



Control charts as an environmental monitoring tool for decision making

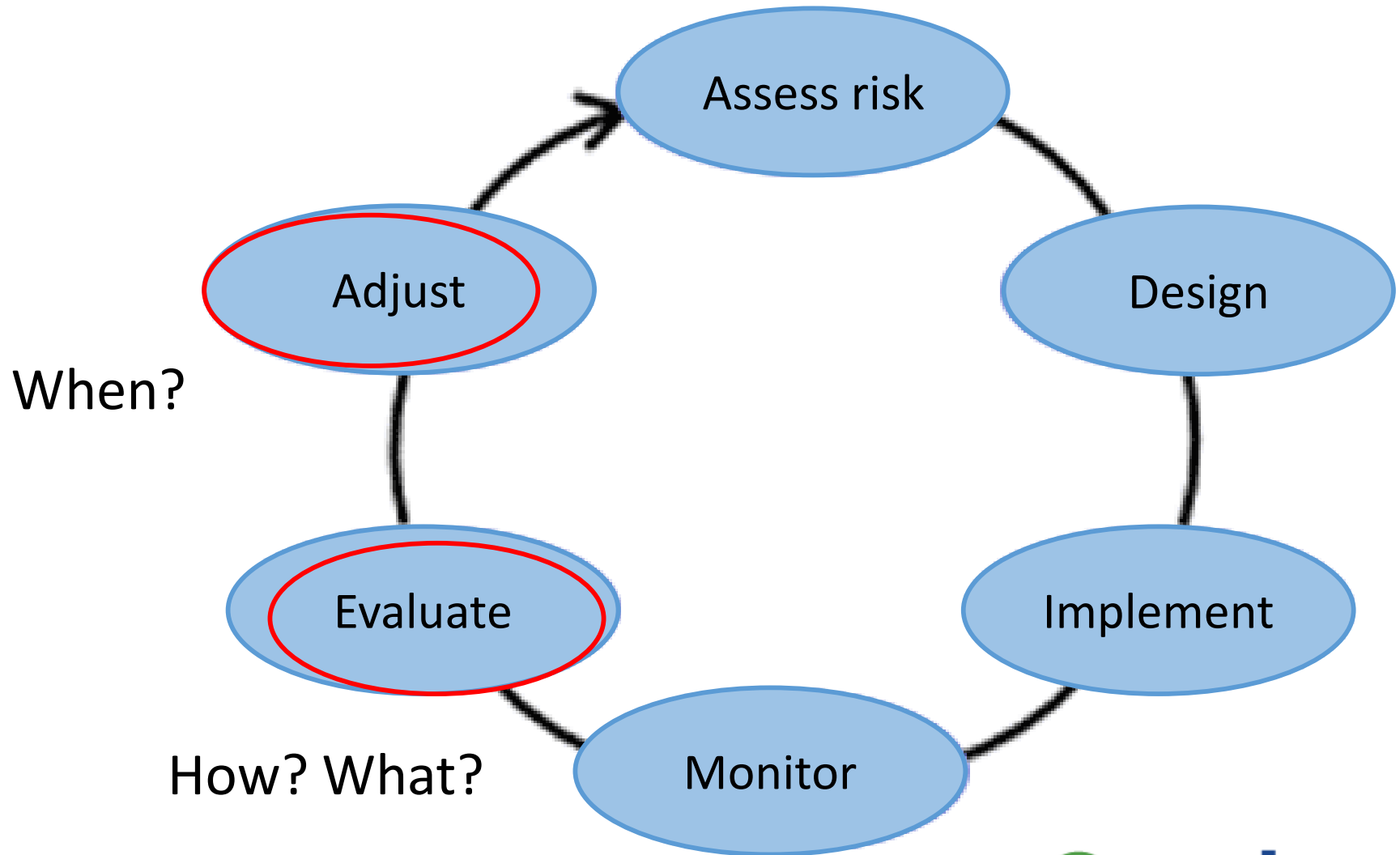
EIANZ Annual Conference
Aaron Gove, Jess Oates and
Robert Archibald
29 October 2015



Why monitor?

- Natural systems are dynamic
- Difficult to predict all impacts prior to development
- Some impacts need to be recognised and managed as they arise
- Basis of adaptive management

Adaptive management



Monitoring challenges

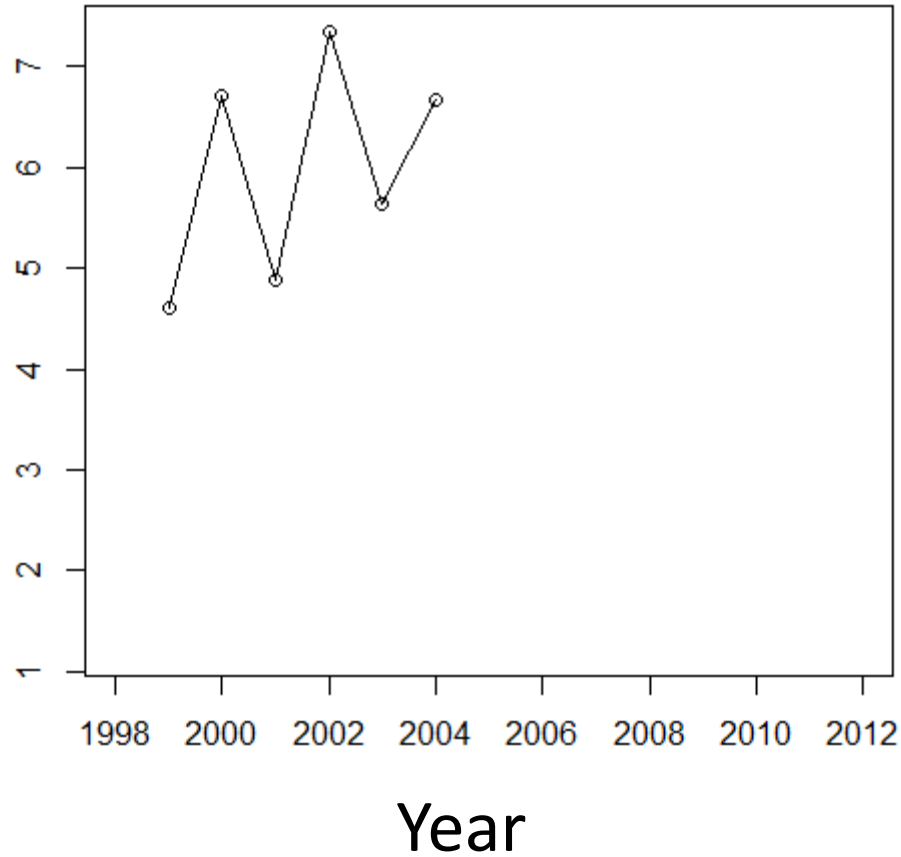
- What to monitor
- Defining 'normal' in naturally variable systems
- Agreeing upon definition of impact
- Identifying when management should intervene

