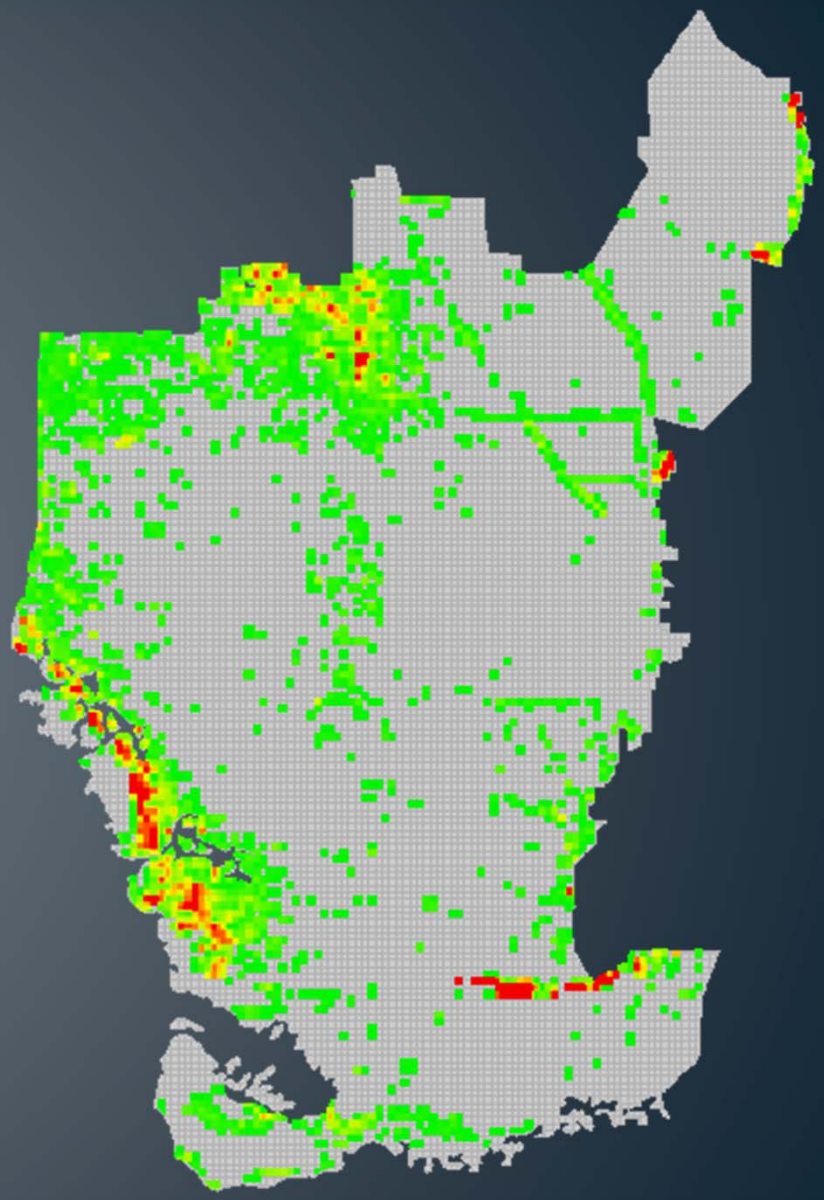
Exotic plant species monitoring across 14,000 km^2, what we've learned by the third year of operating a stratified monitoring design

Jed Redwine, Shea Bruscia, LeRoy Rodgers, Tony Pernas, and Brooke Shamblin



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SOUTH FLORIDA WATER MANAGEMENT DISTRICT

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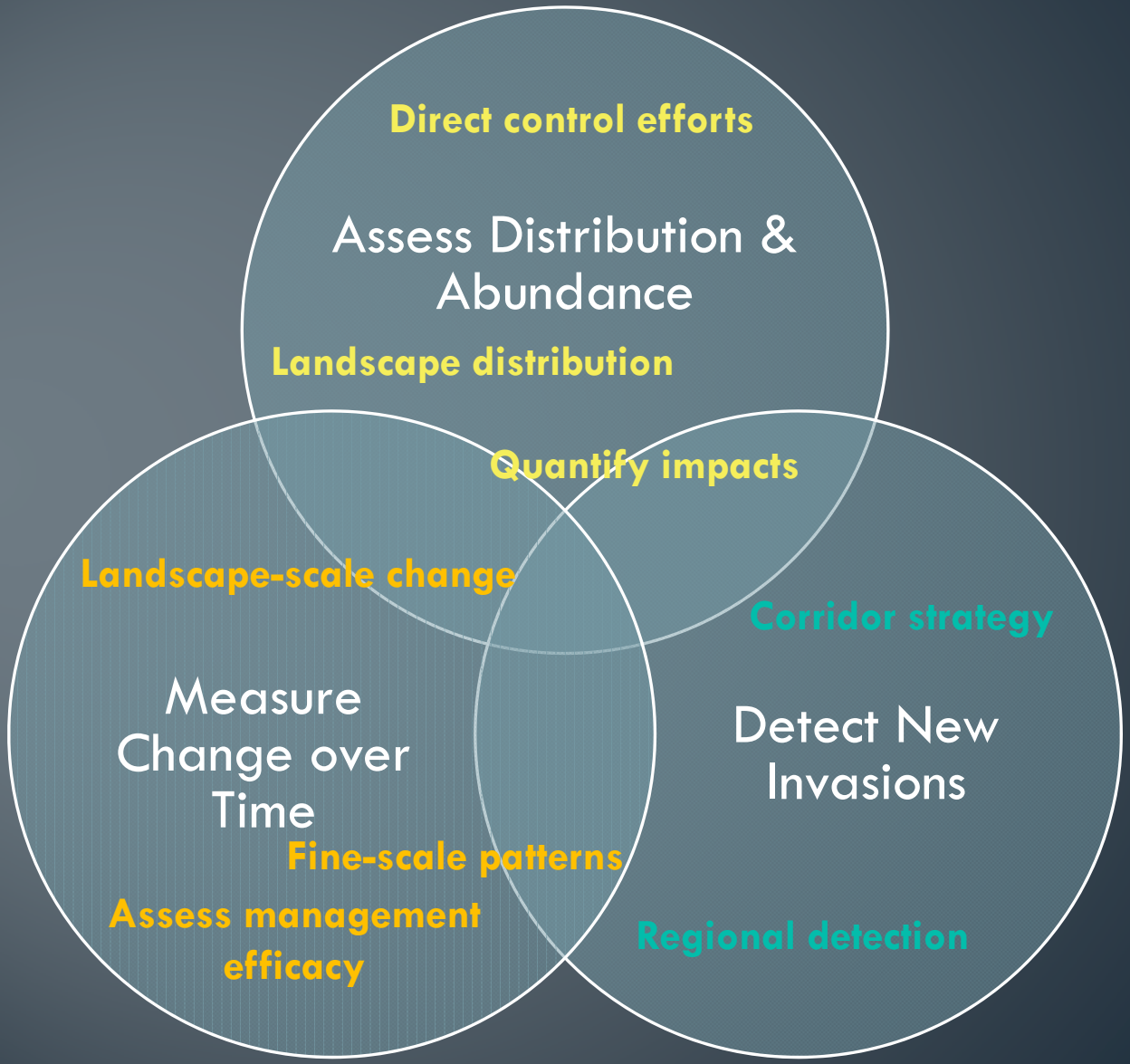
CISMA

