

6th one-day postgraduate course on Current Ecology and Evolution



Welcome!

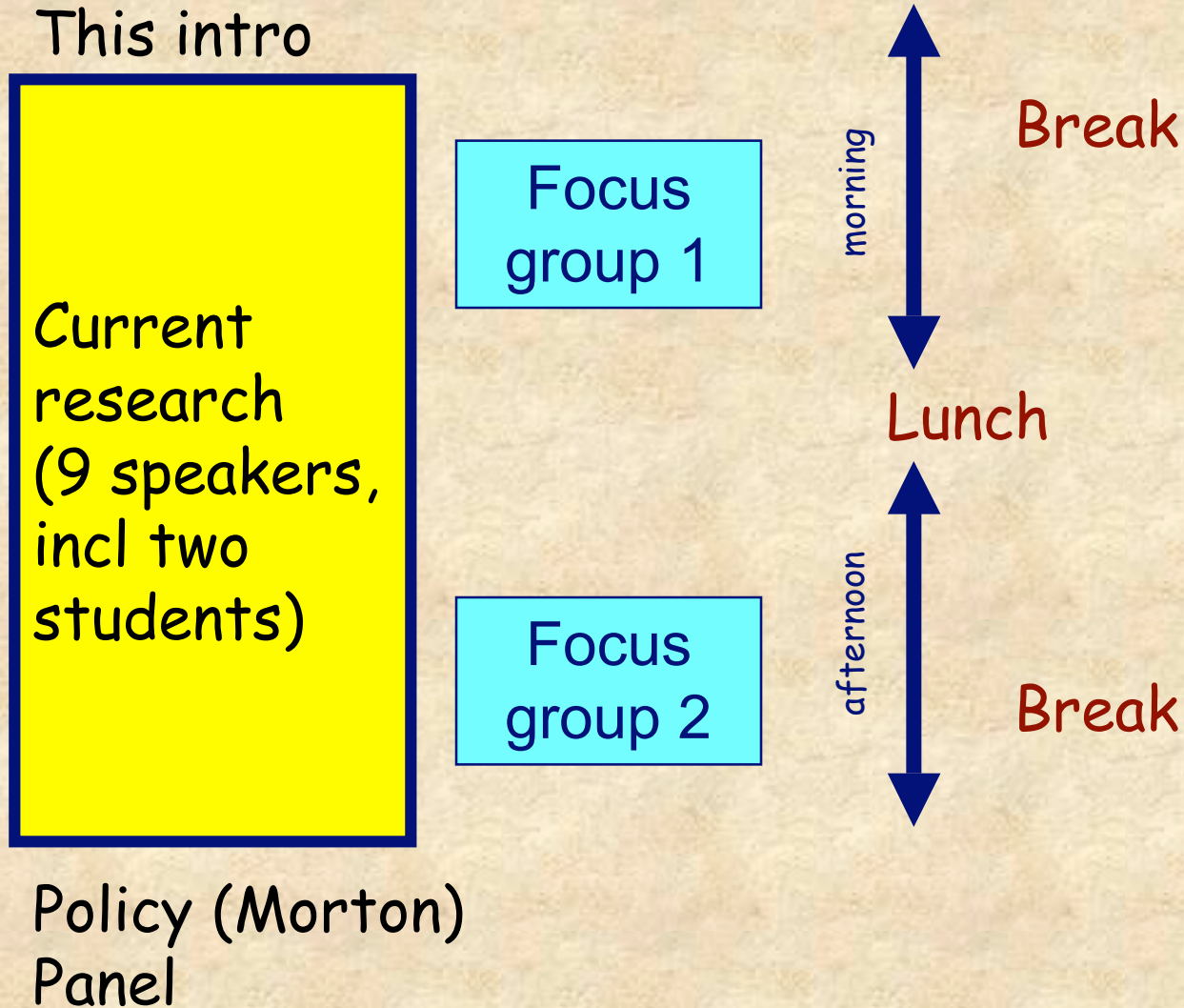
Have a schedule and a label

Overall aim

- Selection of interesting current research in ecology and evolution
- done through ESA/AES to give wider coverage than in any one university
 - Doesn't cover thesis-writing, technical skills, or other matters best dealt with by your own university
- only one day, but successive years are different, so they add to each other



