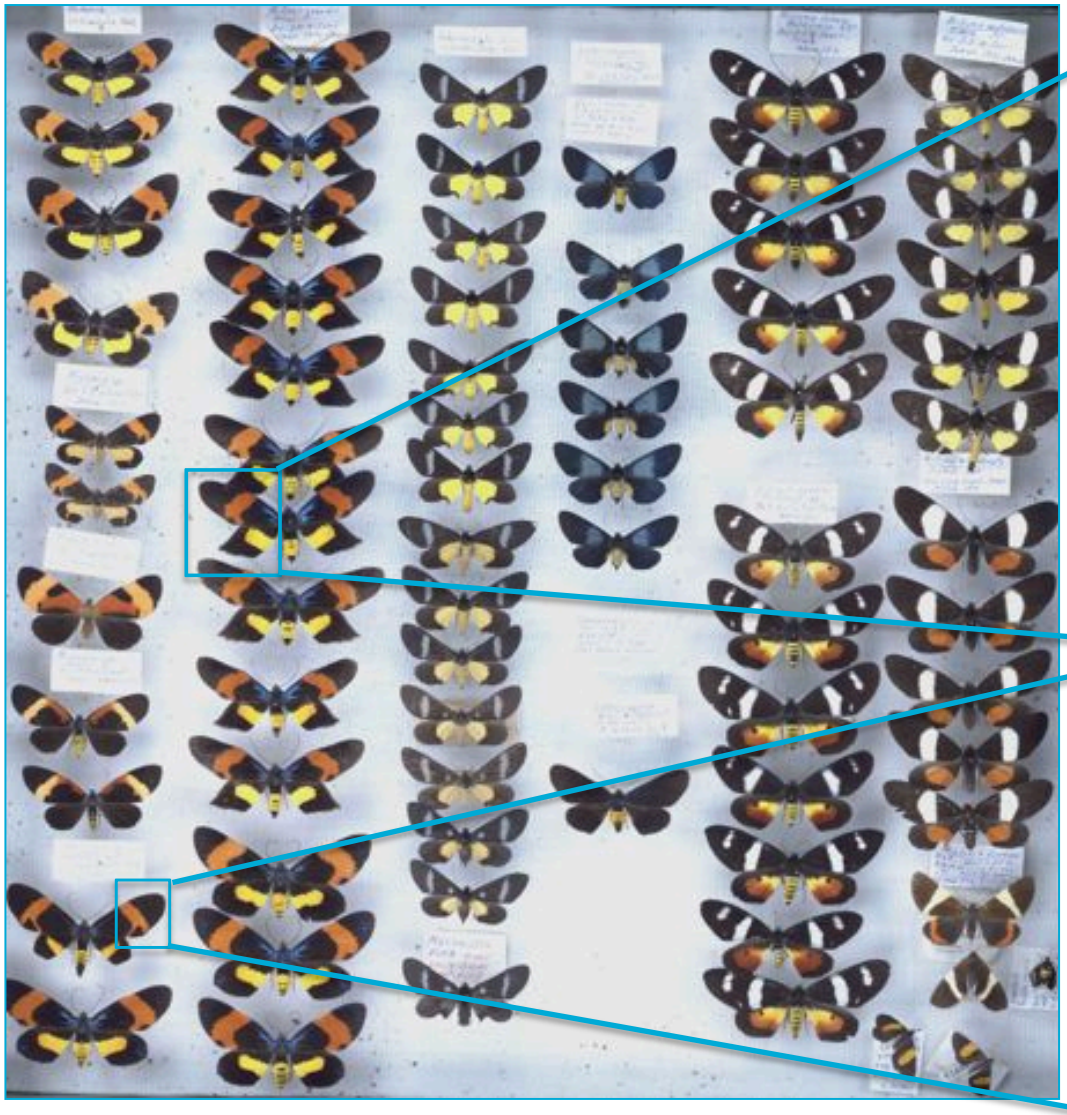
Podocanthus sp. (Tropidoderinae)

Examples – Unsorted material



Unsorted Hemiptera

Example – Curated drawer



Milionia sp. (Geometridae)

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SatScan™ specifications

- Basler A631FC ½" CCD Camera.
- Edmund Optics 0.16X telecentric lens.

- Field of view = 35.5 x 27.7 mm.
- Original image capture resolution = 1280 x 960.
- Final image resolution = 36 pixels mm^{-1}.
- Depth of Field = 6 to 80mm.
- Output file format = 24 bit BMP or LZW-compressed TIFF.
- File size = ~780MB (BMP) and ~340MB (TIFF).
- Exposure time = 1 to 2000 ms.

- Scanning time (50 x 50 cm) = 5 to 7 mins depending on exposure.
- Stitching time (200 – 400 tiles) = 6 to 9 minutes.

