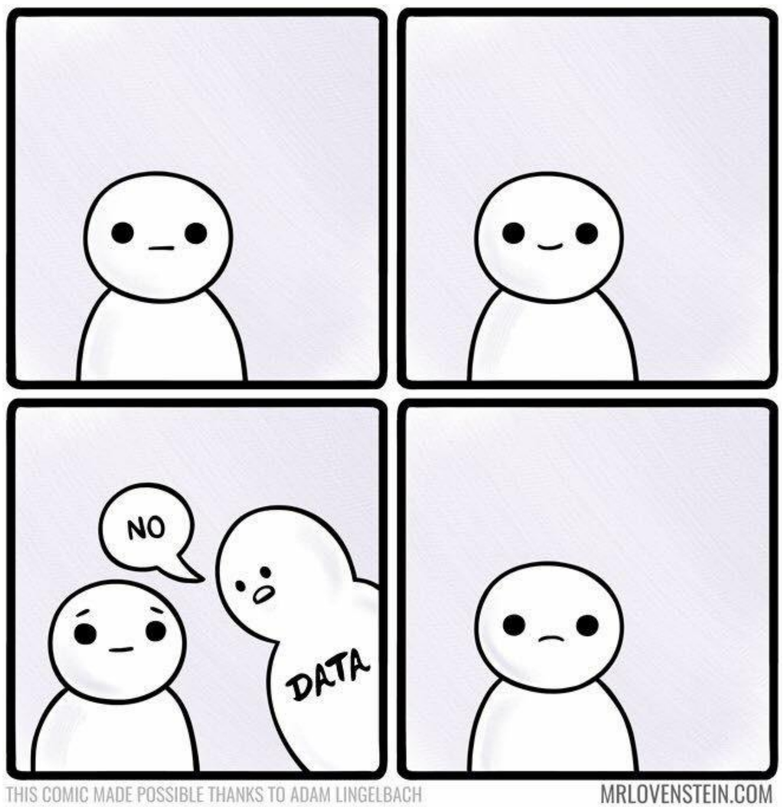
t-tests

ENTMLGY 6702 Entomological Techniques and Data Analysis



Learning objectives

1. Identify the information required to conduct a *t*-test
2. Distinguish between types of *t*-tests
3. Interpret outcome of *t*-tests

t-tests

Used to determine if the means of two groups have statistically clear differences OR used to determine if a mean differs from a specified value (e.g., population mean or 0).

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Assumptions:

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2.

3.

4.

Activity: Based on what you have learned so far about experimental design, sampling, and distributions, list assumptions of the standard t-test

