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Percentage leaf herbivory across vascular plant species

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Abstract. Herbivory is viewed as a major driver of plant evolution and the most important energy pathway from plants to higher trophic levels. Therefore, understanding patterns of herbivory on plants remains a key focus in evolution and ecology. The evolutionary impacts of leaf herbivory include altering plant fitness, local adaptation, the evolution of defenses, and the diversification of plants as well as natural enemies. Leaf herbivory also impacts ecological processes such as plant productivity, community composition, and ecosystem nutrient cycling. Understanding the impact of herbivory on these ecological and evolutionary processes requires species-specific, as opposed to community-level, measures of herbivory. In addition, species-specific data enables the use of modern comparative methods to account for phylogenetic non-independence. Although hundreds of studies have measured natural rates of leaf consumption, we are unaware of any accessible compilation of these data. We created such a data set to provide the raw data needed to test general hypotheses relating to plant–herbivore interactions and to test the influence of biotic and abiotic factors on herbivory rates across large spatial scales. A large repository will make this endeavor more efficient and robust. In total, we compiled 2641 population-level measures for either annual or daily rates of leaf herbivory across 1145 species of vascular plants collected from 189 studies. All damage measures represent natural occurrences of herbivory that span numerous angiosperm, gymnosperm, and fern species. To enable researchers to explore the causes of variation in herbivory and how these might interact, we added information about the study sites including: geolocation, climate classification, habitat descriptions (e.g., seashore, grassland, forest, agricultural fields), and plant trait information concerning growth form and duration (e.g., annual vs. perennial). We also included extensive details of the methodology used to measure leaf damage, including seasons and months of sampling, age of leaves, and the method used to estimate percentage area missing. We anticipate that these data will make it possible to test important hypotheses in the plant–herbivore literature, including the plant apparency hypothesis, the latitudinal-herbivory defense hypothesis, the resource availability hypothesis, and the macroevolutionary escalation of defense hypothesis.

Key words: browsing; climatic variation; defoliation; folivory; global census; grazing; latitudinal gradients; leaf age; leaf consumption; plant–herbivore interactions; primary consumption; trophic interactions.

The complete data sets corresponding to abstracts published in the Data Papers section of the journal are published electronically in *Ecological Archives* at http://esapubs.org/archive (the accession number for each Data Paper is given directly beneath the title).

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METADATA

CLASS I. DATA SET DESCRIPTORS

A. Data set title: Percent leaf herbivory across vascular plant species

B. Data set identification code: Leaf_Herbivory.csv

C. Data set description

The data set includes 2641 spatially explicit measurements of population level leaf herbivory on 1145 species of vascular plants from 189 studies from across the globe. It includes annual and or daily rates of percent leaf area damage. All damage measures are caused by naturally occurring herbivores and span across angiosperms, gymnosperms, and fern species. Each species-specific population level entry includes information about the location of the study site, detailed climate classification, habitat information (e.g., forest, grassland, seashore), plant duration (e.g. perennial, annual) and growth form, and extensive details of the methodology used to measure herbivory, including seasons of sampling, age of leaves, method used to estimate percent area damage, number of replicate plants, and when available we include estimates of uncertainty. The spatial and climatic distribution of the data can be seen in Figures 1 and 2 and the distribution of data according to plant growth form and duration in Figures 3 and 4.

Figure 1: World distribution of sampling sites. Colors illustrate the 30 Köppen-Geiger climate classification as delimited by Peel et al. (2007).

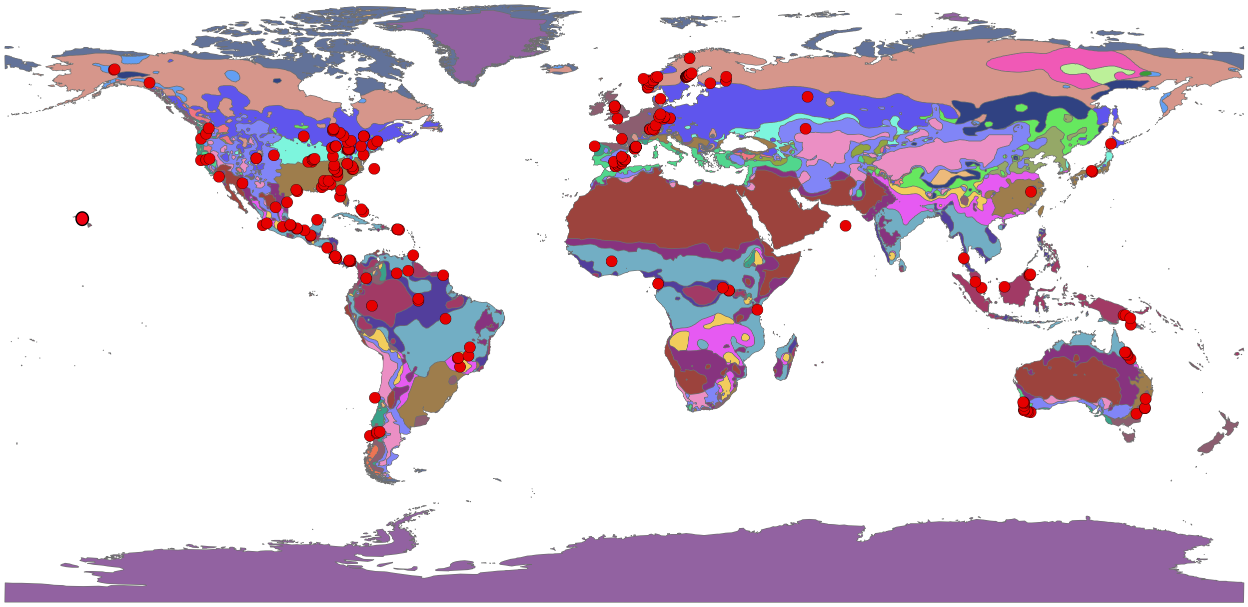


Figure 2: Distribution of data entries among the most frequently studied climate regions according to the Köppen-Geiger climate classification (Peel et al. 2007). Charts represent the proportion of measurements in each climate region that were based on: (A) annual rates of herbivory, (B) daily rates of herbivory, (C) measurements made on standing leaves, and (D) marked leaves.

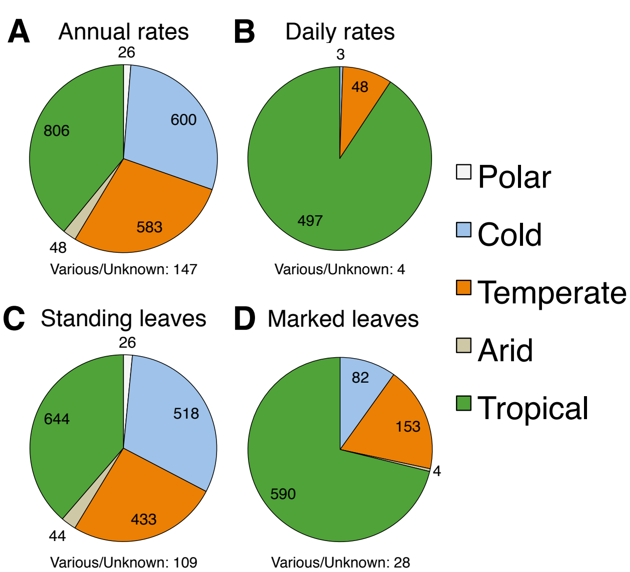


Figure 3: Distribution of data entries among a simplified classification of plant growth form. Charts represent the proportion of measurements falling into each plant growth form category that were based on: (A) annual rates of herbivory, (B) daily rates of herbivory, (C) measurements made on standing leaves, and (D) marked leaves.

