Data Papers

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BODY SIZES OF CONSUMERS AND THEIR RESOURCES

***Ecological Archives* E086-135**

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Abstract. Trophic information—who eats whom—and species' body sizes are two of the most basic descriptions necessary to understand community structure as well as ecological and evolutionary dynamics. Consumer–resource body size ratios between predators and their prey, and parasitoids and their hosts, have recently gained increasing attention due to their important implications for species' interaction strengths and dynamical population stability. This data set documents body sizes of consumers and their resources. We gathered body size data for the food webs of Skipwith Pond, a parasitoid community of grass-feeding chalcid wasps in British grasslands; the pelagic community of the Benguela system, a source web based on broom in the United Kingdom; Broadstone Stream, UK; the Grand Cariçaie marsh at Lake Neuchâtel, Switzerland; Tuesday Lake, USA; alpine lakes in the Sierra Nevada of California; Mill Stream, UK; and the eastern Weddell Sea Shelf, Antarctica. Further consumer–resource body size data are included for planktonic predators, predatory nematodes, parasitoids, marine fish predators, freshwater invertebrates, Australian terrestrial consumers, and aphid parasitoids. Containing 16 807 records, this is the largest data set ever compiled for body sizes of consumers and their resources. In addition to body sizes, the data set includes information on consumer and resource taxonomy, the geographic location of the study, the habitat studied, the type of the feeding interaction (e.g., predacious, parasitic) and the metabolic categories of the species (e.g., invertebrate, ectotherm vertebrate). The present data set was gathered with the intent to stimulate research on effects of consumer–resource body size patterns on food-web structure, interaction-strength distributions, population dynamics, and community stability. The use of a common data set may facilitate cross-study comparisons and understanding of the relationships between different scientific approaches and models.

Key words: allometry; body length; body mass; body size ratio; food webs; parasitoid–host; predation; predator–prey.

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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INTRODUCTION

Body size is one of the most fundamental characteristics of an organism, with profound metabolic, physiological and ecological implications (Peters 1983, Enquist et al. 1999, Gaston and Blackburn 2000) . Recently, the ratio between consumer and resource body sizes, the body size scaling relationship between consumers and their resources, and the body size structure of natural food webs have gained increasing attention (Warren and Lawton 1987, Cohen et al. 1993, Memmott et al. 2000, Cohen et al. 2003) . Specific body-size ratios may stabilize food chains (Jonsson and Ebenman 1998) , and even entire natural food webs, by shaping interaction strength distributions (Emmerson and Raffaelli 2004) . These studies indicate that consumer–resource body size ratios may play a key role in natural communities that deserves further scrutiny. However, scientific progress is limited by the scarcity of empirical food web studies reporting the average body sizes of species (Jonsson et al. 2005) .

Here, we try to reduce such limitations by documenting body size ratios for 16,863 consumer–resource links. The data includes body size ratios from terrestrial (n = 12,398 links), marine (n = 2355 links), freshwater (n = 1,983 links) and soil (n = 51 links) ecosystems. Note that 76 links occur in more than one habitat type and could not be unambiguously assigned to any of the above mentioned habitat categories. Body size data is provided for the food webs of (1) Skipwith Pond, UK (Warren 1989) , (2) a parasitoid community of grass-feeding chalcid wasps in British grasslands (Dawah et al. 1995) , (3) the pelagic community of the Benguela system, Africa (Yodzis 1998) , (4) a source web based on broom in the UK (Memmott et al. 2000) , (5) Broadstone Stream, UK (Woodward et al. 2005) , (6) the Grand Cariçaie marsh at Lake Neuchâtel, Switzerland (Cattin Blandenier 2004) , (7) Tuesday Lake, USA (Jonsson et al. 2005) , (8) Alpine Lake communities in the Sierra Nevada range of California, USA (Harper-Smith et al., *in press*) , (9) Mill Stream, UK (Ledger, Edwards, and Woodward *unpublished data*), and (10) the eastern Weddell Sea Shelf, Antarctica (Jacob, Brey, and Mintenbeck, *unpublished data*). For these food webs, the data set allows the construction of the entire food web architecture along with the body size structure of the community. Further body

size ratios are included for planktonic predators (Hansen et al. 1994) , predatory nematodes (Ruess, *unpublished data* ; Andrassy 1956) , parasitoids (Ulrich 1999, 2001) , marine fish predators (Scharf et al. 2000, Pinnegar et al. 2003) , freshwater invertebrates (Warren, *unpublished data*), Australian consumers (Dell, *unpublished data* ; Rayner, *unpublished data*), and aphid parasitoids (Cohen et al. 2005).