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3. Response variable is normally distributed
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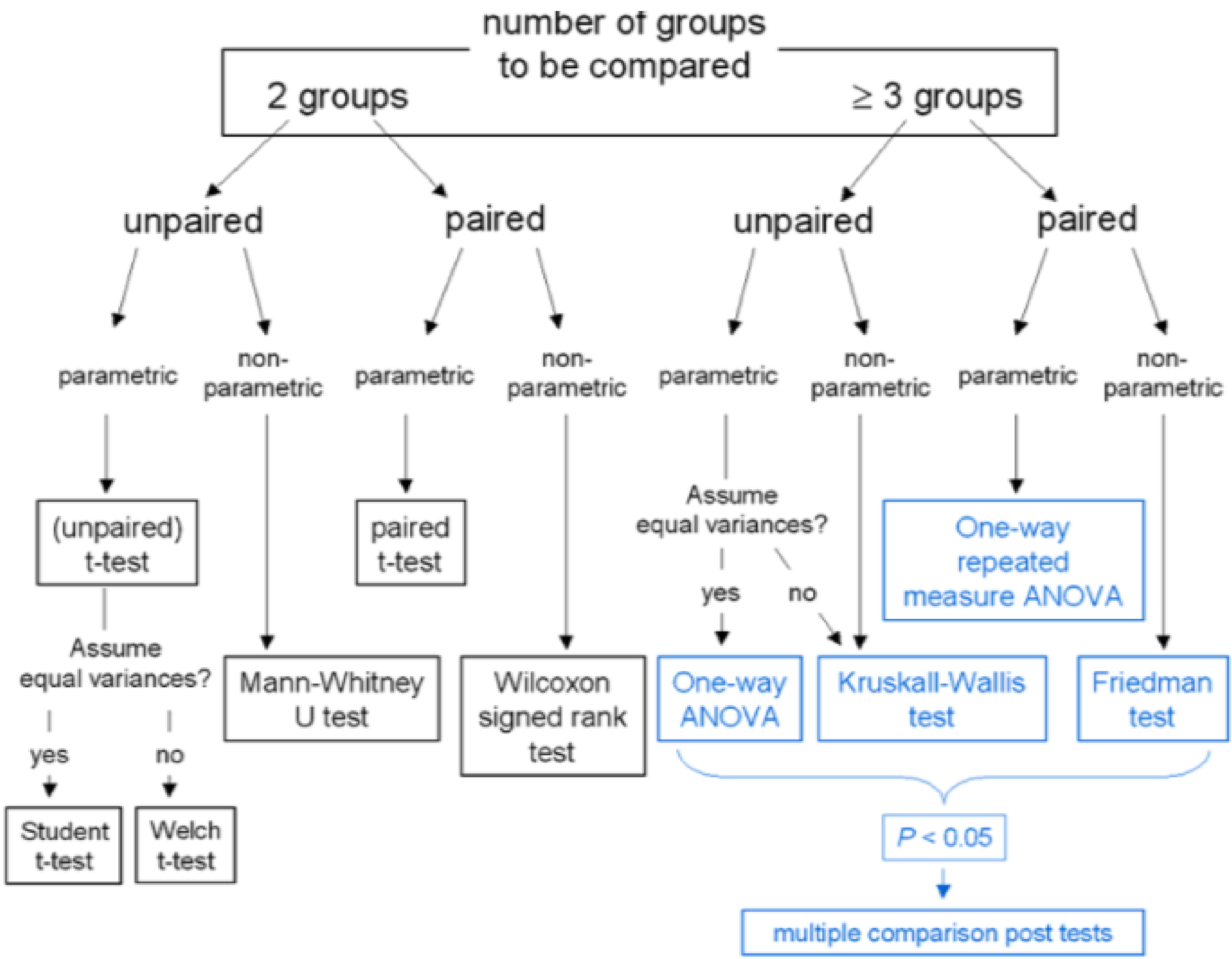
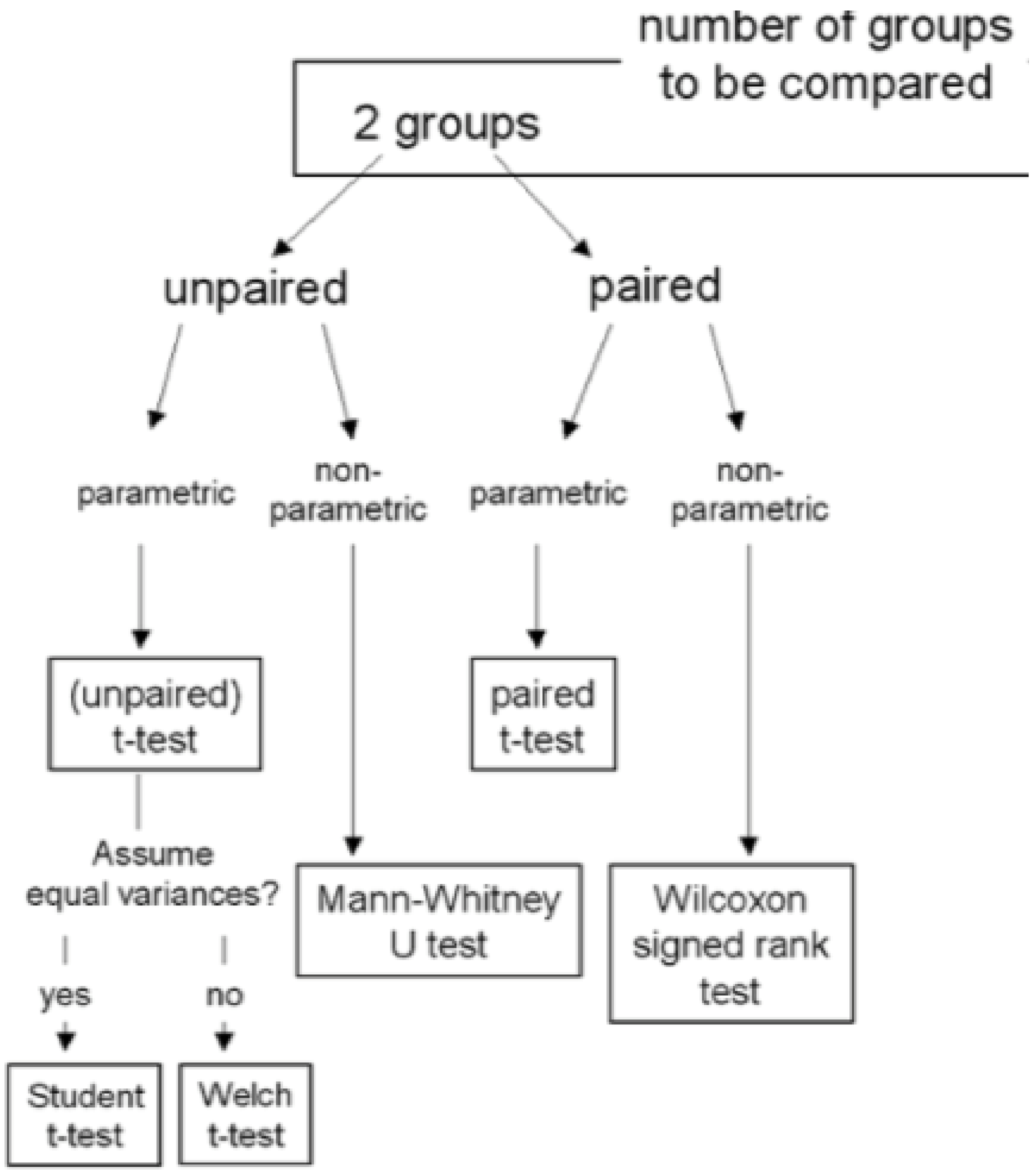
Assumptions:

1. Response (aka dependent) variable (the one we are comparing between groups) is continuous
2. Observations are independent (typically meaning they comprise a random sample)
3. Response variable is normally distributed
4. Variances of the response variable are equal across groups (= homogeneity of variances)

Activity: Based on what you have learned so far about experimental design, sampling, and distributions, list assumptions of the standard t-test



Credit: Liz Thielen



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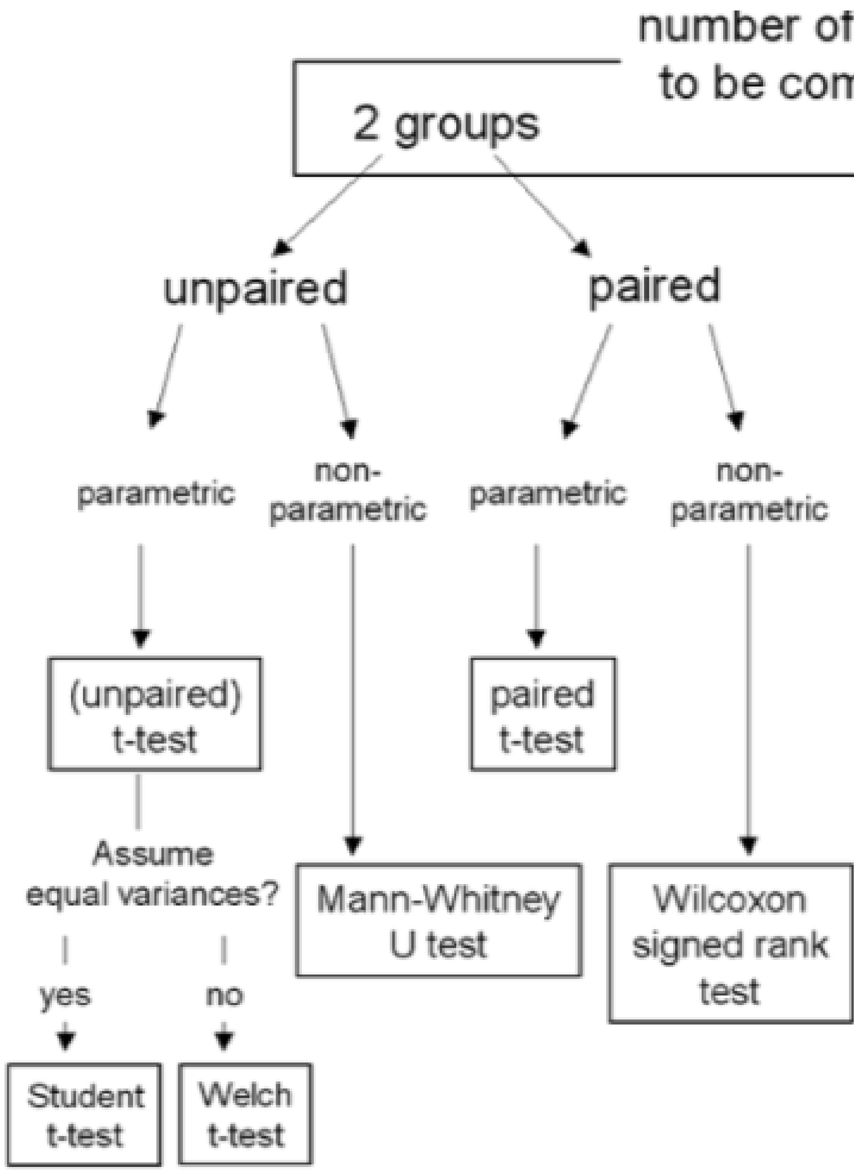
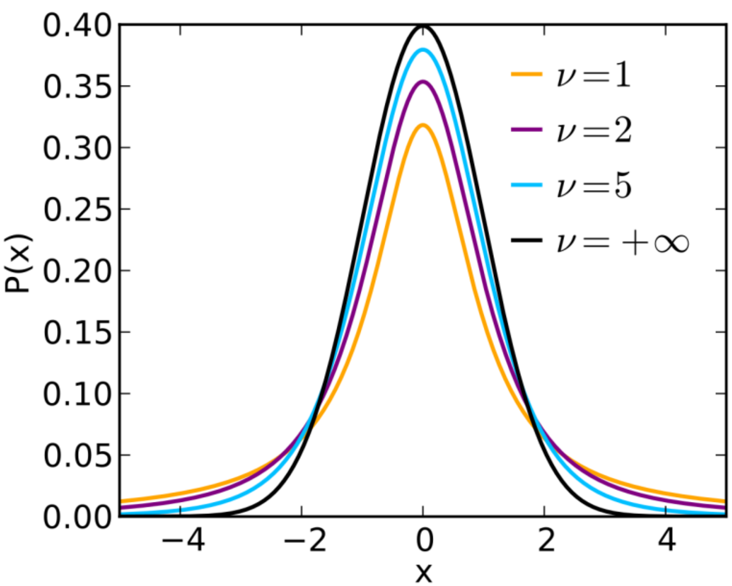


