Appendix S1. Data Set Descriptions

Sixteen data sets that were previously not published are detailed here, including references to research papers published on these data sets

Contents:

DataSource_ID 1102: Ground beetles (Carabidae) in heathlands in the Netherlands

Taxonomic focus: Coleoptera: Carabidae

1. Site description

a. Site type

Temperate seminatural heathland, forest, and grassland on sandy soil.

b. Geography

Decimal degrees:

Latitude: 52.77° - 52.83°

Longitude: 6.41° - 6.60°

c. Habitat

The plots were located in a variety of biotopes within the heathland complex, including dry heath dominated by *Calluna vulgaris* or *Empetrum nigrum*, wet boggy heath dominated by *Erica tetralix* and *Molinia caerulea*, restored heathland, nutrient poor grassland, and various deciduous forest types.

d. Geology / