Supplemental Materials, Methods and Results

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## Materials and Methods

### *Literature collection*

We compiled literature on ectothermic animals that measured physiologcial rates (e.g., metabolic rate) at two or more temperatures both acutely and after having been acclimated (or acclimatized) at these temperatures for an extended period of time. We used data from a previous meta-analysis (*1*) and updated Seebacher *et. al.* (*1*)’s data by extractng data from suitable studies from our own searches that followed the same search protocol. More specically, we performed a literature search on the 28th of June 2017 using the Web of Science database. We limited our search to articles or proceedings papers published in English from 2013 to 2017 (the date after Seebacher *et. al.* (*1*) searches were conducted) using the following topic search string: *"(acclimat* AND (therm\* OR temp*) NOT (plant* OR tree\* OR forest\* OR fung\* OR mammal\* OR marsup\* OR bird\* OR human OR exercis\* OR train\* OR hypoxi*))"*. We further limited to the following research areas: Anatomy Morphology; Biodiversity Conservation; Biology; Ecology; Endocrinology Metabolism; Entomology; Evolutionary Biology; Marine Freshwater Biology; Physiology; Respiratory System, Reproductive Biology, Zoology. Our search resulted in 12,978 papers for screening in Rayyan (*2*). We also cross checked papers we found in our searches with a recent paper by Havird *et. al.* (*3*), which also updates Seebacher *et. al.* (*1*)’s dataset up to 2017. Any papers that were missed beteween our searches and those of Havird *et. al.* (*3*) were crossed checked and integrated if they contained relevant data for our question. As such, our database represents the most up-to-date dataset used by Seebacher *et. al.* (*1*) to answer questions on acclimation across ectotherms.

Given logistical constraints in screening abstracts and titles of the 12,978 papers from our searches we split the screening process among all authors (DWAN, FS, FK and SN) evenly. To ensure consistency among authors in title and abstracts that should be included, prior to screening all authors went through the same set of XX papers independently, and agreed on those that were relevant and those that were not. Where any authors were uncertain we conservatively included a paper for full text screening. After title and abstract screening we were left with a total of 1,321 papers for full text screening. These papers were evenly divided among all four authors. Papers were included only if they: 1)

### *Data Compilation*

We extracted means, standard deviations and sample sizes for physiological rates taken on samples of experimental ectotherms under acute and chronic exsposure to two or more tempetatures. We extracted these data from text, tables or figures of a given paper. Data was extracted from figures using the R package *metaDigitise* (*4*). We also recorded the phylum, class, order, genus and species under study and the latitude and longitude of the population that was being studied. For studies that did not provide latitude and longitude for the population, we searched for similar studies by the lab group to identify where the population was likely to have been sourced or derived from when needed. If the population was derived from the wild we recorded the nearest latitude and longitude of the population to the field collection site. If the animals had been sourced from a commercial supplier, we took the latitude and longitude of the supplier that the paper identified the animals to have originated from. When it was not possible to find latitude and longitude using these methods, we looked up the distribution of the species in question and took the latitude and longitude of the centroid of the species’ distributional range.

### *Calculating New Based Effect Sizes and Sampling Variances*

To compare changes in physiological rates we often look to comparing values, which describe the multiplicative change in physiological rates across a 10°C temperature change. Higher values indicate stronger changes in physiological rates, and it is expected that acclimation should reduce values (*1*). Currently, however, we do not have effect sizes and associated sampling variances derived for based effect size estimates making it challenging to weight effect size estimates by sampling variance. While the Delta method can be used to approximate the sampling variance (e.g., see Havird *et. al.* (*3*)), there are easier ways to derive effect sizes given that is simply a reformulation of a very commonly used effect size in the meta-analysis literature, the log response ratio (lnRR) (*5*, *6*). Recognition of the similarity between lnRR and (i.e., both being ratios) means we can derive based effect sizes using the well known mathematical properties of lnRR, while also providing easy ways to extend this to effect sizes that compare variances in physiological rates (*7*) and acocunt for sources of non-independence that is typical in meta-analysis (*6*, *8*). As such, here we derive a series of based effect sizes along with their associated sampling variances that allow one to compare both mean and variance changes in physiological rates.

#### *Comparing changes in mean physiological rates*

Prior to showing how the relevant effect size can be calculated it can be helpful to understand its similarities to lnRR. The lnRR described by Hedges *et al.* (*5*) and extended by Lajeunesse (*6*) and can be calculated as follows:

In equation (1), is the mean of group 1, often a control group, where as is the mean of group 2 (e.g., a treatment group). The mean of for group *i* can be any measurement type (e.g. a physiological rate, mass etc) so long as the measurement variable is ratio scale. Log transformation of this ratio makes the effect size normally distributed. Equation (2) is the analytical solution for lnRR’s sampling variance where, and is the variance in group 1 and 2, respectively and and is the sample size in group 1 and 2.

The basic solutions for lnRR and its sampling variance allow us to easily extend this to based effect sizes. Recall that is described as follows:

Here, and are mean physiological rates and and are the temperatures that these rates are measured. Log transformation of equation (3) leads to the following log transformed :

Equation (4) is essentially a temperature corrected equivalent to lnRR when the numerator and denomenator are measured at different temperatures. This allows one to compare the mean of two temperature treatments directly regardless of the temperatures that these groups have been measured. Here, we will refer to this as the log response ratio, . Recognition of this equivalence means that we can easily calculate the sampling variance for equation (4) as follows:

#### *Comparing changes in physiological rate variability*

Nakagawa *et al* (*7*) recently proposed analogous effect size estimates to lnRR that allow for comparisons of changes in variance between two groups, the log variance ratio (lnVR) and the log coefficient of variation (lnCVR). Like lnRR, lnVR and lnCVR are ratios that describe the relative difference in trait variablity between two groups. We refer to readers for the equations described by Nakagawa *et al* (*7*), but these can easily be extended to their analogues (and associated sampling varaince) as follows:

Equations (6) and (7) describe the change in physiological rate variance (eqn (6)) across a 10°C temperature change along with its sampling variance (eqn (7)). While this is a useful metric, as discussed by Nakagawa *et al* (*7*) there is often a strong mean-variance relationship that needs to be accounted for in analysing changes in variance. As such, we can calculate the coefficient of variation, which standardises changes in variance for changes in means as follows:

where is the coefficient of variation defined as .

#### *Calculating acute and acclimation , and estimates*

Using the mean, standard deviation and sample size for all acute and aclimation treatments of studies in our databases we derived acute and acclimation , and estimates. For all effect sizes the higher acute or acclimation temperture was in the numerator and the lower of the two temperatures in the denominator. As such, positive effect sizes suggest that the mean or variance is larger at the higher of the two temperatures, standardised to 10°C.

### *Moderator Variables*

We collected a series of

### *Meta-Analysis*

### *Sensitivity Analyses*

### *Publication Bias*

## Results

### *Publication Bias*

## References

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