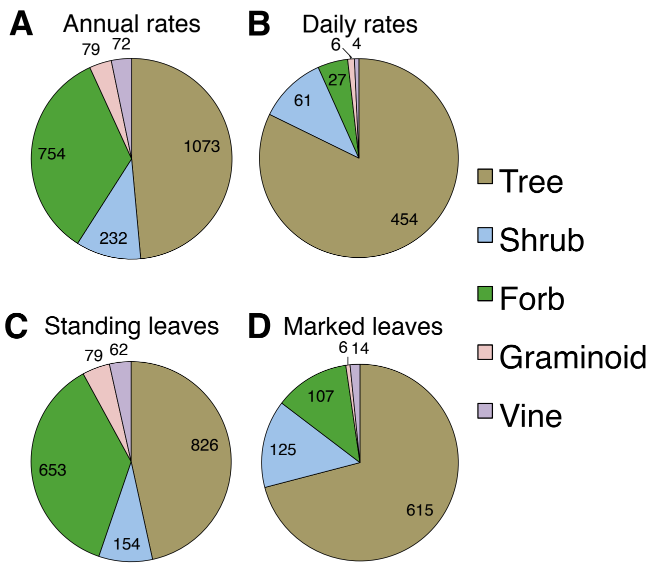
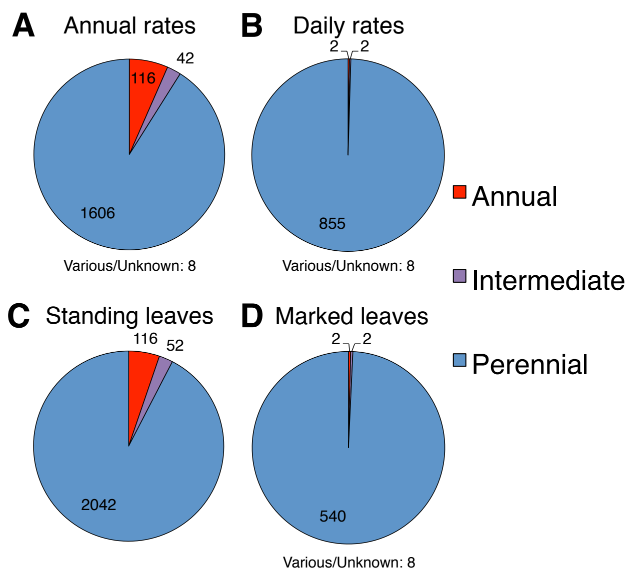


Figure 4: Distribution of data entries among a simplified classification of plant duration. Charts represent the proportion of measurements falling into each plant duration category that were based on: (A) annual rates of herbivory, (B) daily rates of herbivory, (C) measurements made on standing leaves, and (D) marked leaves.



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Abstract: Herbivory is viewed as a major driver of plant evolution and the most important energy pathway from plants to higher trophic levels. Therefore, understanding patterns of herbivory on plants remains a key focus in evolution and ecology. The evolutionary impacts of leaf herbivory include altering plant fitness, local adaptation, the evolution of defenses, and the diversification of plants as well as natural enemies. Leaf herbivory also impacts ecological processes such as plant productivity, community composition, and ecosystem nutrient cycling. Understanding the impact of herbivory on these ecological and evolutionary processes requires species-specific, as opposed to community level, measures of herbivory. In addition, species-specific data enables the use of modern comparative methods to account for phylogenetic non-independence. Although hundreds of studies have measured natural rates of leaf consumption, we are unaware of any accessible compilation of these data. We created such a data set to provide the raw data needed to test general hypotheses relating to plant-herbivore interactions and to test the influence of biotic and abiotic factors on herbivory rates across large spatial scales. A large repository will make this endeavor

more efficient and robust. In total, we compiled 2641 population level measures for either annual or daily rates of leaf herbivory across 1145 species of vascular plants collected from 189 studies. All damage measures represent natural occurrences of herbivory that span numerous angiosperm, gymnosperm, and fern species. To enable researchers to explore the causes of variation in herbivory and how these might interact, we added information about the study sites including: geolocation, climate classification, habitat descriptions (e.g., seashore, grassland, forest, agricultural fields), and plant trait information concerning growth form and duration (e.g., annual *versus* perennial). We also included extensive details of the methodology used to measure leaf damage, including seasons and months of sampling, age of leaves, and the method used to estimate percent area missing. We anticipate that these data will make it possible to test important hypotheses in the plant-herbivore literature, including the Plant Apparency Hypothesis, the Latitudinal-Herbivory Defense Hypothesis, the Resource Availability Hypothesis, and the Macroevolutionary Escalation of Defense Hypothesis.

D. Key words: *browsing, climatic variation, defoliation, folivory, global census, grazing, latitudinal gradients, leaf consumption, leaf age, plant-herbivore interactions, primary consumption,* and *trophic interactions*.

CLASS II. RESEARCH ORIGIN DESCRIPTORS

A. Overall project description

Identity: A spatially explicit compilation of leaf damage on vascular plants species by naturally occurring herbivores.

Period of Study: Dates of publications of source data range from 1960-2012

Sources of funding: The compilation of this data set was supported by the Natural Sciences and Engineering Research Council of Canada and a University of Toronto Connaught Fellowship to MTJJ.

