Nest size influences the foraging distance and detection ability of red imported fire ants

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Red Imported Fire Ants (*Solenopsis invicta)*

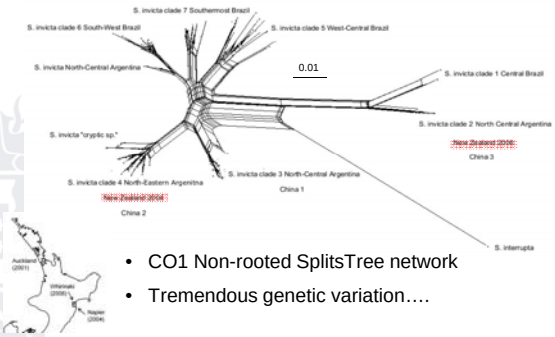
- Introduced to the US in 1940s.
- Cost Texas alone an estimated US$1.2 billion per year.
- Human health impacts, infrastructure impacts,….

Ecological effects

Deer fawn with scars on its head from red imported fire ant stings.

Red imported fire ants can almost completely eliminate ground-nesting birds such as the bobwhite quail.

NZ Fire Ant Incursions



- CO1 Non-rooted SplitsTree network
- Tremendous genetic variation….

Corin, Ritchie & Lester (2008) Sociobiology 52: 129-143

It is easiest to kill an incursion while nests are small…

- What is the best bait to use for detection?
- … and how easy is it to detect a RIFA incursion?
  - Or, how far do fire ants forage from their nests?
  - How does nest size influence foraging distance?

Study site: Gainesville, Florida

- Study undertaken in US autumn & spring, when conditions were most similar to an NZ summer.
- Three different mound sizes examined.


SMALL COLONY

Study site: Gainesville, Florida

Food preferences - Methods

- Foods: Mince, water on cotton wool, hot dog, 30% sugar water on cotton wool, peanut butter in soya bean oil and mince, peanut butter in soya bean oil.
- Foods were placed at random at equal distance (10 cm) from the edge of large and small fire ant mounds.

Ant presence/ absence assessed 1 hour after food placement.

Food preferences - Results

- Significant effect of colony size!
  - Small sized colonies discovered only 2 /108 foods. Large sized colonies discovered 54 / 108 foods.
- First ranked food stayed the same…

	2008			2009		
Food	Rank	Predicted occupation	SE	Rank	Predicted occupation	SE
Hot dog	4	0.592	0.045	2	0.778	0.098
Mince	2	0.833	0.039	4	0.500	0.118
Peanut Butter	3	0.633	0.051	3	0.611	0.115
Peanut Butter + Mince	**1**	**0.850**	**0.033**	**1**	**0.889**	**0.074**
Sugar	5	0	0	6	0.056	0.054
Water	5	0	0	5	0.167	0.088

Foraging distance - Methods

- Attractant baiting and pitfall trapping were conducted at increasing distances from central colonies.
  - Bait peanut butter + mince.
  - Pitfall traps (baited or un-baited) were teflon-coated glass test tubes with an internal diameter of 17 mm.
- Three environmental types: Scrub/ wasteland, urban, industrial (cracked concrete, etc).
- Three mound (colony) sizes.

Foraging distance - Baiting Trial Results

- The maximum distance ants from **small** sized colonies discovered food was 3 m (one occasion).
  - the majority of food discoveries happening at 0.25 and 0.5 m.
- Ants from **large** nests travelled up to 13 m (once) from the nest to a food source within the ~2 h time frame.
  - the probability of detection up to 0.97 for baits 1 m away from the nest.

