

## EXAMINING THE EVIDENCE FOR AN ECOSYSTEM SHIFT IN THE SOUTHERN OCEAN USING VERTEBRATE ABUNDANCE TIME SERIES

CJA Bradshaw<sup>1</sup>, MA Hindell<sup>2</sup>, IC Field<sup>2</sup>, BW Brook<sup>1</sup>

<sup>1</sup>Charles Darwin University, Darwin, Northern Territory, Australia, <sup>2</sup>University of Tasmania, Hobart, Tasmania, Australia

Recent interpretations of biological monitoring data of Antarctic marine predators have concluded that an ecosystem “regime shift” has occurred across the Southern Ocean sometime during the last 50 years. Some have linked this shift to the well-documented changes in the Antarctic climate over this period leading to a re-organisation of the prey available to vertebrate predators. However, previous studies have ignored the complexities inherent in these species’ endogenous population dynamics. We used a multiple-working hypothesis approach based on information theory to examine critically the evidence for categorical shifts in carrying capacity ( $K$ ) and environmental variation (EV). We fitted an *a priori* set of density-independent and density-dependent models to the abundance time series of 23 well-studied populations of seabirds, penguins and seals distributed around the Antarctic and sub-Antarctic. The majority (74%) demonstrated strong evidence for density-dependent regulation (based on multi-model inference using  $AIC_c$ ). We also fitted a single-versus two-segment Ricker-logistic model to incrementing segments of each time series to determine whether there was evidence for a shift in  $K$ . The information-theoretic evidence ratio ( $ER$ ) strongly supported a  $K$ -shift model for 12 (52 %) populations ( $ER > 5$ ). The evidence for the  $K$ -shift was weak in populations exhibiting strong density dependence. We then asked whether the observed changes in the time series might result from a categorical shift in EV rather than mean  $K$ . We detrended the time series by extracting the endogenous signal and re-examined the exogenous evidence (residual variation) for a shift model. Under this analysis, 13 (57%) had strong  $ER$  support for the EV-shift model. Of those species with support for a  $K$  shift, in 5 of them the  $K$ -shift model was better supported, whilst in 7 there was stronger support for the EV-shift model. This suggests that some (mainly diving species such as seals and penguins) have responded more to a mean shift in ecosystem  $K$ , with others (surface feeders) responding to systematic changes in year-to-year environmental variation (although the results were somewhat inconsistent).