Everglades Cooperative Invasive Species Management Area

ECISMA Invasive Plant Monitoring Objectives



State and Federal laws require accountability and monitoring

State:

Everglades Forever Act

- "The district shall …prepare a survey of exotic species every two years"

Federal:

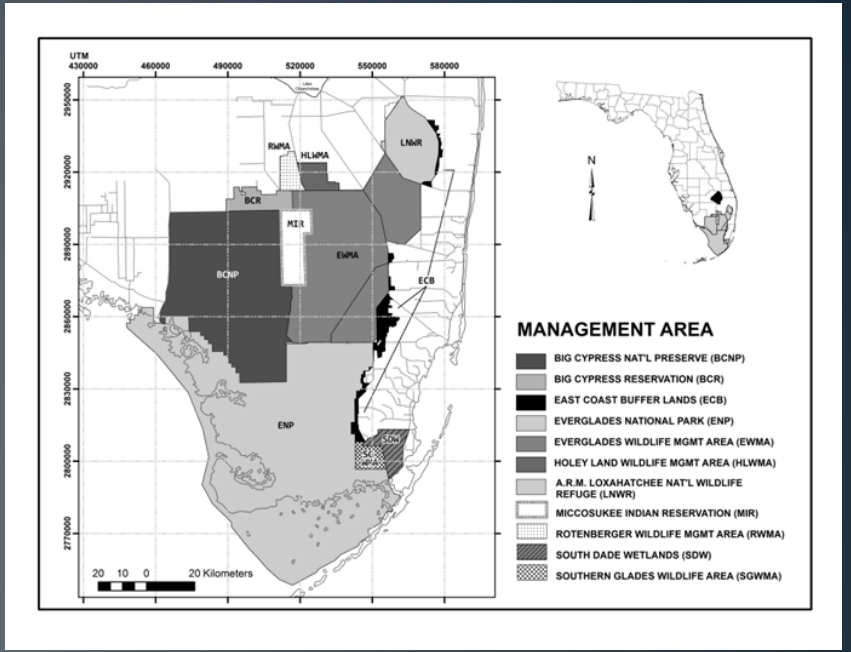
Government Performance and Results Act (GPRA)

- General goals and objectives, including outcome-oriented goals, for the major functions and operations of the agency

GPRA text: http://www.gpo.gov/fdsys/pkg/BILLS-111hr2142enr/pdf/BILLS-111hr2142enr.pdf

