Cycas Megacarpa

Survival outcomes across two translocation programmes

Cycas megacarpa

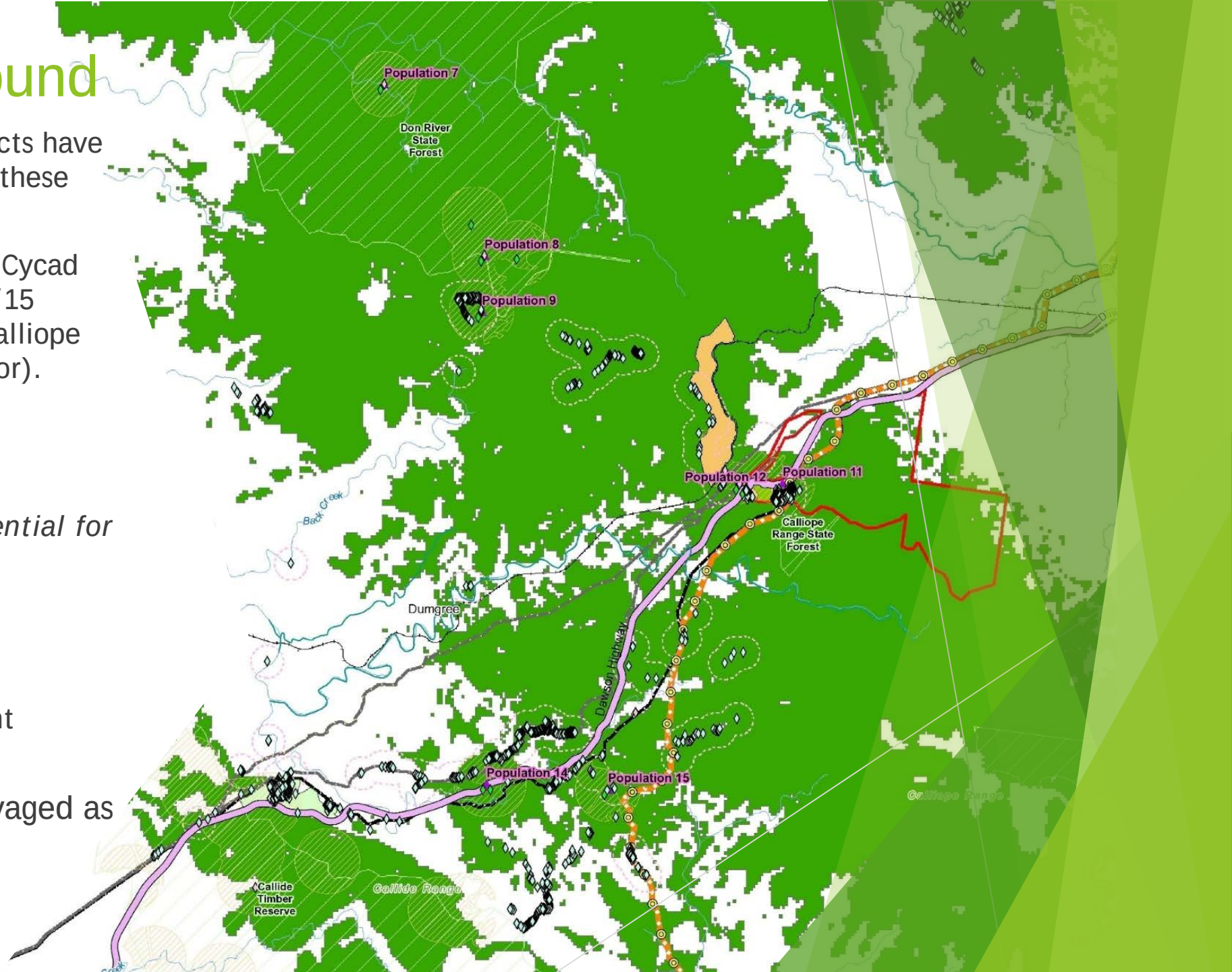
- Species
- Projects
- Approach and Challenges
- Results
- Lessons learnt
- Unknowns

Cycas megacarpa

- Trunked Cycad to ~9m tall
- Listed as ‘Endangered’ both nationally under the Commonwealth’s *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) and at a state level under the Queensland *Nature Conservation Act 1992* (NC Act).
- Endemic to Queensland, Australia.
- Recorded between Gympie and Rockhampton and less than 100km from the coastline.
- Estimated occupancy range of 2,527ha (Queensland Herbarium, 2007).
- ~46 populations have been recorded across its distribution range.
- Only 8 of these populations are considered to be significant and viable/self-sustaining in the long term (>3,500 individuals)

Region background

- Since 2009, 4 major projects have directly impacted on 2 of these populations.
- Projects have intersected Cycad Populations 11/12 and 14/15 through the Callide and Calliope Ranges (~2km wide corridor).
- Projects included:
  - 1 road realignment
  - 3 pipelines (*with potential for a fourth*)
- Future Projects include:
  - 1 railway duplication
  - 1 HVL power easement duplication
- 2800 *C. megacarpa* salvaged as a result.



Projects Covered

Pipeline A

- Traversed through ~23km (lineal) of known *C. megacarpa* habitat
- Incl. ~7km of mapped essential habitat
- Generally 30m wide disturbance footprint
- 357 individuals within the direct disturbance footprint

Pipeline B

- Traversed through ~19km (lineal) of known *C. megacarpa* habitat
- Incl. ~2km of mapped essential habitat
- Generally 30m wide disturbance footprint
- 359 individuals within the direct disturbance footprint

Approach

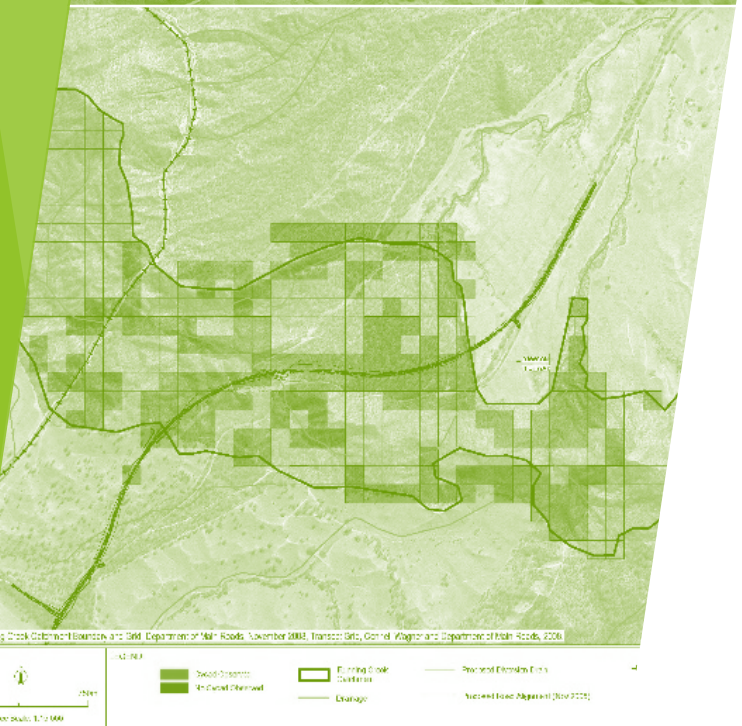
- Survey of the footprints and appropriate buffers;
  - Baseline data.
- Extent mapping and population viability assessment;
  - Aerial surveys (helicopter) and ground truthing of the wider area to identify population extent and connectivity;
  - Also used to identify offsets and recipient sites.
- Cycad working group established to maximise likelihood of success;
  - Ecological, biological, genetic, horticultural, transplant specialties + Govt. representative.
- Translocation Management Plans Developed;
  - Methodologies for salvage, seed collection and propagation, horticultural management and monitoring and reporting.
- Due to timing temporary recipient site identified;
  - Benefits and detractions to this approach.
- Regular consultation with State and Commonwealth Govt. agencies.

Challenges

Projects were not concurrent allowing for lessons learnt from one programme to be applied to subsequent programmes

However……..

- The works were undertaken during a time when legislation and policy was in a state of flux.
- Limited collaboration between the parties.
- Parties were focused on their task at hand and as such large sums of money were spent on the storage of plants rather than on-ground conservation (securing an offset/recipient site).
- Limited government oversight and understanding of process.
- OHS compliance – heavily regulated industry.
- There was limited guidance with respect to monitoring a species such as this (particularly with regards to price driven v conservation outcomes).
- Unlikely to be as big an issue today.



Surveys

Population scale:

- Survey area 1800km^2
- Targeted specific community type – suitable habitat
- Often constrained
  - Landholder consent
  - Accessibility – generally hiking in only way to assess some locations
- Assessed population dynamics
  - Cluster size
  - Age and height classes
  - Male / female ratio's
  - Levels of recruitment
  - Proximity to other clusters
  - Proximity of seedlings to maternal parent

Translocation preparation

- Baseline assessment and tagging:
  - All individuals tagged (fire proof) with a unique identification code
  - Core data captured
  - Seedlings – where confirmation could be made, maternal parent was recognised

- Recipient site prep (temp/perm):
  - any weeds and pest animals were removed from the immediate vicinity;
  - a stable surface area (temp only), firebreak and watering system were established; and
  - cattle proof fencing erected.

Translocation methods

- Hand digging
  - Required for steep slopes
  - Against trees and boulders
- Mechanical removal
  - Where topography and soil type allowed
  - Particularly in drainage lines and gentle slopes
- Helicopter assistance
  - Required for range face activities (salvage)

- Any damage incurred to the plant through the transplant process was recorded and photo-logged for input into the database.
- This assisted in identifying future horticultural requirements and informing monitoring analysis when tracking the progress of a plant (particularly if transplant failure occurred).

Key observations during transplant

- Sub-surface variability.
- No. of pups (old and new) below the surface.
- Coralloid root – up to 1m from stem.

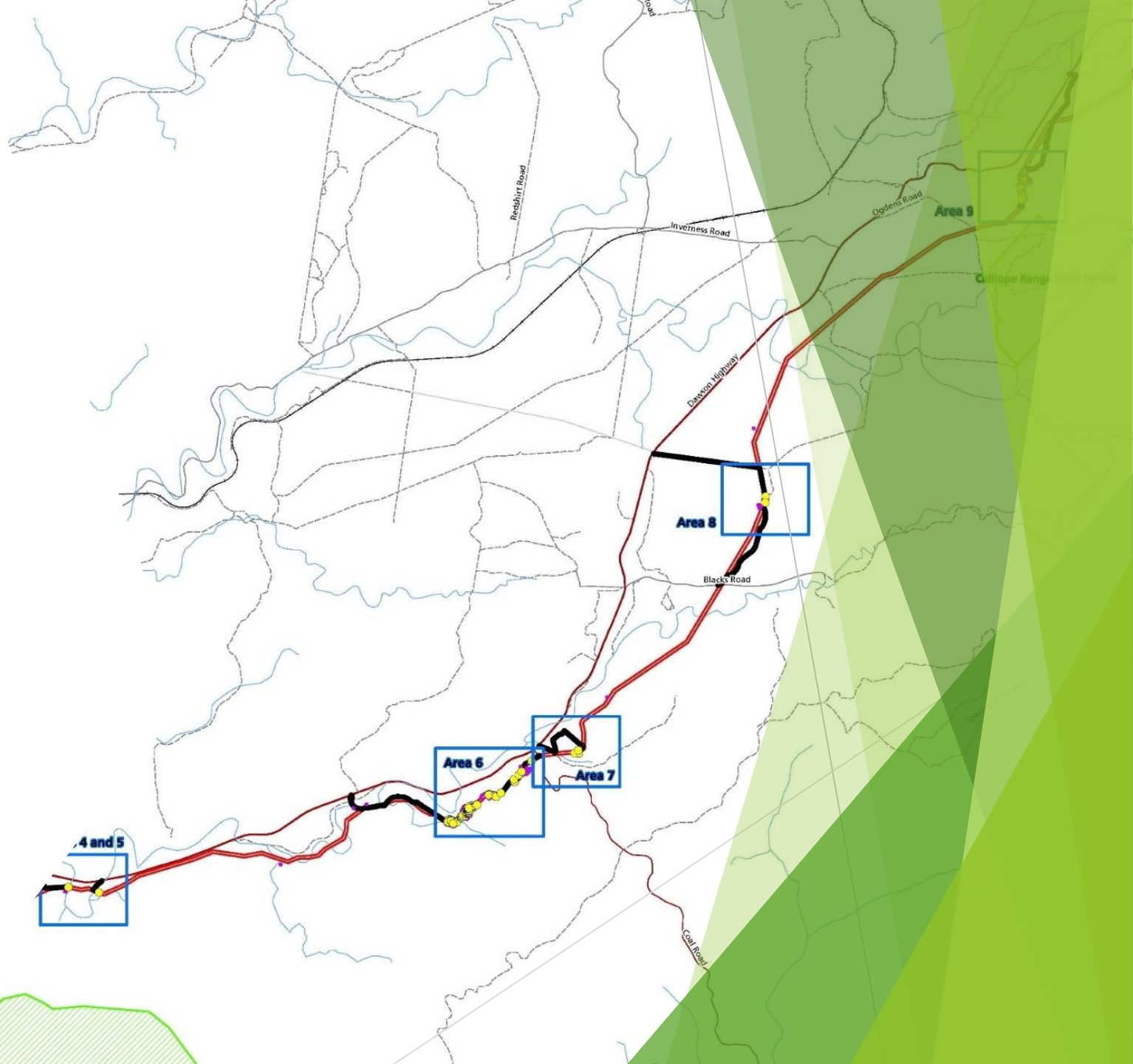
Pipeline A

- 357 individuals salvaged in 2012.
- Potted up and held in temporary storage facility for ~23 months (Sep12 – Aug14).
- Planted into recipient site in August 2014.
- Callide Range (Population 14/15).
- ~3000 seeds collected for propagation and in-situ planting (2012 – 2016).
- Pilot programme of 309 juveniles planted in 2015.

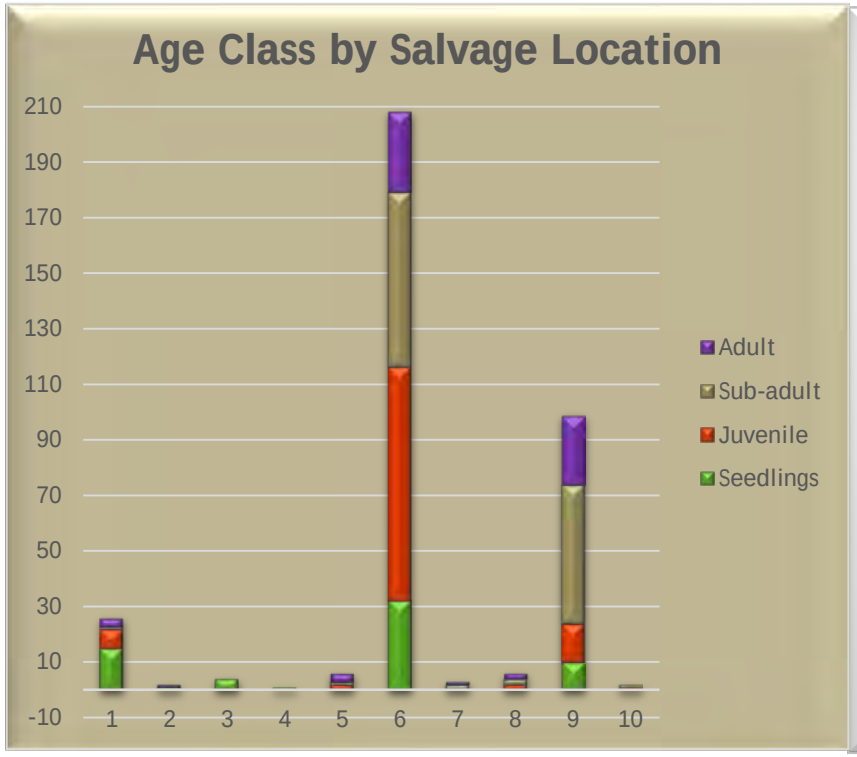
Pipeline A

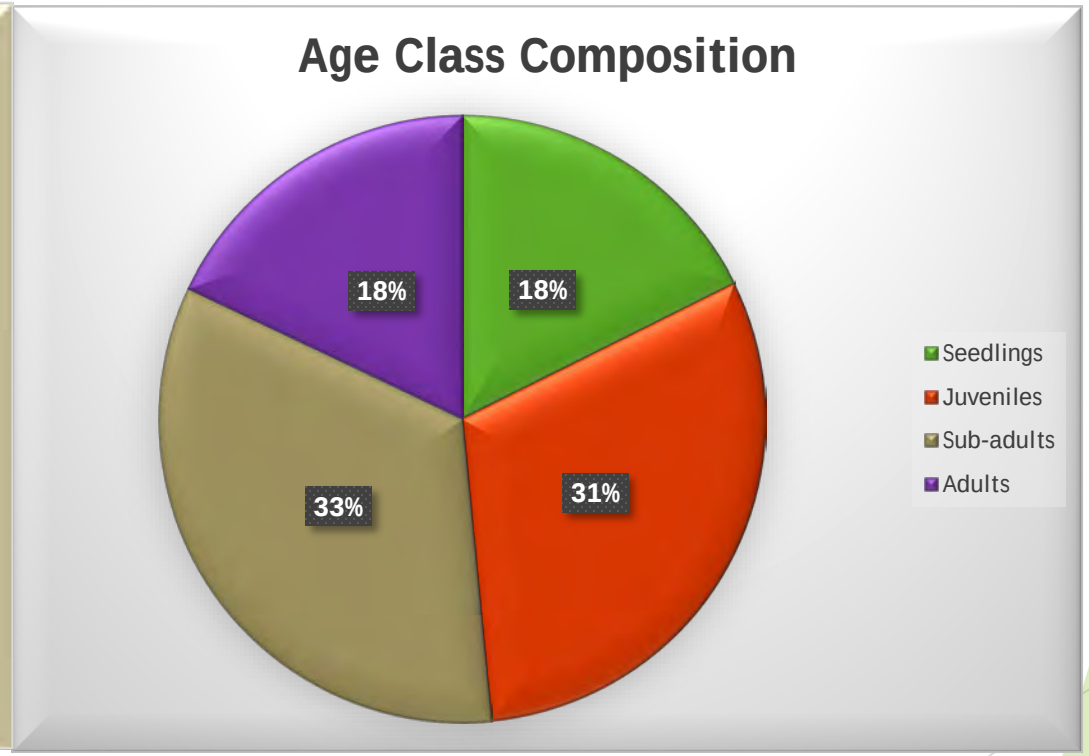
- Individuals salvaged from 10 locations along alignment.

- High density clusters occurred at:
  - SL6 (Callide Range) – 208 individuals (58% of total salvage).
  - SL9 (Calliope Range face) – 99 individuals (27.75% of total salvage).

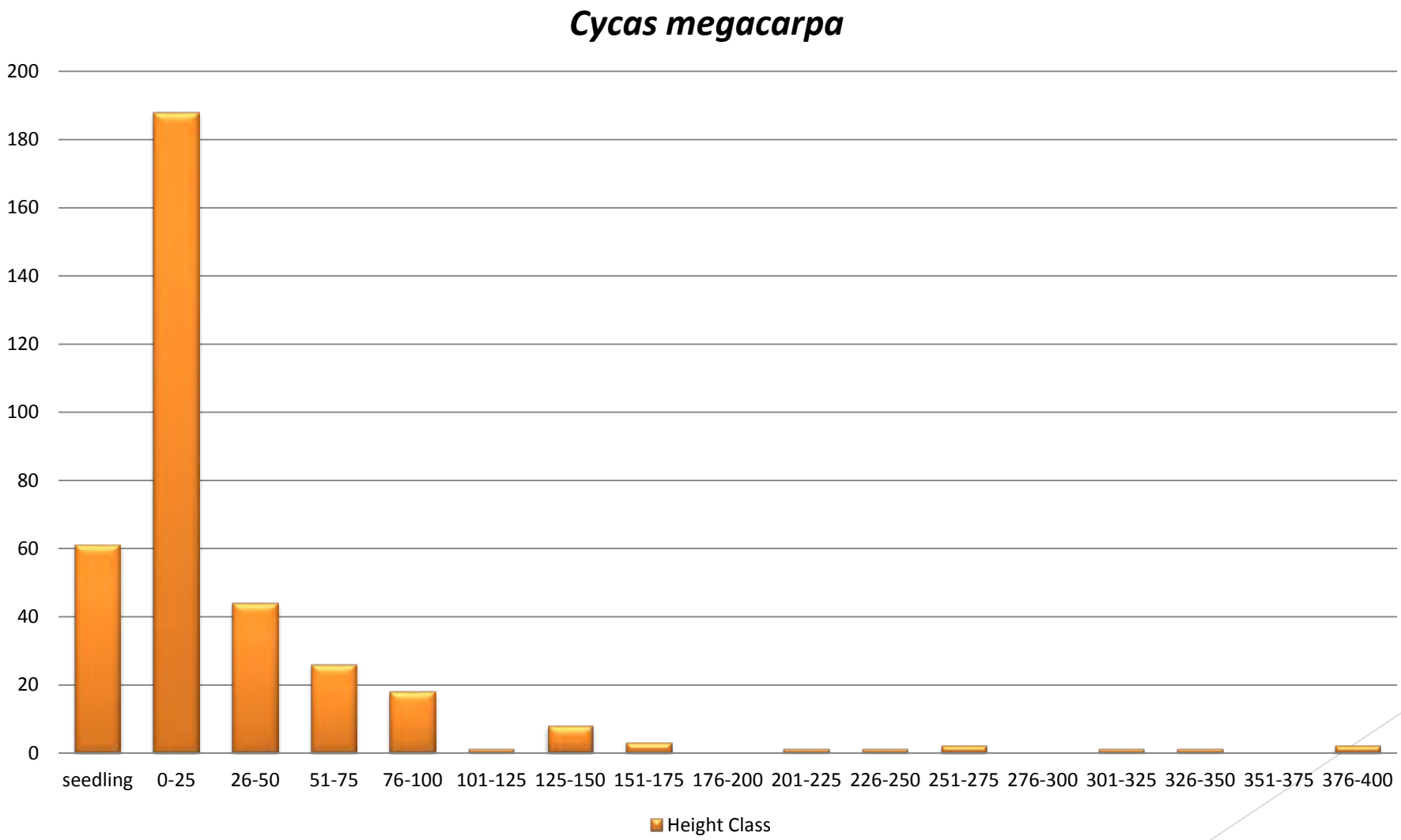


Pipeline A – 357 individuals

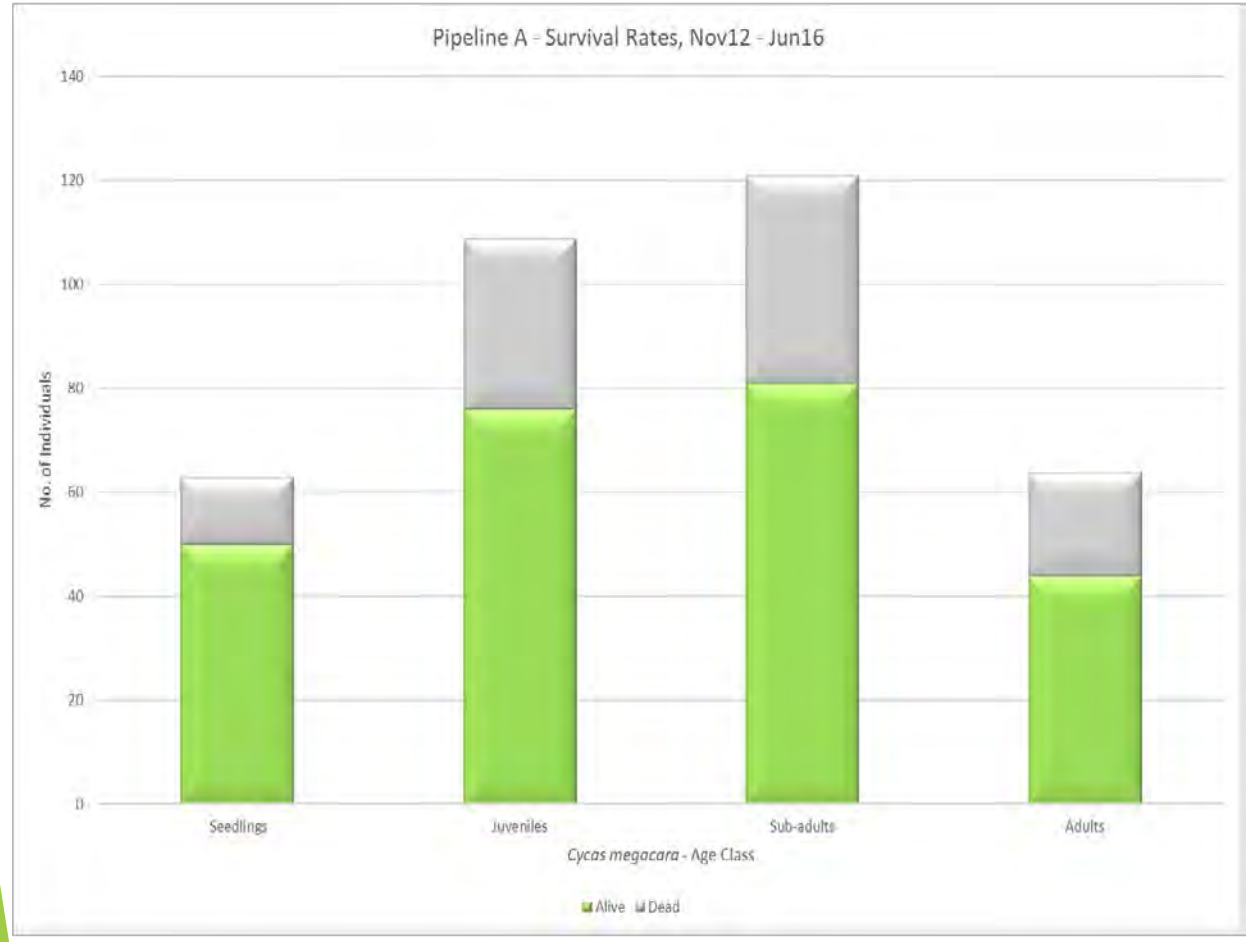




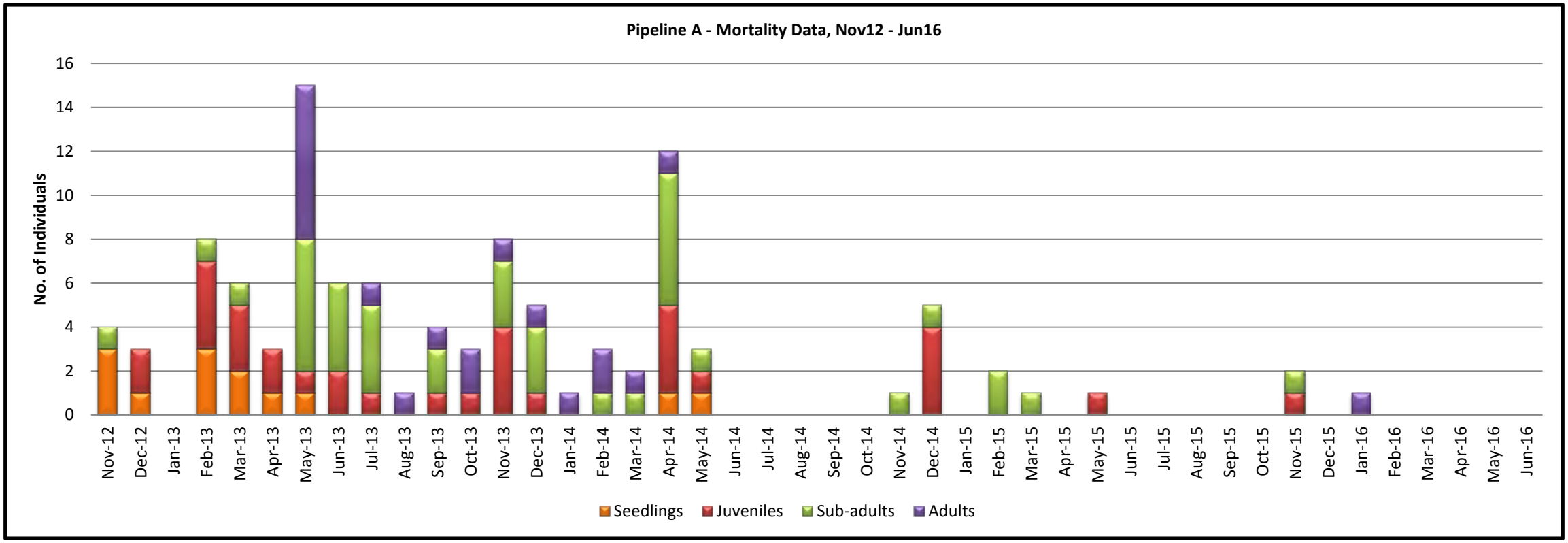
Pipeline A – height class data



Pipeline A - survival rates



- Survival rates (cumulative):
  - Year 1 = 81.25%
  - Year 2 = 73.75%
  - Year 3 = 70.50%
  - Year 4 = 68.25%
- Survival rates (age class):
  - Seedlings = 81%
