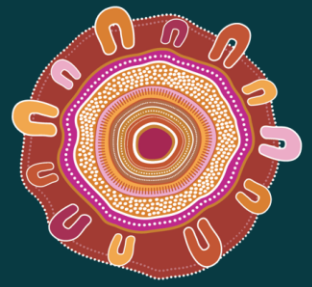
Resilient Landscapes

National Environmental Science Program



We acknowledge the Traditional Owners of Country throughout Australia and recognise their continuing connection to land, waters and culture. We pay our respects to their Elders past and present.

A review of fox management at Booderee National Park

NESP Project 3.12

Hugh Davies

Senior Research Fellow

University of New England

Resilient Landscapes

National Environmental Science Program

We acknowledge the Traditional Owners of Country throughout Australia and recognise their continuing connection to land, waters and culture. We pay our respects to their Elders past and present.

A review of fox management at Booderee National Park

NESP Project 3.12

Hugh Davies

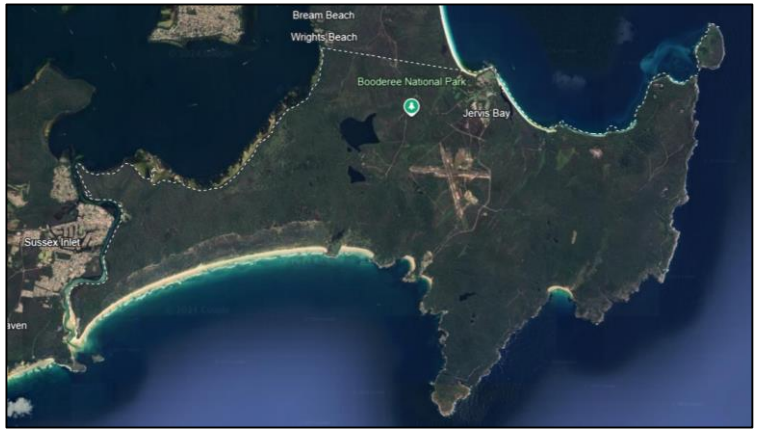
Senior Research Fellow

University of New England

The ‘Foxes on the Run’ Project

- Project aim:
    - To improve fox management and monitoring, as well as native species reintroductions, at Booderee National Park

- Focus of this talk:
    - A review of Booderee’s fox monitoring data



Booderee National Park (BNP)

- ~65 km^2
- Jointly managed by Traditional Owners and Parks Australia
- Significant biodiversity/cultural values

Booderee National Park (BNP)

- ~65 km^2
- Jointly managed by Traditional Owners and Parks Australia
- Significant biodiversity/cultural values

Fox management and monitoring at BNP

- BNP's Plan of Management requires foxes to be managed and monitored
- Both continued since 1999
- Fox management: broad-scale ground baiting (FOXOFF®), small-scale shooting and trapping efforts

Booderee – getting up to speed

- Foxes have been effectively managed
  - “Foxes extremely uncommon” (Lindenmayer et al. 2016)
  - “BNP has effective fox control” (Robinson et al. 2020)
  - “Control of the red fox has created suitable conditions for the reintroduction of species vulnerable to fox predation” (Robinson et al. 2021)

Booderee – getting up to speed

- Foxes have been effectively managed
  - “Foxes extremely uncommon” (Lindenmayer et al. 2016)
  - “BNP has effective fox control” (Robinson et al. 2020)
  - “Control of the red fox has created suitable conditions for the reintroduction of species vulnerable to fox predation” (Robinson et al. 2021)
- Resulted in complex, unexpected responses of native species

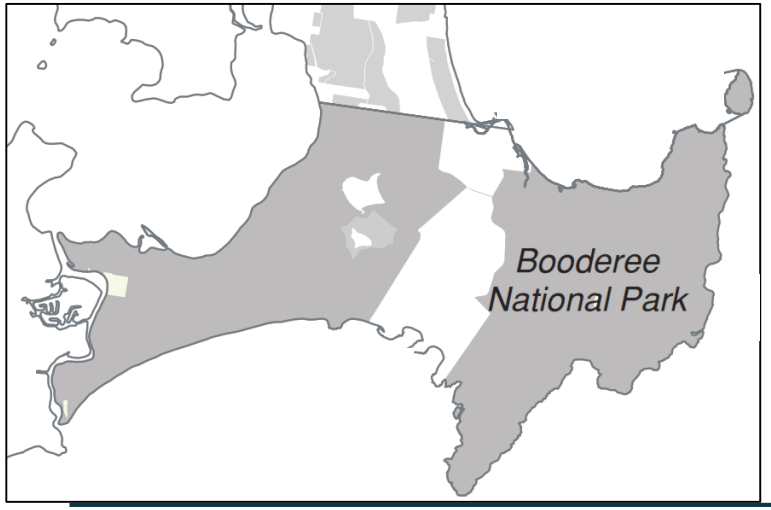
Booderee – getting up to speed

- Foxes have been effectively managed
  - “Foxes extremely uncommon” (Lindenmayer et al. 2016)
  - “BNP has effective fox control” (Robinson et al. 2020)
  - “Control of the red fox has created suitable conditions for the reintroduction of species vulnerable to fox predation” (Robinson et al. 2021)
- Resulted in complex, unexpected responses of native species
- Native species reintroductions affected by fox predation