B. Research Motivation

The consumption of plant tissue by animals is one of the most important ecological and evolutionary interactions in nature. Herbivory is the main conduit of energy and nutrients from primary producers to consumers. The intensity of herbivory has been shown to impact plant community dynamics and composition (Fine et al. 2004, Maron and Crone 2006, Kursar et al. 2009, Paine et al. 2012) as well as ecosystem level primary productivity and nutrient cycling (Cebrian and Lartigue 2004, Schmitz 2008, Chapin et al. 2011). For example, rabbit herbivory can alter the composition of plant communities through direct consumption and by altering competitive interactions among plants species (Crawley 1990). Herbivores can increase the rate of cycling of macronutrients by selecting plants and tissues of higher nutritional quality and because nutrients are often released more rapidly from their faeces than from the plants from which they are composed (Zamora et al. 1999, Schmitz 2008). Alternatively, nutrient cycling can be slowed when consumers prefer plant species with high potential decomposition rates, driving community composition towards slower decomposing species (Pastor and Cohen 1997).

The 415 million years of coevolution between plants and herbivores (Labandeira 2007) is also credited with giving rise to much of the macroscopic diversity on Earth (Ehrlich and Raven 1964, Becerra et al. 2009). The evolutionary importance of this interaction stems from the fact that herbivores can strongly impact plant fitness (Marquis 1992, Bigger and Marvier 1998, Hawkes and Sullivan 2001) and can therefore be an important driver of the diversification of plant defenses

(Becerra et al. 2009, Kursar et al. 2009, Agrawal et al. 2012, Prasad et al. 2012). Similarly, plant speciation and the diversification of defenses can lead to the diversification of herbivores as they evolve counter-adaptations to overcome these defenses (Ehrlich and Raven 1964, Dyer et al. 2007, Wheat et al. 2007, McKenna et al. 2009, Dobler et al. 2012, Zhen et al. 2012). Although herbivory has been studied for decades, many unanswered questions remain, including a firm understanding of the factors that impact its intensity and how these factors interact.

A repository of standardized and comparable estimates of leaf consumption across species in different ecosystems provides a valuable resource that can help address many research questions. Most vascular plants produce leaves, and estimates of leaf herbivory can be obtained easily and quickly without expensive equipment. This means that not only can a large data set be compiled from existing data, but it can also be easily expanded in the future. Damage sustained to non-photosynthetic tissues is also important for ecology and evolution of plants and their herbivores but quantifying its intensity is more challenging and difficult to standardize. For example, quantifying root herbivory requires extensive and careful excavation as well as time-consuming observations (Johnson and Murray 2008). Even with such careful work, it is difficult to accurately quantify herbivory to fine roots, which make up a large percentage of root biomass and is considered the most active root tissue in resource acquisition (Johnson and Murray 2008). Similarly, measuring the consumption of reproductive tissues can be limited by its short temporal availability, which makes comparisons among taxa more difficult. Damage caused by piercing-sucking herbivores might only be properly quantified using manipulative experiments (Zvereva et al. 2010). Furthermore, herbivory from piercing-sucking insects is usually measured as reduced biomass, but it is difficult to separate the direct effects of the phloem and xylem lost to piercing-sucking herbivores versus the negative effects of pathogens that are frequently transmitted to the plants (Miles 1989). These challenges help to explain why leaf damage is the most pervasive measure of herbivory in the literature (Johnson and Murray 2008, Schowalter 2011), and why a comprehensive and standardized data set of leaf herbivory has added value for ecological and evolutionary research.

Rates of herbivory are influenced by multiple biotic and abiotic factors, including plant functional traits that determine how it interacts with its associated herbivore community (Loranger et al. 2012, Schuldt et al. 2012). Quantifying the relative importance of these factors and how they interact requires a large number of measurements under a variety of conditions in different localities. Species-specific data enables researchers to understand how these factors influence species differently as opposed to community level herbivory measurements. Moreover, species-specific data enables the use of modern phylogenetic statistical tools to conduct large-scale comparative analyses that account for phylogenetic non-independence. For example, such analyses permit researchers to tease apart the importance of ecological variation compared to evolutionary history in driving rates of herbivory across sites (Fine et al. 2006, Pearse and Hipp 2012). Also, by listing methodological details, the data set could help identify and correct for certain biases that may arise when quantifying herbivory. Finally, the data set will help identify limitations of published data, such as the rarity of studies measuring herbivory in certain locations, on plants with certain traits (Figs. 1-4), or the rarity of measurements in certain clades (e.g., *Orchidaceae*).