Parametric test	Non-Parametric equivalent
Paired t-test	Wilcoxon Rank sum Test
Unpaired t-test	Mann-Whitney U test
Pearson correlation	Spearman correlation
One way Analysis of variance	Kruskal Wallis Test

Credit: Liz Thielen

William Sealy Gosset

- 1876 – 1937
- Head Experimental Brewer of Guinness
- Developed Student's t-distribution
- Argued – in the literature and probably at the pub – with Ronald Fisher
- Had awesome mustache



$$f(t) = \frac{\Gamma((r+1)/2)}{\sqrt{\pi r}\,\Gamma(r/2)} \cdot \frac{1}{(1+t^2/r)^{(r+1)/2}}$$

Note: *r* and *t* in the above equation are indicated by *v* and *x* on the figure

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

$$s_N = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^2}$$

$$\mathrm{d.f.} = n - 1$$

One sample *t*-test

(includes paired *t*-tests)

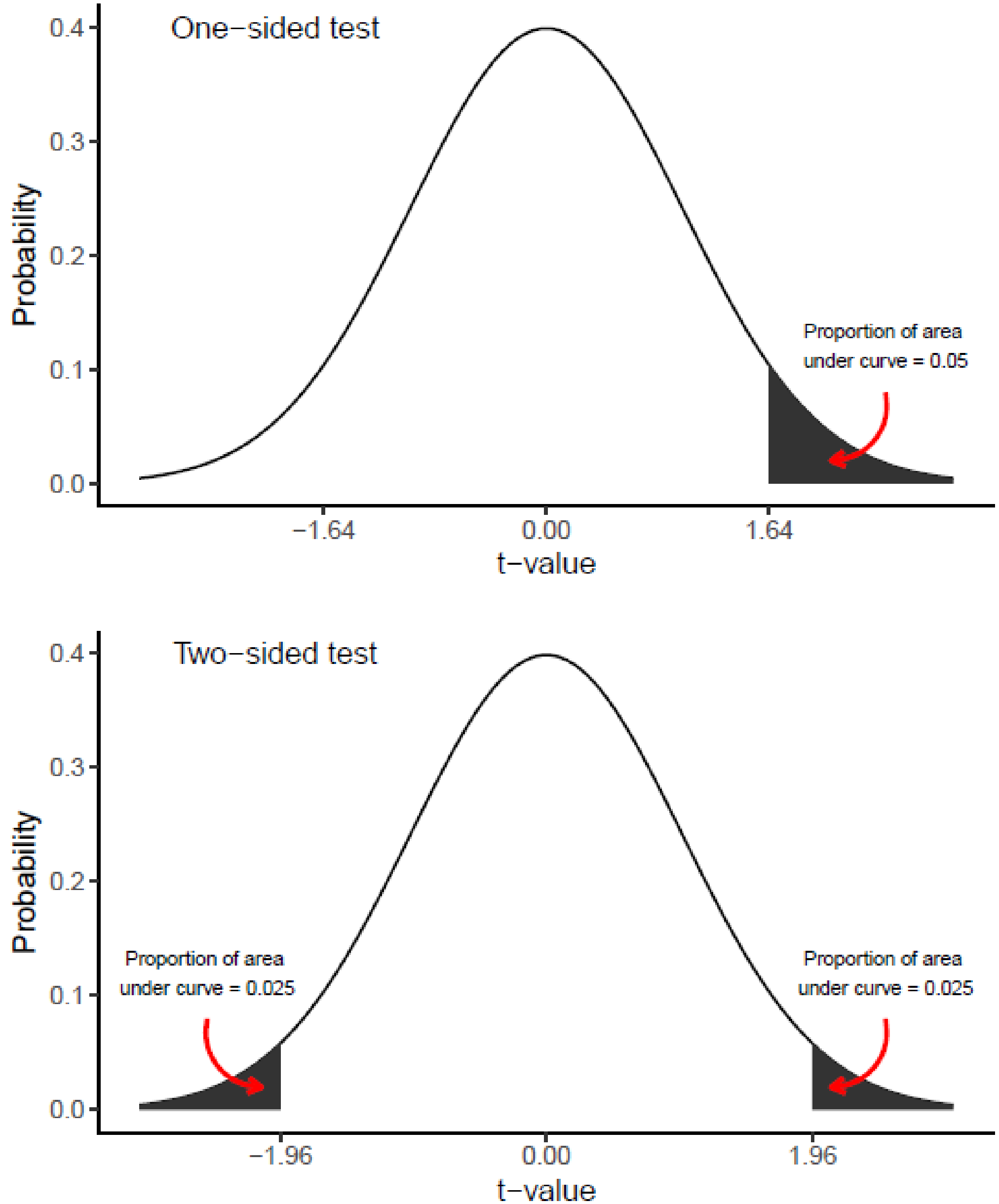
$$t = \frac{\bar{X}_1 - \bar{X}_2}{s_{\bar{\Delta}}}$$

$$s_{\bar{\Delta}} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}.$$

$$\mathrm{d.f.} = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{(s_1^2/n_1)^2}{n_1 - 1} + \frac{(s_2^2/n_2)^2}{n_2 - 1}}.$$

Two sample *t*-test

The above equations are for when your two groups have unequal sample sizes and variances


One−sided test
Proportion of area
under curve = 0.05
Probability
0.4
0.3
0.2
0.1
0.0
−1.64
0.00
1.64
t−value
Two−sided test
Proportion of area
under curve = 0.025
Proportion of area
under curve = 0.025
Probability
0.4
0.3
0.2
0.1
0.0
−1.96
0.00
1.96
t−value

$p \leq 0.05$

Variable effects of temperature on insect herbivory

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Data from: Variable effects of temperature on insect herbivory

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Burkepile, Deron E., Florida International University

Parker, John D., Smithsonian Institution

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Abstract

Rising temperatures can influence the top-down control of plant biomass by increasing herbivore metabolic demands. Unfortunately, we know relatively little about the effects of temperature on herbivory rates for most insect herbivores in a given community. Evolutionary history, adaptation to local environments, and dietary factors may lead to variable thermal response curves across different species. Here we characterized the effect of temperature on herbivory rates for 21 herbivore-plant pairs, encompassing 14 herbivore and 12 plant species. We show that overall consumption rates increase with temperature between 20 and 30 C but do not increase further with increasing temperature. However, there is substantial variation in thermal responses among individual herbivore-plant pairs at the highest temperatures. Over one third of the herbivore-plant pairs showed declining consumption rates at high temperatures, while an approximately equal number showed increasing consumption rates. Such variation existed even within herbivore species, as some species exhibited idiosyncratic thermal response curves on different host plants. Thus, rising temperatures, particularly with respect to climate change, may have highly variable effects on plant-herbivore interactions and, ultimately, top-

Data files

Download dataset

May 01, 2015

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