Booderee fox data

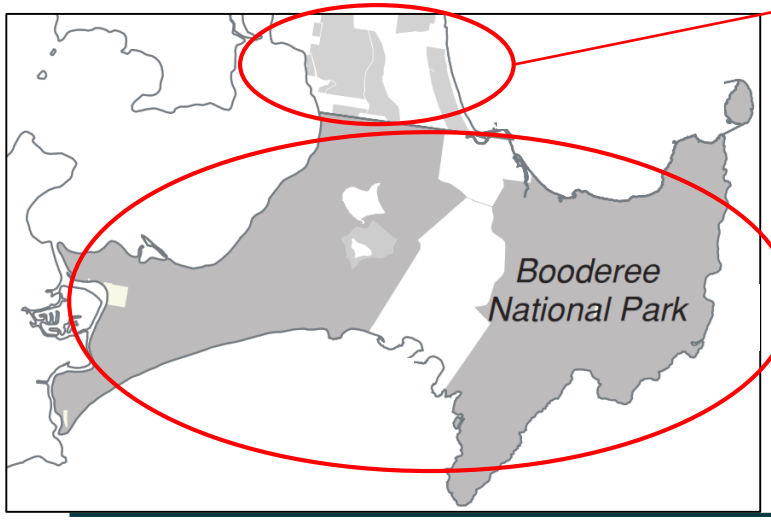
1999–2024

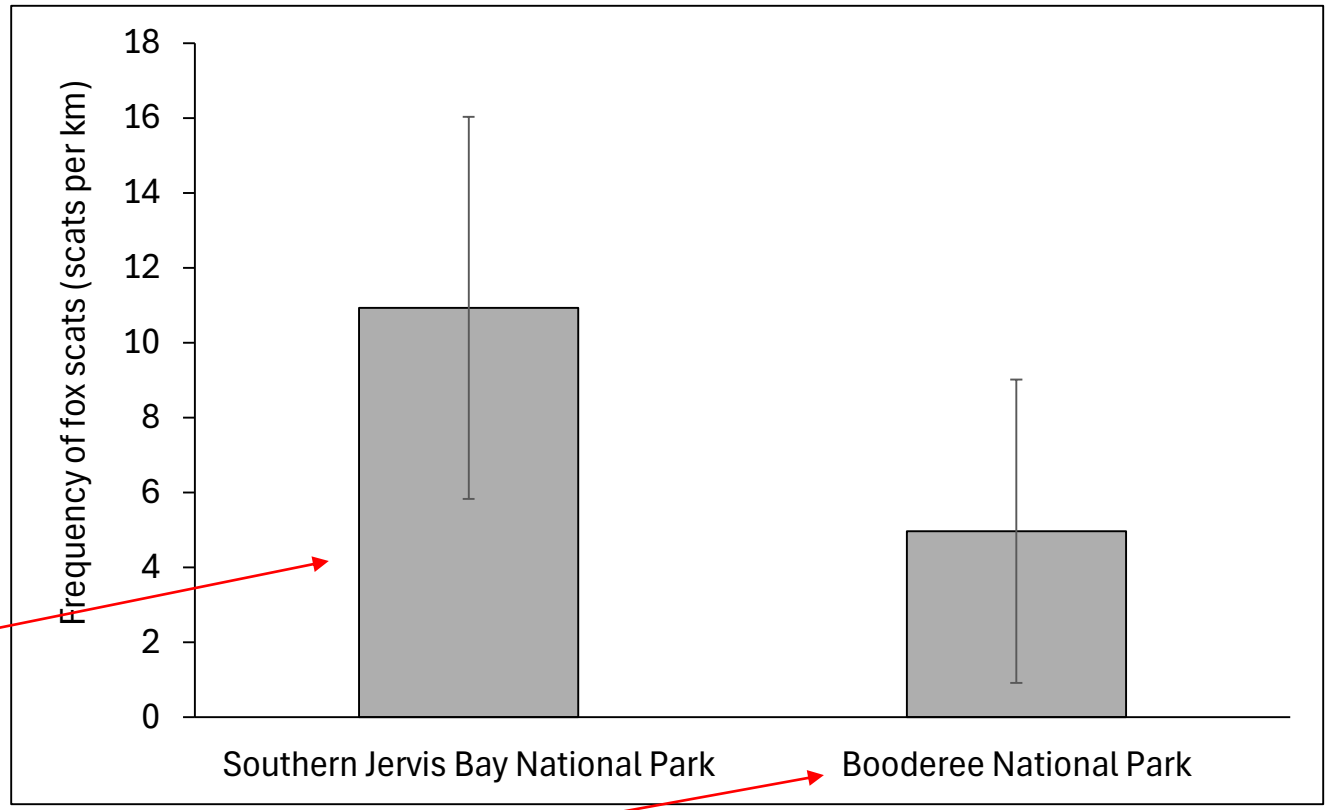
Fox scat data



Fox scat data

- Fox scats less frequently recorded within BNP
- Indication that fox abundance is lower in BNP





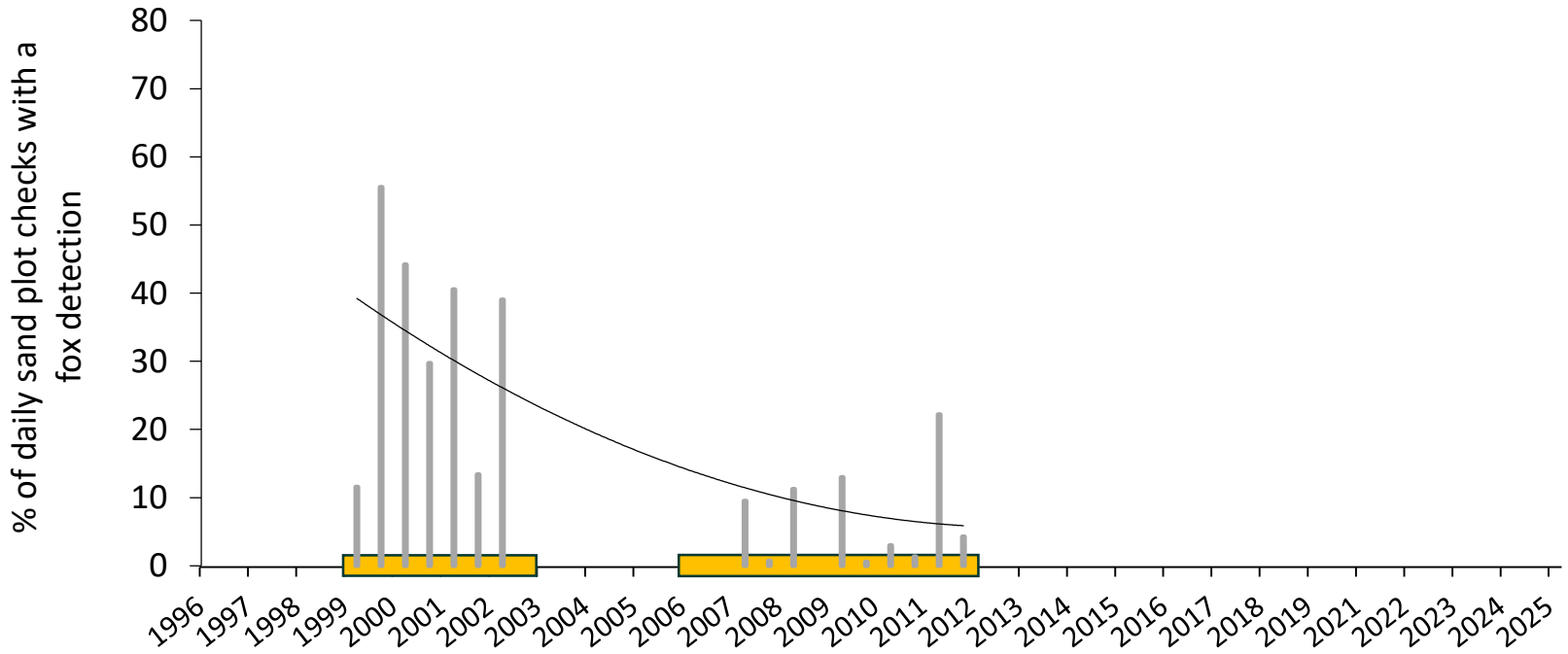
(Roberts *et al.* 2006, *Wildlife Research*, 481–488)

