

Ongoing decline in the native mammal fauna of the Top End

John Woinarski

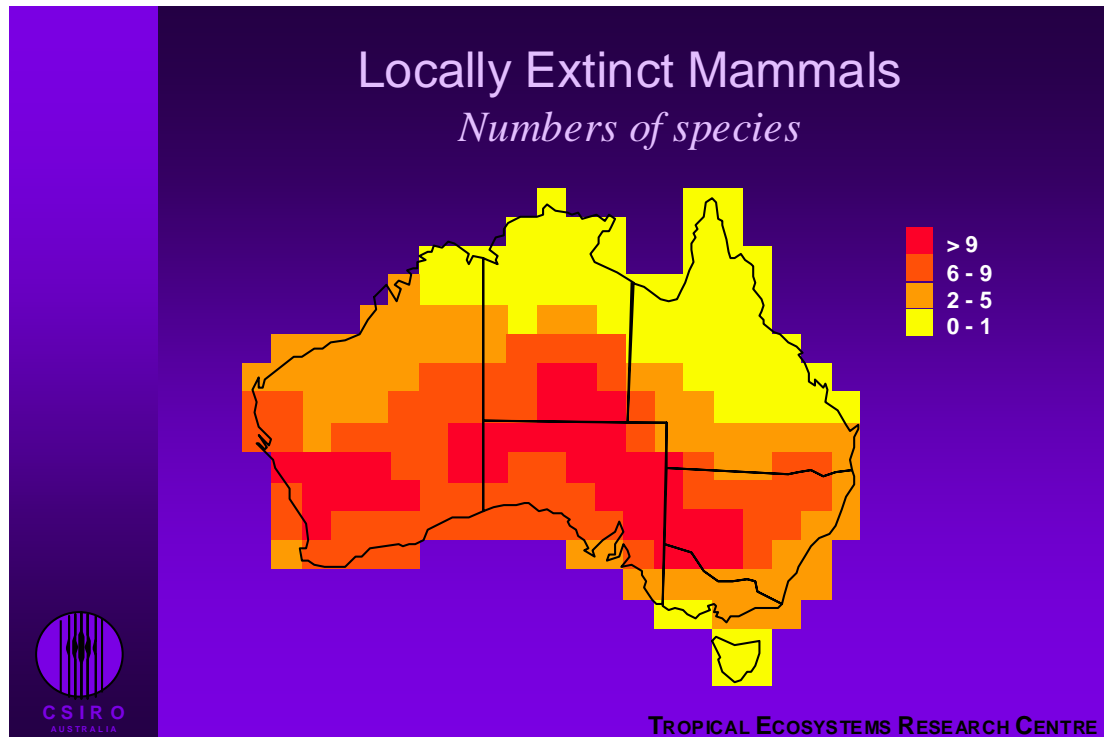
Ron Firth, Alaric Fisher, Tony Griffiths, Brydie Hill, Carol Palmer, Brooke Rankmore, Simon Ward, Michelle Watson, Mark Ziemnicki

context

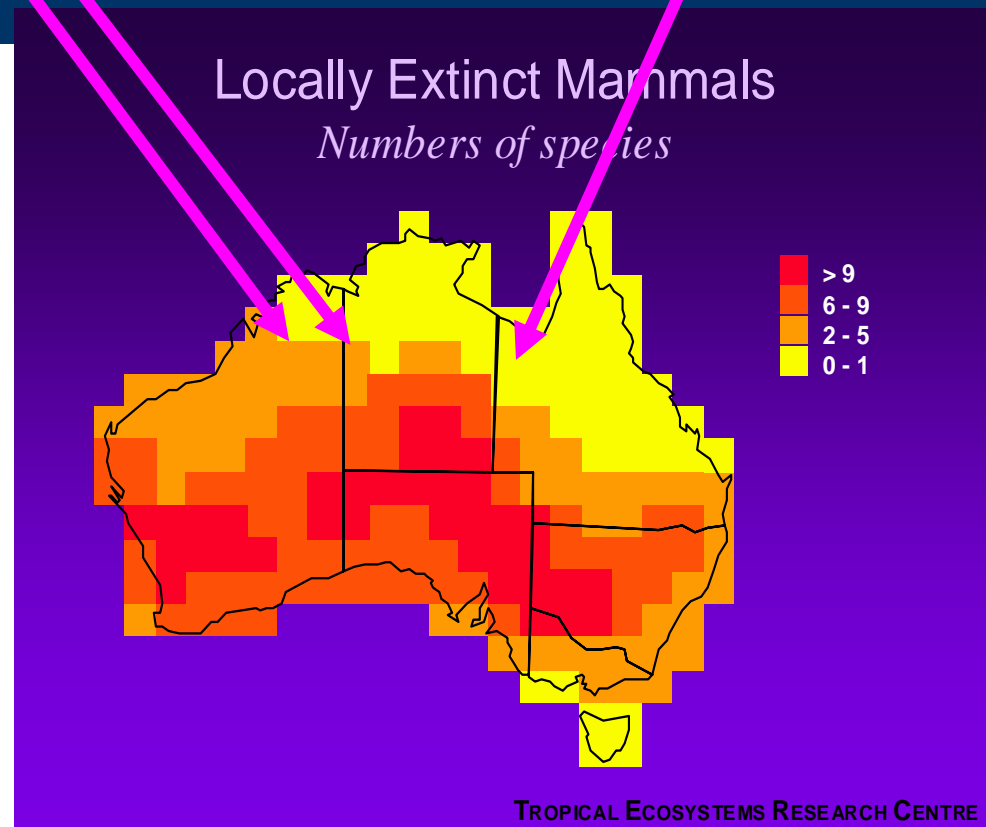
- Extinction of 17 species of native mammals mostly in central Australia over the last 100 years (up to 1950s);
- One of the world's worst losses of biodiversity;
- Causes – mostly feral predators (cats, foxes), with some influence from habitat change (due to altered fire regimes, livestock, feral animals);
- Some mammal groups particularly affected (bandicoots, larger rodents, possums, larger dasyurids)

So, what is happening with the mammals of northern Australia?

- Paradigm of intactness & security;
 - [Woinarski & Braithwaite (1990). *Search* 21, 65-69.]