Aperture and Depth of Field

Aperture	Exposure (ms)	DoF (mm)	Smallest resolvable structure (μm)
Completely open	11	6	56
Midway	41	17	59
Completely closed	810	80	98

Table adapted from Blagoderov et al. 2010

open

midway

closed

Aperture open

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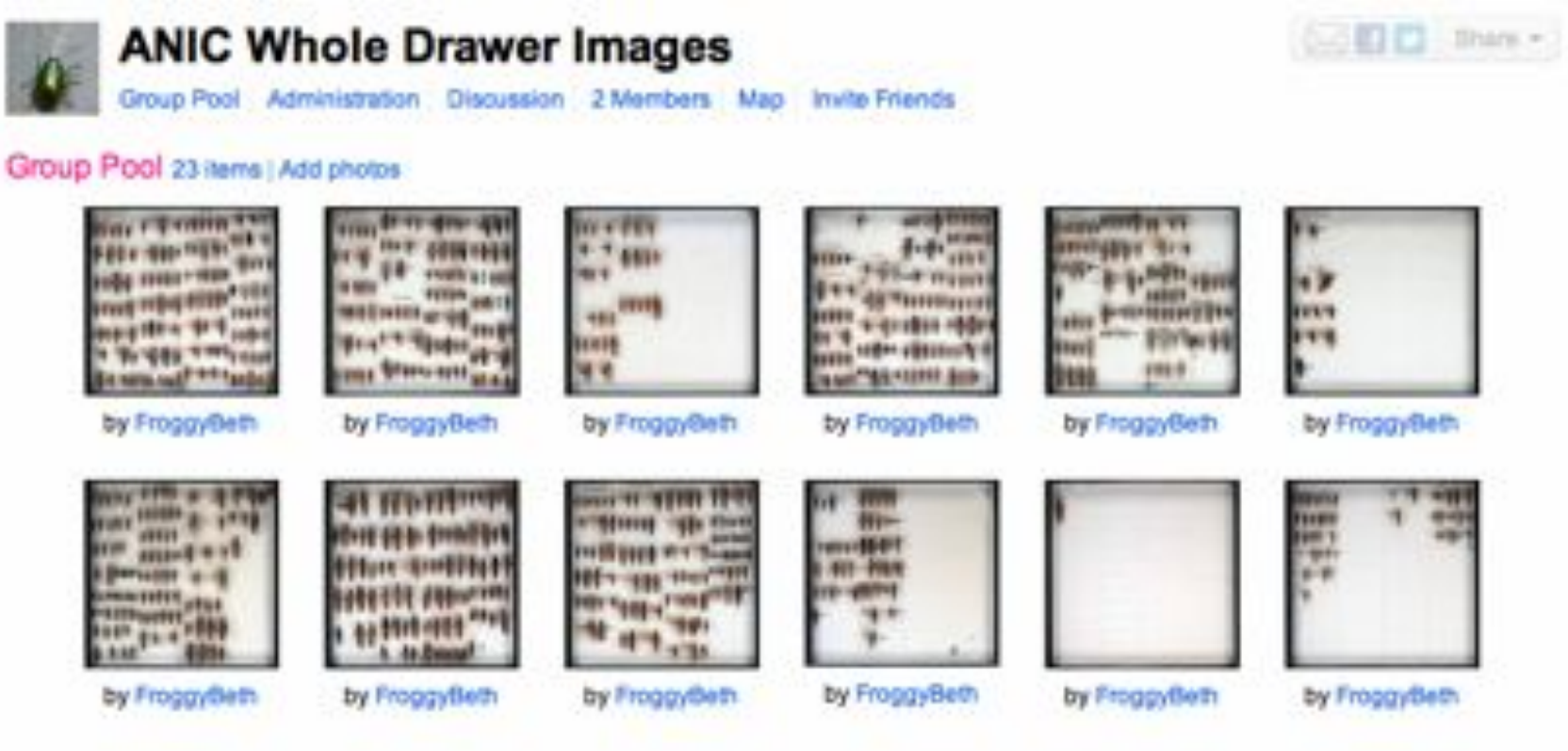
Applications in the ANIC

- Research:
  - High through-put imaging for automatic character recognition systems. (MacLeod et al. 2010)
  - Morphometric specimen analysis.
  - Colour and pattern analysis.
  - Population biology.
  - Identifications (“virtual curation”).
- Collection Management:
  - Auditing & security.
  - Collection valuations and assessments.
  - Remote access to collection.
  - Facilitating image and loan requests.
  - Identifications (by both specialists and citizen science initiatives).
  - Type and label checking.
- Public Engagement.