Sand plot activity

Sand plot activity

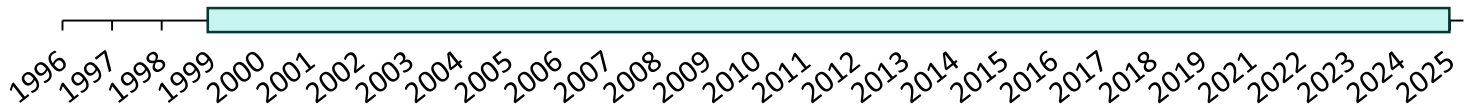
- Decreased fox activity on sand plots

- Indication of reduced fox abundance within BNP



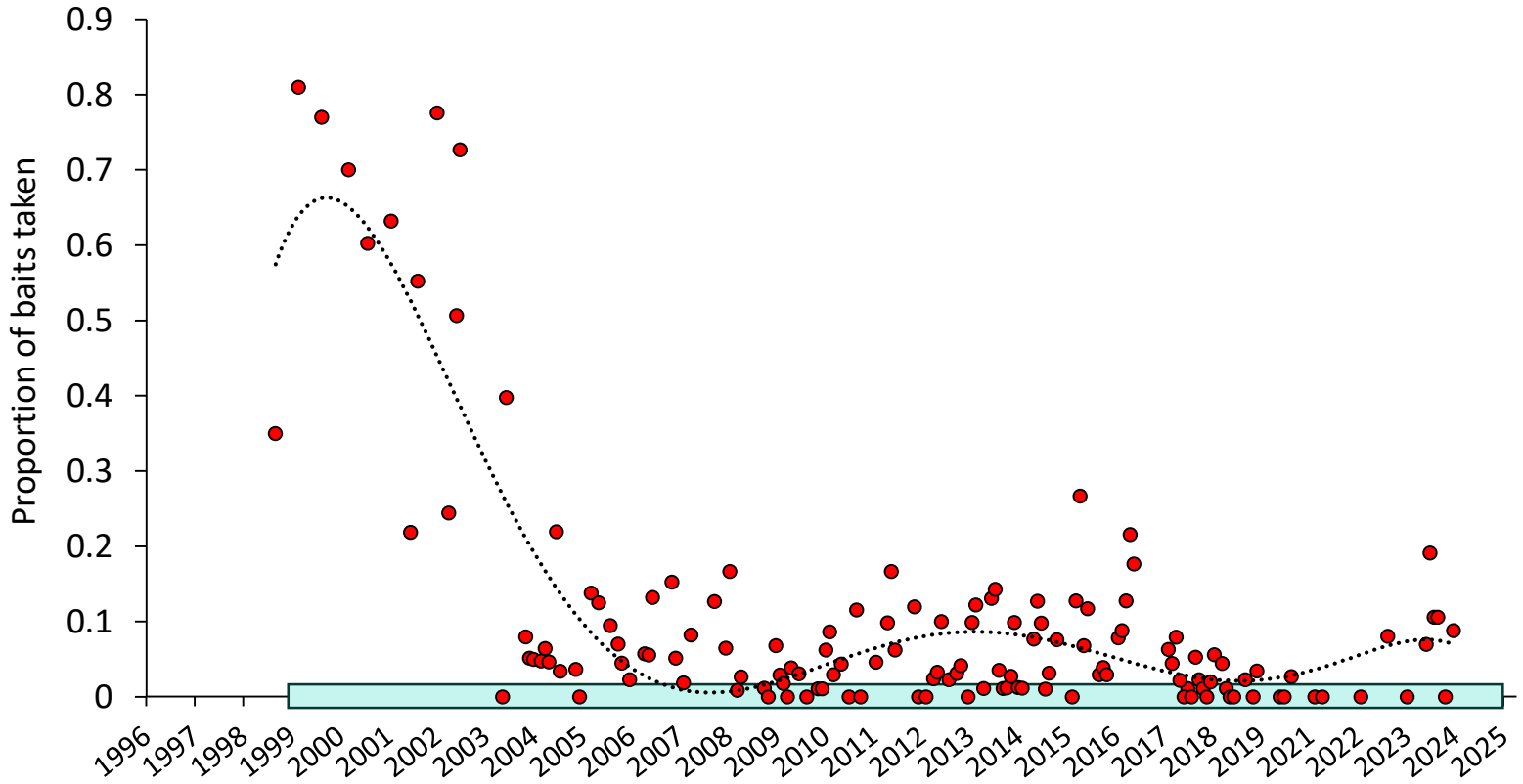
(Lindenmayer *et al.* 2018, *Biological Conservation*, 279–292)

Bait-take


1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2021
2022
2023
2024
2025

Bait-take

- Substantial decrease followed by long-term ongoing suppression
- Interpreted as a large reduction and ongoing suppression of fox abundance in BNP
- Used in numerous papers



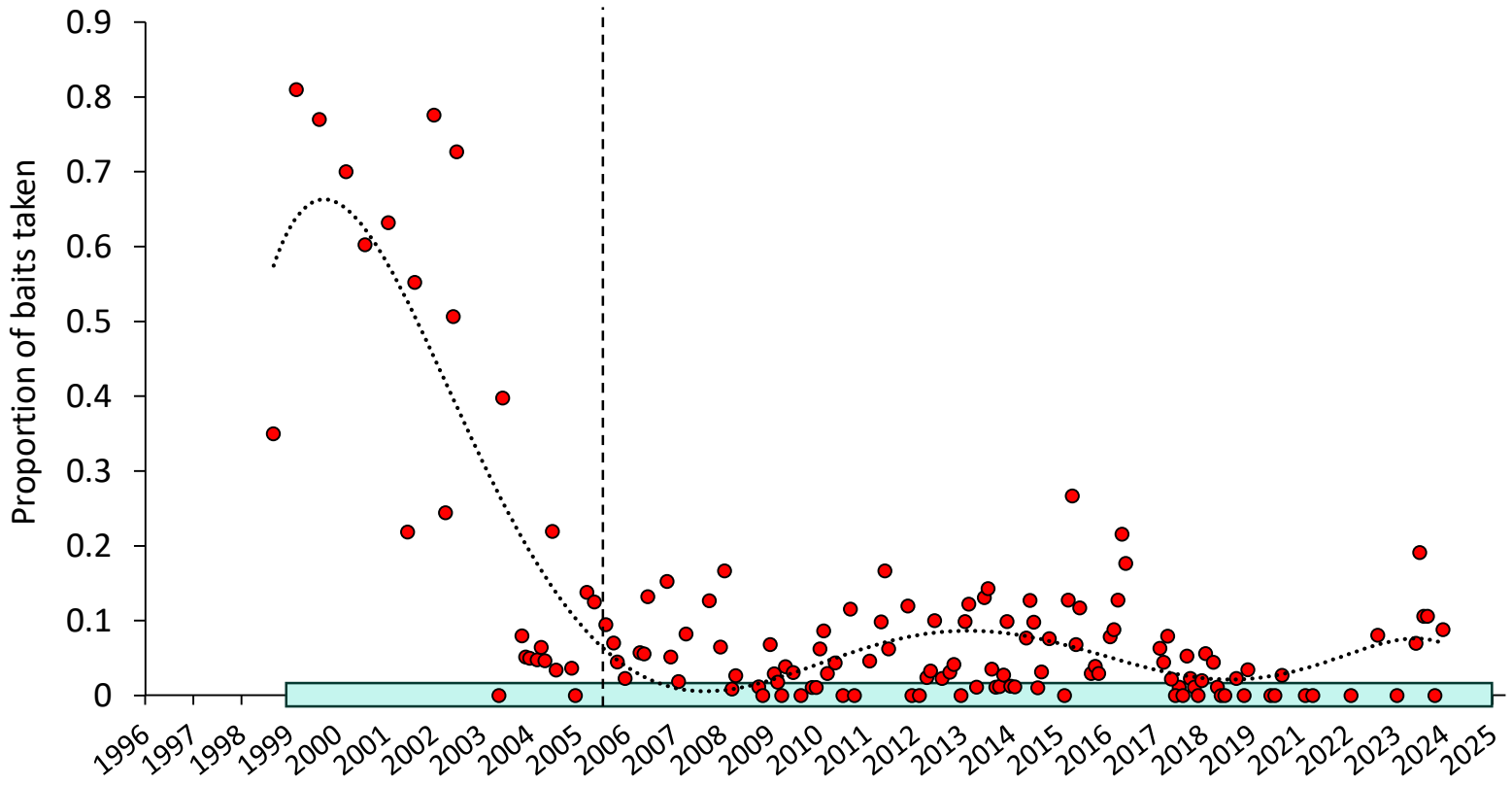
(Lindenmayer *et al.* 2018, *Biological Conservation*, 279–292)

Data limitations

- Scat, sand-plot, bait-take data: All susceptible to variation due to factors other than changes in fox abundance
- Martin-Garcia et al. (2022) found more fox scats in an area with fewer individual foxes detected on camera-traps
- Need to be interpreted cautiously