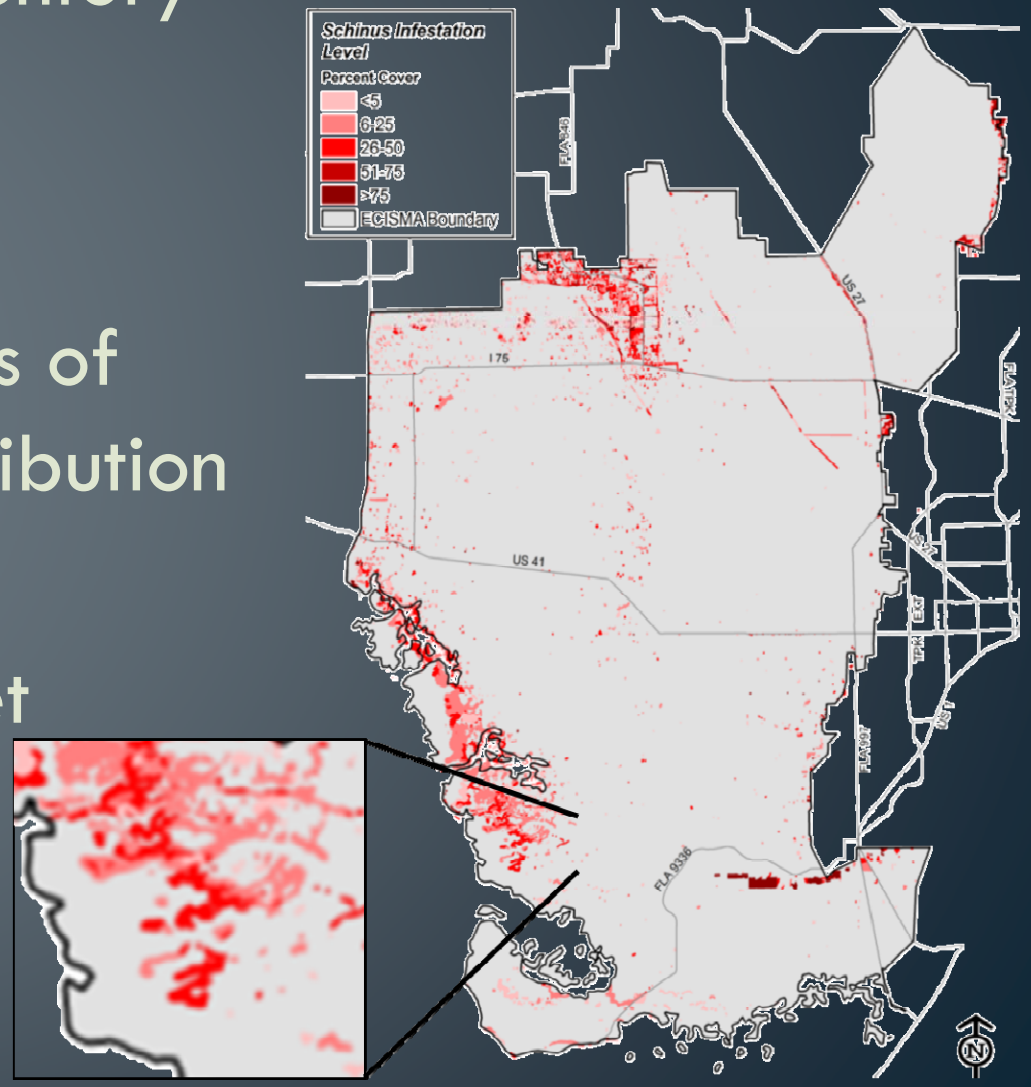
Challenges

- The Everglades is big! (~14,000 km^2)
- Landscape is complex
- Multiple jurisdictions
- Numerous monitoring objectives
- Over 70 Category I invasive plant species
- New species continue to establish



Digital Aerial Sketch Mapping

- Landscape-scale inventory
- 2-year cycle
- Four priority species
- Best current estimates of abundance and distribution for these species
- Not all objectives met



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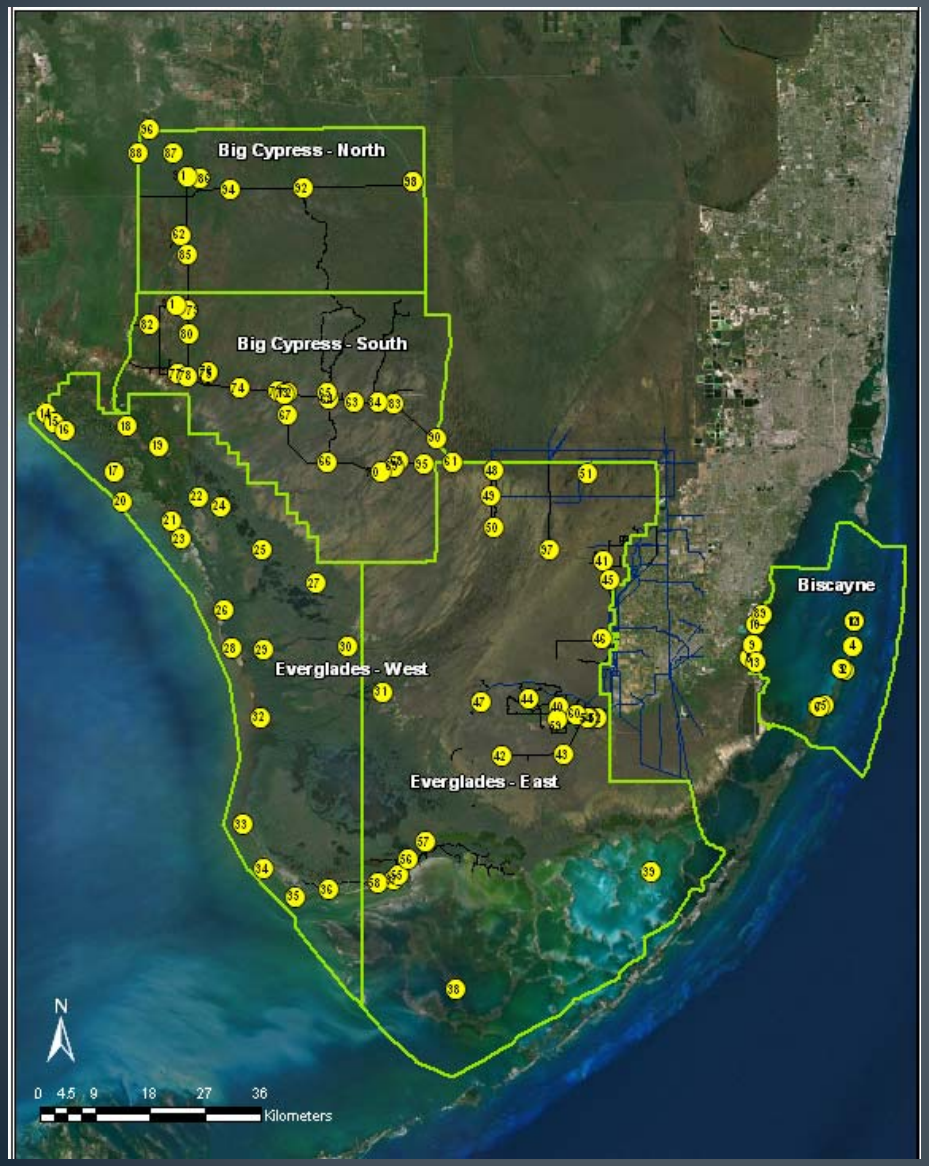
Corridors of Invasiveness



A NPS initiative focused on **Early Detection and Rapid Response**

- There are 99 sites in three National Parks (BICY, BISC, EVER).
- All sites are surveyed in a five year period.