C. General Methodology

We identified and collated estimates of leaf herbivory from a phylogenetically diverse array of vascular plants using a large literature search (for details see Data Acquisition section below) in addition to providing our own data. From each study we collected detailed information on the study sites, the methodologies employed to measure herbivory, and entered additional plant trait information. Finally, we classified whether these measures corresponded to annual or daily rates of percent leaf herbivory.

1) Selection criteria and data acquisition

We first summarize the criteria for inclusion in the data set as well as how we obtained data and supplemental information concerning study sites and plant species. We included data that pertained to damage caused by naturally occurring herbivores and excluded studies or treatments that experimentally altered the density of herbivores. A few experimental studies were included that used fences to exclude large grazing herbivores; we note this information in the 'Population Information' column.

We selected studies that report percent leaf area consumed, including chewing, grazing, and mining damage, but we excluded leaf damage caused by necrosis, galling, phloem and xylem feeding. We excluded studies that did not report plant species-specific rates of damage. We extracted herbivory estimates and error values from tables or figures. We used Web Plot Digitizer (http://arohatgi.info/WebPlotDigitizer/) to extract data that were only available in graphical format. In all cases our estimates represent the mean or median percent leaf damage from multiple replicate plants. We noted when authors mentioned the most common consumers and categorized them into their major taxonomic groups. We then identified plant growth form and duration using the source literature and from online trait data sets (e.g., www.plants.usda.gov). We identified the family and order of species using currently accepted taxonomy (www.plants.usda.gov; The angiosperm phylogeny group 2009, Lehtonen 2011). Finally, we identified the locality of each sampling site using GPS coordinates reported by authors of each study, or by estimating them ourselves using online tools (e.g., Google Earth). We then used ArcMap 10.1 (www.esri.com) to associate each site with a Köppen-Geiger hierarchal climate classification as delimited by Peel et al. (2007).

2) Assessment of leaf damage

The methods used to quantify leaf herbivory included a 'standing' measure and a 'marked' leaf method that each has their own advantages and limitations (Coley 1982, Lowman 1984, Landsberg 1989, Coley and Barone 1996). The standing measure consists of measuring the damage on leaves present on a plant at a single point in time. The 'marked' leaf method consists of quantifying damage and marking leaves, using felt pens or attaching colored rings, on one day and then returning after a number of weeks to quantify the change in leaf damage. Because standing measures are relatively rapid and easy to use, they remain the most commonly employed method and are often the only method used for certain clades (e.g. gymnosperms). However, standing measures can underestimate damage (Lowman 1984, Filip et al. 1995) if one does not look for evidence of completely consumed leaves (Lowman 1985, Massey et al. 2006, Brenes-Arguedas et al. 2009). Conversely, the marking approach is more accurate and can also provide daily rates of damage. The marking approach suffers from being more time consuming and it can potentially overestimate damage if one assumes that all missing leaves were entirely consumed, as opposed to being dropped following incomplete damage, or if the marks themselves influence herbivory rates (Landsberg 1989, Cahill Jr et al. 2001, Hik et al. 2003, Shaw et al. 2006).

3) Daily and annual rates of herbivory

We accumulated both daily and annual rates of herbivory because both types of estimates are commonly provided in the literature and each has unique advantages. Some researchers have advocated the use of daily rates of herbivory because this measure can account for wide variation in leaf lifespan and production (Coley 1982, Brown and Ewel 1987, Lamarre et al. 2012). Daily rates require the marking approach with a known length of marking and thus cannot be applied to standing measures. Nevertheless, standing measures can still be informative given that they can represent annual rates of herbivory. Annual rates are useful because they represent the total fraction of leaf production lost to herbivores each year. We included annual values if measurements, either standing or marked, summarized most of the damage a leaf endures in its lifetime. Although some species retain leaves for more than one year, most of the damage occurs within their first year of growth (Coley and Barone 1996). Specifically, in deciduous species we included estimates that were taken near the end of the growing season.

