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Climate impacts on biological systems in the Western Australian region

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Centre for Australian Climate and Weather Research
A partnership between CSIRO and the Bureau of Meteorology
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Seabirds as bio-indicators

Bio-indicators of trophic (food & productivity) conditions within marine ecosystems

- Higher order predators
 - Near top of marine food-chains
 - Integrate bio-physical processes operating in those ecosystem
- Colonial nesters
 - Facilitating repeated sampling for monitoring programs





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Seabirds as bio-indicators

- Central-place foragers when breeding
 - Different species different foraging ranges
 - Opportunities to monitor changes on range of scales
- Occupy a range of marine ecosystems
 - Species range from estuarine to coastal, continental shelf to oceanic
 - Provide information on changes in different marine ecosystems – monitor from one focal location



JN Dunlop



Seabirds as bio-indicators

- Breeding performance robust indicator of prevailing, within-season, oceanographic and trophic conditions
 - High energy demands associated with rearing young gives marked variation in reproductive output
- Pelagic seabirds have conservative life histories
 - Strongly philopatric, long-lived delayed maturity, low capacity for increase and rest years
 - Change in population size / distribution reflect trends in marine ecosystems and not short-term spikes





Seabirds as bio-indicators

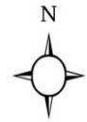
- Central & sw WA mix of tropical and temperate cool-water species
 - Due to Leeuwin Current
 - Change in seabird community composition and structure potential indicator of shifts in ocean climate
- Visible and popular subjects for observation
- Historical record of breeding distributions back to colonial period