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South Florida Caribbean Network

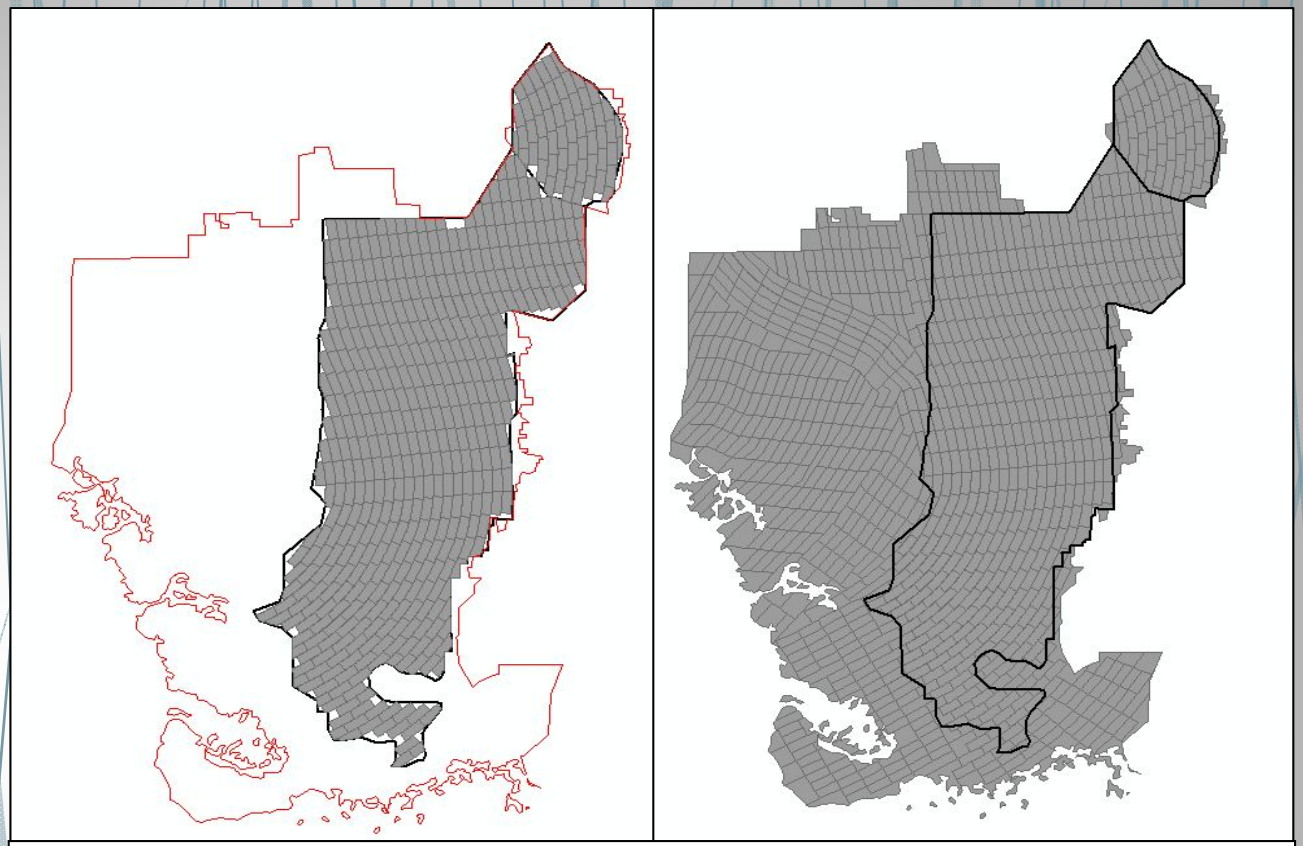


Figure 3. Left: The ridge, slough, and tree island GRTS tiles as developed by Philippi 2007 within the ECISMA boundary. Right: The extension of the GRTS tiles within the entire ECISMA boundary developed by Jed Redwine.

Evolution of monitoring system

ECISMA sampling design expands the themes driving CERP landscape sampling design to the expanded ECISMA area (doubling sampled area)

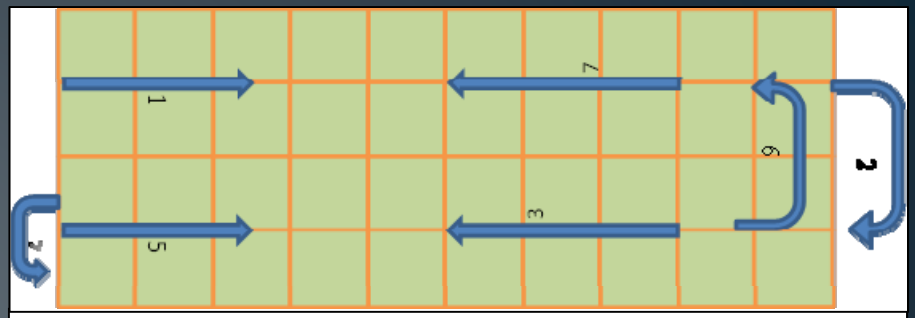


Figure 9: The flight path taken for each of the selected tiles.