Main features of schedule



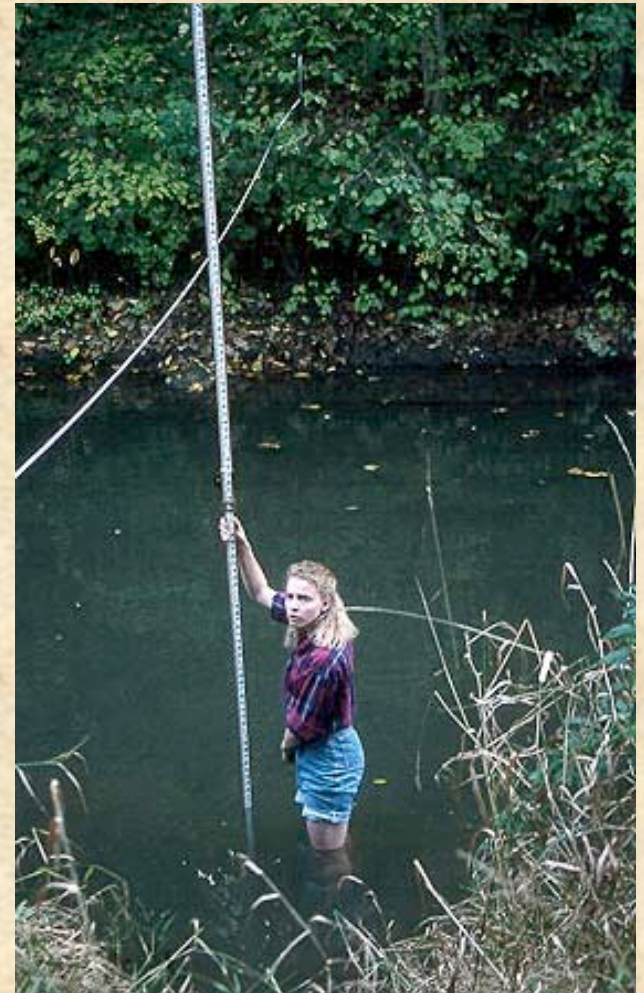
current research

- 7 researchers from different areas of ecology and evolution
 - Asked to choose an interesting recent paper and explain why it's important and where it might lead
- Also 2 p/g researchers
 - nominated a paper, kindly volunteered to talk about its influence



Your participation

- Two focus group sessions
 - Ecology of eastern vs western Australia?
 - Climate change and CO₂ increase: will the consequences be more severe in Australia than elsewhere, or less?
- Panel discussion at end of day
 - Opportunity to raise whatever points or issues
- Long breaks and lunch for you to meet each other and the speakers





some
themes in
the history of
ecology in
Australia

10-minute version!
not comprehensive!

Theme 1: balance vs stochasticity in population dynamics

random events



Nicholson 1933, 34, 54; CSIRO Entomology via Sydney; balance of nature is logically inevitable; sheep blowfly *Lucilia cuprina* was important in his thinking



Many biol control programs 1970-present



Andrewartha & Birch (pic) esp 1954 book; most pop'ns spend most time growing at 'r' following a crash; Aust plague locust *Chortoicetes terminifera* was important in their thinking

stochasticity

Andrewartha & Birch 1954



Sale (Sydney & Canada)
1977: coral reef fish do not
coexist by niche separation
but by "lottery" processes



Chesson (Adelaide, USA,
ANU, USA): generalized
lottery process as storage of
temporary success (1981)

Underwood (Sydney):
textbook examples such as
intertidal dominance by
mussels or *Pyura* are not
consistent due to stochastic
recruitment

Chesson (1996) subsequently
clarified relationship between spatial
averaging and smooth regulation

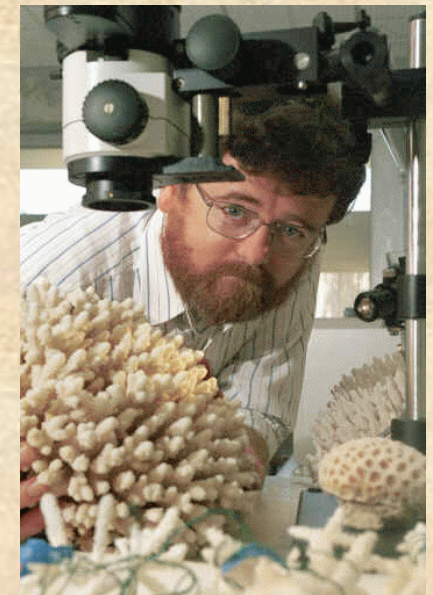
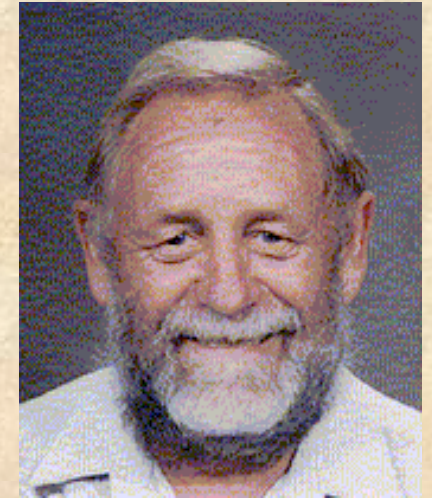
Australian coral reef school

Australian coral reef tradition

- especially JCU, Aust Inst Marine Sci, Sydney
- 1970-80s focus on stochasticity of local recruitment
- 1980-90s identifying continuing high-recruitment vs low-recruitment areas
- currently scaling to Indo-Pacific, connecting local diversity to evolutionary diversification



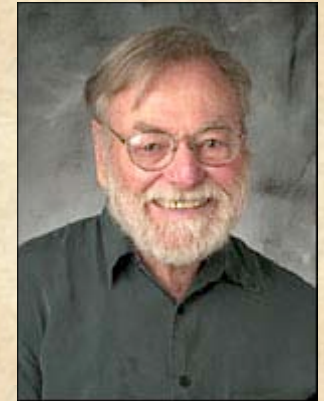
Howard Choat, NZ
and Australia



Terry Hughes

Theme 2: episodic events

- Dynamics under recurrent fire
 - Jackson 1968 (Tasmania) “Earth, Air, Fire and Water”
 - Ashton 1976 (Melbourne) mountain ash regeneration
 - Noble & Slatyer 1980 (ANU) vital attributes scheme
- Intermediate Disturbance Hypothesis
 - Connell (USA but visiting coral and rainforest sites in Australia since 1962-3)
- event-driven dynamics in rangelands and arid zone
 - Westoby 1979, 89 (Macquarie), Stafford-Smith & Morton 1990 (CSIRO)
 - Harrington edited text for 1984 Int Rangelands Cong, Ludwig ed 1977 (CSIRO)
- reproductive strategies
 - marsupials vs placentals Low 1978 (CSIRO)
 - cooperative breeding in birds (Ford et al 1988 UNE, Heinsohn et al 1990 ANU)



Joe Connell, hon
lifetime ESA member



Bobbi Low, Alice
Springs and Michigan

cast:

Dave Ashton

Ion Maher, ranger
at Kinglake NP

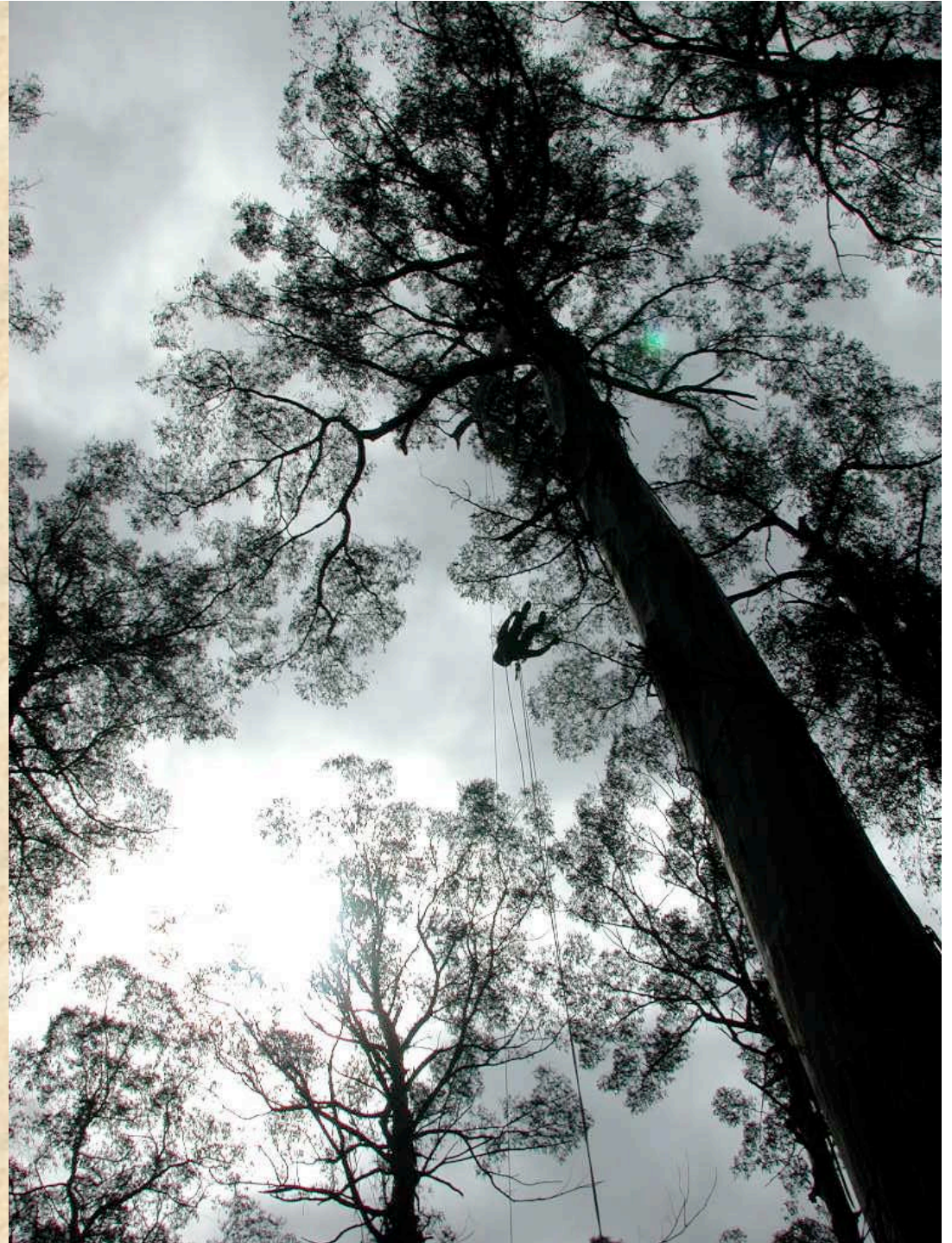
tree-climbers Tom
Greenhill, Brett
Mifsud

arborists from U
Melbourne

Dan Falster,
Macquarie U



up!









down

Theme 3: low soil phosphorus: a main reason for sclerophylly?

P (unlike N) is a property set by the rock material. Through P the regolith influences what sort of species maintain populations at a site.

- Traditionally, hard and narrow leaves had been interpreted mostly as drought adaptation
- Beadle 1954 et seq: sclerophylly as adaptation to low soil P
 - Long leaf lifespan → long nutrient retention
 - Subsequently recognized in northern hemisphere also, e.g. Loveless 1961



Noel Beadle (Syd then UNE)

low soil P: enrichment experiments

- Dark Island Heath experiment showed that nutrient addition changed the nature of sclerophyll vegetation
- in Sydney sandstone veg'n, exotic weeds are associated with P enrichment specifically
 - not with any other form of disturbance
 - Leishman 1990, 2004a, b

South Aust:
Specht
papers
1957-1990s



Triodia (aka spinifex, hummock-grass)

- Sclerophyll grass on low-nutrient sands in arid zone
 - main ground layer across about 40% of continent
- Major food chain supported leads to termites and thence to legless lizards
 - James & Morton



Steve Morton, currently leader CSIRO Sustainable Energy and Environment



First draft
circulated in
1980s

Biol. Rev. (2007), **82**, pp. 393–423.
doi:10.1111/j.1469-185X.2007.00017.x

393

Ecology of Australia: the effects of nutrient-poor soils and intense fires

Gordon H. Orians^{1,*} and Antoni V. Milewski²

¹ *Department of Biology, Box 351800, University of Washington, Seattle, Washington 98195, USA (E-mail: blackbrd@serv.net)*

² *Percy FitzPatrick Institute of African Ornithology, University of Cape Town, South Africa (E-mail: milewski@rts.com.au).*