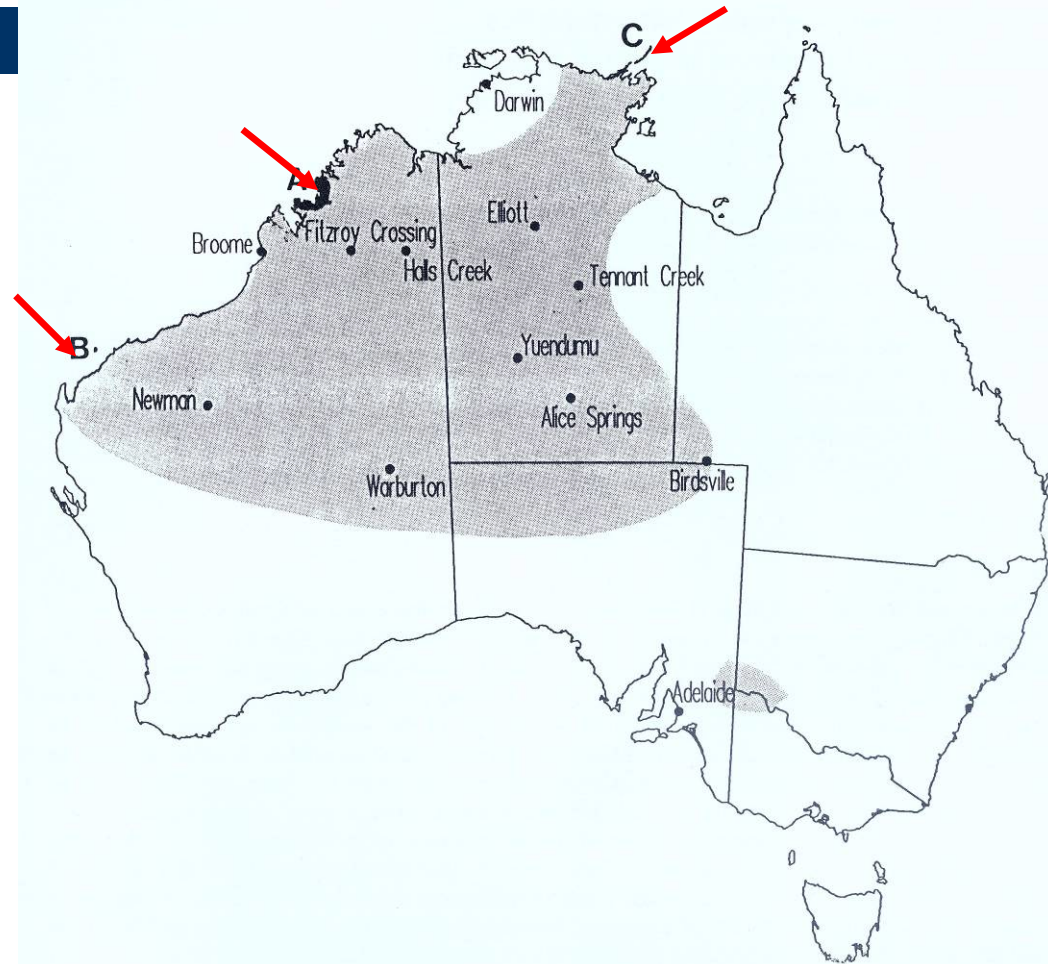


loss of bandicoots, quolls, possum, tree-rats from SW Kimberley, SE Kimberley, Victoria River District, Gulf



Kitchener (1978). *Rec. WA. Mus.* **6**, 189-219.
McKenzie (1981). *J. Biogeog.* **8**, 263-280.

decline of golden bandicoot



So, what is happening with the mammals of northern Australia?

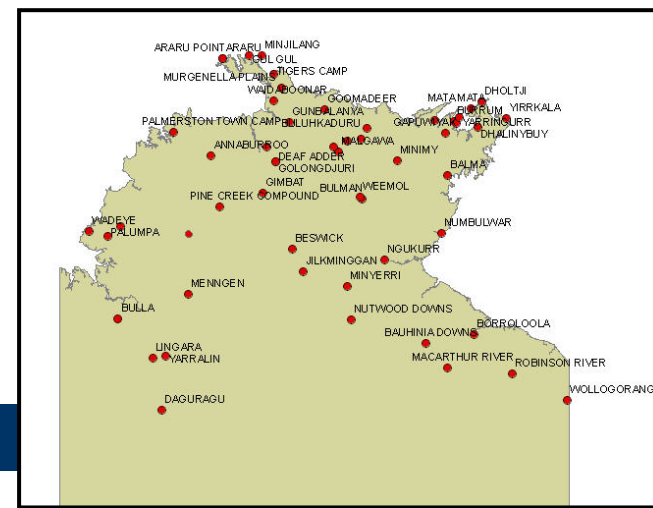
- Evidence of decline comes from:
 - Oral history/traditional knowledge;
 - Early explorers/naturalists;
 - Broad scale survey;
 - Experimental & ecological studies;
 - Monitoring plots

Historical traces

- Rock art attests to loss of Thylacines and Tasmanian devils from Kakadu area (4000 years ago);
- Fossils suggest loss of northern hopping-mouse from Kakadu around European contact;
- [fossil and other evidence for loss of bandicoots, quolls, larger rodents from VRD, SE & SW Kimberley over last 100 years]

Oral history

- 2006-08: systematic attempt to document Aboriginal knowledge of mammals across the Top End;
 - Past status
 - Extend geographical range
 - New or updated records
 - Current status & timing of decline for some species
 - although generally not well defined, especially for CWR mammals
 - Ecological information
 - Highlights the value of IK
 - but also what has been lost



Early explorers & naturalists

[northern brush-tailed phascogale]

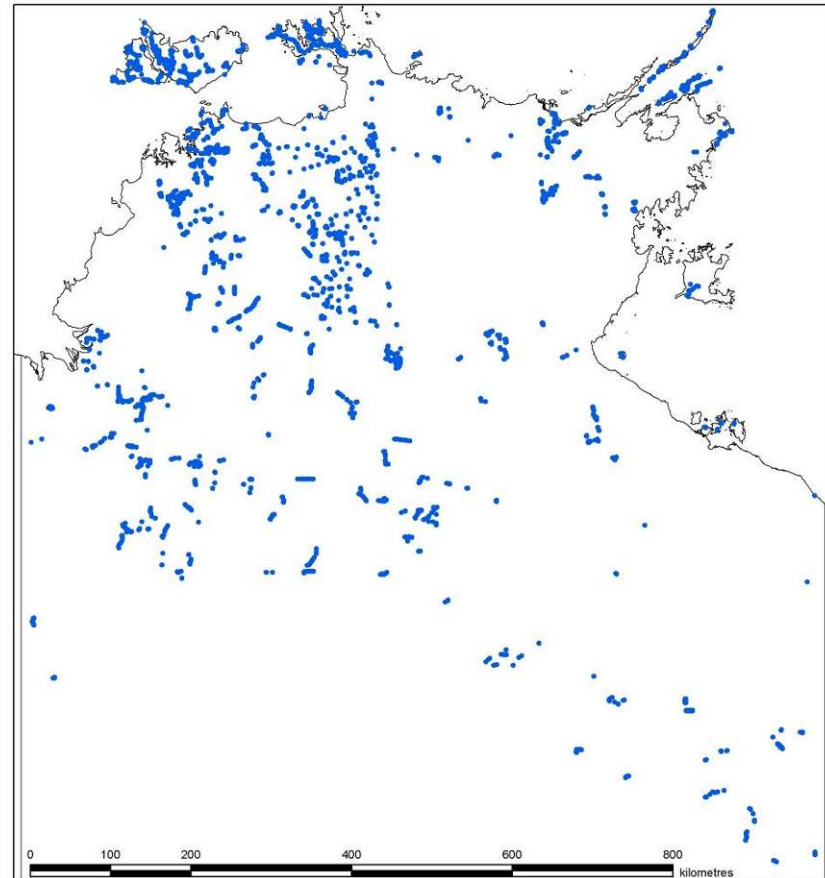
“on the rivers Mary and Katherine it was frequently observed. In fact, nearly everywhere inland it was very constant, and on a moonlight walk one would generally expect to see this little marsupial”

[Knut Dahl 1896]