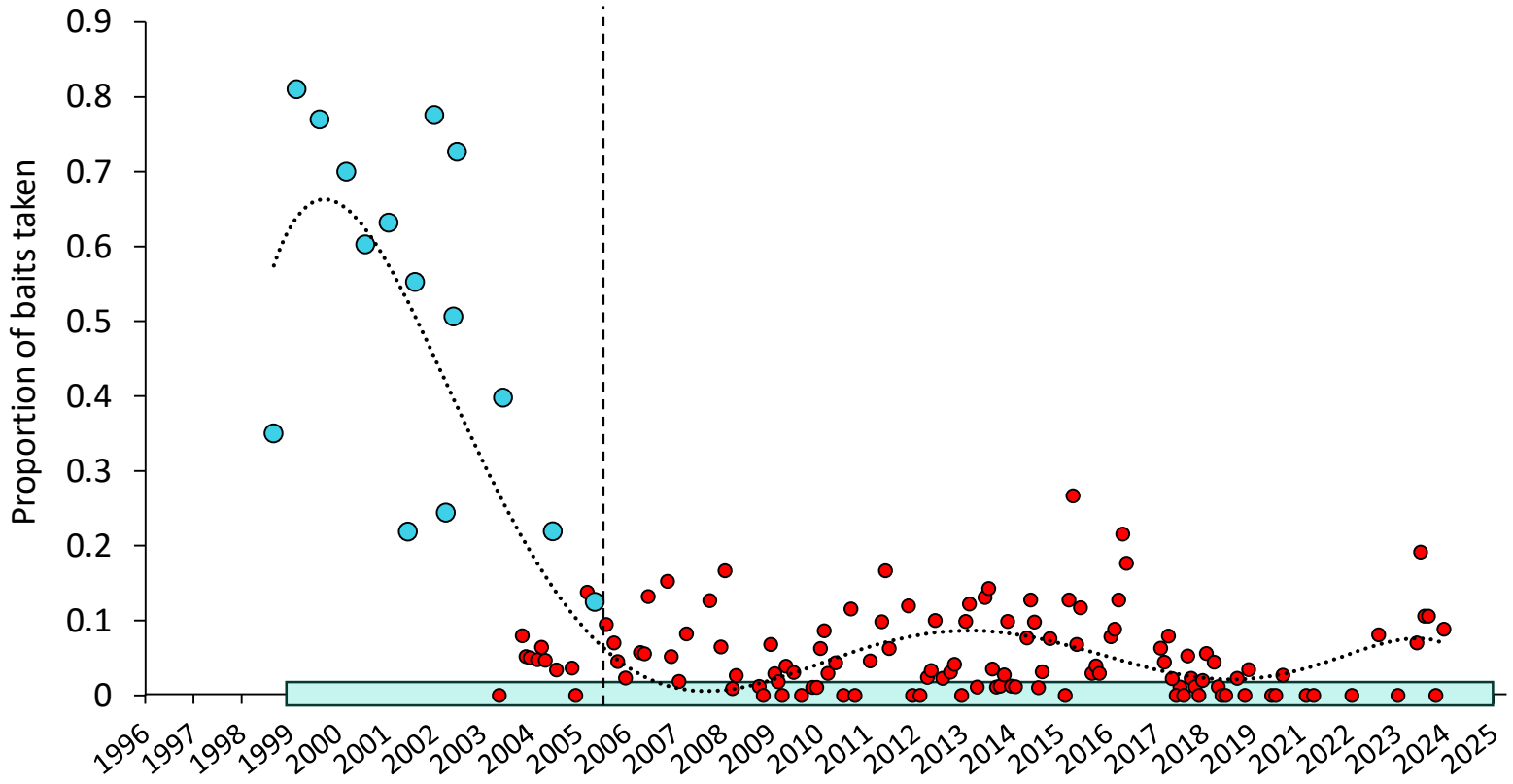
Bait-take trend revisited

- Numerous changes made to the baiting program through time
- The most important of which occurred in 2006



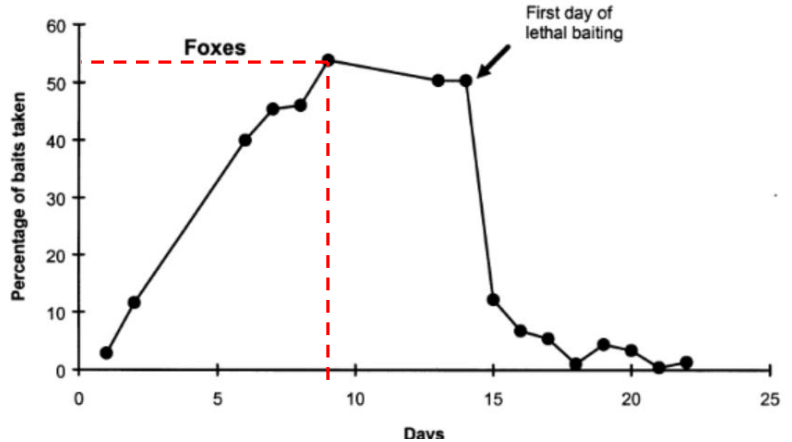
Bait-take trend revisited

- Between 1999–2006, baiting sessions included 9-days of free-feeding of non-toxic baits
- Other baiting sessions used only toxic baits

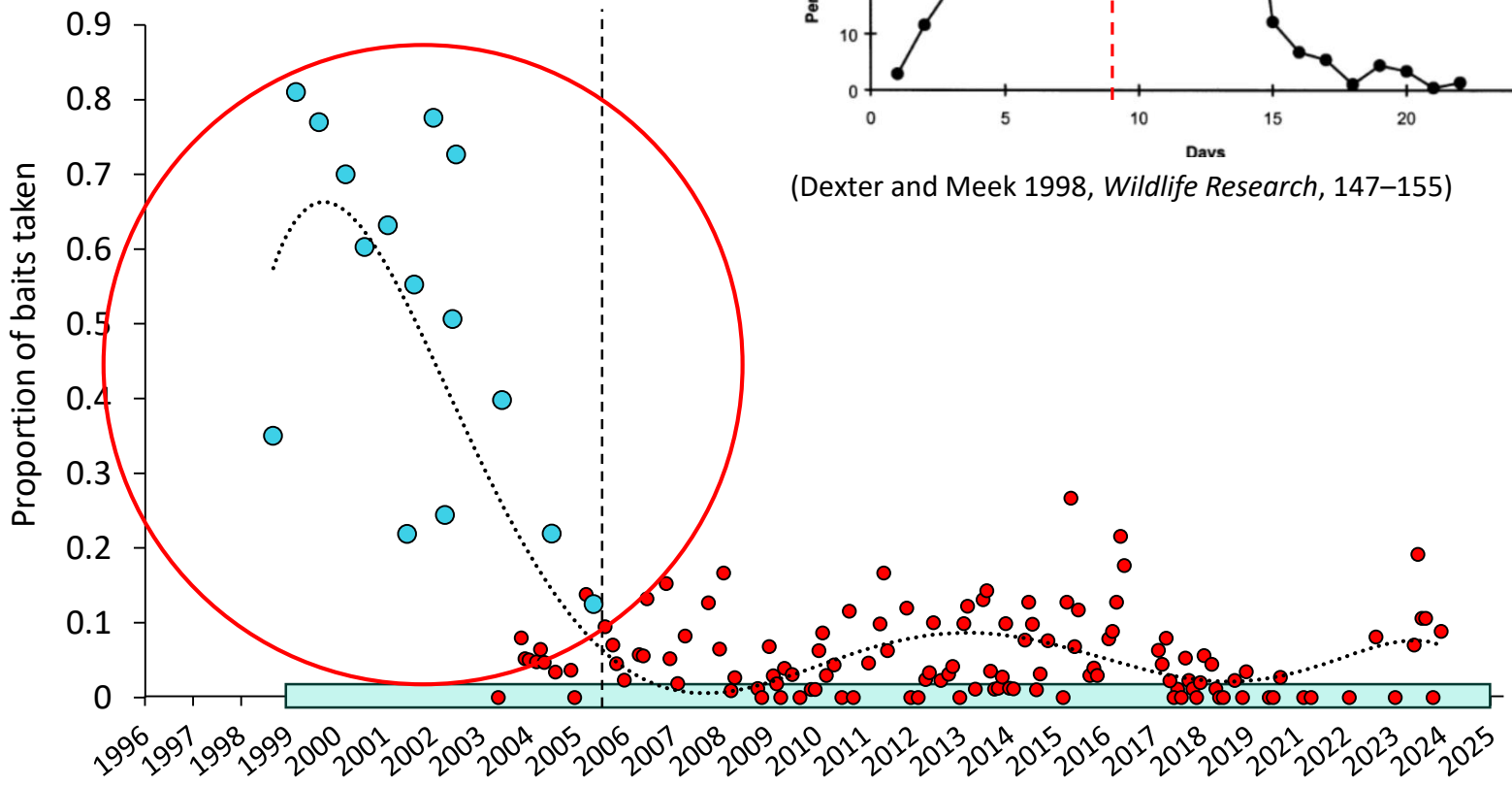


Bait-take trend revisited

- Free-feeding changes the behaviour of foxes
- Foxes are trained to search for and remove baits
- This does not occur in other baiting sessions

