Detecting climate change induced range shifts: where and how should we be looking?

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Immediate detection of biological responses to contemporary climate change is vital if we are to improve our capacity to predict change and attempt to initiate management strategies in time to counter species loss and mitigate impacts to biodiversity. Upslope and poleward shifts in species' distributions have regularly been cited as evidence of climate related change (eg. Parmesan & Yohe 2003; Root *et al*. 2003). To date, however, documentation of upslope shifts has lagged behind that of poleward shifts. This is despite the potential for upslope shifts to mask important poleward shifts (Hill *et al*. 2002) and the immediate threat of climate warming on mountaintop restricted species (Williams *et al*. 2003; Hilbert *et al*. 2004; Shoo & Williams 2004; Shoo et al. 2005a, 2005b) that by virtue of their distribution are incapable of migrating latitudinally.

Research to date has provided valuable first evidence of altitudinal range shifts (Grabherr *et al*. 1994; Pounds *et al*. 1999; Konvicka *et al*. 2003; Hill *et al*. 2002; but see Archaux 2004). Most analyses however, have been reliant on the comparison of contemporary data with historical data sets not originally collected with the explicit purpose of investigating range shifts. Therefore an evaluation of baseline data characteristics most likely to promote the detection of range shifts would be both timely and valuable for informing the design of future monitoring programs. Randomisations of a contemporary data set on rainforest birds of north-eastern Australia were used to quantify the sensitivity of three measures for assessing

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range shifts along altitudinal gradients (ie. upper range boundaries, lower range boundaries and mean position of presence records - see Fig. 1). Using this approach, smaller range shifts were detectable by analyzing change in the mean altitude of presence records rather than upper or lower range boundaries (Shoo et al. in press). Randomizations also demonstrate that range shifts measured at range boundaries can be potentially misleading when differences in sampling effort between contemporary and historical data sets are not taken into account (Shoo et al. in press).

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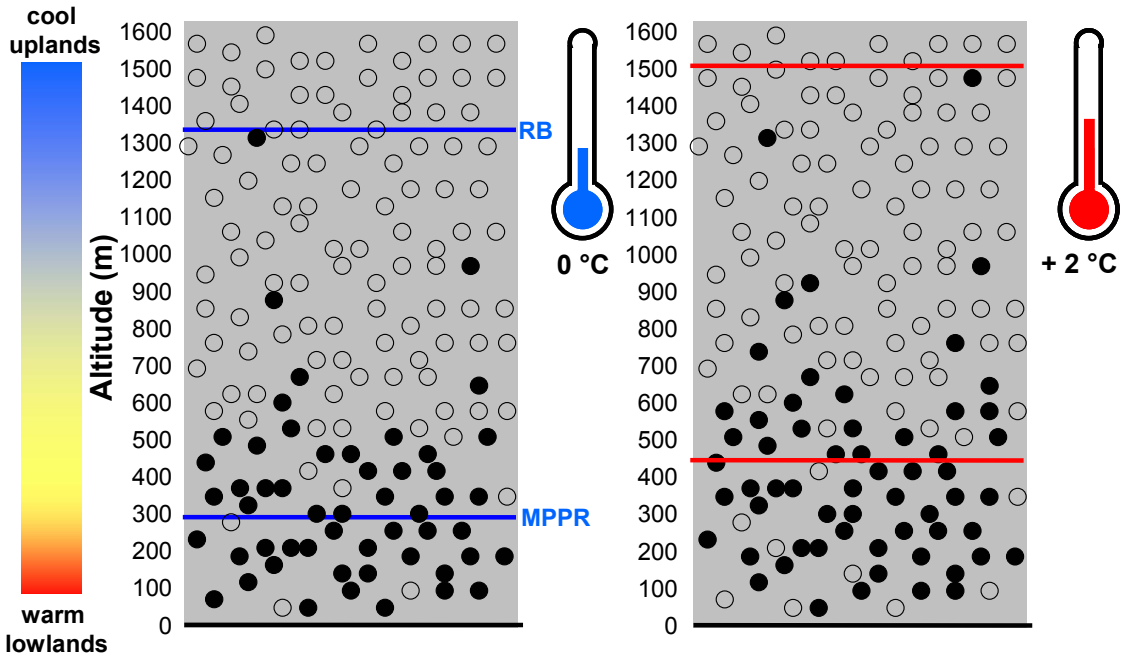

Figure 1: Diagrammatic representation of a data set describing the altitudinal occurrence of a hypothetical lowland species under current (ie. 0 °C, assuming no temperature increase) and future (ie. +2 °C of global warming) climates. Altitudinal position is estimated at the range boundary (RB) and the mean position of presence records (MPPR). Presence records and absence records are indicated by filled circles and open circles respectively.

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