Specifically, we included data that quantified accumulated damage present on mature leaves since these should have experienced most of their lifetime damage. In addition, we included data of marked expanding leaves that summed damage of individual leaves over more than one month. Although leaf expansion might be completed in less than one month, in most tropical and temperate systems this period is too short to capture most of the lifetime herbivory a leaf experiences (Coley and Barone 1996). This approach assumes that damage incurred over the lifetime of a single leaf is representative of the damage received by leaves that are produced at other times during the same year. We provide details of the method of sampling, its length, seasons sampled, and months of sampling so that researchers can set their own criteria for data inclusion.

D. Data Limitations and Potential Enhancements

Here we discuss limitations in the existing data set and propose future directions of research that could greatly enhance our understanding of plant-herbivore interactions across the globe. We recognize that comparing herbivory across systems is a difficult task and these challenges have been discussed extensively by previous authors (Coley 1982, Lowman 1984, Landsberg 1989, Coley and Barone 1996). Nevertheless, there are several common deficiencies with the most commonly employed methods used to measure herbivory that limit the quality of the data. For example, leaf lifespan and the number of flushes per year can complicate measures of herbivory. Although marking leaves and tracking damage through time improves our ability to accurately quantify damage, ideally the rate of leaf production should also be accounted for. Lamarre et al. (2012) demonstrated an approach that quantifies the consequences of herbivory as an opportunity cost for the plant, by accounting for both the amount of biomass removed by herbivores and the rate at which this biomass can be replaced. In addition, marking studies should not assume that the majority of damage occurs during leaf expansion, as this is only supported for shade tolerant species in wet tropical forests (Coley and Barone 1996). Ideally, marking studies should last for an entire year, or more appropriately for the lifespan of a leaf, but this is often impractical.

We urge future researchers to provide additional methodological details when reporting herbivory measures. Many studies, using either the marking or standing methods, do not report how frequently they observe completely missing leaves or how these observations are treated. Moreover, authors should report the developmental stage of the plants which can greatly impact herbivory rates (Boege and Marquis 2005), as well as the composition of the surrounding plant community (Massey et al. 2006, Loranger et al. 2013). Finally, a proportion of studies fail to report confidence or error estimates for mean herbivore rates. Although less common in modern studies, this problem still occurs in some recently published data. The lack of confidence estimates limits the usefulness of these entries for explicit meta-analyses. A related issue is the omission or lack of clarity in the number of replicate plants and leaves measured per plant.

Our compilations revealed striking patterns in the application of measurement methods across different ecosystems or among plant life forms. Figures 1-4 reveal that the daily rate measures, and hence studies that apply the marking technique, are almost exclusively performed on tropical perennial trees. We also show a lack of data from large areas of the globe including Africa, Asia, and Polynesia (Fig.1), and a heavy focus on data from a few well-studied locations (e.g., Barro Colorado Island in Panama and Northeastern United States). This unbalanced sampling could bias our understanding of general patterns of herbivory. We encourage researchers to add data using multiple techniques, from plants with a variety of life forms and from poorly represented areas. These data would enable new tests of important ecological and evolutionary questions across all major areas of the globe.

Perhaps the largest limitations of the data set pertain to gaps in data that relate to different plant tissues and the underrepresentation of particular plant lineages. Our data set focuses on leaf consumption whereas it should ideally be extended to include the removal of non-photosynthetic tissues such as roots, fruits, flowers, and xylem and phloem sap, as well as other types of damage to leaves including necrotic and galling damage. Regrettably, these data are scarce. With the addition of these data one could test the relative extent of damage to different tissues, which remains rarely untested (Rasmann and Agrawal 2008). These data would also allow for a test of how biotic and abiotic factors differently impact herbivory on different tissues. We see equally large gaps in taxonomic coverage of sampling. Although the data set covers 166 families of vascular plants, major lineages are still missing or under-represented, such as clubmosses (Lycopodiopsida), horsetails (*Equisetum*), and orchids (*Orchidaceae*). Aquatic plants are also sparsely represented in the data set. Adding missing clades could help better quantify macroevolutionary patterns of herbivory and defense (Coley et al. 1985, Fine et al. 2004, Fine et al. 2006, Agrawal 2007, Futuyma and Agrawal 2009). The addition of more domesticated plants (both horticultural and agricultural) could also provide a more robust quantitative test comparing rates of herbivory in an applied context.