Highly inconsistent with current status

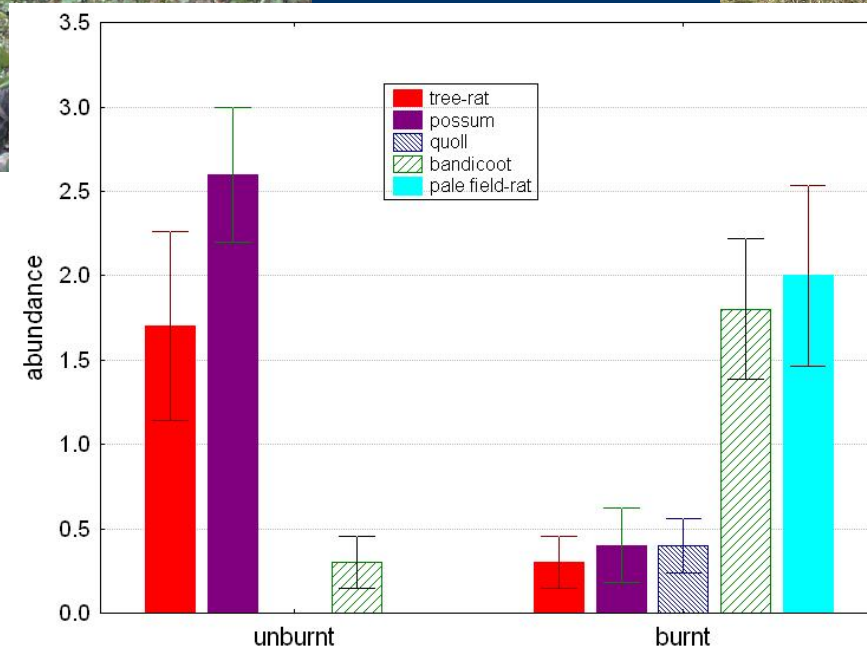
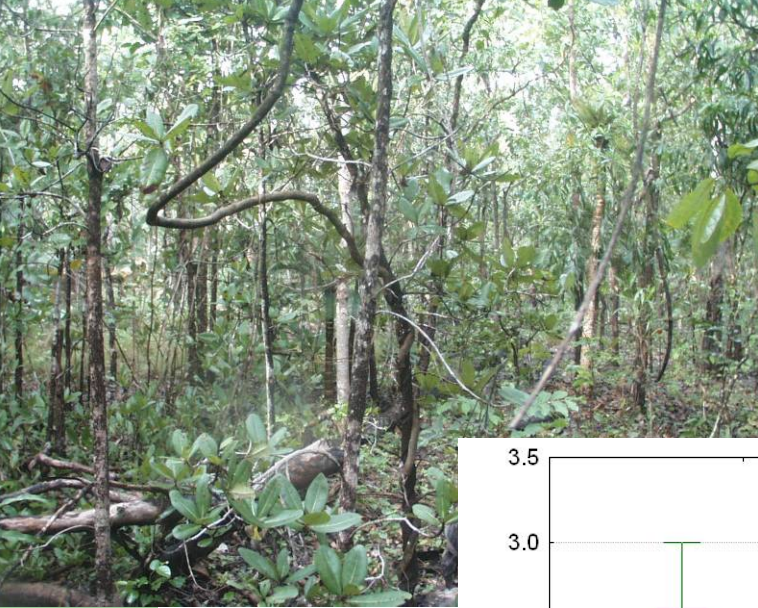
Broad-scale surveys

- Extensive systematic survey over last 20 odd years (>5000 sites)



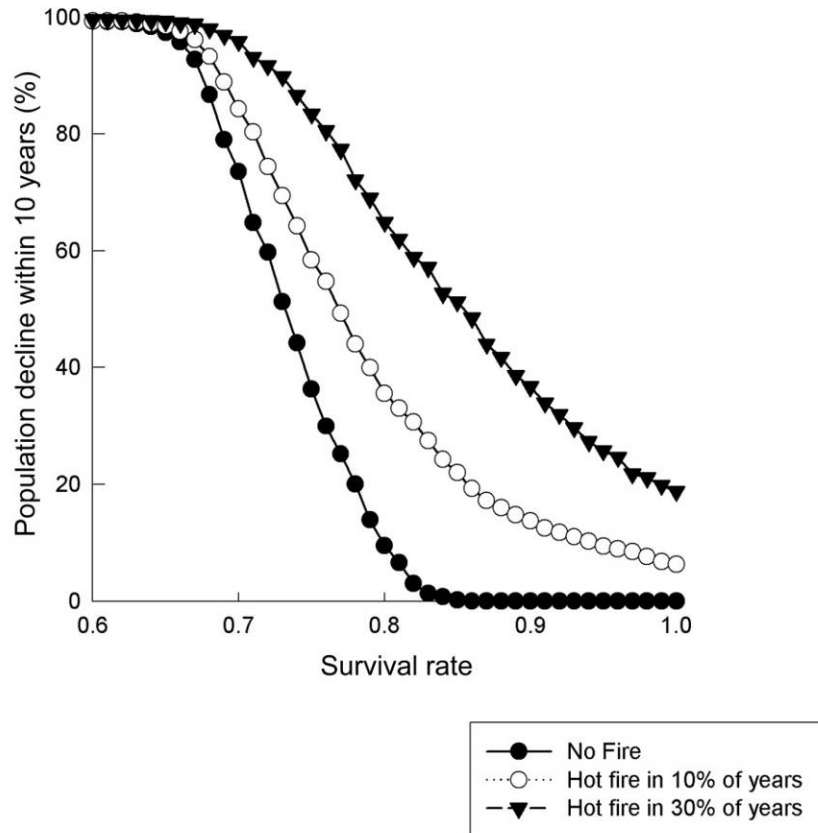
Experimental & ecological studies

- Kapalga fire study – declines of some mammal species (e.g. bandicoots) in all treatments, but especially in frequently burnt late dry season fires [Pardon *et al.* 2003. *J. Anim. Ecol.* **72**, 106-115];
- Intensive studies of individual species (e.g. brush-tailed rabbit-rat) show dependence upon hollow logs, tree hollows, perennial grasses [e.g. Firth *et al.* (2006) *Wildl. Res.* **33**, 397-407];
- Little Nourlangie Rock – substantial declines of several species after fire [e.g. Begg *et al.* (1981). *Aust. Wildl. Res.* **8**, 515-527]



Solar Village – cross-fence comparison - different mammal communities in annually burnt compared with long-unburnt forest [Woinarski *et al.* (2004). *Aust. Ecol.* **29**, 156-176]

Experimental & ecological studies



Based on ecological & demographic data, modelling predicts doomsday for some species



Rabbit-rat story

Pre-contact abundance:

“in Arnhem Land is everywhere common in the vicinity of water” (Dahl 1897);

“Numerous all over Arnhem Land, and in great numbers on the rivers on the lowlands” (Collett 1897).

As further corroboration of its status in the area at this time, Tunney collected 40 specimens in the Alligator Rivers region between 1902 and 1903.