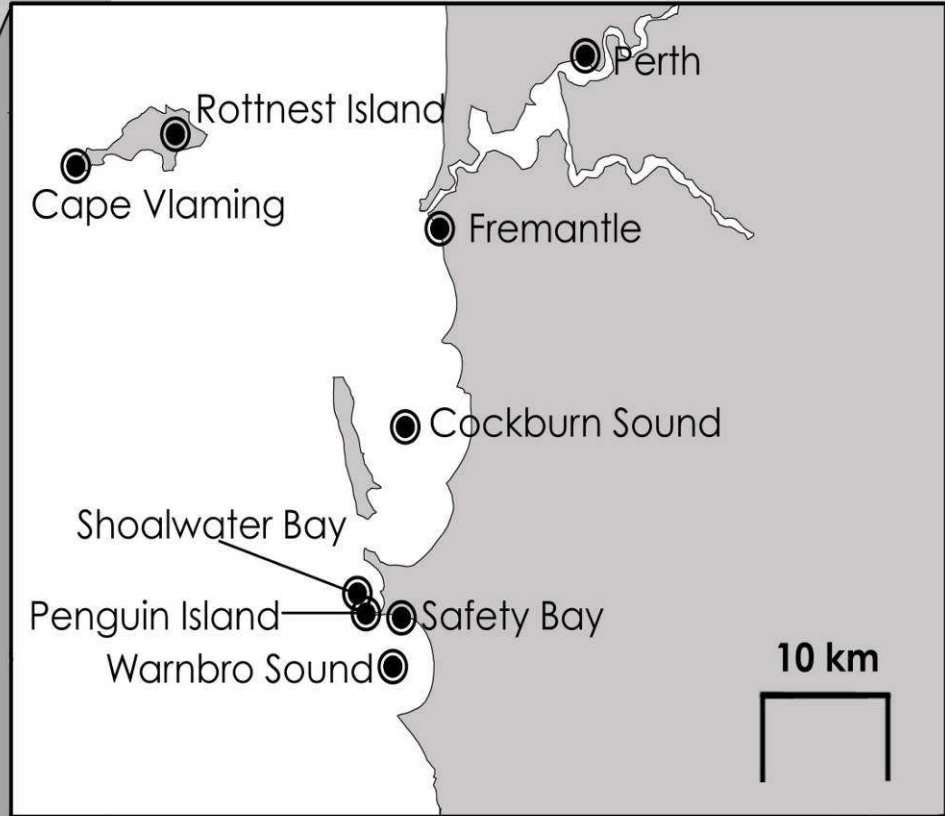
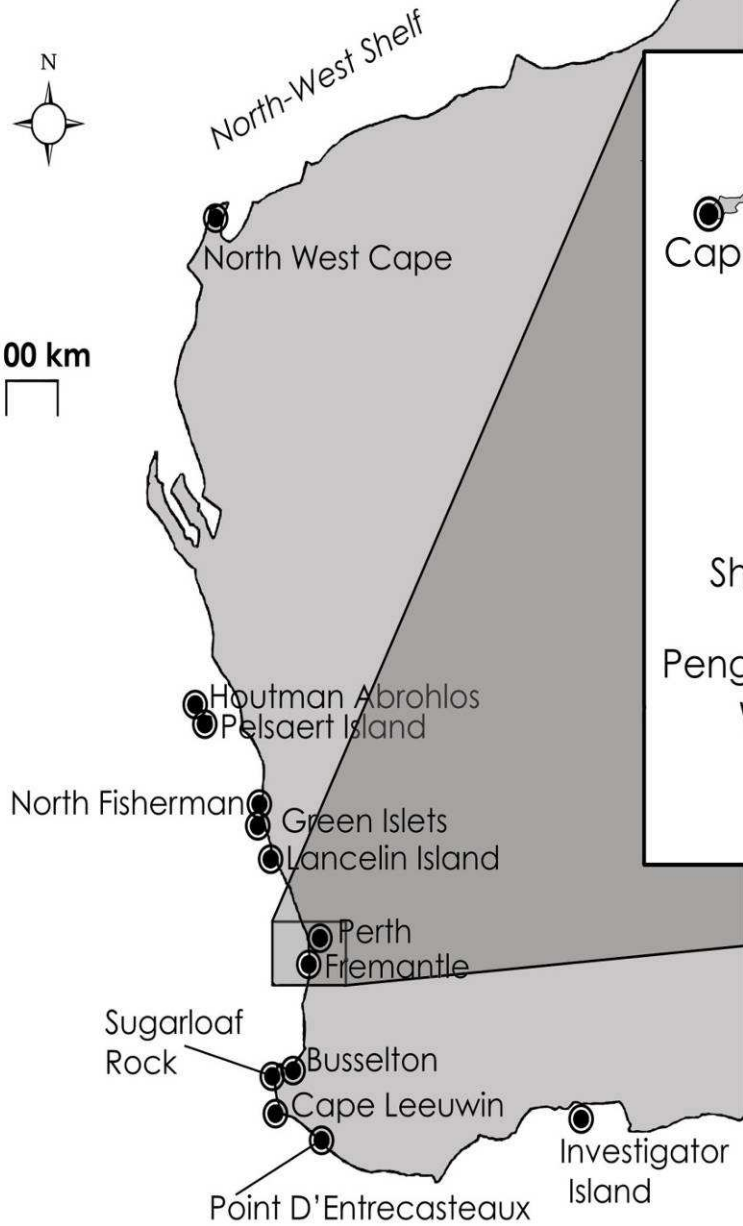