The data set provides, where available, information on consumer and resource taxonomy, their common names, measurements of their body sizes (average as well as minimum and maximum body length or weight), the geographic location of the study, the habitat studied, the feeding type of the link and the species' metabolic categories (see below for a detailed description). Due to our focus on trophic links, there are multiple entries for species with more than one trophic link. Furthermore, one consumer–resource species' pair has more than one entry if the location or time of the body size ratio measurement differs. The purpose of this data set is to provide an overview of consumer–resource body size ratios across taxonomic groups and habitats. Accordingly, the only restriction that we imposed on the data included was that consumers and their resources were measured similarly. Between studies, the methods used to measure body sizes and establish the existence of trophic links differed. The information provided is based on techniques that range from detailed gut contents analyses and well-replicated measurements of body weight, to trophic link and body length data based on expert estimates or field guides. Because not all of these data are well suited for every purpose, we provide information on each type of measurement in the data table. This information allows a cautious use of the data in subsequent studies that focus on specific types of body size measurements. Most of the body sizes are measured as body masses (n = 13,085 links), whereas body lengths have been used in other cases (n = 3778 links). Well established mass-length regressions for animal (Peters 1983) and plant species (Niklas and Enquist 2001) were used to transform measurements of body length into body weight: mass [gram] = a * length [meters] ^{b}. The constants a and b of these mass-length regressions are specific to broad taxonomic groups: carnivorous mammals (a = 23,000; b = 2.73), marine mammals (a = 40,790; b = 2.47), birds (a = 7,390; b = 2.74), legless herptiles (a = 720; b = 3.02), legged herptiles (a = 28,000; b = 2.98), frogs (a = 181,000; b = 3.24), fishes (a = 10,600; b = 2.57), insects (a = 8,800; b = 2.62), planktonic invertebrates (a = 80; b = 2.1), and plants (a = 27; b = 3.79). This transformation adds an additional source of error to the body size ratio data. As these body size ratios span several orders of magnitude, this additional error is not likely to be large enough to preclude comparative studies. If a higher accuracy of measurement is necessary, however, analyses should be restricted to ratios of directly measured body weights (n = 13,085).

With respect to the consumers' metabolic categories, this data set is extensive for predators (n = 15,381 links) and aquatic herbivores (n = 718 links), but is sparse for parasitoid species (n = 262 links), detritivores (n = 214 links), bacterivores (n = 30 links), pathogens (n = 3 links) and devoid of fungivores (n = 0 links) and terrestrial herbivores (n = 0 links). Again, 46 links could not be unambiguously assigned to any of the above mentioned feeding categories. The present data set raises two general problems in trophic ecology: the definitions of (1) trophically interacting populations and (2)

individual body masses. In some cases, generalizing trophic links over entire populations appears appropriate. In other cases, only certain subsets of two populations trophically interact (e.g., certain life stages or sub-populations of certain body sizes). This means that the ratios between population-averaged body sizes might misrepresent the trophic interaction and to fully understand the relationship between consumer and resource body sizes, it is important that the data correctly represent the body sizes of the individuals involved in the trophic interactions. In particular, the cannibalistic feeding interactions in the present data set are most likely mischaracterized by consumer–resource body size ratios of unity, which would imply that equally sized individuals within the population consume each other. Rather, it is likely that bigger individuals consume smaller ones. Furthermore, there is variation in what constitutes a trophically interacting unit within a population. For instance, for mammalian predators such as lions or wolves where a single individual within the herd seldom hunts and eats on its own, a trophically interacting unit appears better characterized by entire tribes or herds than by an individual. Rather than being an annoying obstacle, we think that these questions provide interesting challenges that will serve to stimulate deeper understanding of the forces that structure natural communities.

METADATA CLASS I. DATA SET DESCRIPTORS

A. Data set identity:

Title: Body sizes of consumers and their resources.