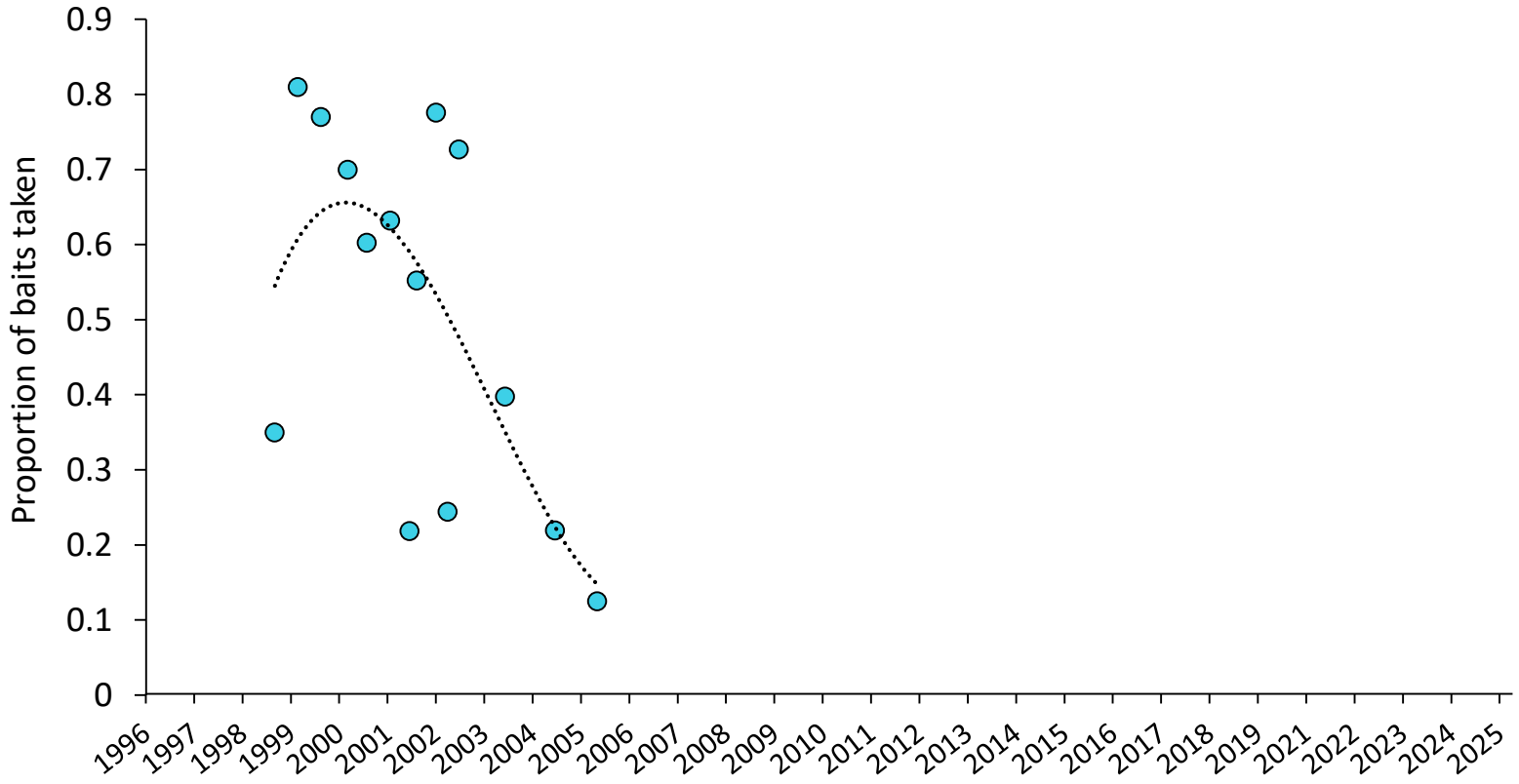


(Dexter and Meek 1998, *Wildlife Research*, 147–155)