Control charts

- Visual plot of indicator over time
- Focus on environmental outcomes
- Forces the selection of monitoring variables
- Account for natural variability in a system
- Provide clear, robust and transparent thresholds (“control limits”)
- Flexible approach
- An example...

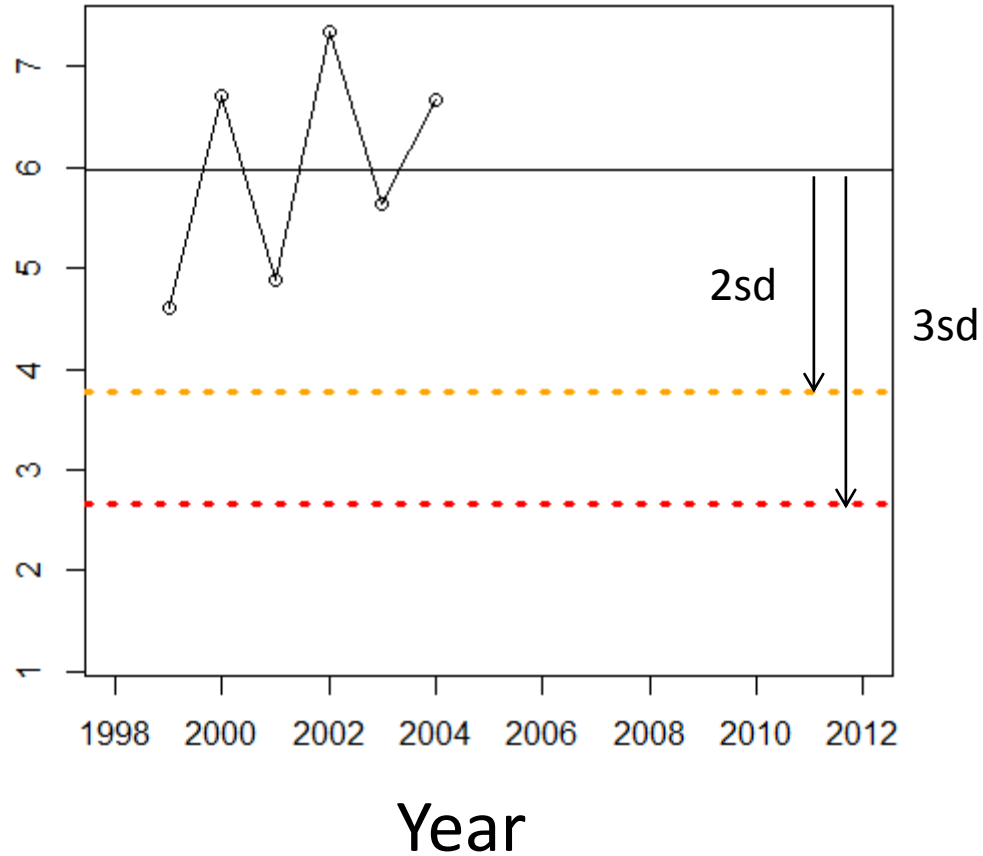
An example

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surveys



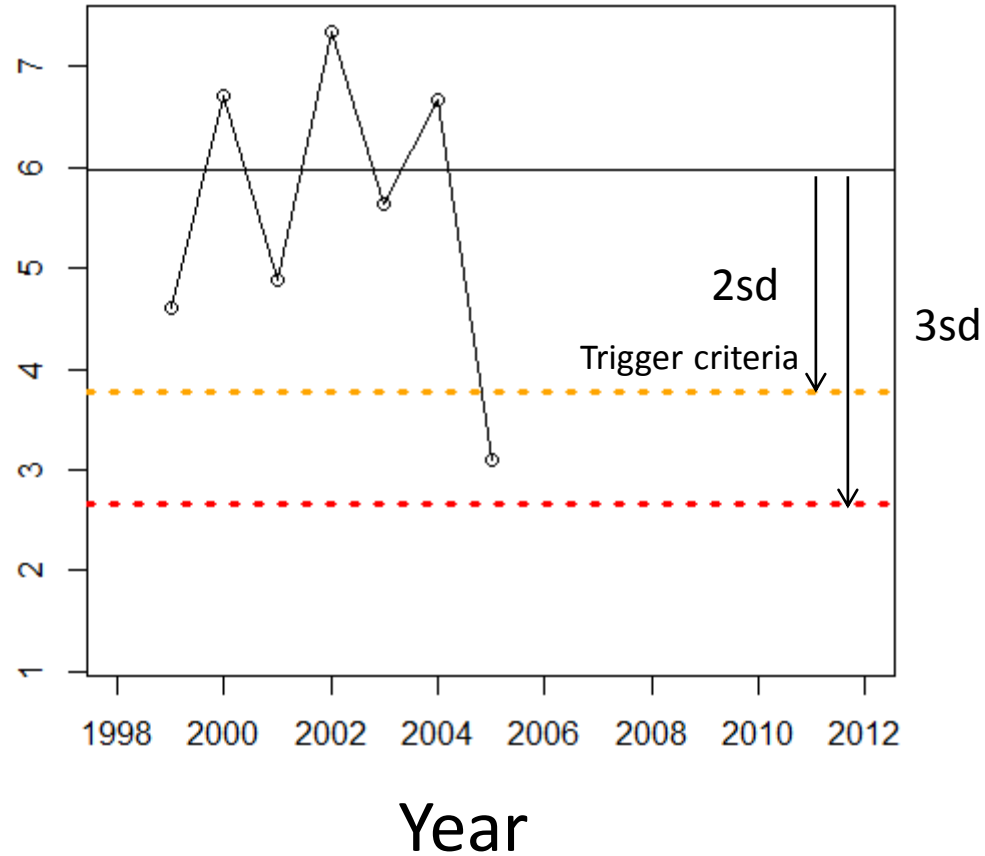
An example

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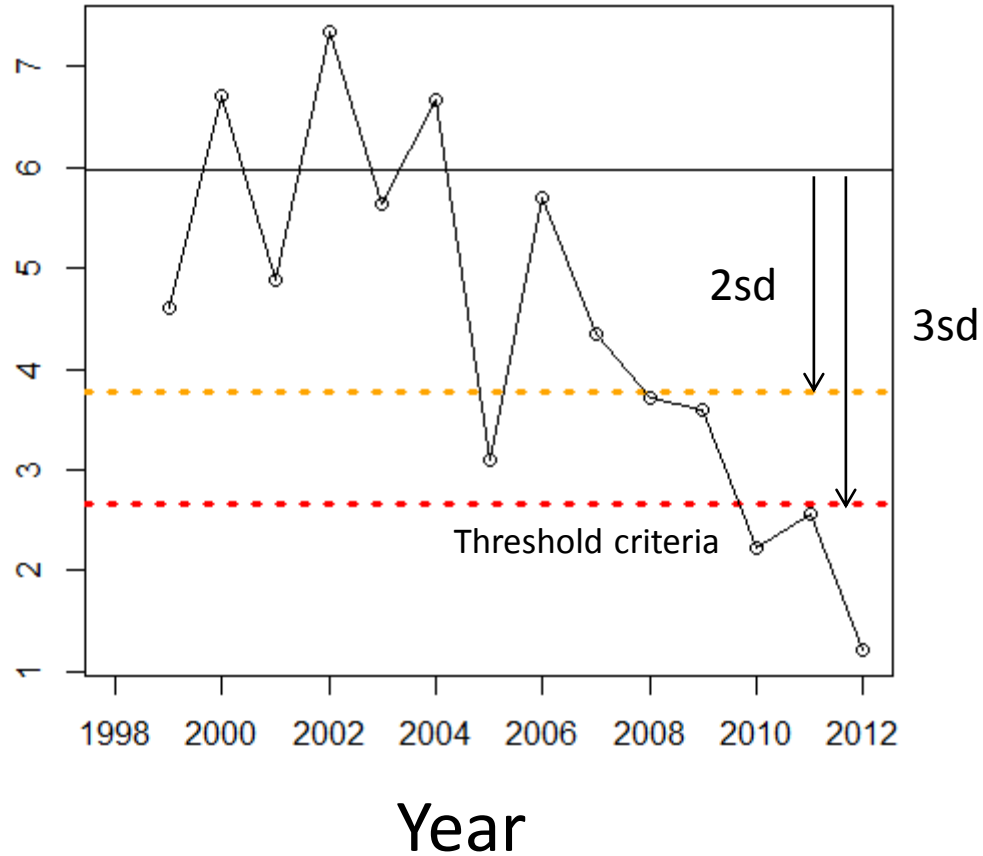