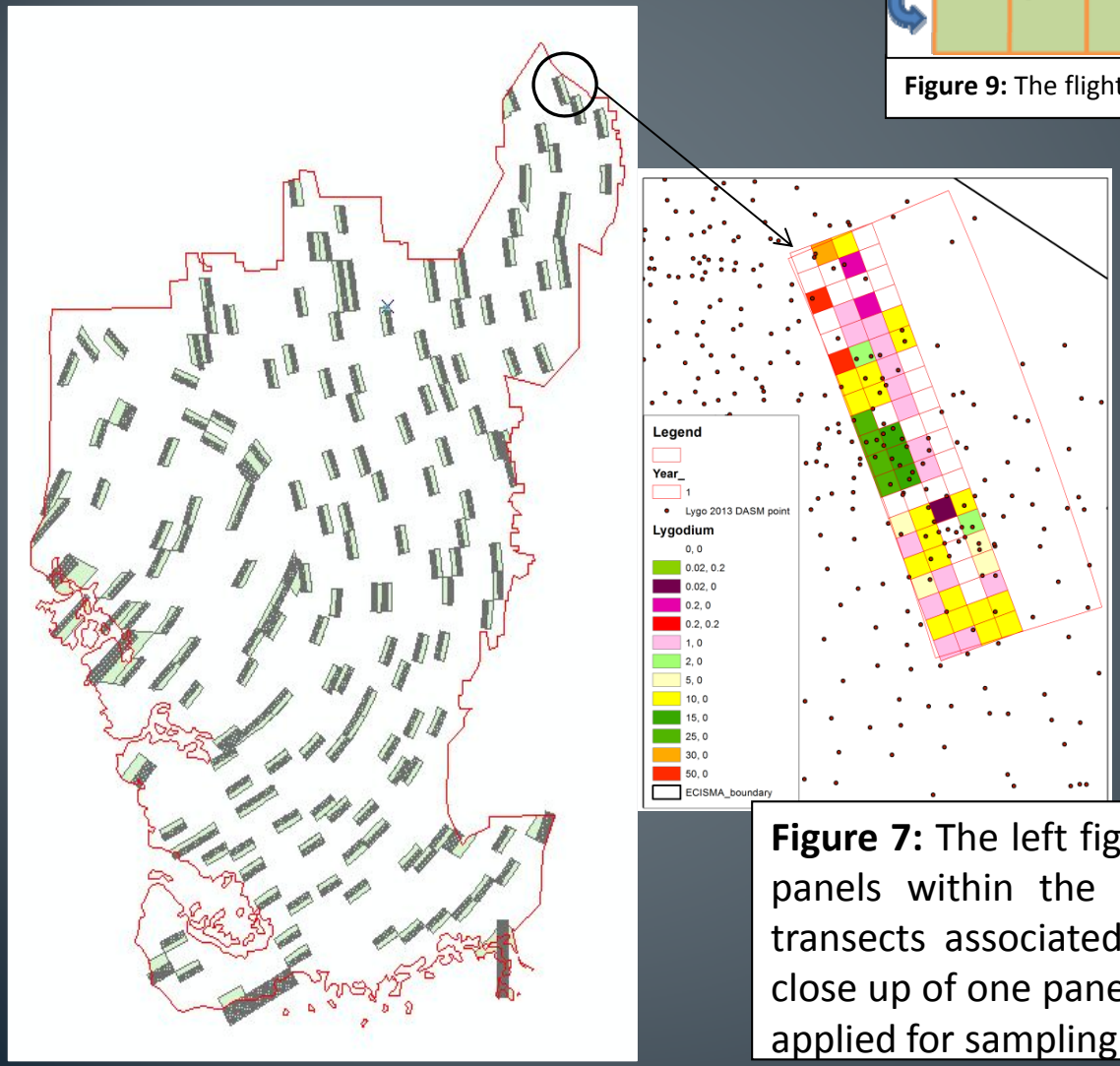
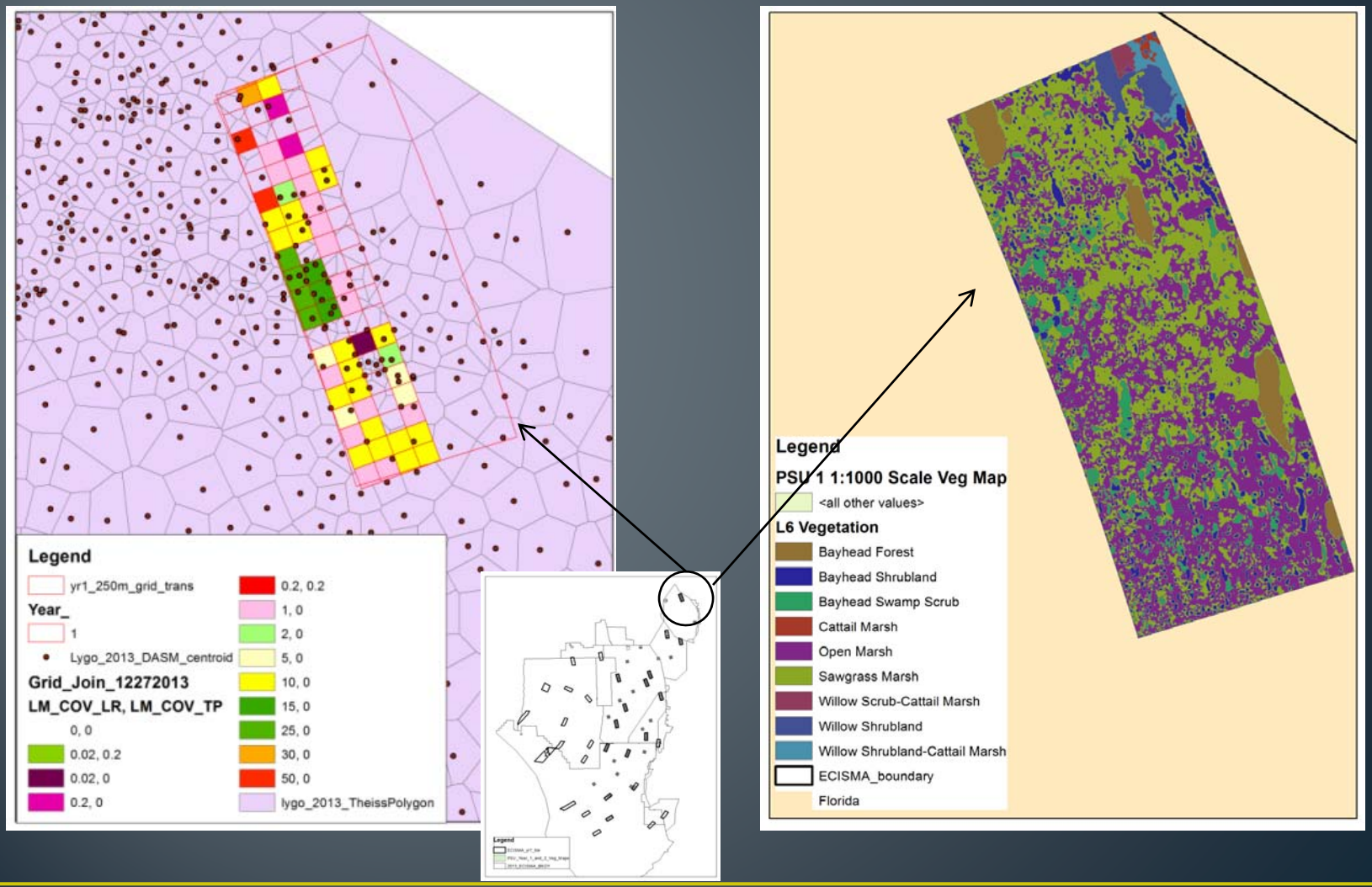