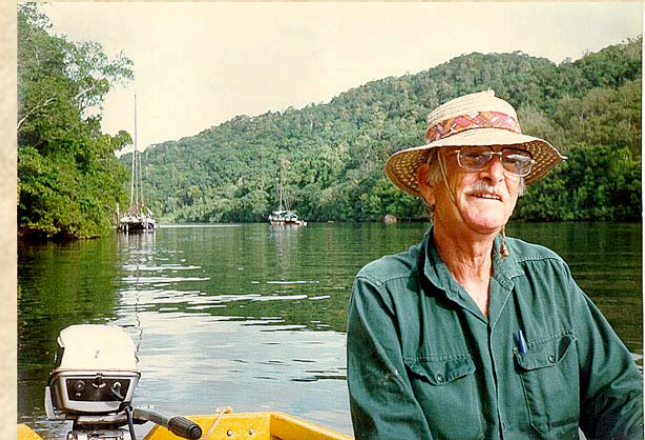
(Received 15 November 2006; revised 9 February 2007; accepted 2 May 2007)

ABSTRACT

Australia, the flattest, driest, and geologically oldest vegetated continent, has a uniquely high proportion of nutrient-poor soils. We develop a “Nutrient-Poverty/Intense-Fire Theory,” which postulates that most anomalous features of organisms and ecosystems of Australia are the evolutionary consequences of adaptations to nutrient poverty, compounded by intense fire that tends to occur as a result of nutrient poverty. The fundamental tenet of

Theme 4: Distinctive evolutionary history?

- Webb, Tracey et al, CSIRO rainforest surveys 1950s-1960s showed Aust RF was indigenous and old
 - justified for chemical prospecting
 - actual benefits were respect for rainforest, plus new multivariate classification methods
- Webb was science spearhead of political successes in rainforest conservation 1970s-1980s

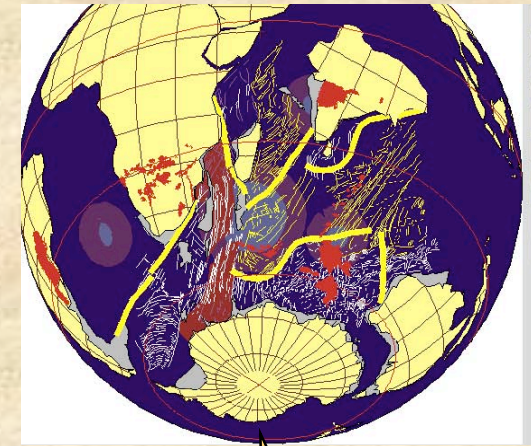


Len Webb



Geoff Tracey

By 1970s palaeobotanists had a picture of Australia at ~60 Ma



- Closed subtrop RF throughout, with floristic differences N-S
 - High rain throughout, temps warm (20-25 °C in south) despite latitude 40-70°S.
- flora then seen as “Gondwanan”
 - recently disconnected from Antarctic, longer disconnected from NZ, India, S America etc
- but molecular phylogenies are now showing that only a minority of lineages in the present flora continued directly through from Gondwana

