# Sand Temperatures at a Major Flatback Rookery Suggest a Masculinising Trend in Recent Decades

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Quantifying primary sex ratios at breeding sites is essential for assessing how global warming will influence the population dynamics of species with temperature-dependent sex determination (TSD). Process-explicit (mechanistic) models can accurately estimate primary sex ratios but require the resolution of the key physiological parameters that influence sex determination. Further, models need to be validated by testing their predictions against empirical data from field nests. To address these goals we conducted incubation experiments on flatback sea turtle (*Natator depressus*) embryos from a large winter-nesting rookery at Cape Domett in the east Kimberley region of Western Australia. A TSD model fitted to data from laboratory experiments and field nests indicated that the pivotal temperature producing equal sex ratios was approximately 29.4°C. Back-switch experiments, where eggs are moved between male and female-producing temperatures for different portions of development, revealed that the thermosensitive period (TSP) when gonads differentiate into testes or ovaries, occurs between 43% and 66% of development to hatching. Taken together, these new physiological data allowed us to accurately estimate the sex ratios from a small sample of nests where the sex-ratio of late-stage embryos was measured in 2012. Integrating the physiological information with sand temperatures reconstructed from 23 years of historical climate data, show that male biased sex ratios are likely at Cape Domett if the TSP falls during the Austral winter. Annual variation in the simulated sand temperatures increased from 1990-2013, with cooler winters producing conditions that favoured male hatchlings for longer periods. The same model projected to 2030 and 2070 suggests that female-biased primary sex ratios will become more prevalent over time. Our results show that accurate modelling of primary sex ratios depends on quantifying the thermal biology of embryos and on parameterising mechanistic models of sand temperatures with site-specific climate data.

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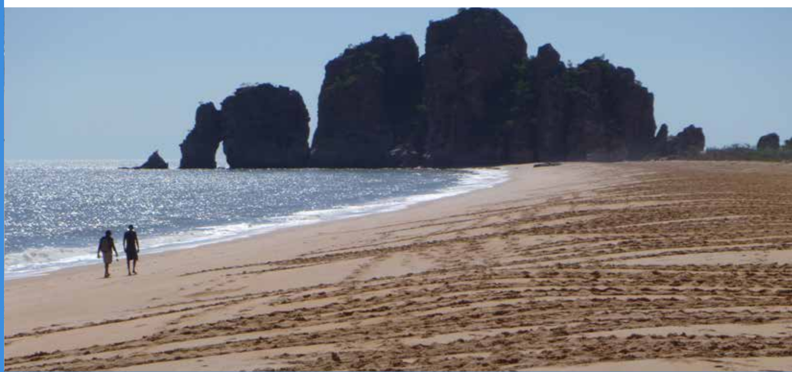



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