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Seabird study sites



100 km



10 km

Western Australia



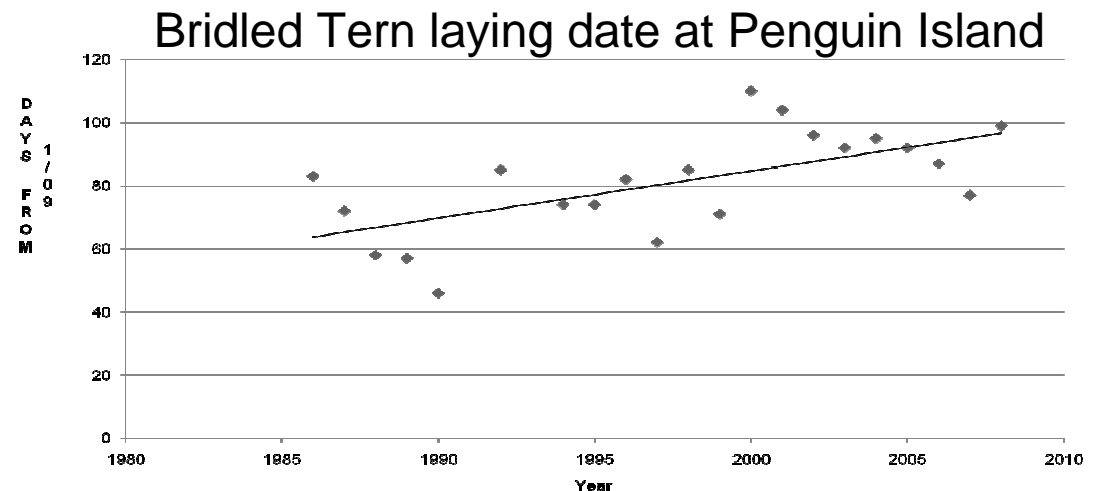
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Sea Surface Temperature Changes

Expect: southward expansion or shifts, altered reproductive success & timing, foraging areas & possibly prey species

Observed:

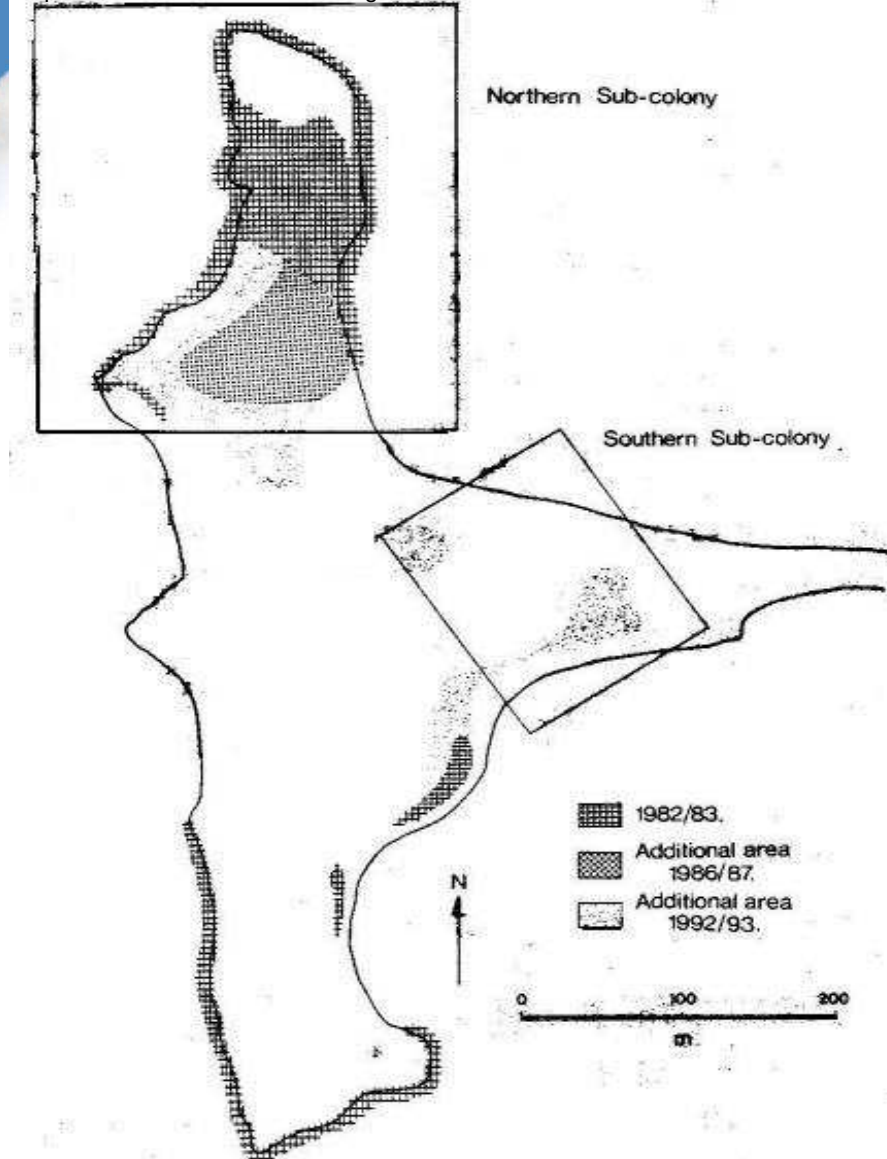
- Southward expansion of tropical seabirds
 - Rapid growth of southern colonies of 7 species in last 3-4 decades
- Later breeding (post 2000)
 - Bridled Tern, Sooty Tern, Common Noddy and Less Noddy
- Reduced breeding participation and success in ENSO years