Figure 7: The left figure represents all of the 168 selected panels within the ECISMA boundary and the gridded transects associated with the tiles. The right figure is a close up of one panel with a 5 x 20 grid (250 m wide cells) applied for sampling.

Panel Vegetation Maps

Vegetation maps are developed for CERP panels

and are useful for supporting analysis of infestation patterns

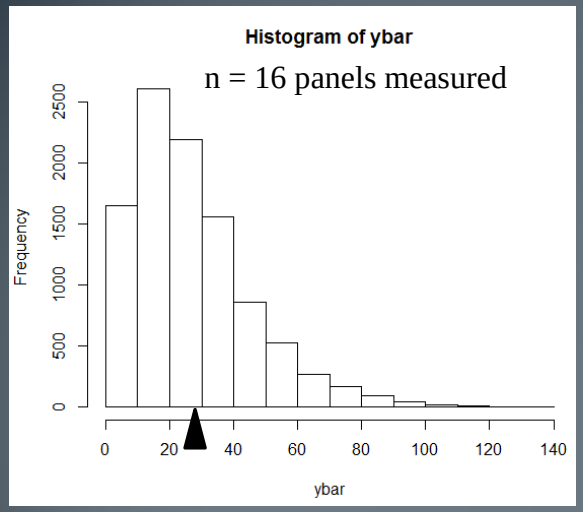


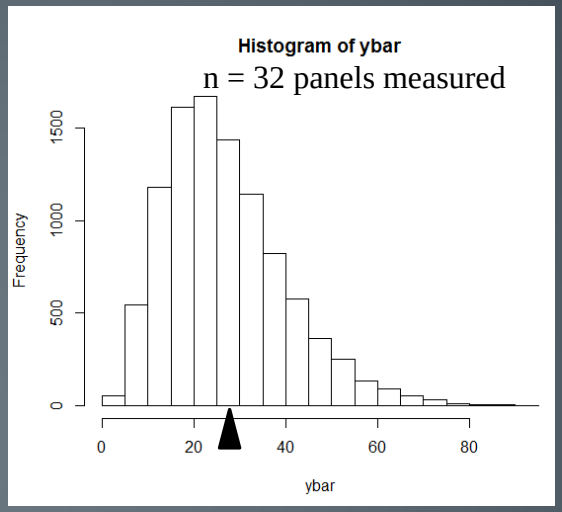
Complementing CERP monitoring with Exotic plant monitoring allows…

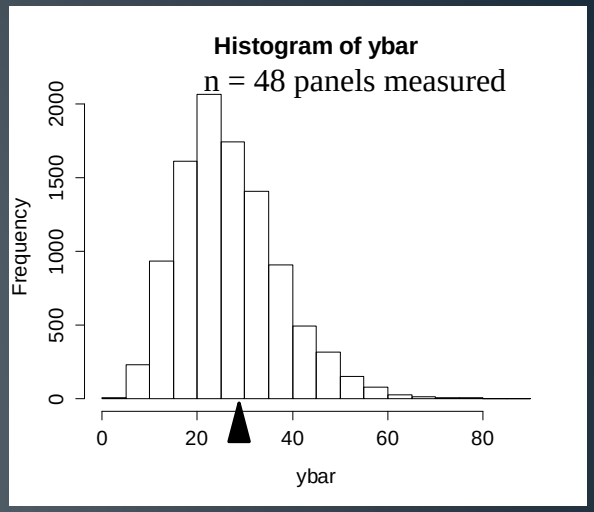
- **Enhanced monitoring precision:**
  - A source of information to identify monitoring challenges associated with habitat type
  - Population trends may be more easily detected across the full spectrum of conditions that occur over 14,000 km^2.
- A basis for identifying causal mechanisms to focus management on specific areas.