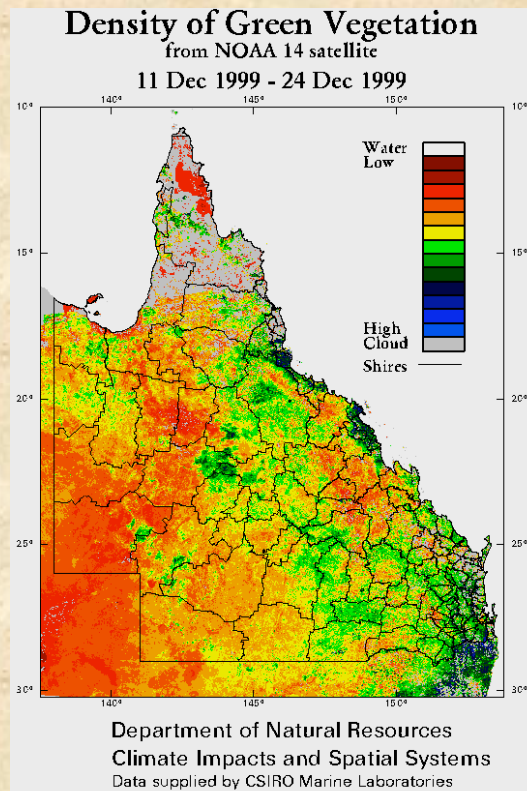
Plate
tectonics
accepted
1963-4



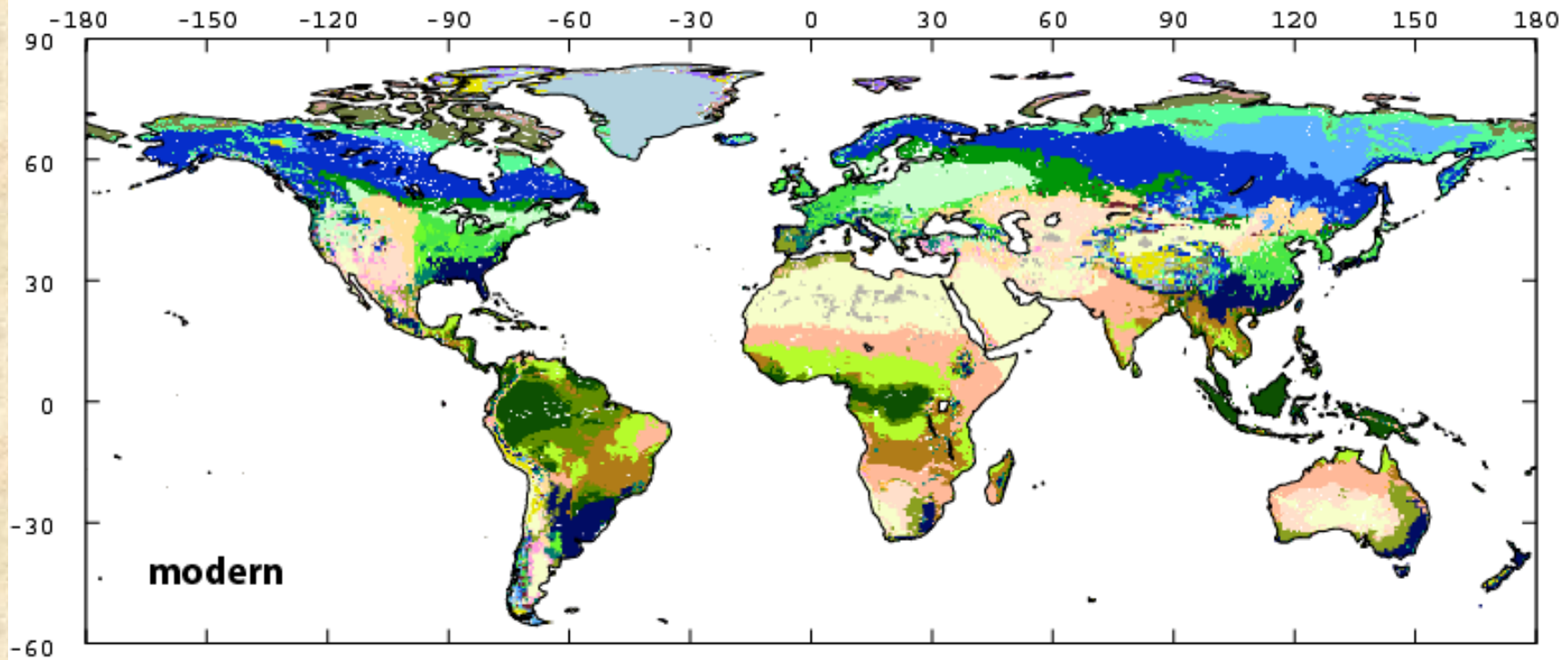
Henry Nix (CSIRO/ANU)

Theme 5: shift to continental and global scales

- Driven by
 - needs of global change
 - land and sea-region management problems
 - are episodic events local or regional?
- bioclimate modelling
 - pioneered by Nix's BIOCLIM
- National Carbon Accounting System: brings together GIS with bioclimate models and with fresh sampling



A current issue: are global-scale vegetation models satisfactory when applied to Australia?



Biome4 (Kaplan et al 2003) calculates NPP for each plant functional type in relation to local climate. Vegetation type is defined by the two top-ranked PFTs

It's easy to criticize
the map of Australia
produced by such
models



dark blue	warm-temperate evergreen broadleaf & mixed forest
orange	tropical deciduous broadleaf forest & woodland
light green	tropical savanna
light orange	tropical xerophytic shrubland
light yellow	temperate xerophytic shrubland
dark green	temperate sclerophyll woodland and shrubland

But what should we do
to improve them?

- Theme 4: biota with distinctive history?
- Theme 3: low soil P?
- Theme 2: importance of episodic events?
 - But how, exactly, would each of these be incorporated into models?
- Or maybe it's time we took less pride in being different?
 - and aimed instead to unify Australian ecological science with world?

Summary: some themes in the history of Australian ecology



Gee Chapman investigating

- Balance vs stochasticity in pop'n dynamics
- Episodic events
- Low soil P
- Distinctive phylogenetic history
- Current push to wider scales