Spread of the Bridled Tern Rapid growth of southern colonies in recent decades

Spread of Bridled Terns on Penguin Island



Southern-most distribution

- 1843 Abrolhos
- 1889 Rottnest Is
- 1921 breeding Shoalwater Bay
- 1956 Cape Leeuwin islands
- 1990s Point d'Entrecasteaux
- 2008 Albany and Recherche Archipelago



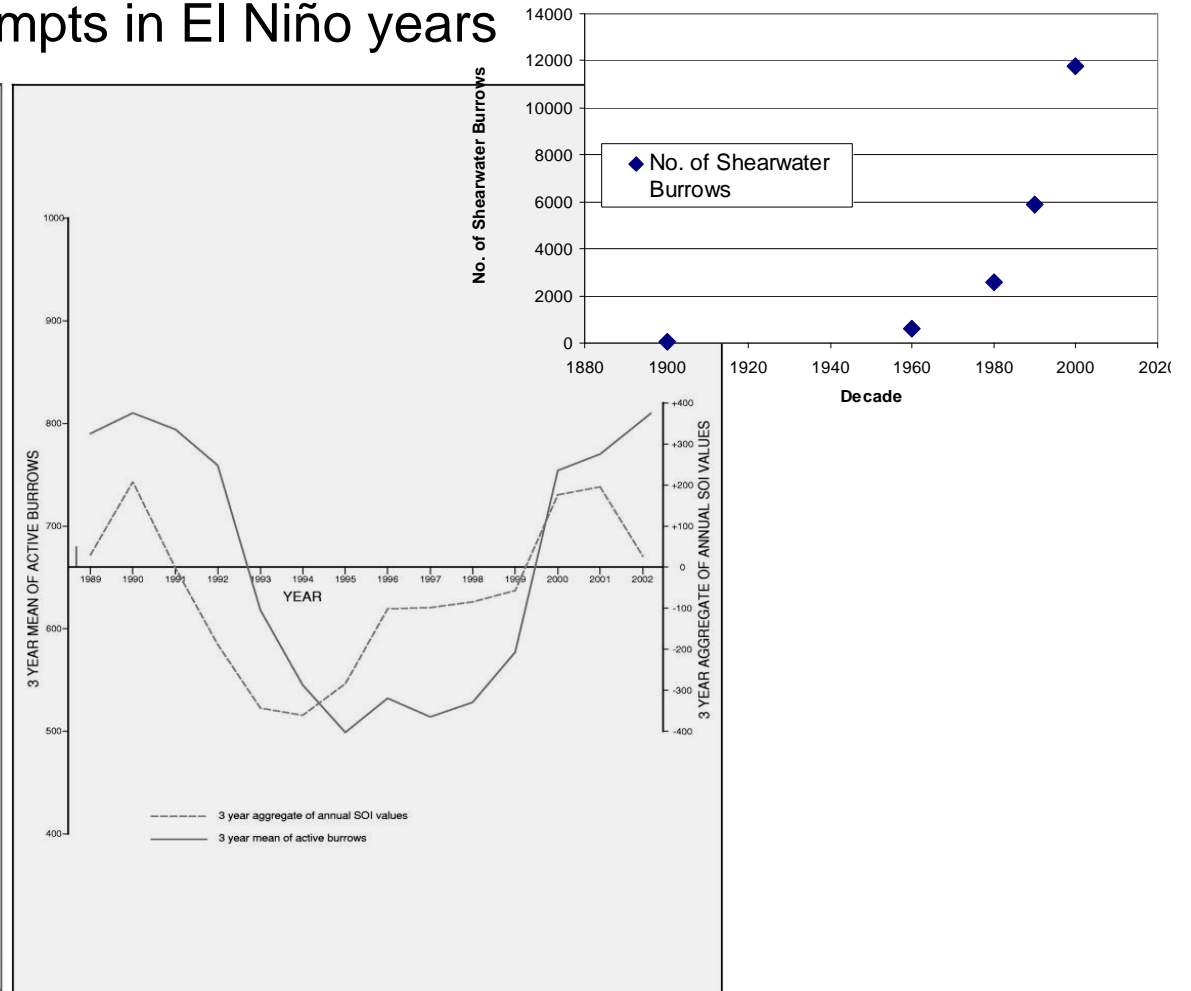
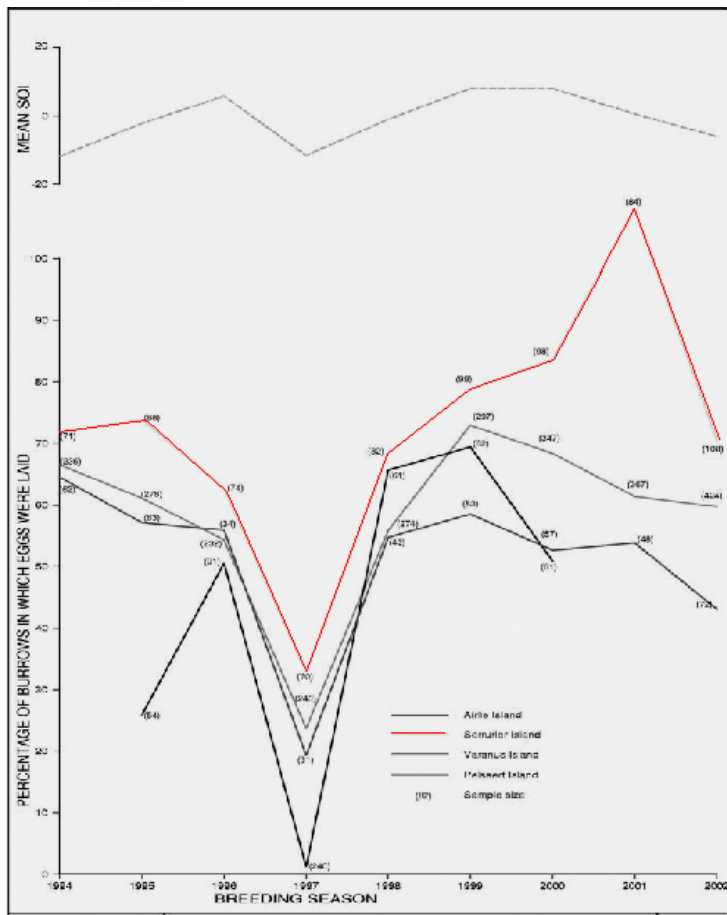