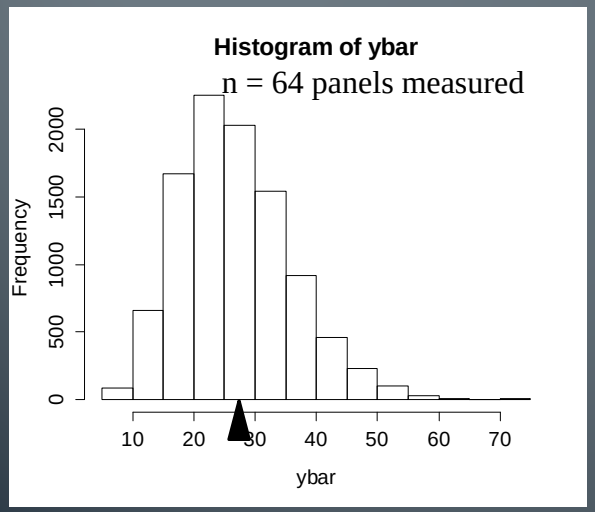
Simulating the performance of a monitoring design –

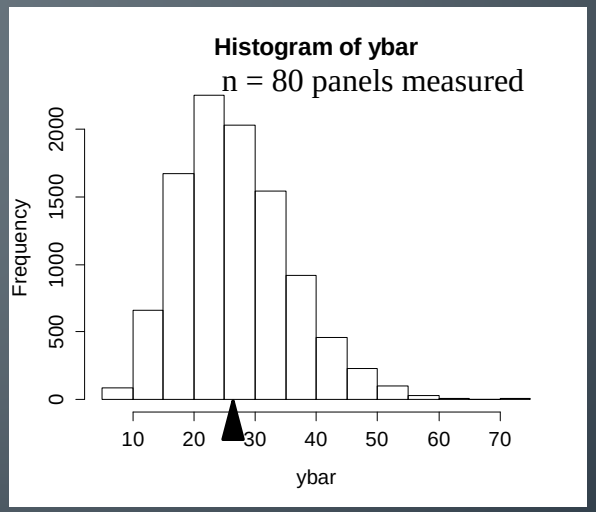
Schinus terebinthifolius bootstrapping process: Simple random sampling





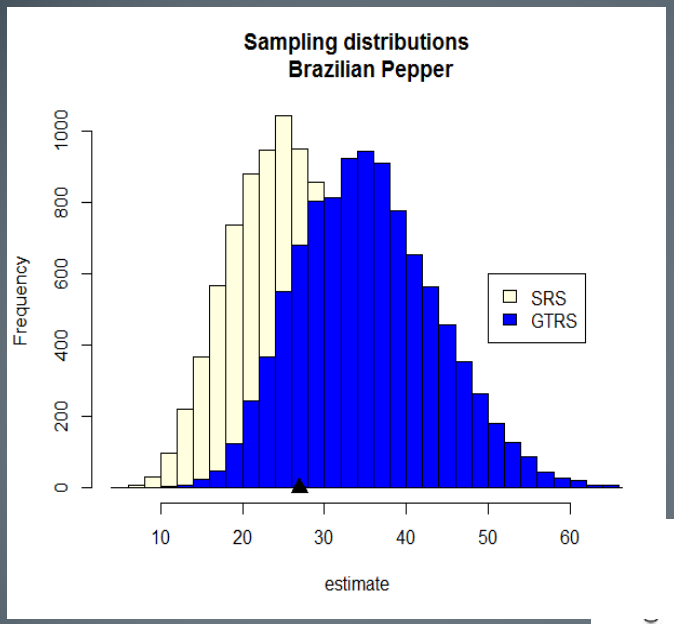


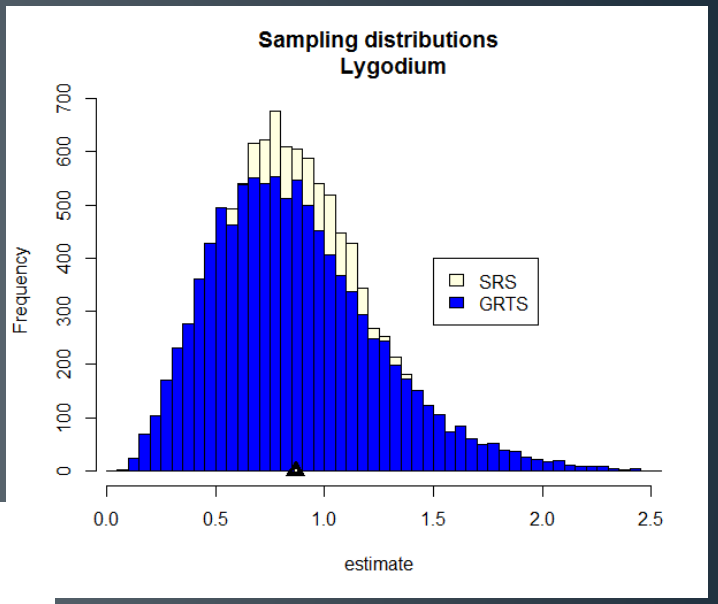


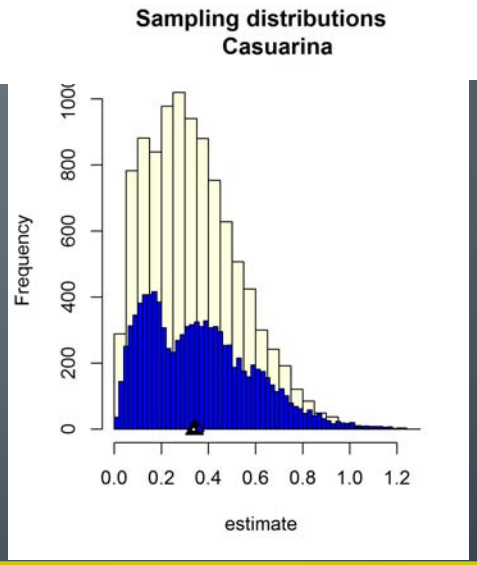


As number of sampled panels increases, so does the precision of estimates increases!