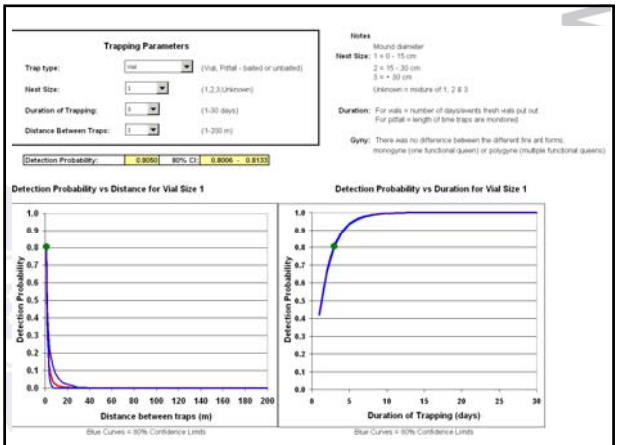
Foraging distance - Baiting Trial Results

	d.f.	deviance	mean deviance	deviance ratio	chi pr
Size	**2**	**79.72**	**39.858**	**39.86**	**<.001**
Distance	**3**	**85.11**	**28.370**	**28.37**	**<.001**
Distance x Size	**2**	**15.47**	**7.735**	**7.74**	**<.001**
Site	**2**	**10.23**	**5.116**	**5.12**	**0.006**
Year	**1**	**12.00**	**11.999**	**12**	**<.001**
Gyny	2	4.61	2.305	2.3	0.1
Date	29	39.90	1.376	1.38	0.086
Arm	3	0.42	0.141	0.14	0.935
weather	2	3.58	1.788	1.79	0.167
Distance x Site	**2**	**6.16**	**3.081**	**3.08**	**0.046**
Distance x Year	1	0.95	0.950	0.95	0.33
Distance x Gyny	2	2.68	1.340	1.34	0.262
Distance x Weather	5	9.06	1.812	1.81	0.107
Arm x Nest	**159**	**277.66**	**1.746**	**1.75**	**<.001**

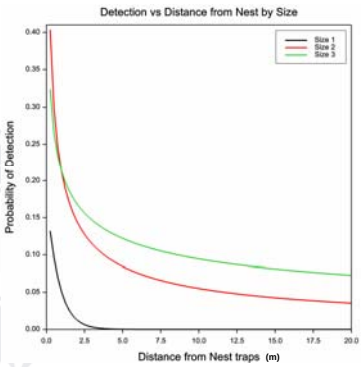
Foraging distance - Pitfall Trap Results

- Only data for 2008, due to issues with a study site.
- There were large size and distance interactions.
- There was also an effect of adding a food source to the pitfall trap, making it more attractive to foragers.

	d.f.	deviance	mean deviance	deviance ratio	F pr.
Size	**1**	**287.55**	**287.55**	**14.05**	**<.001**
Distance	**2**	**263.14**	**131.57**	**6.43**	**0.002**
Distance x Size	**2**	**649.65**	**324.82**	**15.87**	**<.001**
Baited	**1**	**103.37**	**103.37**	**5.05**	**0.026**

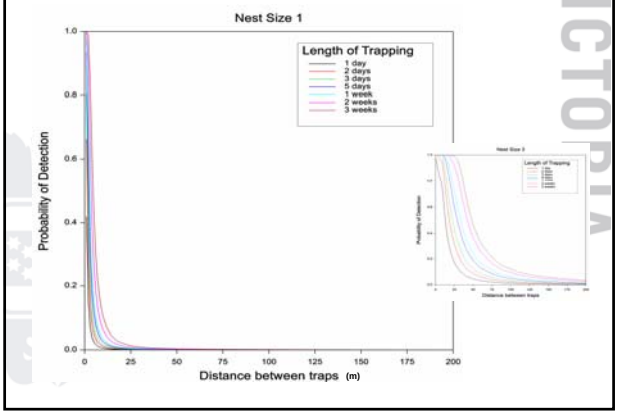


Model output



The probability of food bait detection for the different sized nests assuming one trap used on one occasion to attract the ants.

Model output



Conclusions

- Consistently preferred food: Peanut butter in soya bean oil and mince.
- Small sized colonies are difficult to detect: 0.42 probability of detection when the trap is 1m from the nest.
- Baits > baited pitfall traps > pitfall traps.
- Model provides an ability to do a cost-benefit analysis.

Acknowledgements

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Model:
http://www.biosecurity.govt.nz/pests/red-imported-fire-ant