An example

% of
surveys



An example

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surveys



Multivariate control charts

Is a species assemblage changing?



Ecological Applications, 14(6), 2004, pp. 1921–1935
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MULTIVARIATE CONTROL CHARTS FOR ECOLOGICAL AND ENVIRONMENTAL MONITORING

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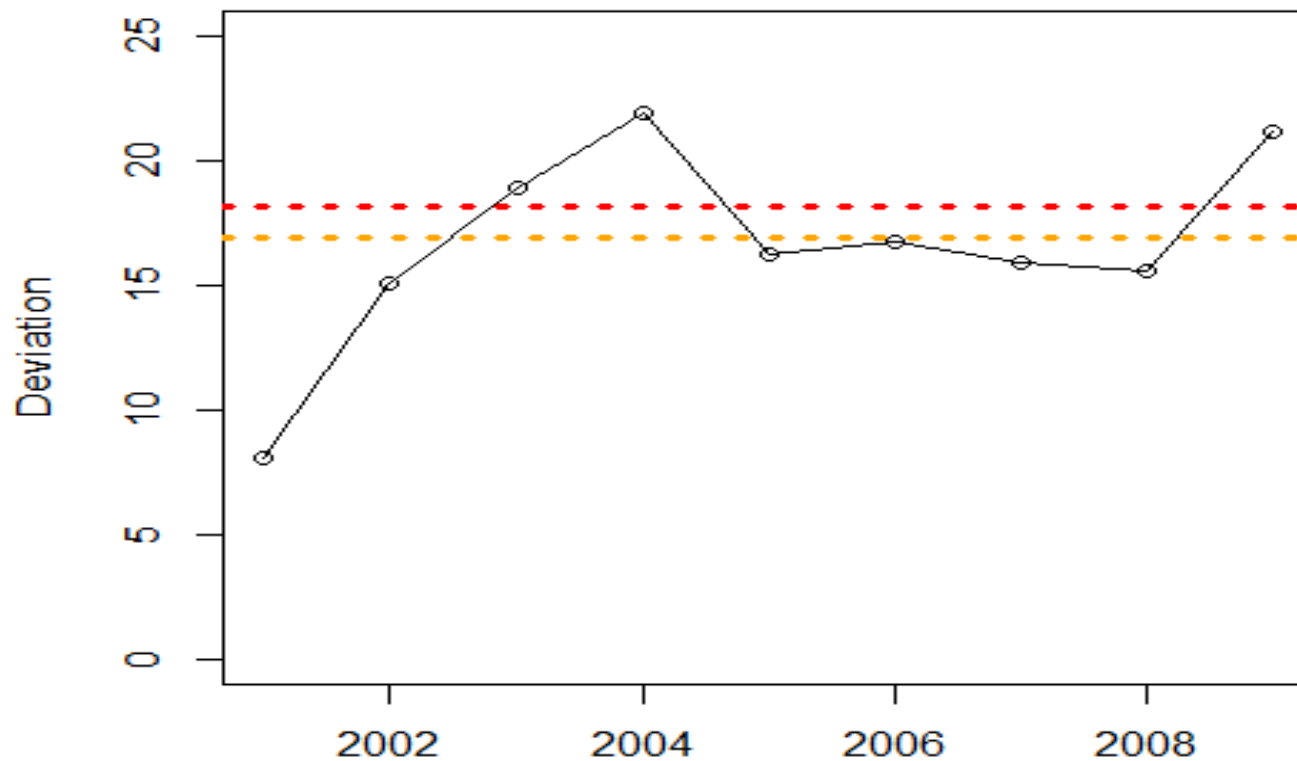
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Multivariate control charts

Is a species assemblage changing?