Simulating the performance of the stratified design bootstrapping n= 160 panels

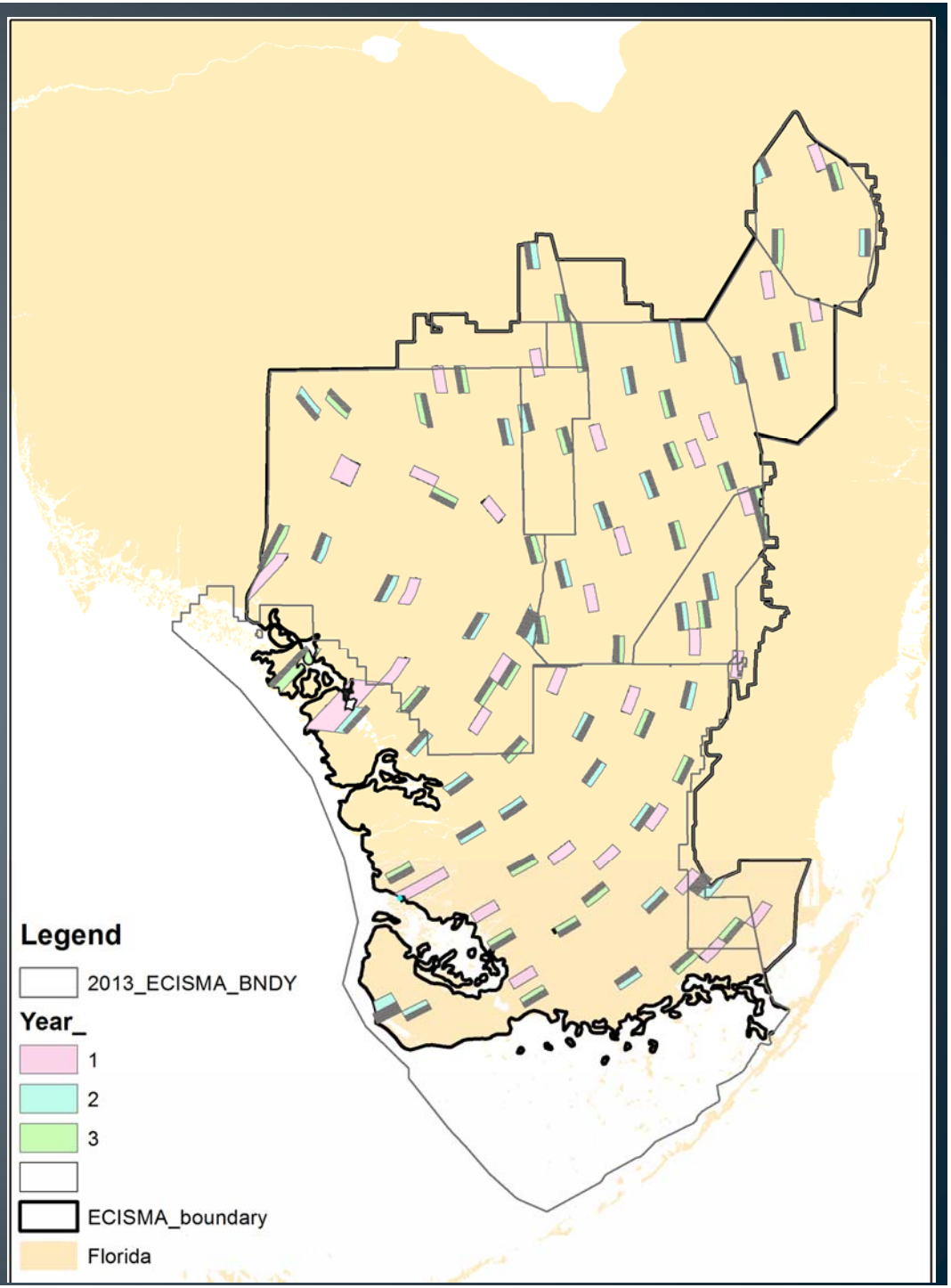






What we've sampled so far.

Total of ~15 helicopter days over 3 year period



Species	Total number of cells observed		Total number of exotic occupied cells		Average number of observers		Number of occupied cells seen by both	
Casuarina	3128	2896	29	5	1.5	2	6	2
Lygodium	3128	2896	56	63	1.5	1.6	3	15
Melaleuca	3128	2896	208	255	1.82	1.71	68	121
Schinus	3128	2896	221	266	1.81	1.67	134	124

Species	Average count of % Cover agreed		Total Count of cells expected to be occupied (based on DASM)		Total Count of cells where DASM expectation was confirmed		expected confirmed/expected occupied	
	Yr1	**Yr2**	**Yr1**	**Yr2**	**Yr1**	**Yr2**	**Yr1**	**Yr2**
Casuarina	0.8	0.5	9	2	5	2	0.556	1.00
Lygodium	0.667	0.04	42	31	30	21	0.714	0.68
Melaleuca	0.826	0.35	113	67	63	28	0.558	0.42
Schinus	0.552	0.24	123	211	85	141	0.691	0.67

Conclusions

- Species issues:
  - Casuarina appears to be declining
  - Lygodium is still hard to see
- Methods issues:
  - Presence/absence is consistently detectable
  - Relative abundance…..disagreement is more likely than agreement
  - Recommend simplifying the experience in the helicopter as much as possible to limit differences between observers
- System issues:
  - Sparse/low level infestations are (at least) **twice** as frequent as previously estimated
  - Better confidence in identifying areas where invasive species are absent
  - Sampling design works! (because it makes more efficient use of scarce resources)