Rabbit-rat story

1960s-1970:

Alligator Rivers Region Fact-finding study: Calaby (1971) stated that, in the Kakadu area, it was:

“a reasonably common species, found chiefly in woodland with suitable hollow tree shelters”

Rabbit-rat story

1980s:

Braithwaite (1985) stated that, in Kakadu:

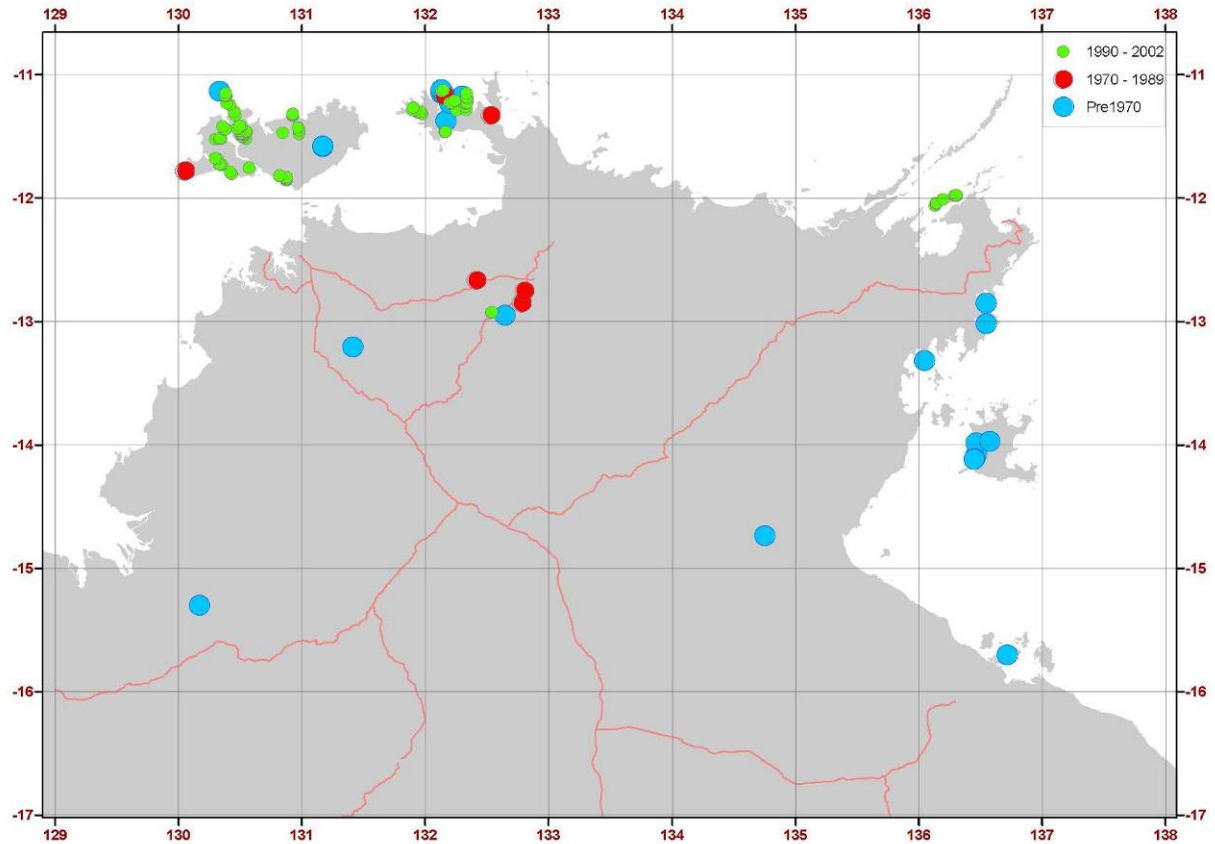
“This beautiful uncommon species is likely to be widespread in open forest and woodland”.

(Recorded at 3 of 18 survey sites)

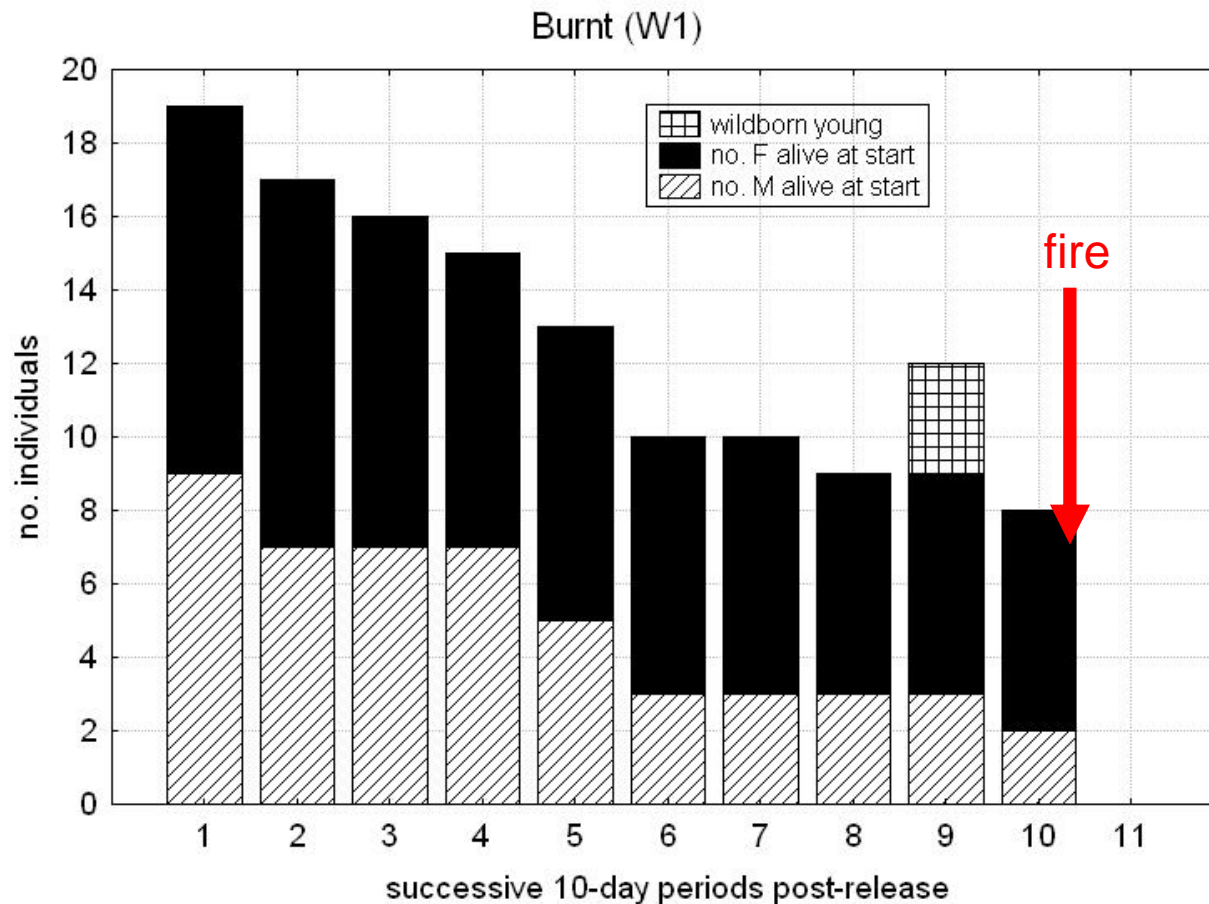
1990s-2000s:

Recorded at 0 of about 500 survey sites, including those 3 where recorded in 1980s