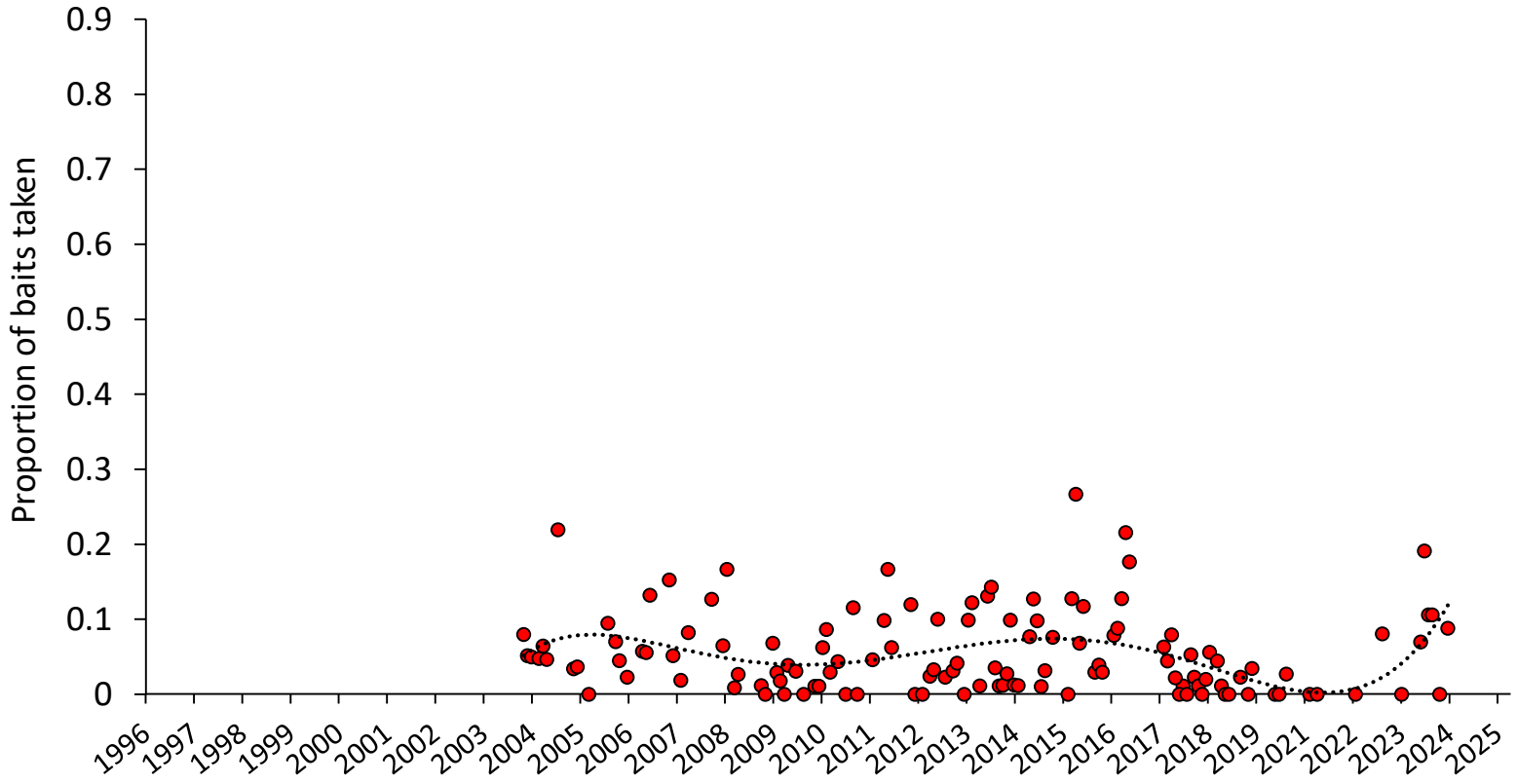
Bait-take trend revisited

- Downwards trend in bait-take between 1999 and 2006



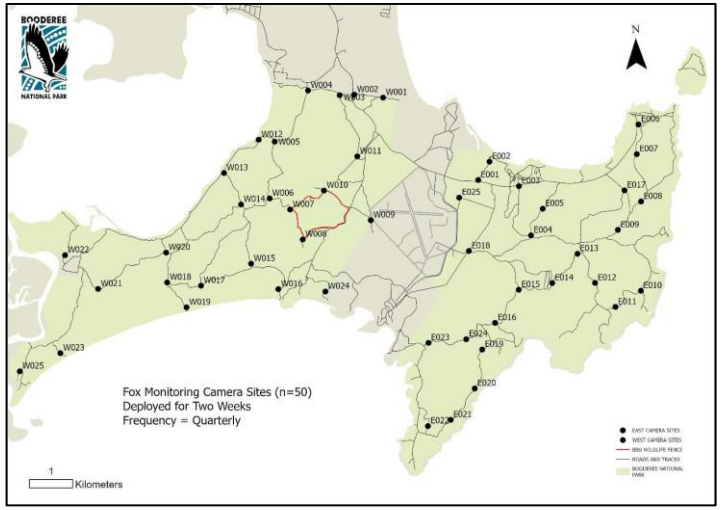
Bait-take trend revisited

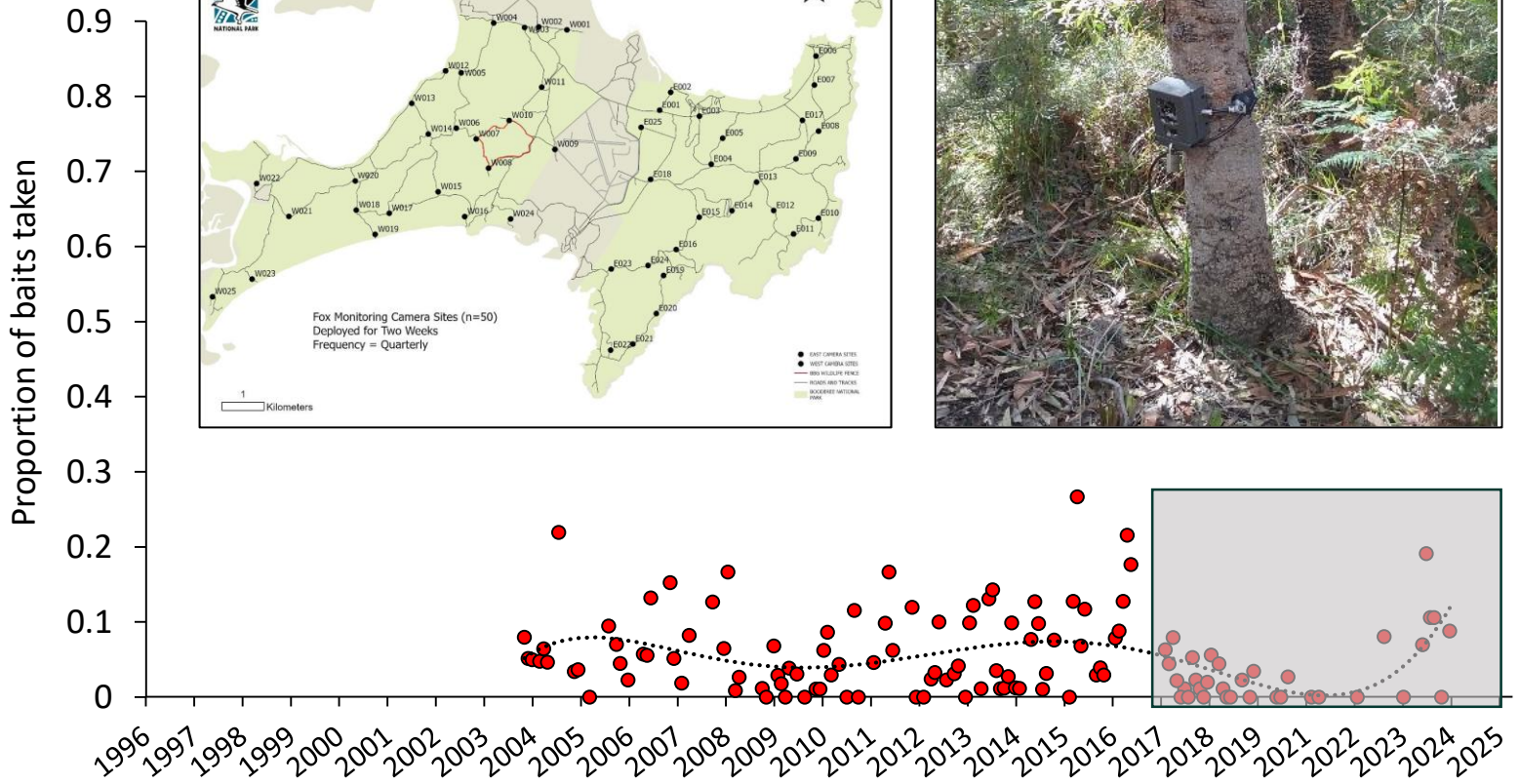
- 20-years of bait-take data from non free-feeding sessions
- No clear long-term trend