B. Data set identification code

Suggested Data Set Identity Code: ECRBSR001

C. Data set description

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Abstract:

Trophic information – who eats whom – and species' body sizes are two of the most basic descriptions necessary to understand community structure as well as ecological and evolutionary dynamics. consumer–resource body size ratios between predators and their prey, and parasitoids and their hosts, have recently gained increasing attention due to their important implications for species' interaction strengths and dynamical population stability. This data set documents body sizes of consumers and their resources. We gathered body size data for the food webs of Skipwith Pond, a parasitoid community of grass-feeding chalcid wasps in British grasslands; the pelagic community of the Benguela system, a source web based on broom in the United Kingdom; Broadstone Stream, UK; the Grand Cariçaie marsh at Lake Neuchâtel, Switzerland; Tuesday Lake, USA; alpine lakes in the Sierra Nevada of California; Mill Stream, UK; and the eastern Weddell Sea Shelf, Antarctica. Further consumer–resource body size data are included for planktonic predators, predatory nematodes, parasitoids, marine fish predators, freshwater invertebrates, Australian terrestrial consumers, and aphid parasitoids. Containing 16,863 records, this is the largest data set ever compiled for body sizes of consumers and their resources. In addition to body sizes, the data set includes information on consumer and resource taxonomy, the geographic location of the study, the habitat studied, the type of

the feeding interaction (e.g., predacious, parasitic) and the metabolic categories of the species (e.g., invertebrate, ectotherm vertebrate). The present data set was gathered with intent to stimulate research on effects of consumer–resource body size patterns on food-web structure, interaction-strength distributions, population dynamics, and community stability. The use of a common data set may facilitate cross-study comparisons and understanding of the relationships between different scientific approaches and models.

D. *Key words:* *body mass; body length; body size ratio; predator-prey; parasitoid-host; food webs; predation; allometry*.

CLASS II. RESEARCH ORIGIN DESCRIPTORS

A. Overall project description

Identity: International collaboration on consumer–resource body sizes

Originator: Ulrich Brose

Period of Study: 2003–continuing

Objectives: To understand body size ratios between consumers and their resources, their distribution in natural food webs and their impact on interaction strengths and food-web structure and stability.

Abstract: This research project, initiated in 2003, endeavors to compile consumer–resource body size ratios for a broad range of taxonomic groups, habitat types and geographical locations. The data set is available for public use to test for taxonomic, geographical or habitat trends in body size patterns. We aim to make studies on body size patterns comparable by supplying a common data set.

Source(s) of funding: German Research Foundation, U.S. National Science Foundation, UK Natural Environment Research Council.

B. Specific subproject description

Site description: Data were obtained for trophic interactions in various habitats. Although this is a global database, entries are more comprehensive for species from North America and Europe. Additional data for African, Asian, Australian, South American, or Arctic communities are needed.

Experimental or sampling design: Most data were obtained from published sources on food webs or consumer–resource species pairs. In many cases, the trophic information – who eats whom – has been published as indicated in the link reference column, whereas most of the body size data are published here for the first time. The exceptions to this are indicated by cited references in the body size reference column.

Research Methods: The data were collected from published literature and experienced field ecologists. In general, we considered all data on known consumer–resource species pairs, for which the body sizes of the consumer and resource species have been measured with similar methods. We preferred to collect information on body weight or volume. If only body length was available, we used length-mass regressions (see *Introduction*) to transform lengths into body weight.

Project Personnel: n/a

CLASS III. DATA SET STATUS AND ACCESSIBILITY

A. Status

Latest Update: 19 July 2005

Latest Archive date: 19 July 2005

Metadata status: 19 July 2005, metadata are current

Data verification: Most of the data are based on field measurements of body sizes by experienced field ecologists. All data entries have been double checked against the original data sets as published or submitted to the first author.

B. Accessibility

Storage location and medium: Original data file exists on primary author's personal computer in Microsoft Excel and Ascii formats.

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Copyright restrictions: None

Proprietary restrictions: None

Costs: None, authors believe scientific data should be free for scientific use.

CLASS IV. DATA STRUCTURAL DESCRIPTORS

A. Data Set File

Identity: bodysizes.txt

Size: 16,863 records, not including header row.

Format and Storage mode: Ascii text, tab delimited. No compression schemes used.

Header information: Headers are given here as header name followed by more information such as measurement units or other basic descriptor. More information on the variable definitions can be found in Section B, variable information. Link ID to identify a specific consumer resource body size ratio in the data set, Link reference for trophic interactions, Body size reference, Geographic location, General habitat, Specific habitat, Link methodology, Body size methodology, Taxonomy consumer, Lifestage consumer, Common name(s) consumer, Metabolic category consumer, Type of feeding interaction, Minimum [m], Mean [m] and Maximum length [m] consumer, Minimum [g], Mean [g] and Maximum mass [g] consumer, Taxonomy resource, Lifestage resource, Common name(s) resource, Metabolic category resource, Minimum [m], Mean [m], Maximum [m] length resource, Minimum [g], Mean [g] and Maximum mass [g] resource, consumer–resource body mass ratio, Notes.

Alphanumeric attributes: Mixed

Special characters/fields: -999 denotes lack of information for that field.