  - Juveniles = 68%
  - Sub-adults = 64%
  - Adults = 64%
- Survival rates (locational)
  - Temporary storage = 73.75%
  - Permanent recipient site = 92.5%

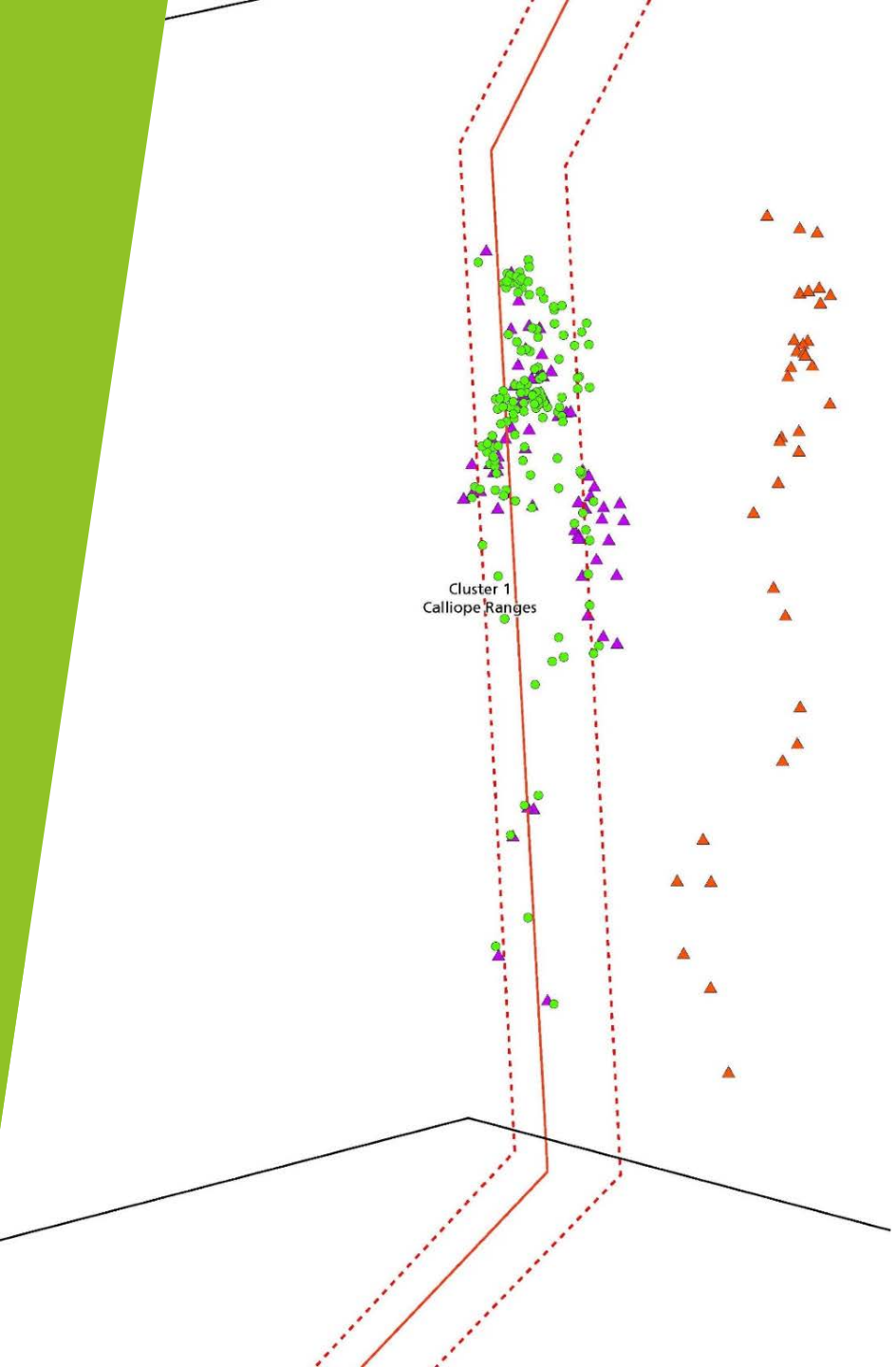


In terms of mortality rates, 59.25% of deaths occurred within first 12 months post translocation

Adults took at least 6 months to die but numbers stabilised in this age class after ~18 months