Rabbit-rat story



Rabbit-rat story – experimental translocation



quoll story

Declining trend across northern Australia
over last 10-100 years;

but then

Rapid local extinctions following cane
toad arrival

In response to likely loss of Kakadu (and
other Top End) quolls, we translocated
64 individuals in 2003 to two islands off
NE Arnhem Land

quoll story

Pobasso Island (4 km²)

2003: 19 colonists

2007: >818

Astell Island (13 km²):

2003: 45 colonists

2007: >4820

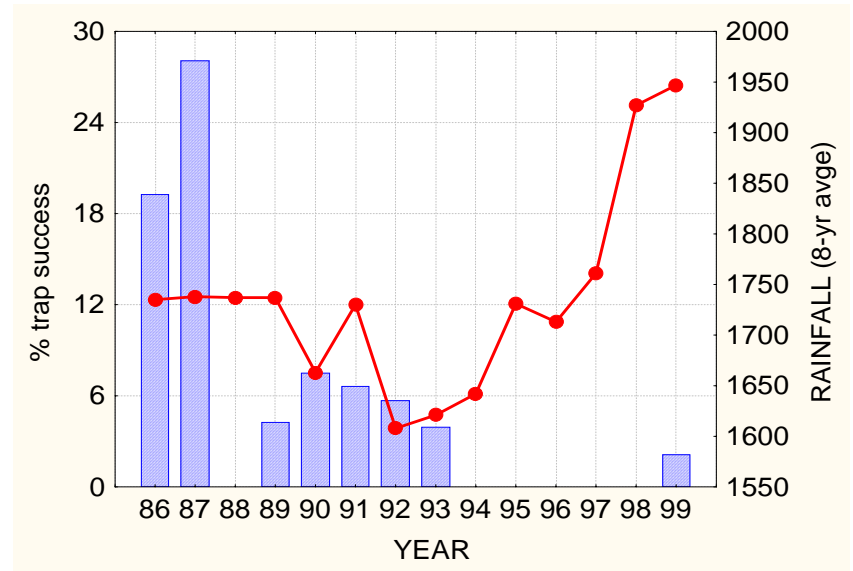
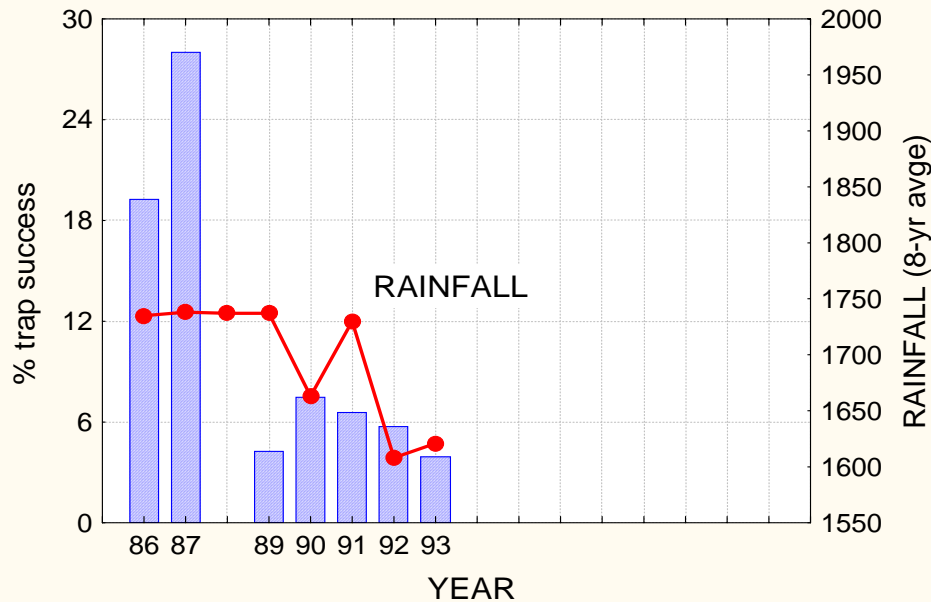
Cyclone Ingrid (Category 5) in 2005;
Astell burnt by fire in August 2003

Monitoring

Provides explicit quantitative information on trends at fixed sites.

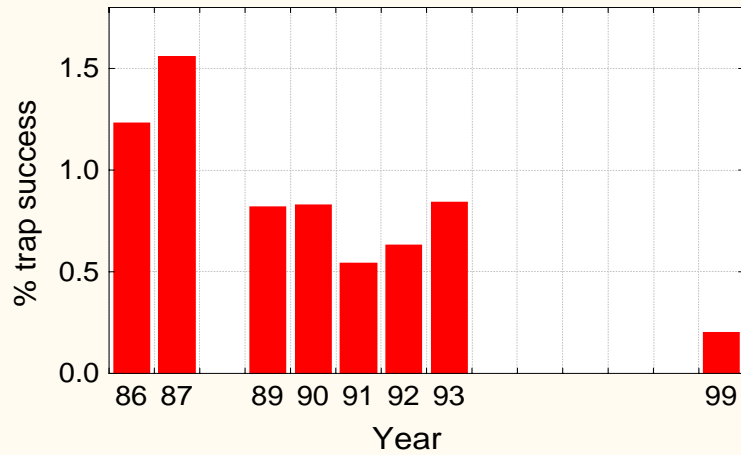
- **Kakadu Stage 3 (Mary River)**
 - [repeat sampling of 263 quadrats initially sampled in 1988-1990 in 2001]
- **Kapalga**
 - [repeat sampling of CSIRO studies in 1986-93, in 1999] [Woinarski *et al.* (2001). *Aust. Ecol.* **26**, 360-370].
- **Kakadu Fire plots**
 - [133 plots; 15 first sampled for mammals in 1996]

Monitoring results: Kapalga [1986-93 to 1999]

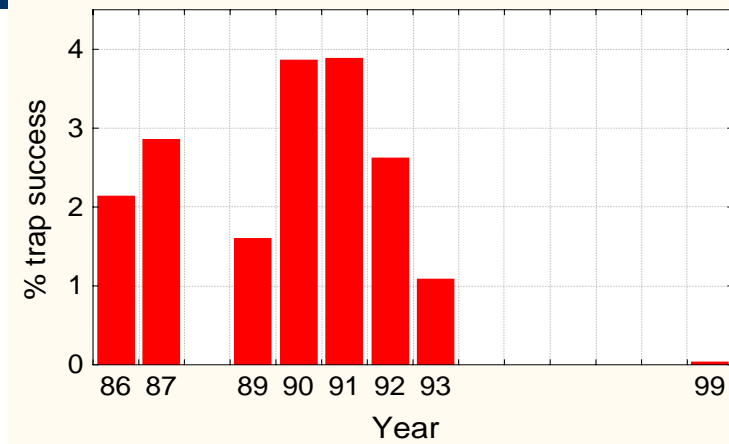


Monitoring results: Kapalga [1986-93 to 1999]