Bird assemblage

Devn from 1998-2000

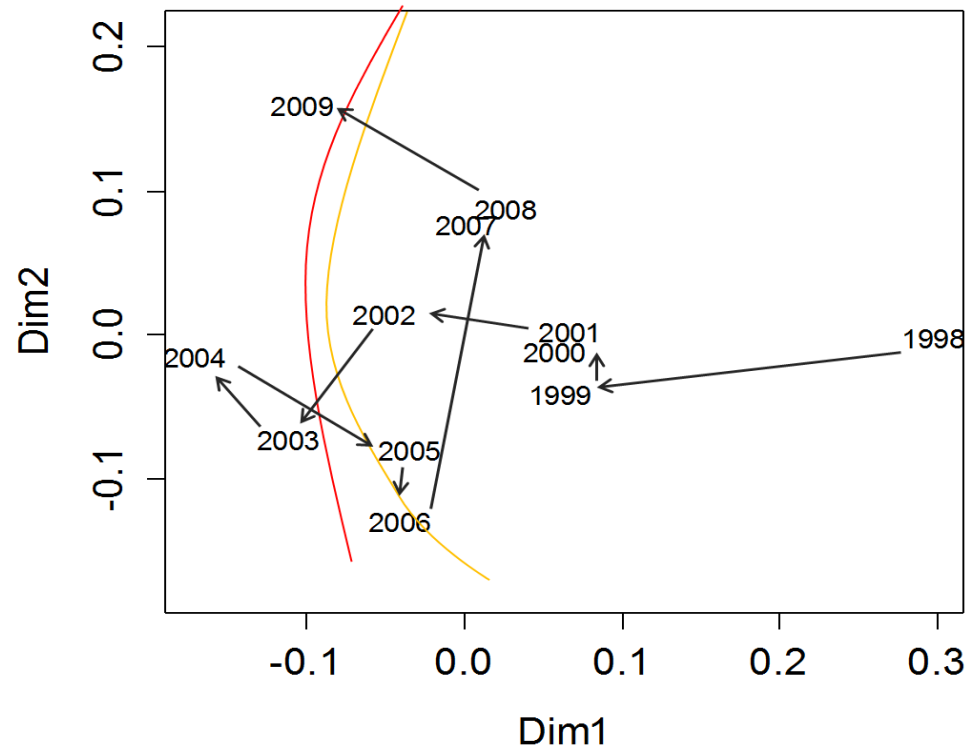
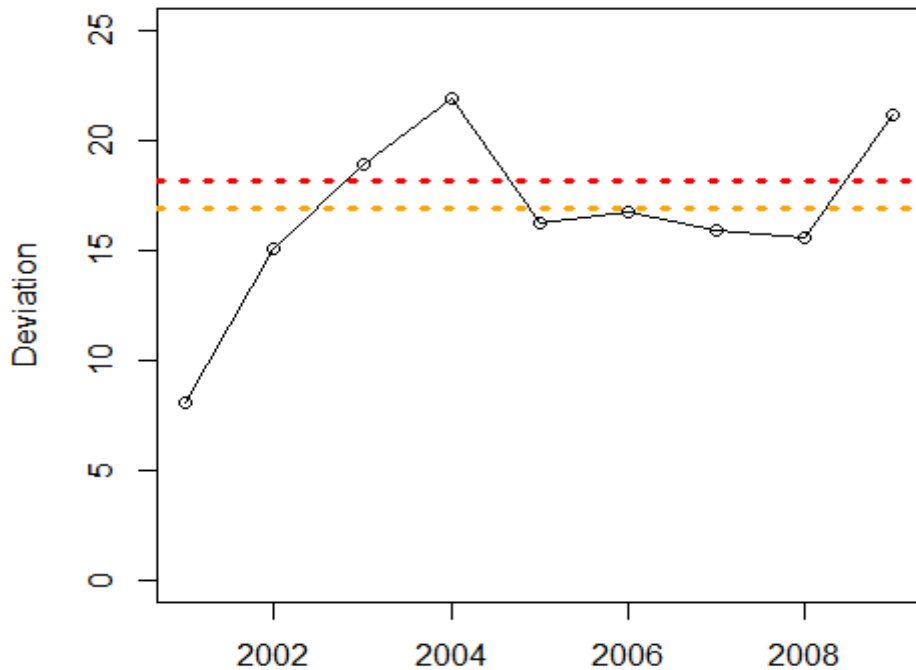


Multivariate control charts

Is a species assemblage changing?