Pipeline B

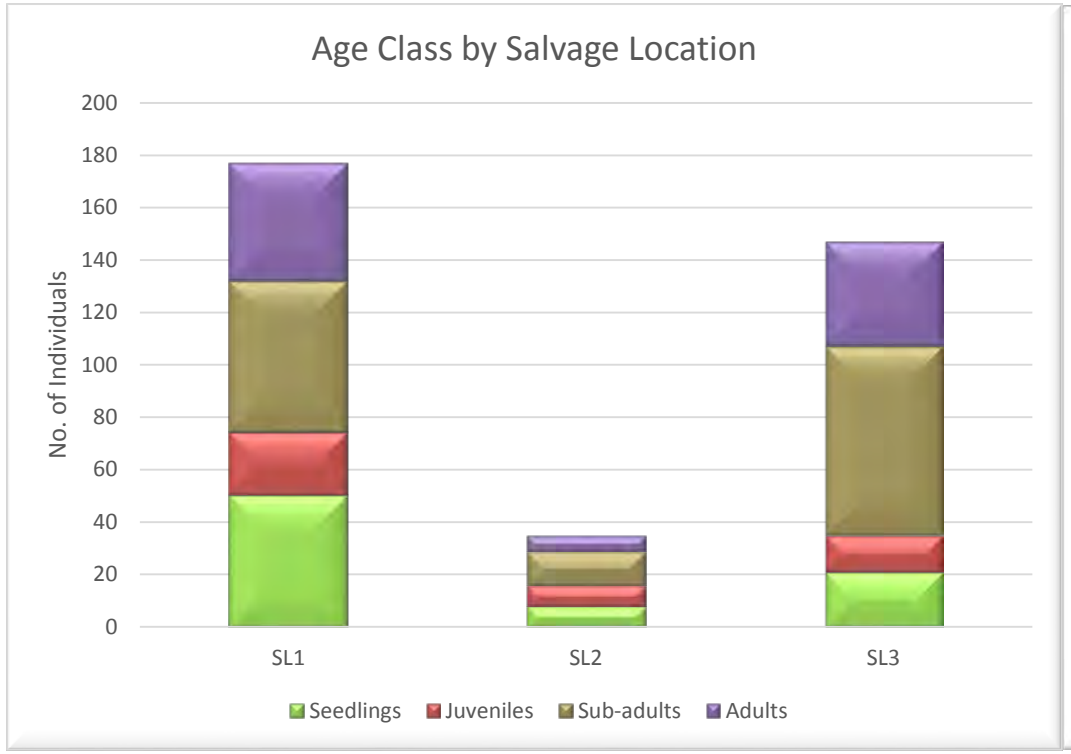
- 359 individuals salvaged between Aug and Oct 2011.
- Potted up and held in temporary storage facility for ~5yrs (Oct11 – Sep16).
- Planted into recipient site in September 2016.
- Calliope Range (Population 11/12).
- Controlled burn ~2 months prior to transplant (June 2016).
  - Weed and fuel load reduction.
- Remaining weeds mechanically removed from planting area during transplant activities.