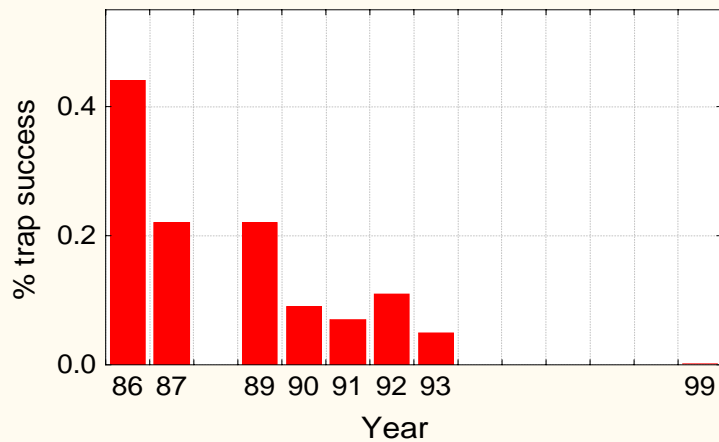
Northern Quoll



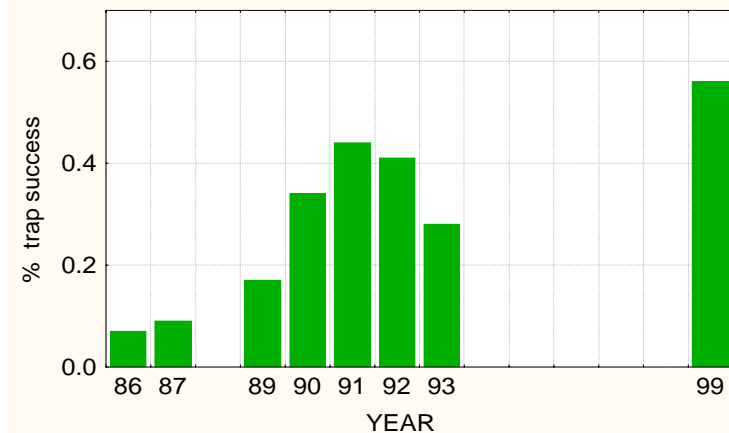
Northern Brown Bandicoot



Black-footed Tree-rat



Melomys burtoni



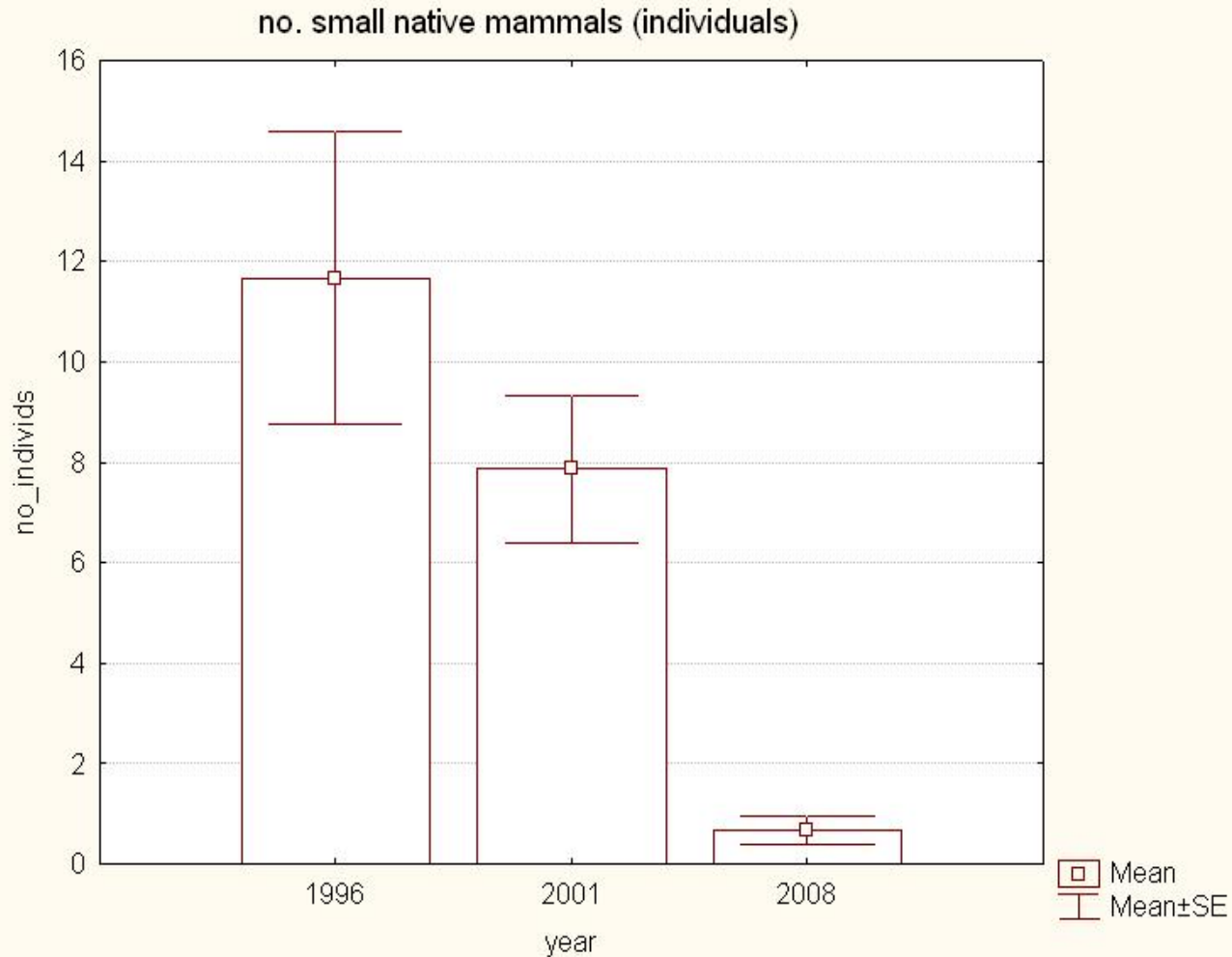
Monitoring results – Kakadu fireplots

year	no. plots baseline sampled	no. plots re-sampled	cumulative no. plots re-sampled	cumulative no. plots sampled
1995/96	15	0	0	15
2000/01	5	15	15	20
2001/02	36	0	15	56
2002/03	14	0	15	70
2003/04	45	0	15	115
2004/05	0	0	15	115
2005/06	0	0	15	115
2006/07	0	0	15	115
2007/08	13	63	63	128

Monitoring results

- fireplots [1996; 2001; 2008]