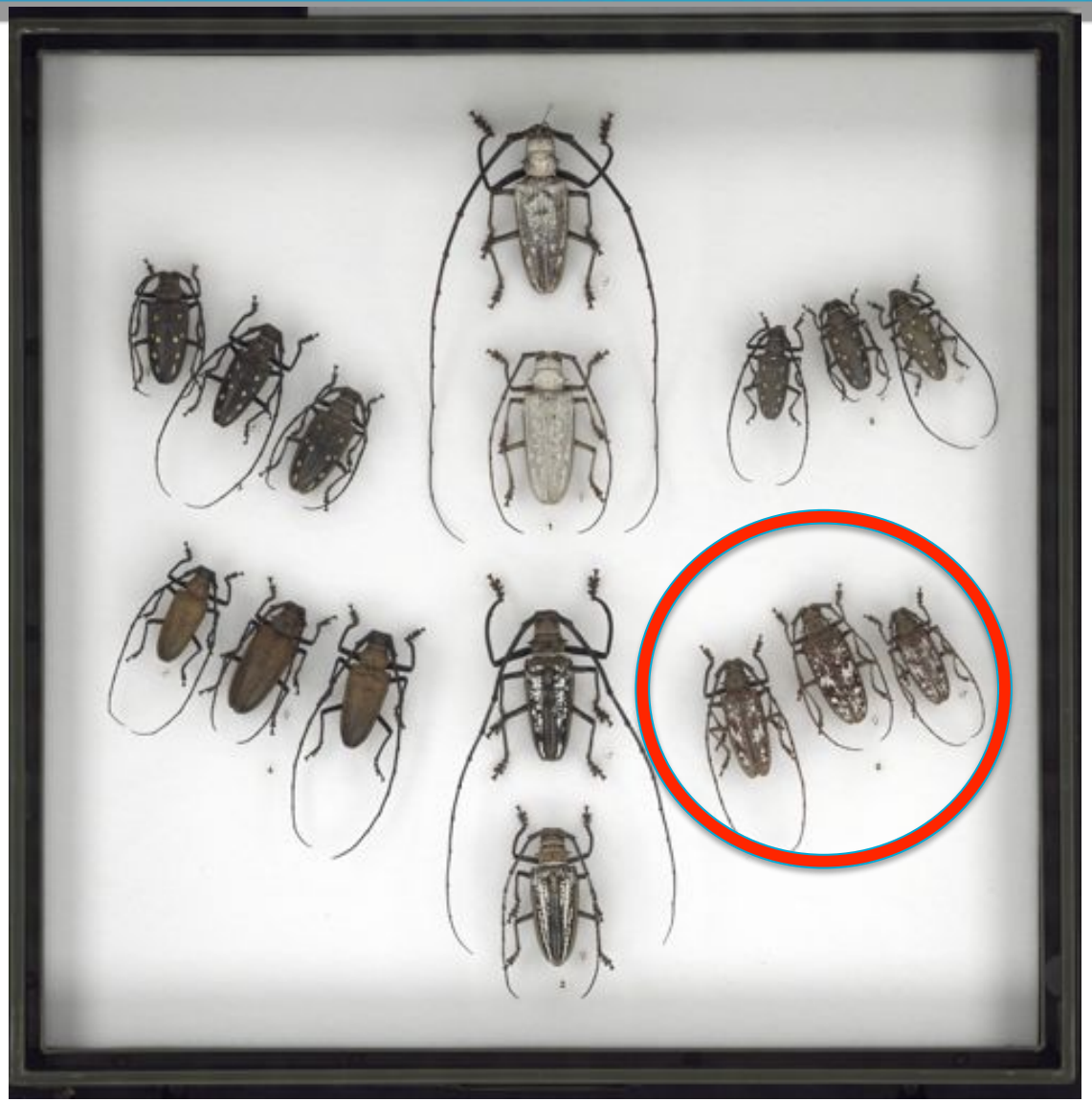
Loans enquiries…

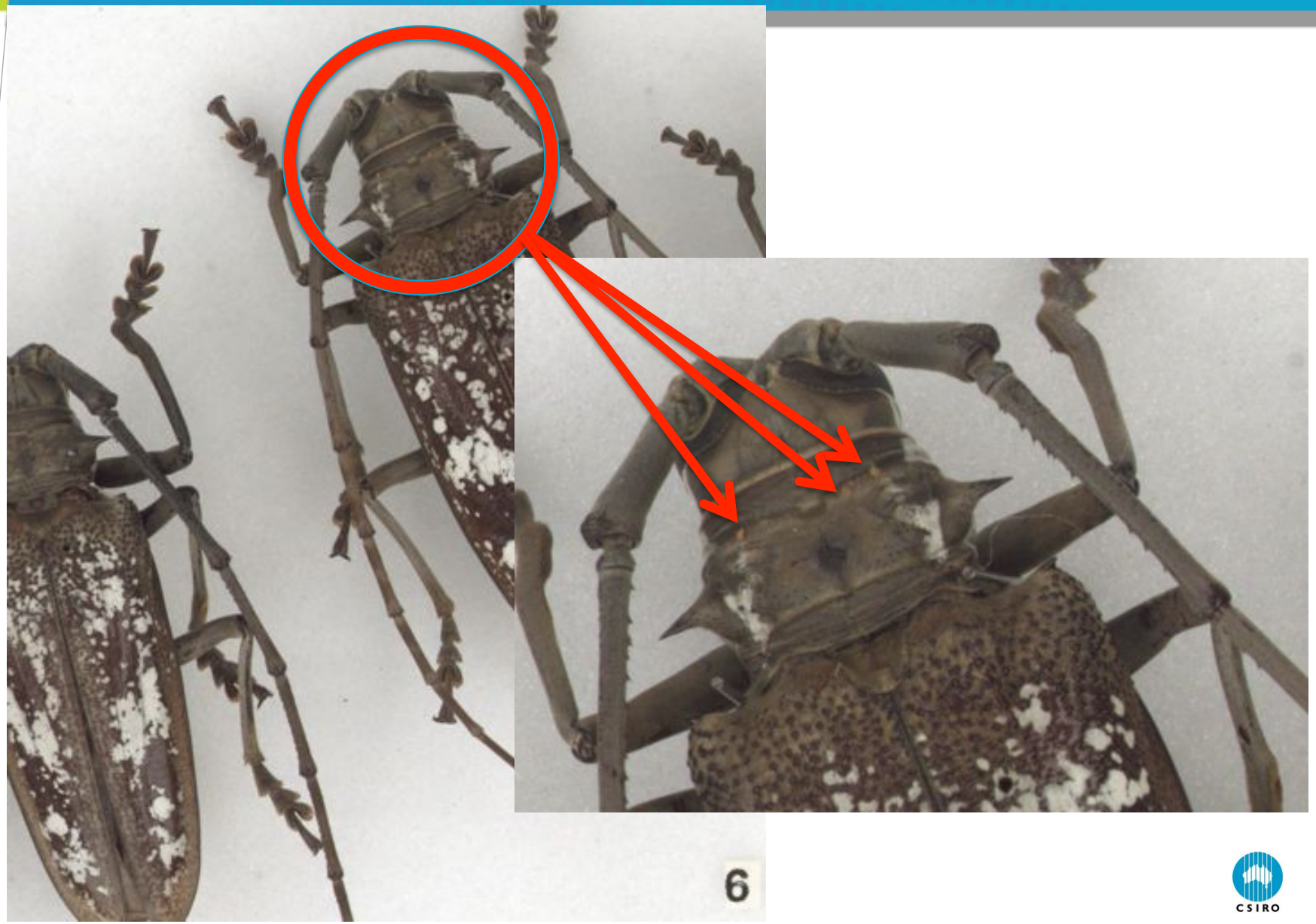
Orthoptera: Buforaniidae



http://www.flickr.com/groups/anic_drawers/

Unexpected discoveries…

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Morphometrics research…

CSIRO. An assessment of the SatScan(TM) whole-drawer imaging system.

“Did anyone know about this…?”

CSIRO. An assessment of the SatScan(TM) whole-drawer imaging system.

Logistics

- Best suited to drawers with similar-sized, uniformly positioned specimens.
- Excellent results with larger specimens (e.g. beetles):
  - Can generally identify to species.
- Very small specimens present challenges:
  - However, label information is visible (barcodes?).

- ANIC = 25,000 entomological drawers.
  - Imaging 40 drawers per day is reasonable (batch stitching overnight).
  - Whole collection could be imaged in 624 days (2.5 working years) with one system.

Challenges

- Development of workflow:
  - Drawer image is out-of-date immediately after capture.
  - Maintain list of drawers that have ‘changed’ due to sorting, curation, changes to agreed taxonomy etc.
- Metadata capture and handling:
  - Linking images with specimens: Morphbank, LSIDs?
  - Interacting with & annotating image metadata.
  - Integration with collection management system.
  - Image storage (25,000 drawers = 12TB).
- System limitations:
  - Scanning area ~ 500 x 600 mm.
  - Errors during batch stitching.
  - Focusing is time consuming and clumsy.

Future Plans

- Develop and implement imaging workflow.
- Australian Morphbank (www.morphbank.net) as image repository.
- Integration with collection management system.
- Barcodes on unit trays & drawers to link images with metadata.
- Incorporation of specimen-level identifiers on images.

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