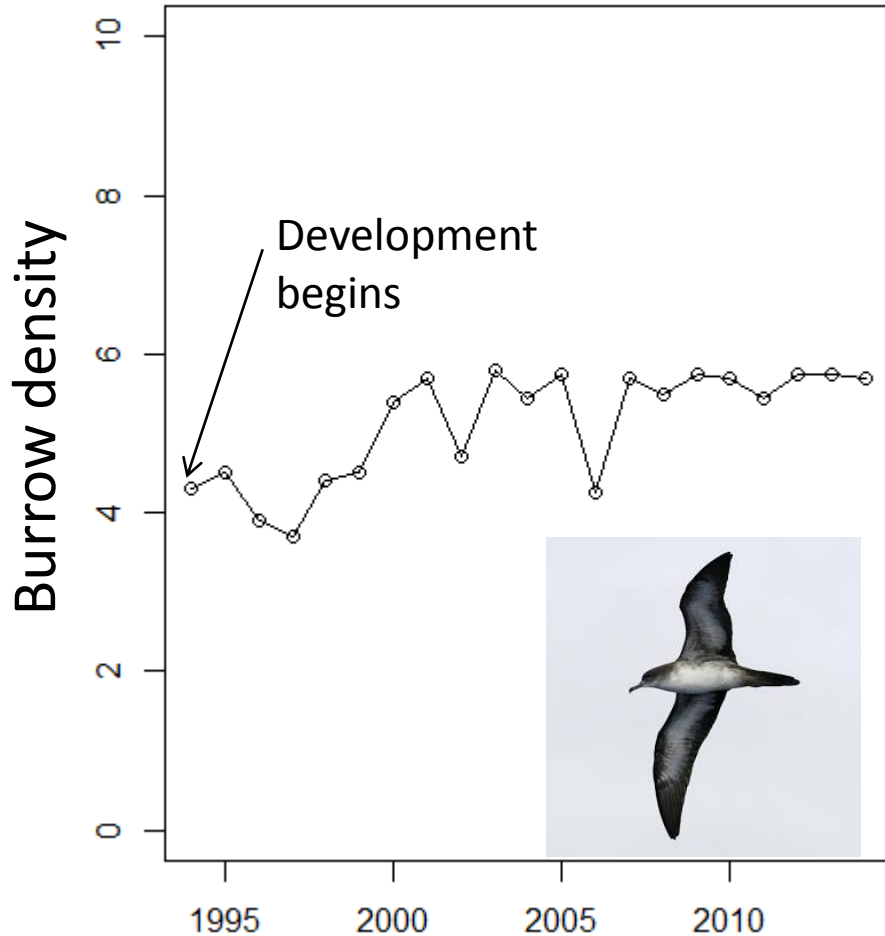
Bird assemblage

Devn from 1998-2000



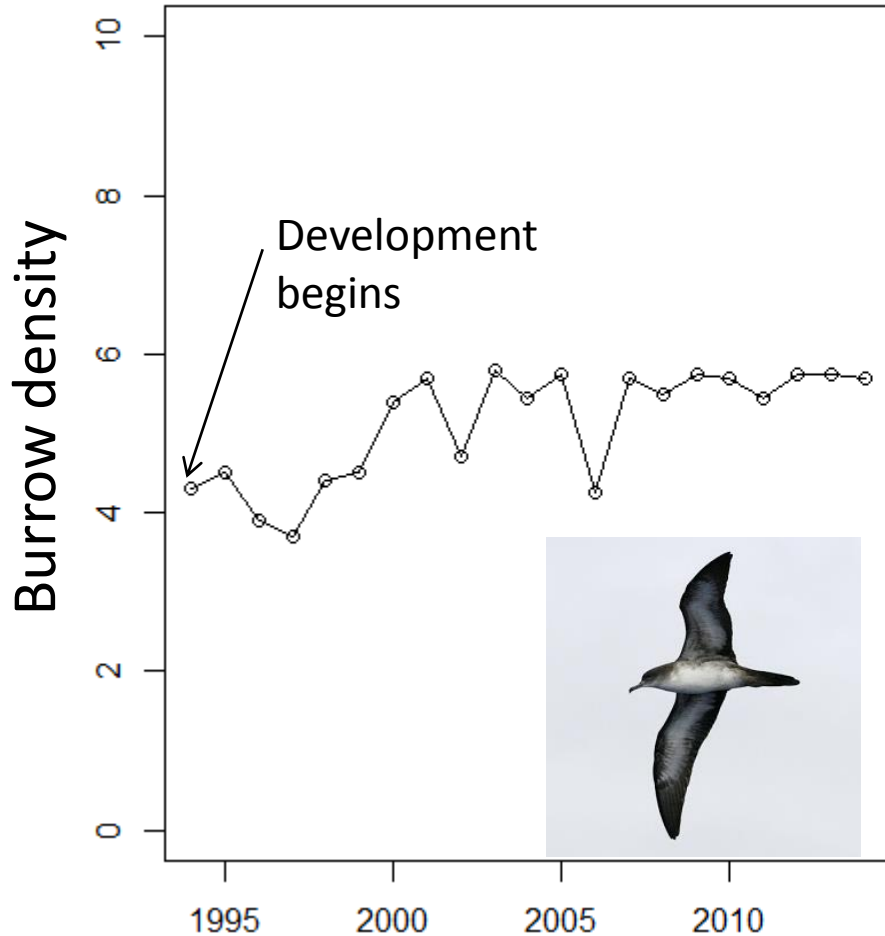
Challenges: No baseline period

Potential impact site

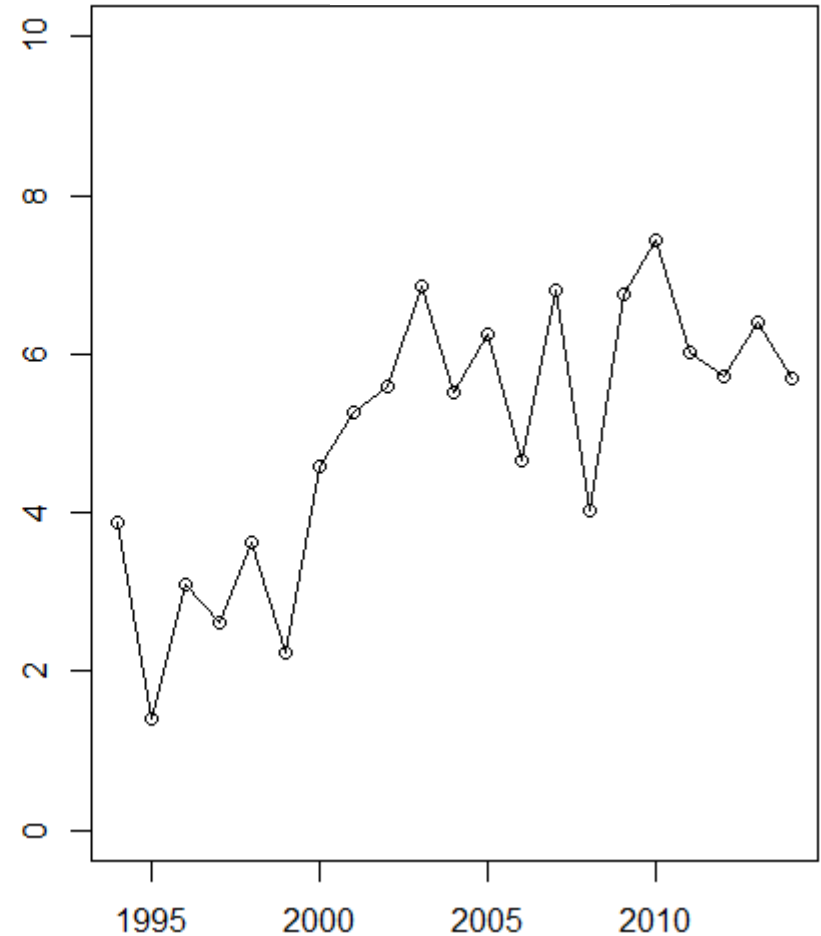


Include control sites

Potential impact site

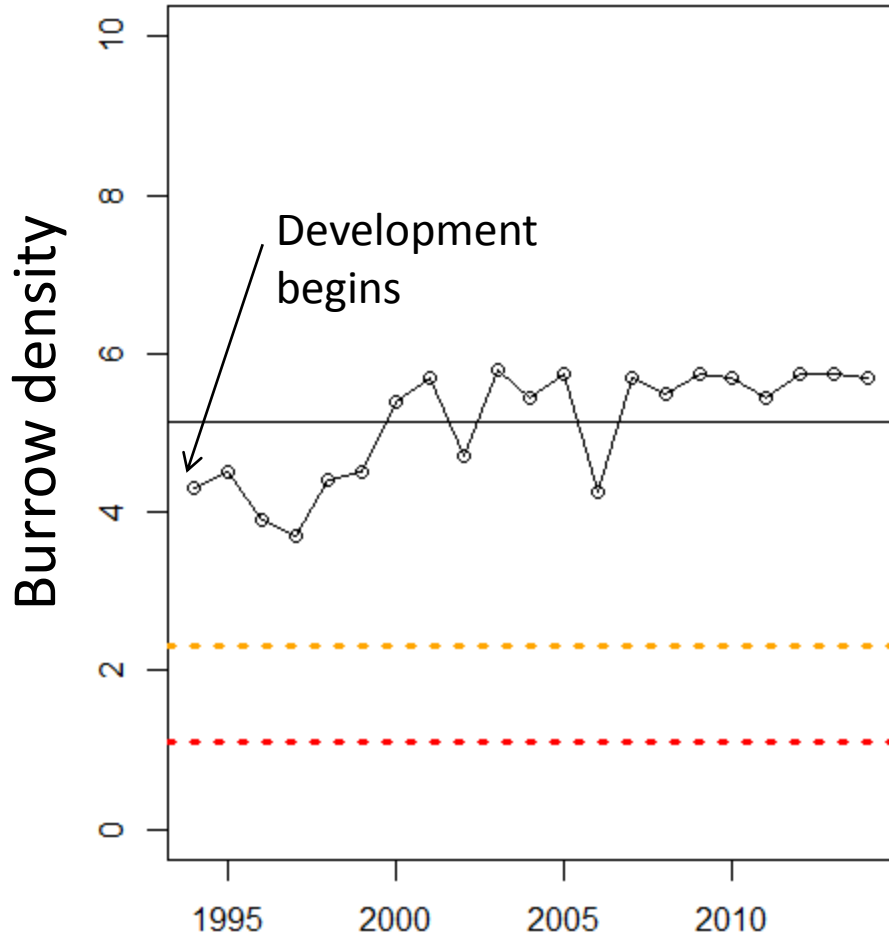


Control site

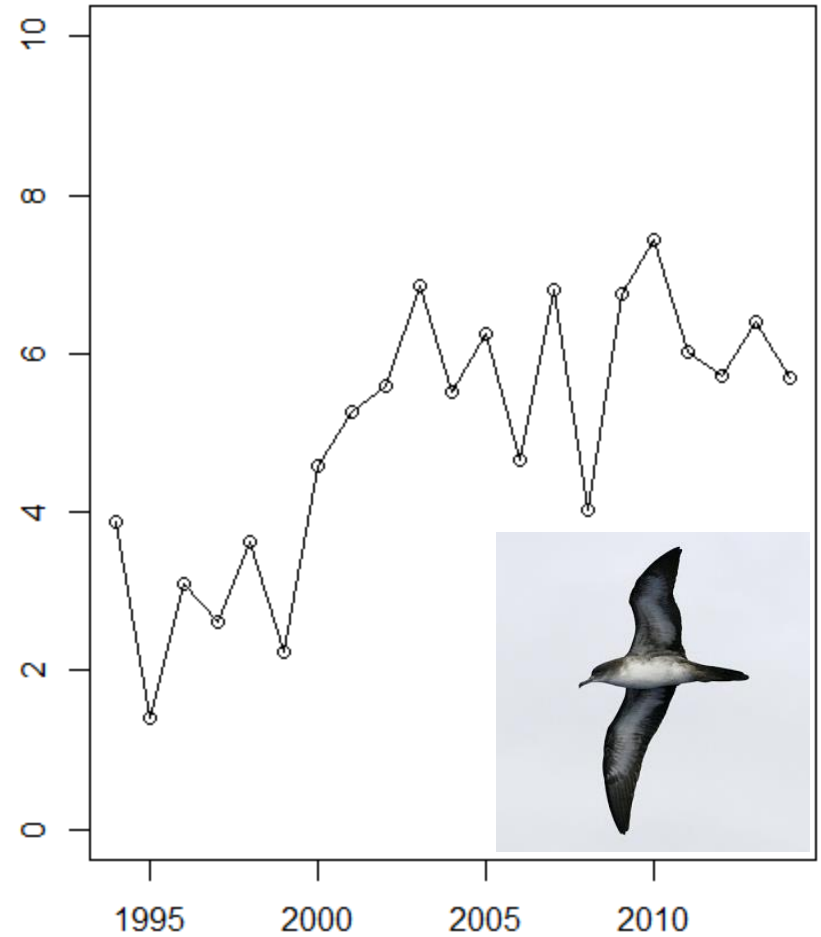


Include control sites

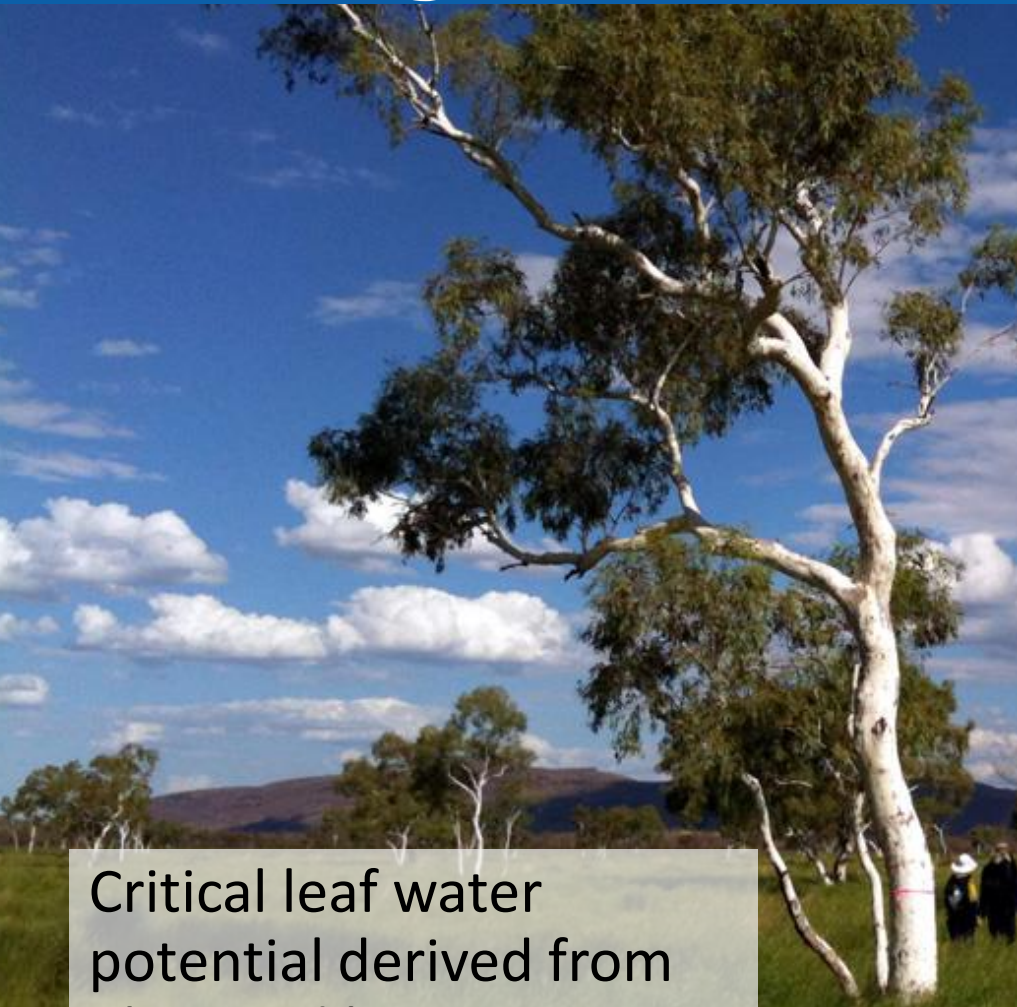