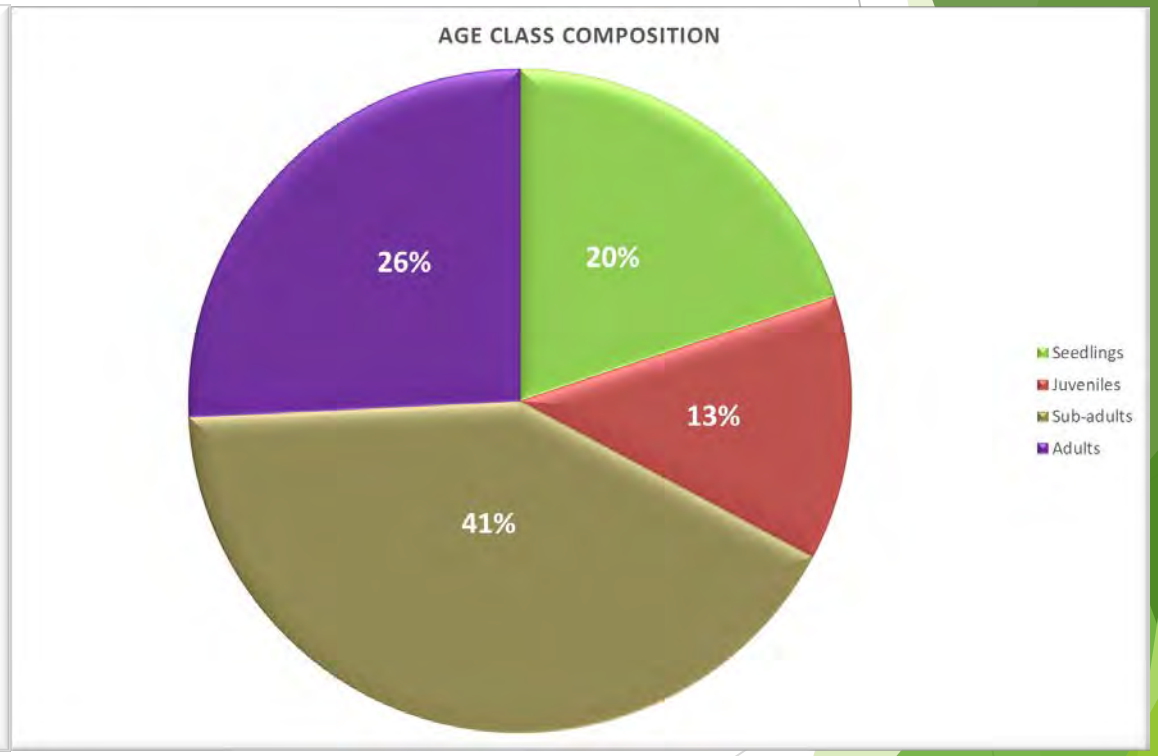


Pipeline B

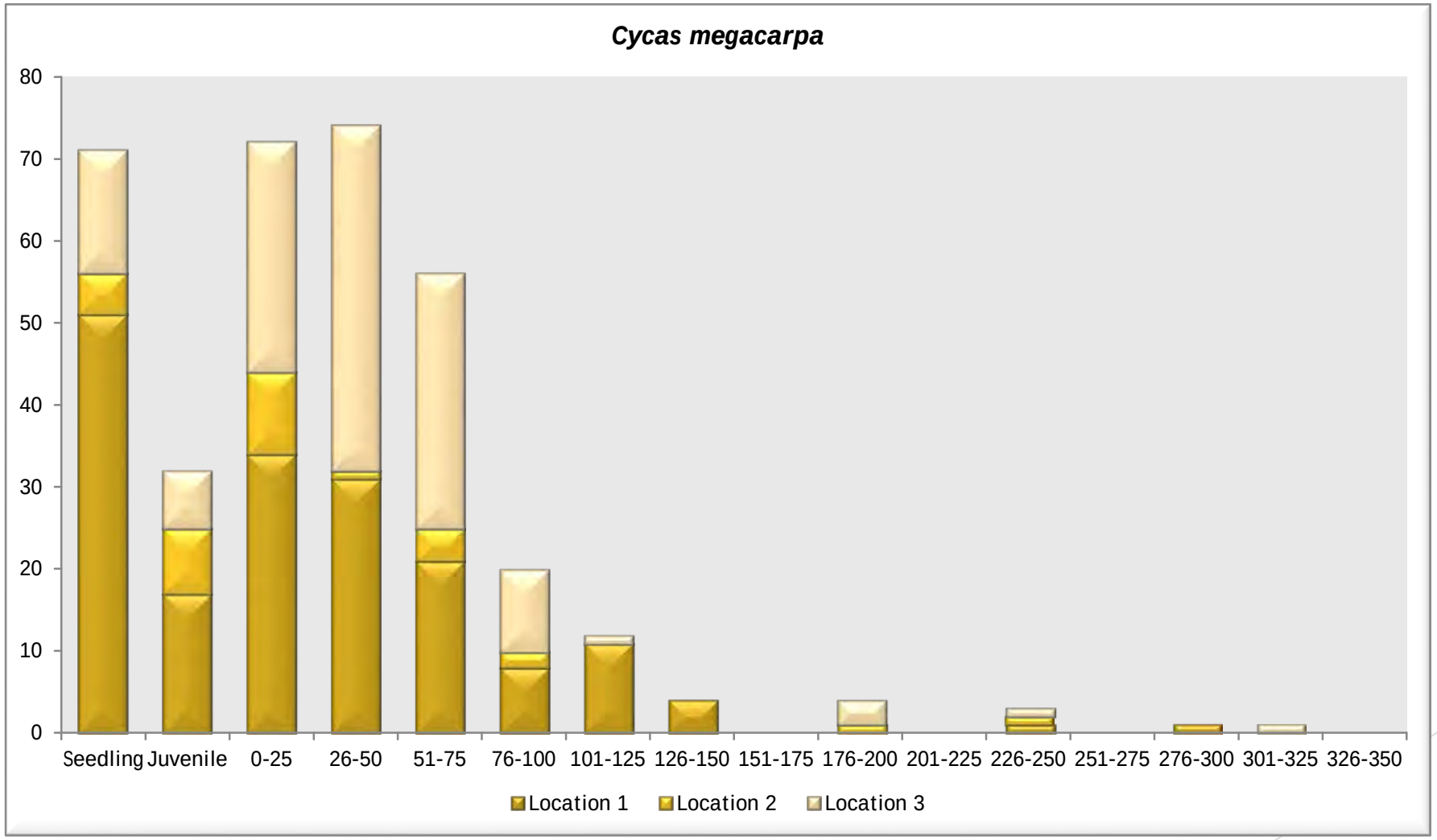
- Individuals salvaged from 3 locations along alignment.
- High density clusters occurred at:
  - SL1 (Calliope Range face – 177 individuals (49.25% of total salvage).
  - SL3 (Callide Range) – 147 individuals (41% of total salvage).