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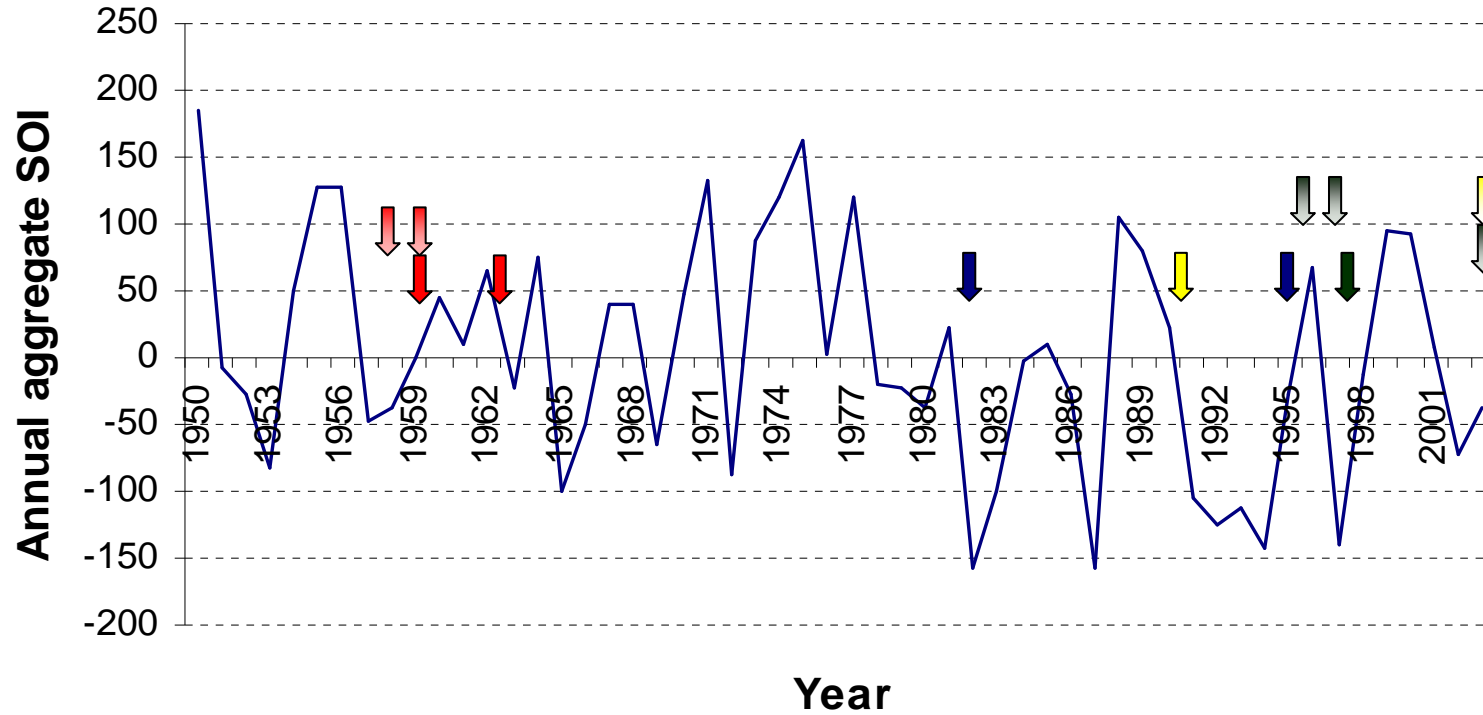
Wedge-tailed Shearwater and ENSO



- Rottneest Popⁿ growing in period of declining breeding performance (driven by immigration from northern colonies) – attributed to increased ENSO frequency
- Reduced breeding attempts in El Niño years



Tropical Seabird Responses to ENSO- 1950-2003



- Red-tailed Tropicbird prospecting/breeding ↓ ↓
- Roseate Tern prospecting/breeding ↓ ↓
- Sooty Tern prospecting/breeding ↓ ↓
- Brown Noddy prospecting/breeding ↓ ↓