**Introduction**

Tropical species, which account for the majority of global biodiversity (Gaston 2000), are expected to be particularly vulnerable to warming (Colwell et al. 2008; Deutsch et al. 2008a; Diamond et al. 2012; Trisos, Merow, and Pigot 2020). Tropical species have narrower thermal tolerance ranges, so they are more likely to experience temperatures exceeding their upper limit (Deutsch et al. 2008b; Kellermann, Overgaard, et al. 2012; Khaliq et al. 2014). They may be unable to disperse far and fast enough to bridge the large gaps between their current and projected ranges (Colwell et al. 2008). As species’ distributions shifts poleward or upslope following climate change (Freeman and Class Freeman 2014), no species source pools are available to replace climatically displaced or declining species in the tropical lowland ecosystem (Colwell et al. 2008; Lenoir and Svenning 2015). Consequently, tropical regions face a higher risk of biodiversity attrition based on features of the residents’ thermal performance.

Nevertheless, the impact of the projected warming will differ if the species’ distribution is not constrained by the environmental temperature but other factors. For example, drought may instead be a more important environmental constrain than temperature in tropical lowland (Engelbrecht et al. 2007). Behavioral thermoregulation on heterogeneous landscape could increase resilience to warming (Bonebrake et al. 2014; Kearney, Shine, and Porter 2009). Last but not the least, tropical forests are notable for their intense biotic interactions (Roslin et al. 2017), which may predominantly drive realized distributions (DeRivera et al. 2005; Wisz et al. 2013) and alter their individualist response to warming ((Davis et al. 1998)). Thermal niche deduced from a species’ realized distribution may therefore not accord to their true tolerances (Feeley and Silman 2010). Correlation between a species’ fundamental thermal niche and realized distribution serves as a foundation to study the role of temperature in driving species’ distribution patterns (Kearney and Porter 2004). The generality of this relationship is key to realistically estimate the magnitude of the impact of warming on tropical species.

Asymmetry has been observed in the relative role of high and low temperature in determining species’ distribution, resulting in unequal shifts at their cold boundaries and warm boundaries in response to warming (Chen et al. 2011). Although both upper thermal limit and cold resistance are correlated with distribution and abundance (Batista, Rocha, and Klaczko 2018; Kellermann, Loeschcke, et al. 2012; Kellermann, Overgaard, et al. 2012), physical constraints by the low temperature are thought to have more profound role in setting the limit of distribution range (Bishop et al. 2017; de La Vega and Schilman 2018; Overgaard, Kearney, and Hoffmann 2014): Large comparative studies suggest that heat tolerance varies less than cold tolerance (Hoffmann 2010a; Sunday, Bates, and Dulvy 2011); organisms in warmer environment are hypothesized to experience higher level of biotic interaction, which predominantly drive ecological limits at warm boundaries (O’Brien et al. 2017).

Thermal tolerances evaluated using different choice of traits sometimes differ markedly between each other (Hoffmann 2010b; Sinclair et al. 2016), which also change their relationships with realized distribution (Overgaard et al. 2014). Reproduction indicates the population-level performance of species within communities. Physiological response to sublethal condition links more tightly with organisms’ capacity to survive during a short period of extreme climatic conditions (Overgaard et al. 2014). In reality, instantaneous measures of organisms’ physiology (e.g. development rate, metabolism, mobility) are often the practical choice to be used to understand distribution patterns and inform predictions of future [CITATION]. There have been very few comparative studies exploring their relationship with each other and their capacity to predict species’ distributions.

In this study, the altitude gradient enables comparison of the effect of high temperature and low temperature on species turnover in connected communities. We hypothesized that low temperature constrains species’ distribution at tropical highland; in contrast, higher abundance toward tropical lowland arises not from stronger heat tolerance. Therefore, species which are found predominantly at high altitude (compared with themselves) are predicted to have stronger cold tolerance; the heat tolerances are similar among all the species and/or do not correlate with distribution patterns. To test the hypotheses, we compared relative abundance of 6? *Drosophila* species at difference altitude on the Australian tropical mountains, and studied the relationship between the species’ distribution pattern and thermal tolerance based on different performance. Contrary to our predictions, heat tolerance, rather than cold tolerance, is correlated with distribution inclination. Physiological tolerance and reproductive tolerance agree with each other in predicting distribution. These results suggest that high temperature constrains *Drosophila* species on Australian tropical mountains, thus implying the vulnerability of tropical insects to future warming.