Authentication procedures: The number of records for consumer–resource body size ratios should be 16,863. The sum of the consumer–resource body mass ratios should equal $2.4735\ 10^{20}$.

B. Variable definitions

Variable name	Variable definition	Storage type	Range of numeric values (-999 not incl.)	Missing value codes
Link ID	ID for the consumer resource interaction	Numeric	1 – 16,863	-999
Link reference	Reference for the trophic link between consumer and resource	Character		-999
Body size reference	Reference for the body sizes of consumer and resource	Character		-999
Geographic location	Description of where the study took place – longitude and latitude if available	Character		-999
General habitat	Broad habitat description: terrestrial, marine, freshwater, soil (belowground)	Character		-999
Specific habitat	Habitat description	Character		-999

Link methodology	How was the trophic link established: published account (e.g., journal, book, internet), expert (data obtained from expert knowledge), field (direct observation in the field), extrapolated from similar taxa, gut/stomach analysis, scat analysis, pellet analysis, tracer study, feeding trial, rearing, natural history (e.g., morphological information)	Character		-999
Body size methodology	Methodology of body size measurement: measurement (individuals are field-sampled, then lengths or masses are measured), regression (weight-length regression with measured lengths), published account (e.g., field guide), expert (data obtained from expert knowledge)	Character		-999
Taxonomy consumer	Taxonomic description of the consumer species	Character		-999
Lifestage consumer	Characterizes the lifestage of the species that is involved in the trophic interaction: adults, juveniles, larvae, nymphs, nauplii	Character		-999
Common name consumer	Common name of the consumer if applies	Character		-999
Metabolic category consumer	invertebrate, ectotherm vertebrate, endotherm vertebrate, photo-autotroph, heterotrophic bacteria, heterotrophic fungi	Character		-999
Type of feeding interaction	Predacious, parasitoid, parasitic, herbivorous, detritivorous, bacterivorous, fungivorous, pathogen (bacteria and fungi)	Character		-999

Minimum length [m] consumer	Minimum length measured	Floating Point		-999
Mean length [m] consumer	Mean length of the population that is involved in this trophic interaction – this can be all individuals of a species or sub-groups such as adults	Floating Point		-999
Maximum length [m] consumer	Maximum length measured	Floating Point		-999
Minimum mass [g] consumer	Minimum mass measured	Floating Point		-999
Mean mass [g] consumer	Mean mass of the population that is involved in this trophic interaction – this can be all individuals of a species or sub-groups such as adults	Floating Point		-999
Maximum mass [g] consumer	Maximum mass measured	Floating Point		-999
Taxonomy resource	Taxonomic description of the resource species	Character		-999
Lifestage resource	Characterizes the lifestage of the species that is involved in the trophic interaction: adults, juveniles, larvae, nymphs, pupae, nauplii	Character		-999
Common name(s) resource	Common name of the resource if applies	Character		-999
Metabolic category resource	invertebrate, ectotherm vertebrate, endotherm vertebrate, primary producer, heterotrophic bacteria, heterotrophic fungi, detritus	Character		-999
Minimum length [m] resource	Minimum length measured	Floating Point		-999
Mean length [m] resource	Mean length of the population that is involved in this trophic interaction – this can be all individuals of a species or sub-groups such as adults	Floating Point		-999
Maximum length	Maximum length measured	Floating Point		-999

[m] resource				
Minimum mass [g] resource	Minimum mass measured	Floating Point		-999
Mean mass [g] resource	Mean mass of the population that is involved in this trophic interaction – this can be all individuals of a species or sub-groups such as adults	Floating Point		-999
Maximum mass [g] resource	Maximum mass measured	Floating Point		-999
consumer–resource body mass ratio	Ratio of mean body masses of the consumer and the resource. If the consumer or resource species is lacking information on body weight, the masses are calculated by a standard relationship (see above).	Floating Point		-999
Notes	Additional information	Character		-999

C. Data set references

The references of the data sets used are given at the end of the metatext file.

CLASS V. SUPPLEMENTAL DESCRIPTORS

A. Data acquisition

Data forms: n/a

Location of completed data forms: n/a

B. Quality assurance/quality control procedures

Data were entered directly from source material into the computer file and values were double checked upon entry. After complete entry of data, all data points were checked against original source material. Researchers are encouraged to send additional data to the first author, which will be published online as the need arises.

C. Related material: n/a

D. Computer programs and data processing algorithms: n/a

E. Archiving: n/a

F. Publications and results: n/a

G. History of data set usage: n/a

H. Data set update history: n/a

I. Review history: n/a

J. Questions and comments from secondary users: n/a

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