- 15 plots

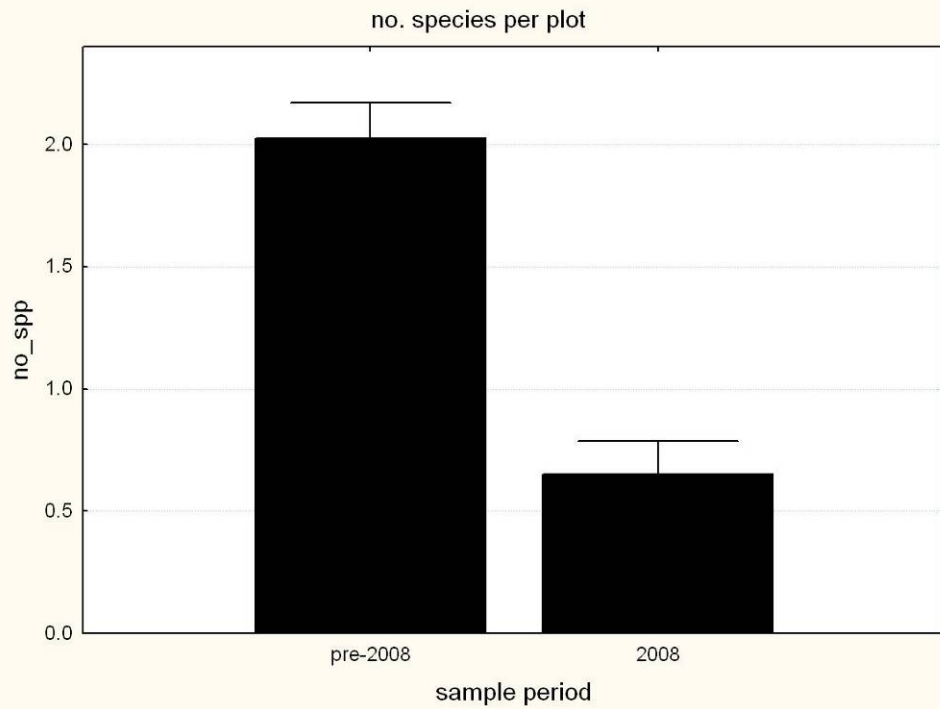


Monitoring results

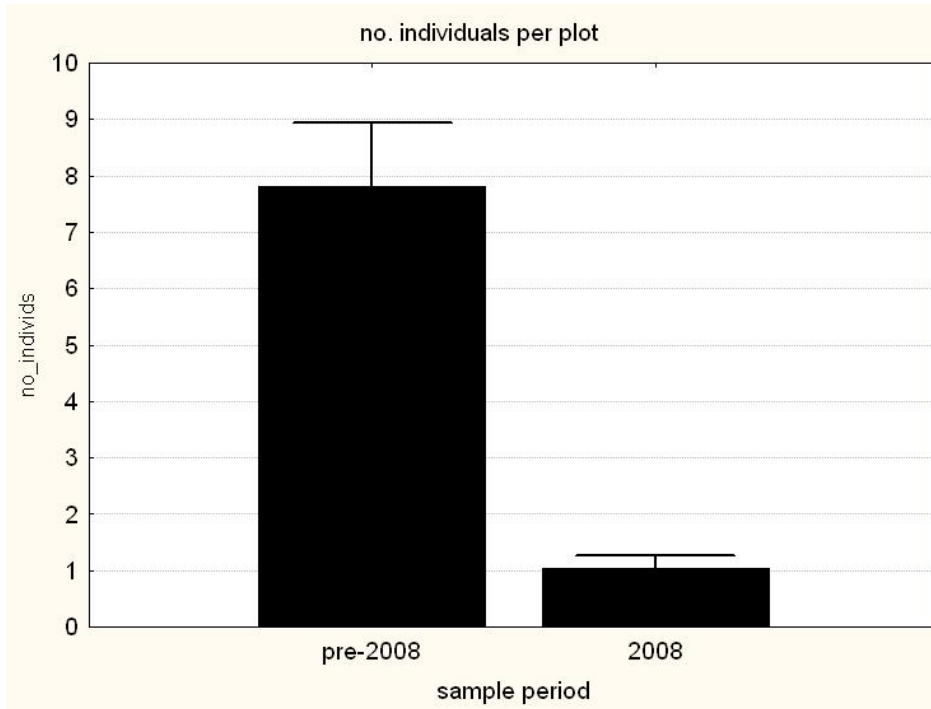
- fireplots [2000-04; 2008]

63 plots

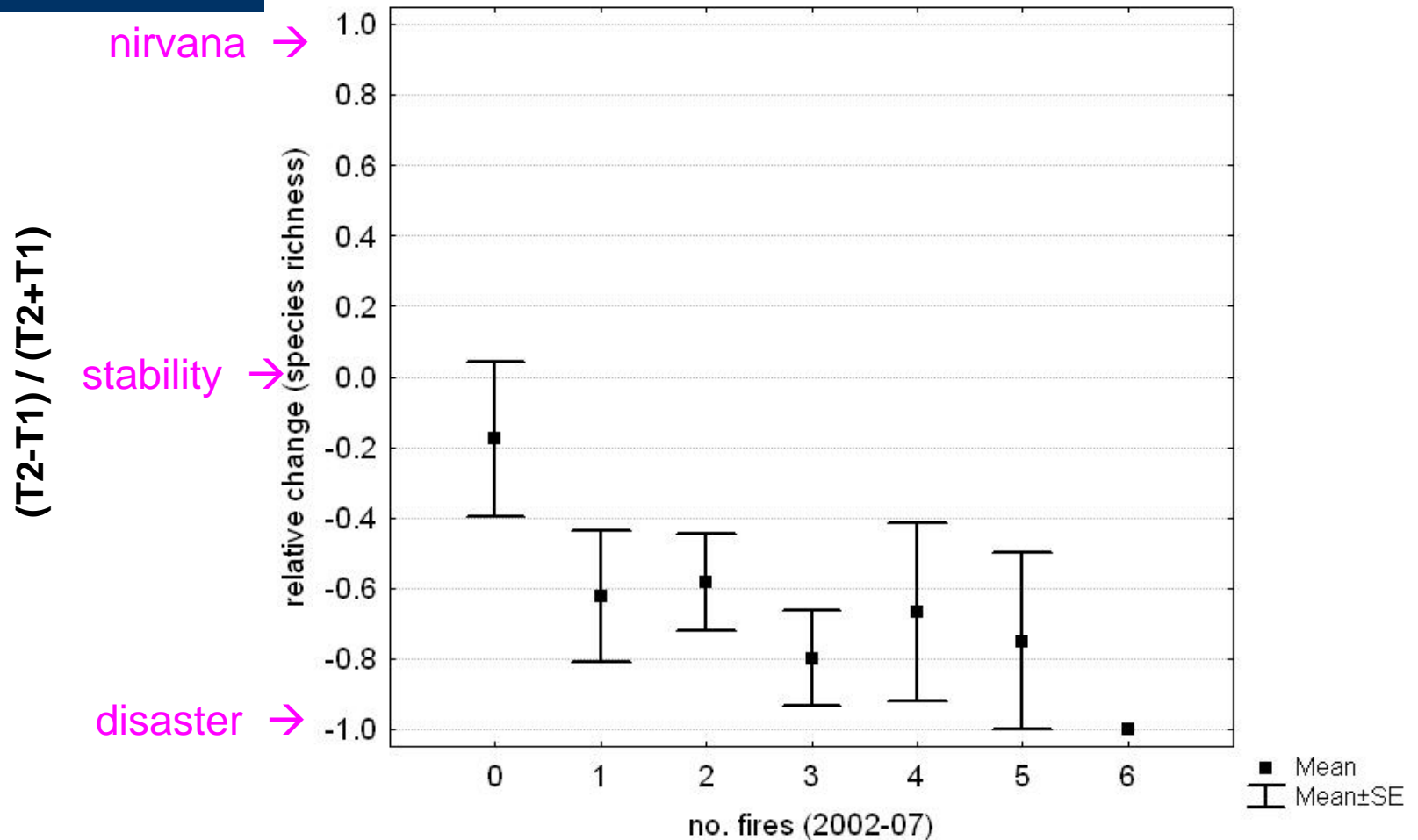
no. species



no. individuals



Relationship between change and fire history – across individual plots



Monitoring results

- fireplots [2000-04; 2008]

- Significant declines in:
 - Total native species;
 - Total no. individuals;
 - Northern quoll;
 - Northern brown bandicoot;
 - Fawn antechinus;
 - Pale field-rat
- Significant increases in:
 - Nothing [except maybe non-native black rats]

Is it Kakadu alone?