Pipeline B – 359 individuals

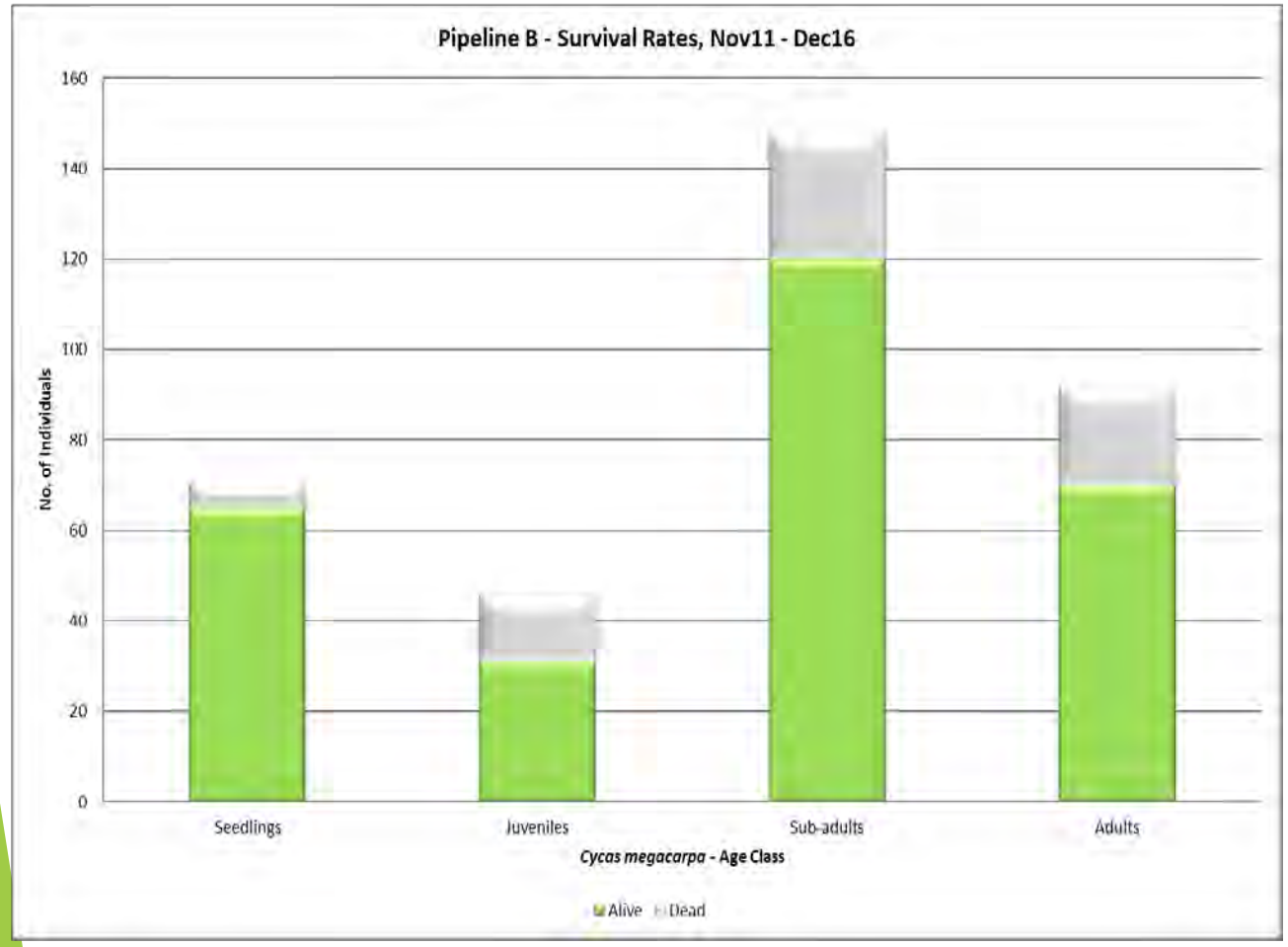




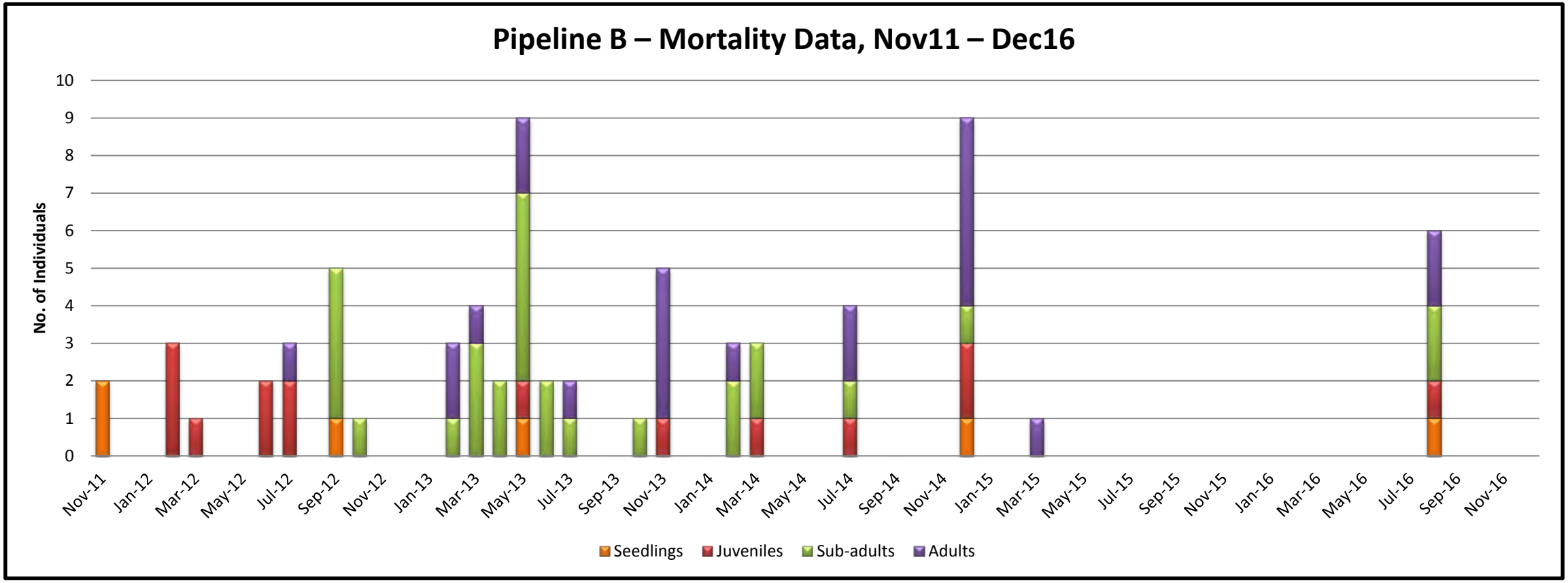
Pipeline B – height class data



Pipeline B – survival rates



- Survival rates (cumulative):
  - Year 1 = 95%
  - Year 2 = 87.25%
  - Year 3 = 84.50%
  - Year 4 = 81.75%
  - Year 5 = 80%
- Survival rates (age class):
  - Seedlings = 91.50%
  - Juveniles = 67.25%
  - Sub-adults = 81%
  - Adults = 76%
- Survival rates (locational)
  - Temporary storage = 80%
  - Permanent recipient site = TBC



In terms of mortality rates, the highest rates of death occurred during year 2 (39%) – Cyclone Oswald.

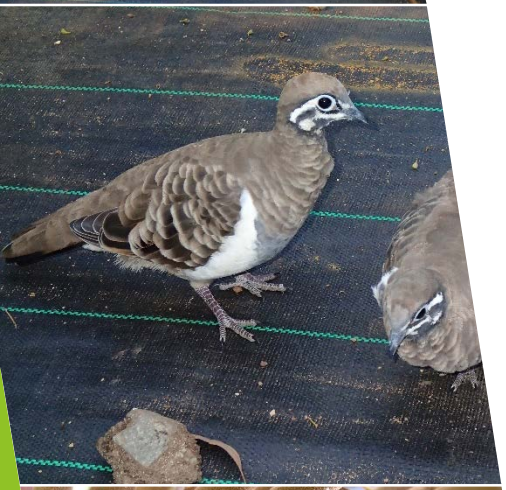
Adults took at almost a year to die.

Uncontrollable events

- Wildfires
  - Impacted Pipeline B plants 1 week prior to salvaging.
- Cyclones
  - Otswald (Jan 2013).
  - Debbie (Mar 2017).
- Record breaking rainfall
  - >1000mm rainfall between Jan & Feb 2013 (incl. 200mm in a 24 hr period)
  - Region mean = 860mm p/a;
- Wind storm

Notable monitoring observations

- Flies and their larvae
- Foliage predation
- Coleoptera mating practices



Notable monitoring observations

- Bush rats
- Squatter pigeons
- Frogs
- Birds (nesting)
- Red back spiders
- Funnel web spiders

Other notable observation

Resilience

Lessons Learnt

- The age of *C. megacarpa* cannot be accurately measured by height or cataphylls;
  - dormancy/fire/stem breakage all impact on these measurements.
- *C. megacarpa* appear to develop reproductive material once they exceed 50cm in surface height;
  - <50cm incl. those buried beneath sediment do not appear to produce reproductive material.
- Development of reproductive material:
  - Pollen cones develop within 12 months post translocation;
  - Megasporophylls were observed <5yrs post translocation in in-situ environments;
  - Seed and long term viability appeared to be an issue during that period;
  - Recruitment observed within 7 years post translocation (in-situ).
- Plant spacing is important for long term viability and dispersal;
- Very difficult to determine if sex change occurs due to difficulties in capturing baseline data prior to translocation;

Lessons Learnt

- Communication flow within compartmentalised translocation teams is critical
- Bag material and size was critical in temporary storage
  - Humidity / length of time in bag / OHS (heavily regulated industries)

Benefits

- Cycad working group.
- Genetic study of the plants across distribution range.
- Mapped out new viable populations or extended / joined populations.
  - Particularly populations 8, 11, 12, 14 and 15.
- Inform the next recovery plan for the species.
- Inform the translocation guidelines for Cycad taxa.
- Engagement with local landholders into the value of the species.
  - Previously seen as a threat to grazing activities (historically poisoned in response to government decrees).
  - Local landholders now actively avoid clearing of the species.
- Opportunity to involve local school kids in the programme.

Unknowns

- Still more questions than answers on the biology of the species:
  - Pups
    - Incl. whether they have capacity to change sex of base plant
  - Age of the plants and growth rates
  - Reproductive traits
    - females do not appear to be seasonal
    - viability of reproductive material – early years
  - Invertebrate relationships
    - Appear to have mutualistic relationships with some invertebrates (e.g. ants).
    - Role of Cycad in mutualistic relationship between Lycaenid butterflies and ants.
- Cyanobacteria and the symbiotic relationship - specific or generalist?
- Dormancy triggers and levels of survivability
  - For example some plants appeared healthy but remained dormant for years
- Impacts of salvage on local cluster relationships
- Impacts of seed collection on long term population dynamics

Acknowledgements

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