CLASS III. DATA SET STATUS AND ACCESSIBILITY

A. Status

Latest update: August 2013

Latest Archive date: August 2013

Data verification: Data is mostly from published sources. We searched for extreme values and corrected any transcription errors.

B. Accessibility

Contact person: Martin M. Turcotte, Department of Biology, University of Toronto at Mississauga, Mississauga, Ontario, L5L 1C6, Canada mart.turcotte@gmail.com

Copyright restrictions: None.

Proprietary restrictions: Please cite this data paper when the data are used in publications. We also request that researchers and teachers inform us how they are using the data.

Costs: None.

CLASS IV. DATA STRUCTURAL DESCRIPTORS

COMMUNITY DATA

A. Data Set File

Identity: Leaf_Herbivory.csv

Size: *2641 records, 1,332,259 Bytes*

Format and storage mode: comma-separated values (.csv)

Header information: See column descriptions in section B.

Alphanumeric attributes: Mixed.

Data Anomalies: If no information is available for a given record, this is indicated by 'NA'.

B. Variable information

1) Plant Species Information

Variable	Variable Definition	Type / Units	Variable Values
Record ID Number	Data set record entry, sorted by taxonomy.	Integers	00001 → 02641
Order	Order name	Characters	Various
Family	Family name	Characters	Various
Species	Scientific species name (*Genus species*)	Characters	Various
Selection history	Whether the species is a wild or a crop species	Characters	Crop; Wild

Plant growth form	Plant growth form, some sources also explicitly state if the plant is woody	Characters	Forb/herb; Graminoid; Liana; Shrub; Subshrub; Tree; Vine; Woody liana; Woody vine
Duration	Lifespan of plant (life-history)	Characters	Annual; Biennial; Perennial

2) Study Site Information

Variable	Variable Definition	Type / Units	Variable Values
Study Code	Study code to identify the data source. See the ‘Literature cited in Data set’ for citation.	Characters	Variable
Country	Site is located in what country	Characters	Country name
Location	General location of site	Characters	Various descriptions
Latitude	Latitude of site	Degrees, minutes, seconds, (DDdMM’SS”N)	Various
Longitude	Longitude of site	Degrees, minutes, seconds, (DDdMM’SS”W)	Various
Coordinates notes	Notes describing how coordinate data were obtained	Characters	Various
KG climate simple	Highest tier of Köppen-Geiger climate classification (Peel et al. 2007)	Characters	Various
KG climate full	Full Köppen-Geiger climate classification (Peel et al. 2007)	Characters	Various

Habitat description	Simple habitat description provided by the authors	Characters	Various
Population information	Information used by sources to distinguish sites or samples, can represent locations, plant ages, or treatments	Characters	Various
Population origin	Whether the studied plants were growing naturally or planted	Characters	Natural; Planted

3) Sampling Methods

Variable	Variable Definition	Type / Units	Variable Values
Year	Year of sampling (can be a range of values)	Integers	1964 to 2012
Season	Season during sampling	Characters	All seasons; Dry; Fall; Growing; Spring; Summer; Wet; Winter
Month	Month of sampling	Characters	Specific months, or 'all year'
Standing or marked leaves	Whether the method for measurement was made on standing stock or marked leaves	Characters	Standing; Marked
Leaf age	Age of leaves measured	Characters	Expanding; Mature; mix = both expanding and mature leaves included; Lifespan = marked leaves from early expansion well into maturity
Area measurement method	Method used to estimate percent leaf damage	Characters	Automatic = automated measurement (e.g. scanning); Planimeter = manual

			tool; Grid = visual aide; Photocopy = weighing photocopy cutouts; Visual
Sampling details	Details on the method of sampling, can include the age of the plant, number of leaves, how plants or leaves were selected, and how long marking lasted	Characters	Various
Length of marking (days)	Number of days between marking and herbivory measurement	Integer (days)	Various

4) Herbivory Data

Variable	Variable Definition	Type / Units	Variable Values
Data source	Location of data within the manuscript (e.g., table, figure, text) and modifications of values (such as conversions) and whether herbivory values are medians or mean	Characters	Various
Annual herbivory rate (%)	Estimate of annual leaf herbivory (% area consumed), most studies report mean values unless noted in the 'Data Source' column	Numeric (% leaf area damage)	Various
Annual error estimate	Unit of error if reported for annual herbivory rate	Characters	CV = coefficient of variation; SD = standard deviation; SE = standard error; C.I. = 95% confidence interval; range
Annual error value	Value of error estimate if available	Numeric	Various
Number of replicates	Number of plants measured, some descriptions were unclear and had to be estimated	Integers	Various