Potential impact site



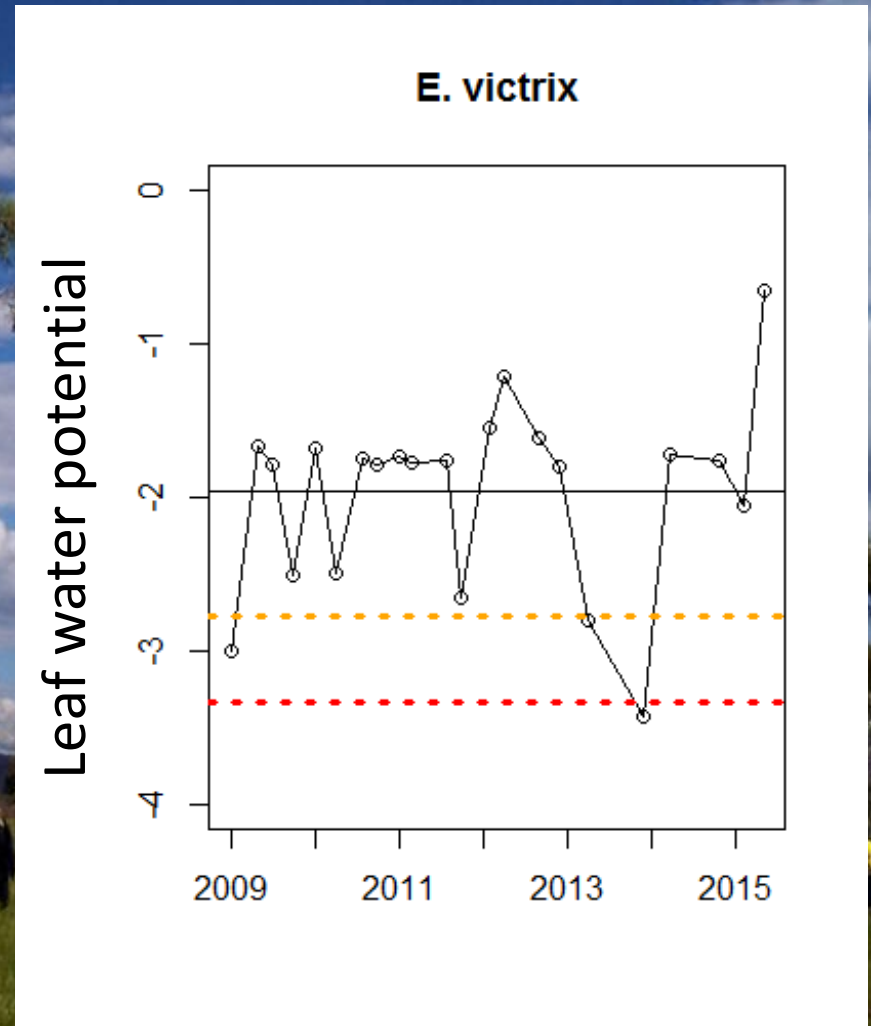
Control site



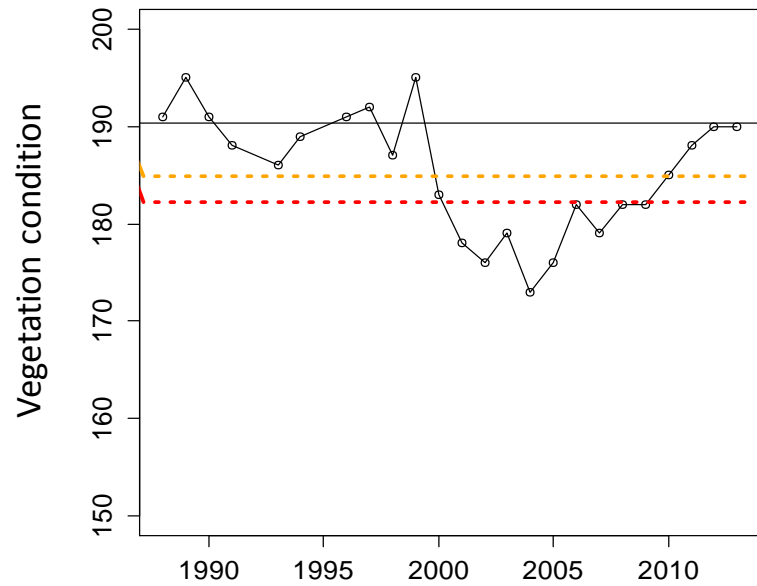
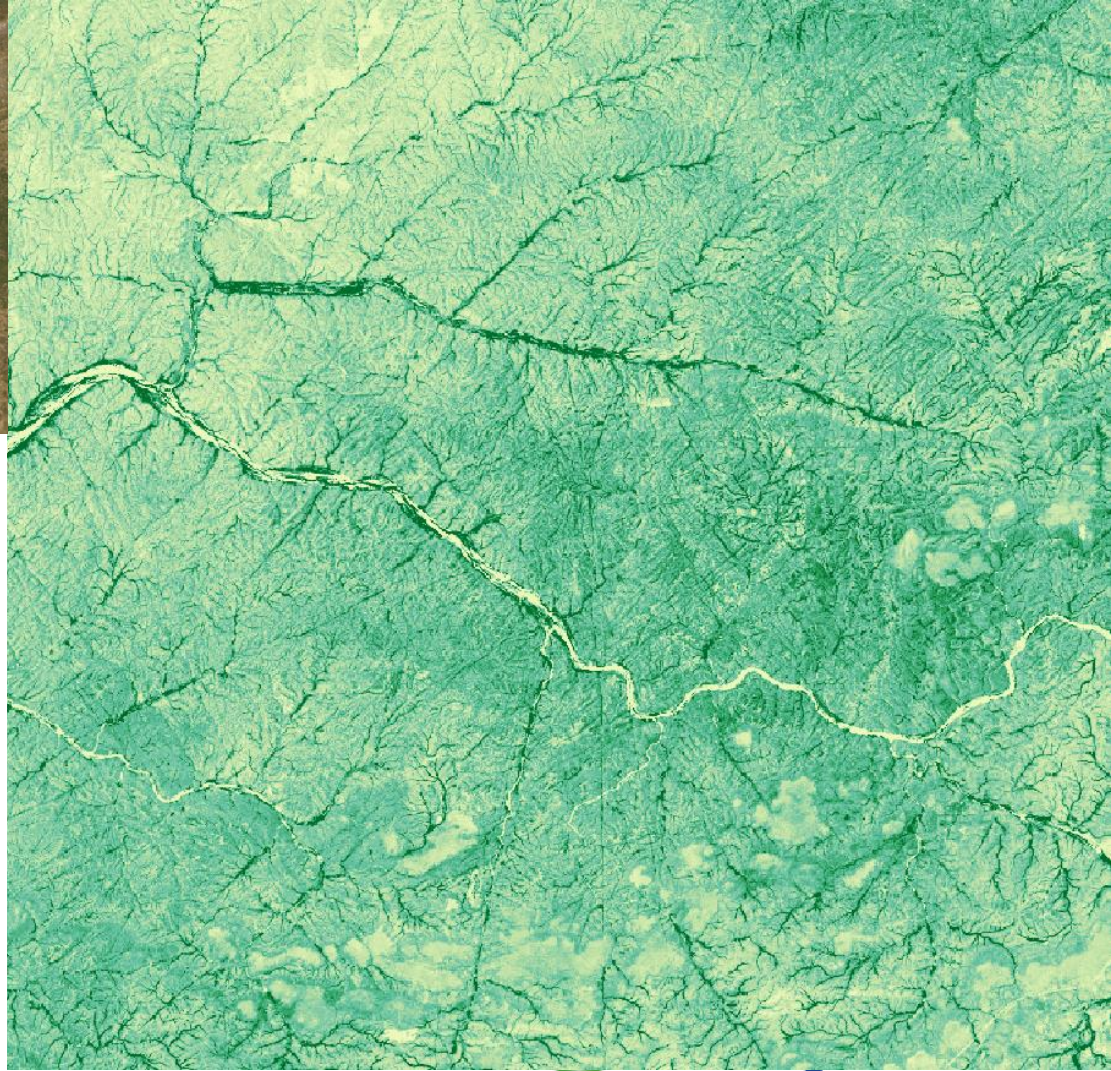
Biological control limits



Critical leaf water potential derived from observed limitations to tree condition



Remote sensing



Summary

- Control charts are numerically robust and transparent
- Focussed on environmental outcomes
- Facilitate decisions on what to monitor and when to intervene
- Technology such as remote sensing is increasing datasets and applications
- How to intervene is still up to managers and understanding recovery of natural systems is still important

References

- Anderson, M. J., & Thompson, A. A. (2004). Multivariate control charts for ecological and environmental monitoring. *Ecological Applications*, 14(6), 1921-1935
- Gove, A. D., Sadler, R., Matsuki, M., Archibald, R., Pearse, S., & Garkaklis, M. (2013). Control charts for improved decisions in environmental management: a case study of catchment water supply in south-west Western Australia. *Ecological Management & Restoration*, 14(2), 127-134.
- Morrison, L. W. (2008). The use of control charts to interpret environmental monitoring data. *Natural Areas Journal*, 28(1), 66-73.