Bait-take trend revisited

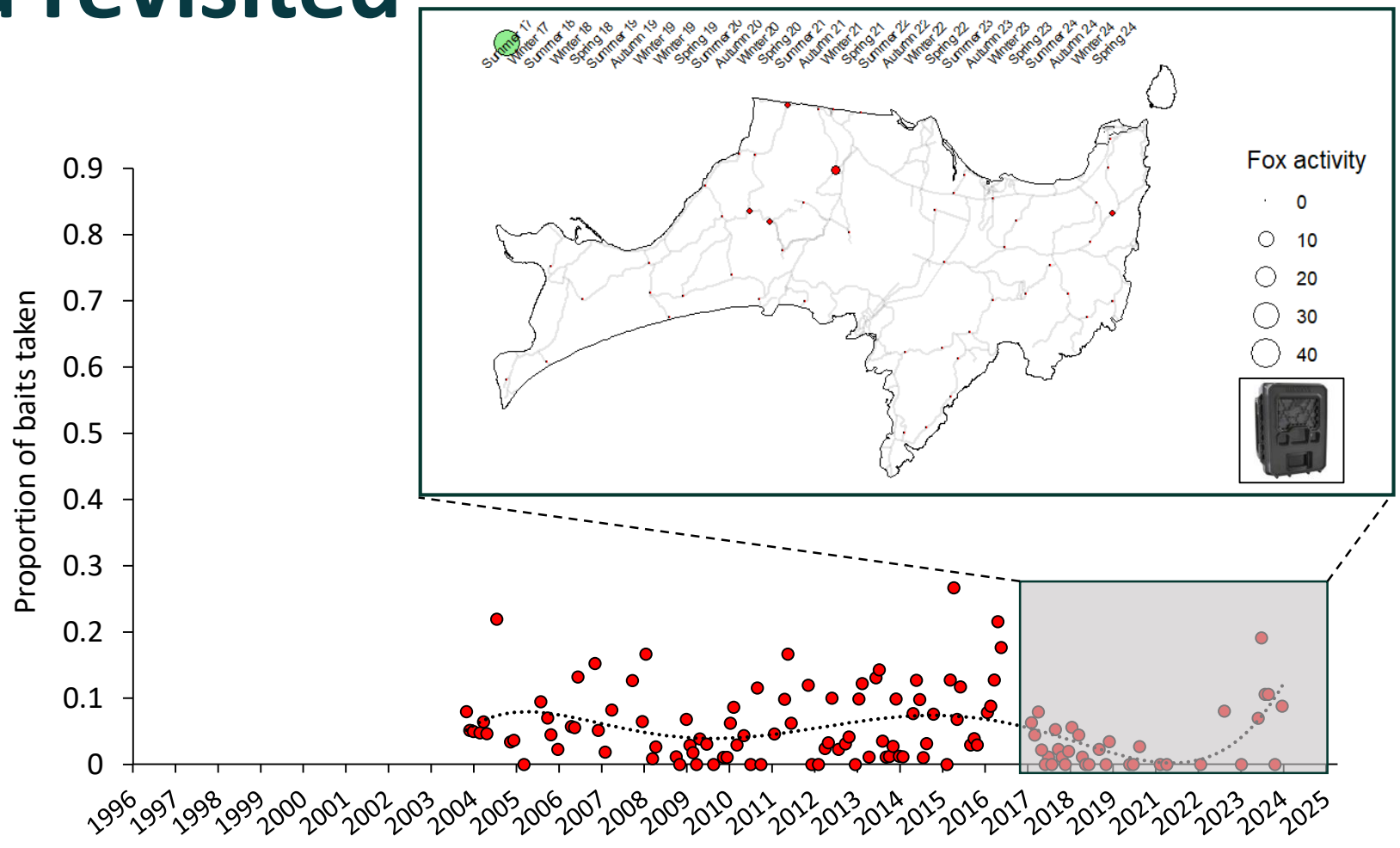
- 8-years of over-lapping camera-trap and bait-take data





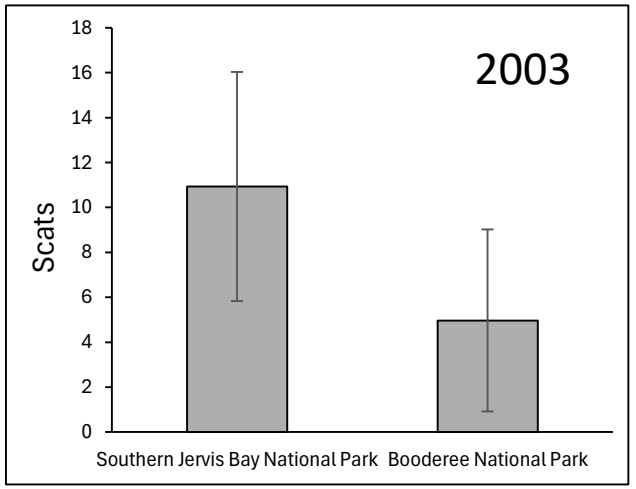
Bait-take trend revisited

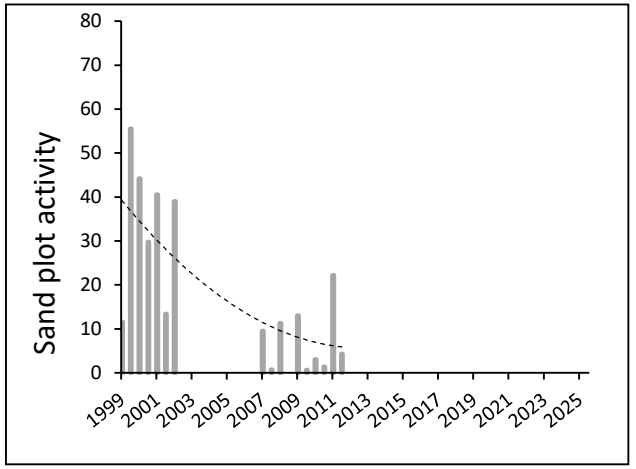
- 8-years of over-lapping camera-trap and bait-take data
- Large change foxes in the camera-data not clearly discernible in bait data

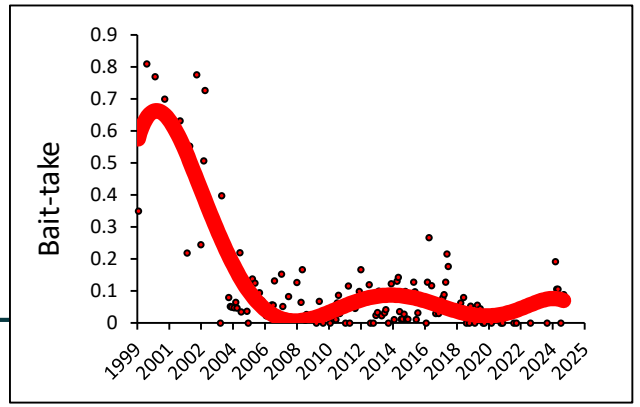


BNP fox abundance (prior to review)

- The prevailing interpretation of these data was that fox abundance at BNP was significantly reduced, and had remained low



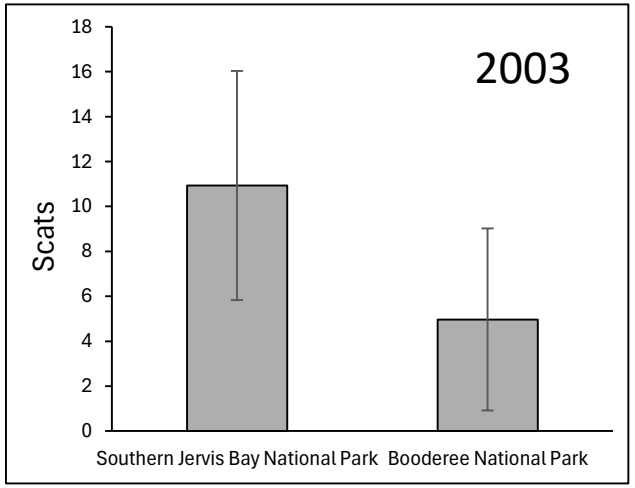


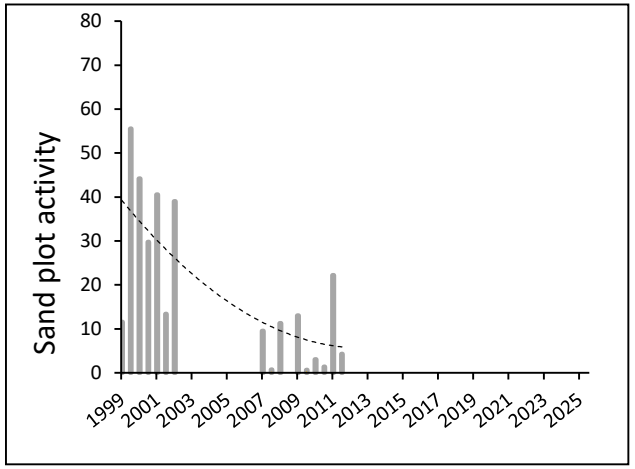


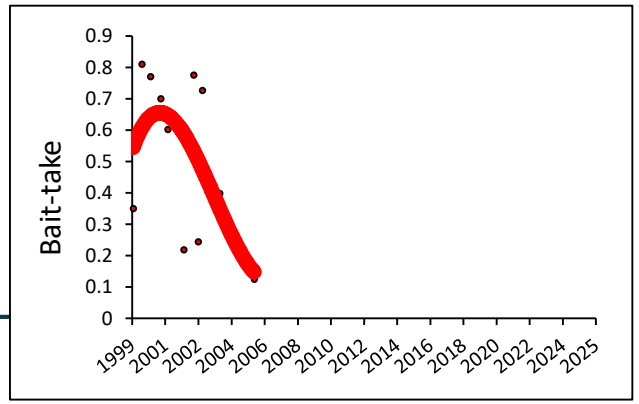
BNP fox abundance (updated)