Daily herbivory rate (%)	Estimate of daily leaf herbivory (% area consumed per day), most studies report mean values unless noted in the ‘Data Source’ column	Numeric (% leaf area damage per day)	Various
Daily error estimate	Unit of error for daily herbivory rate	Characters	CV = coefficient of variation; SD = standard deviation; SE = standard error;
Daily error value	Value of error estimate	Numeric	Various
Consumers	Most common herbivores mentioned by the authors, in most cases this a qualitative statement and not quantified explicitly and refers to the entire study	Characters	Arachnida; Crustacea; Gastropoda; Pathogens; Vertebrata; Within Insecta: Coleoptera; Diptera; Hemiptera; Homoptera; Hymenoptera; Lepidoptera; Miscellaneous; Orthoptera

CLASS V. SUPPLEMENTAL DESCRIPTORS

A. Data acquisition

1. Data forms or acquisition methods

We initiated the data set with a large literature search on October 28th 2011. Using SciVerse Scopus (www.scopus.com) we searched titles, abstracts, and keywords using the following series of related combinations of terms for herbivory:

TITLE-ABS-KEY("rate of grazing" OR "grazing rate" OR "amount of grazing" OR "level* of grazing" OR "grazing level*" OR "rate* of herbivor*" OR "herbivor* rate" OR "amount of herbivor*" OR "herbivory level*" OR "level* of herbivory" OR "degree of herbivor*" OR* *"rate* of defoliat*" OR "defoliat* rate" OR "amount of defoliat*" OR "defoliation level*" OR "level* of defoliation" OR "foli* damage*" OR "foli* level*" OR "level* of foli*" OR "leaf min* damag*" OR "leaf area remov*" OR "leaf damage" OR "damage to lea*" OR "percent leaf area" OR "leaf area damage" OR "removal of leaf" OR "leaf consumption" OR "consumption of leaves" OR "leaf herbivor*" OR "canopy consumption" OR "consumption of canopy" OR "canopy damag*" OR "canopy defoliation" OR "foliage damag*" OR "foliage consum*" OR "consumption of foliage" AND NOT *plankton* AND NOT alga*) AND DOCTYPE(ar OR ip OR cp OR le OR no OR sh)*

* Indicates words with all possible ending will be identified

Of the 3371 studies identified we examined studies published from the 50 most frequent journals (Table 1). We then added studies identified in other review papers. We also performed supplementary searches for underrepresented lineages such as ferns, and added some of our own unpublished data. In total approximately 1450 studies were evaluated for inclusion into the data set.

Table 1: The fifty most frequent journals identified with the literature search.

Acta Horticulturae	Global Change Biology
Acta Oecologica	HortScience
Agricultural and Forest Entomology	Hydrobiologia
Agriculture, Ecosystems and Environment	Journal of Applied Ecology
Agronomy Journal	Journal of Chemical Ecology
American Journal of Botany	Journal of Ecology
Annals of Botany	Journal of Economic Entomology
Aquatic Microbial Ecology	Journal of Experimental Botany
Austral Ecology	Journal of Experimental Marine Biology and Ecology
Biological Conservation	Journal of Plant Nutrition
Biological Control	Journal of Range Management
Biological Invasions	Journal of Tropical Ecology
Biotropica	Marine Biology
Canadian Journal of Forest Research	Marine Ecology Progress Series
Crop Protection	New Phytologist
Crop Science	Oecologia
Ecological Applications	Oikos
Ecological Entomology	Plant and Soil
Ecological Research	Plant Disease
Ecology	Plant Ecology
Entomologia Experimentalis et Applicata	Plant, Cell and Environment
Environmental Entomology	Planta
Environmental Pollution	Scientia Horticulturae
Forest Ecology and Management	Tree Physiology
Functional Ecology	Water, Air, and Soil Pollution

3. Data entry/verification procedures

F. Publications and Results

G. History of data set usage

Turcotte et al. (In review) used the annual herbivory measurements to calculate species level mean herbivory rates. They used these values to conduct a phylogenetically explicit analysis exploring the macroecological and macroevolutionary patterns of herbivory within and among major plant lineages.

1. Data request history: None

2. Data set update history: None

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