- No. General, but patchy, declines across northern Australia
 - oddity of good mammal populations near Darwin;
 - trends for decline first in drier fringe (Gulf, VRD, SW Kimberley, SE Kimberley)
 - Some areas with high mammal richness & abundance remain
- Litchfield NP fireplot monitoring [47 plots]:
 - 1996-2002: no change
 - 2002-2007: significant decline (>50%)
- There were almost no mammals in Nitmiluk NP fireplot monitoring (46 plots: 2005)
 - only 13% of sampled plots had small native mammals
 - (cf. 47% Kakadu and 87% for Litchfield)

Summary of mammal status in Kakadu

- Extinctions ca. 4000 years ago
 - Thylacine; Tasmanian devil
- Extinctions around European contact
 - Northern hopping mouse
- Probable extinctions within last 1-100 years
 - False water-rat (last record 1903);
 - Golden-backed tree-rat (1969);
 - Golden bandicoot (1967)
- Likely extinctions within the next 10-20 years
 - Brush-tailed rabbit-rat;
 - Northern quoll

Summary of mammal status in Kakadu

- Currently undergoing marked decline
 - Northern brushtail possum;
 - Northern brush-tailed phascogale;
 - Northern brown bandicoot;
 - Arnhem rock-rat;
 - Pale field-rat;
 - Black-footed tree-rat
- Status uncertain
 - Echidna;
 - Fawn antechinus;
 - Common planigale;
 - Sandstone planigale;
 - Red-cheeked dunnart;
 - Kakadu dunnart;
 - Sandstone antechinus;
 - Rock ringtail possum;
 - Water rat;
 - Short-tailed mouse;
 - Delicate mouse;
 - Western chestnut mouse;
 - Arnhem pebble-mound mouse;
 - Dusky rat
- Status stable or secure
 - Sugar glider;
 - Grassland melomys;
 - Common rock-rat

Summary of mammal status in Kakadu

- Pattern of decline is non-random:
 - mostly larger rodents and larger dasyurids, possums, bandicoots
 - i.e. the same type of species that have proven extinction-prone elsewhere in Australia.
 - Some disturbance–favoured (“weedy) species doing well
 - e.g. common rock-rat, delicate mouse

whodunit?

- Possible causes:
 - Changed fire regimes;
 - Predation (by feral cats);
 - Disease;
 - Habitat change (e.g. through weed invasion, feral animals);
 - Climate change;
 - Cane toads
 - scientists

whodunit? – changed fire regimes

- Explicit evidence of responses of mammals in fire studies, experimental manipulation and monitoring;
- Key resources of hollow logs, seeds, tree hollows, fruit trees are all affected by fire (detrimentally by frequent hot fire)
- Frequent extensive hot fires increase predation risks

whodunit? – cat predation

- Compelling evidence from elsewhere about ability of cats to cause local extinctions of Australian mammals;
- Persistence of native mammals on north Australian islands (until cat introduction);
- Cats have long been in the area, but anecdotal evidence of recent increase in cat numbers (?outstation movement; dingo control)
- Declines more in lowland than rocky areas;
- Declining mammals are cat dinner size

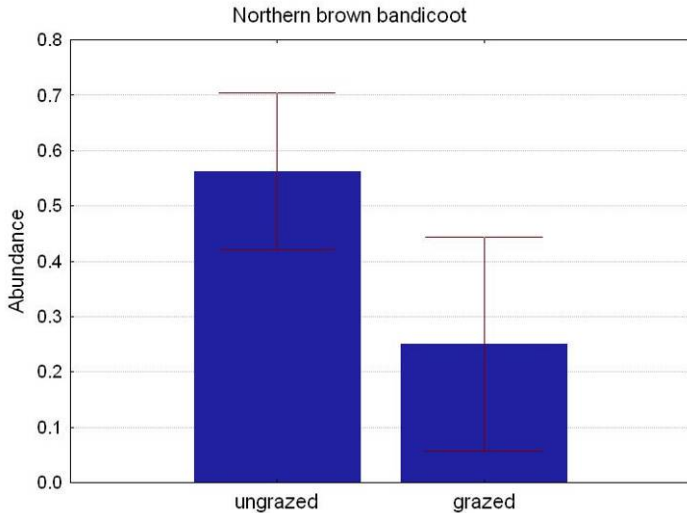
whodunit? – cat predation

- Best independent evidence of impact of cat predation in Kakadu is from a 10 month long radio-tracking study of tree goannas;
- Of 50 radio-tracked goannas (many tracked for < 10 mo), 6 were killed by cats, by far the highest cause of death (=60% of all mortality with known cause) [Sweet 2007].

whodunit? – disease

- Tasmanian devils demonstrate capability of disease to cause declines;
- Other recorded instances of disease outbreaks associated with mammal decline;
- May be associated with cats (e.g. toxoplasmosis)
- May be associated with non-native black rats;
- Persistence of small mammals on isolated islands;
- Evidence often hard to obtain

whodunit? – habitat change (through stock & weeds)



- Timing of mammal decline broadly consistent with increases in livestock and feral stock, and increases in weeds;
- May affect key resources (e.g. native seeds, fruits);
- Persistence of island populations;
- Some evidence of inverse relationship between stock numbers and native mammals (and decline occurred earliest in pastoral areas);
- Interactions with fire, and predation;
- But mammal declines have occurred in areas without weeds or many feral stock.

whodunit? – climate change

- No evidence

whodunit? – cane toads

- Undoubtedly caused decline in quolls;
- May have caused declines in some other species (antechinus, dunnarts, planigales, bandicoots, possums), but no substantial evidence;
- Expect a reverse response (i.e. increase) in non-carnivorous species

whodunit? – scientists

- Levels of collection were generally modest;
- Unlikely to have spread disease;
- Declines also occurred in remote areas away from study areas;
- We're not getting less competent

whodunit? – conclusions

- Key factors may be different for different species (the *Anna Karenina* effect);
- Most likely causes are changed fire regime (too frequent, intense and extensive fire) and predation by cats, operating in compound manner;
- Disease not exonerated;
- Timing is awkward to explain.

What does it matter?

- If these species can't persist in our largest and best resourced National Park, what's the point of having a National Park; and where will this mammal fauna be secure?
- Country should be healthy; mammal decline is an indication that it is not.
- PoM aim (5.8)
 - “through working with Bininj, ecological processes are maintained to ensure the viability of populations of native plants and animals currently occurring in Kakadu”

What can be done?

1. Recognise as a critical issue
 - for Kakadu & Australia
 - that requires priority management response.

What can be done?

2. Attempt to more clearly identify cause(s).
 - e.g. cat enclosure fencing;

What can be done?

3. More intensively manage to remedy cause(s).
 - More benign fire management;
 - Intensive cat control

What can be done?

4. Maintain & expand monitoring (including to provide for feedback on management interventions).

Other implications

- Measuring conservation progress by increase in reserved area is way insufficient;
- Integrated secure long-term biodiversity monitoring is essential (but NCRIS, TERN)
- Need for a management-oriented environment research facility;
- CFOC
- Need for commitment to management that is measurable and explicitly directed at biodiversity conservation, especially in key conservation reserves;
- Need for funding commensurate with those management requirements.