- These data indicate that fox abundance at BNP was reduced up until 2011, but there are no data that demonstrates that fox abundance has remained suppressed

- These data provide limited information regarding the extent that the fox population and/or impact has been reduced





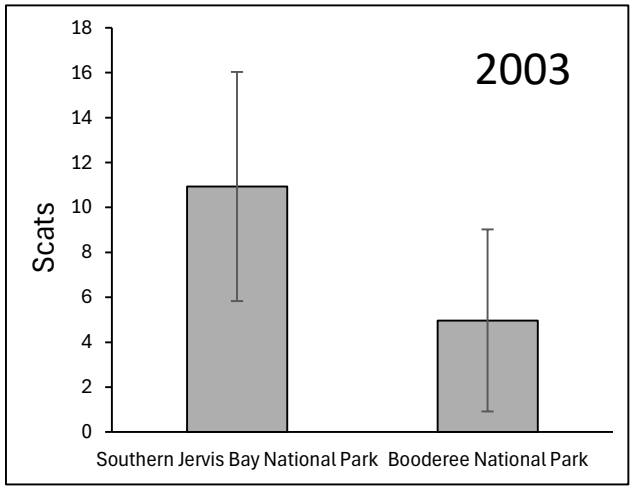


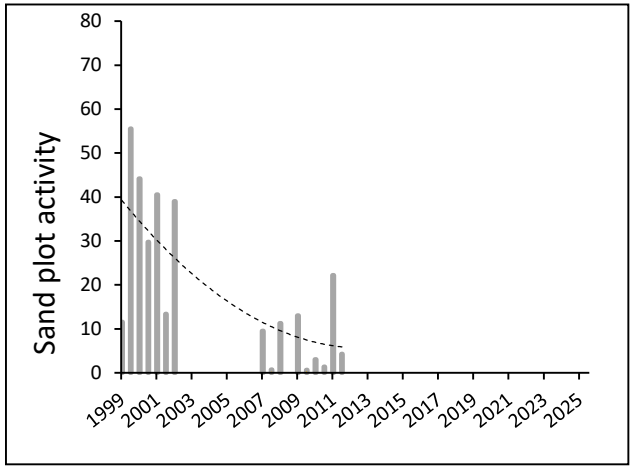
BNP fox abundance (updated)

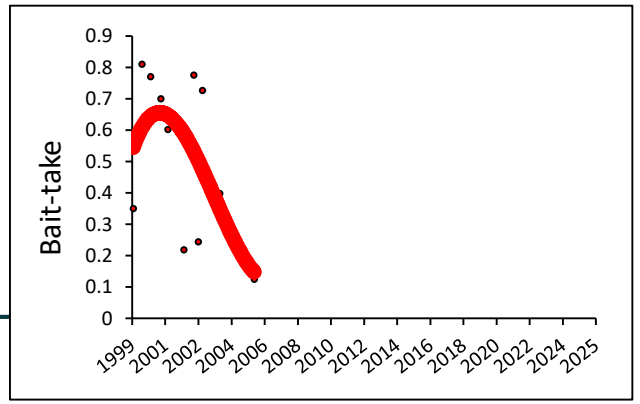
- These data indicate that fox abundance at BNP was reduced up until 2011, but there are no data that demonstrates that fox abundance has remained suppressed

- These data provide limited information regarding the extent that the fox population and/or impact has been reduced

- This does not mean that fox control has been ineffective, it means we currently lack data that clearly demonstrates it has been effective







Implications

- Trends in native fauna at BNP predominantly interpreted through a lens of effective fox control
    - Need to consider/test the potential for ongoing fox impacts

- Native species reintroductions
    - Risk assessments based on an exaggerated perception of fox abundance reduction

Fox monitoring at BNP: where to from here?

- Fox monitoring at Booderee has undergone many changes over the past 25 years
- Such changes are not unique or unexpected for such a long-term operational program
- …..but pose real difficulties when trying to interpret data

Fox monitoring at BNP: where to from here?

- Fox monitoring at Booderee has undergone many changes over the past 25 years

- Such changes are not unique or unexpected for such a long-term operational program

- …..but pose real difficulties when trying to interpret data

- Main recommendation: bolster our understanding of fox population size and impact, and the effectiveness of fox control at BNP through:
    - Robust consistent monitoring
    - Fox density and bait knock-down

Broader lessons

- Conducting a review can be very insightful and worthwhile

Broader lessons

- Conducting a review can be very insightful and worthwhile
- Ecological data are often complex and difficult to interpret

Broader lessons

- Conducting a review can be very insightful and worthwhile

- Ecological data are often complex and difficult to interpret, be careful and sceptical

county	year	county_ra	v001_raw	v001_num	v001_den	v001_cilo	v001_cihi	v001_race	v001_race	v001_ra
United States	2019		6900.63	3745538	9.08E+08	6890.349	6910.912			
Alabama	2019		9917.233	80440	13636816	9815.191	10019.27			
Autauga County	2019	1	8824.057	815	156132	7935.326	9712.788	10471.25		8706.6
Baldwin County	2019	1	7224.632	2827	576496	6794.128	7655.136	10042.47	3086.606	7277.7
Barbour County	2019	1	9586.165	451	72222	8200.118	10972.21	11332.56		7309.6
Bibb County	2019	1	11783.54	445	63653	10159.98	13407.11	14812.54		11327.
Blount County	2019	1	10908.1	1050	161107	9895.583	11920.62		5619.645	11336.
Bullock County	2019	1	12066.91	205	29266	9519.704	14614.12	14336.54		6638.6
Butler County	2019	1	14018.61	393	54804	11976.43	16060.78	15793.58		12797.
Calhoun County	2019	1	12217.76	2333	321406	11484.59	12950.93	12955.02		12447.
Chambers County	2019	1	11273.17	691	93770	9948.759	12597.58	10774.82		11794.
Cherokee County	2019	1	11294.41	575	71014	9767.023	12821.8	16395.25		10965.
Chilton County	2019	1	10831.92	850	123617	9733.842	11929.99	12000.44		11110.
Choctaw County	2019	1	12047.19	273	35489	9740.13	14354.24	12215.47		12163.
Clarke County	2019	1	9688.374	412	67037	8207.626	11169.12	12447.32		7394.5
Clay County	2019	1	9666.041	271	36916	7821.948	11510.13	12628.16		9302.0
Cleburne County	2019	1	11985.56	334	41389	9955.606	14015.5			
Coffee County	2019	1	7933.13	743	143899	7085.258	8781.002	10333.51	6033.742	7652.6
Colbert County	2019	1	10332.48	1016	149595	9321.505	11343.46	11604.94		10386
Conecuh County	2019	1	10635.37	272	34170	8546.834	12723.9	11100.61		10319.

Resilient Landscapes

National Environmental Science Program

Acknowledgments

Dr Paul Meek, Dr Nick Dexter, Dion Maple, Dr Matt Hayward, George Brown, Crissy Locke, Dr Guy Ballard, Dr Deane Smith, Lucy Collingridge, Prof David Lindenmayer, Christopher MacGregor, Rob Brewster, Margarita Goumas.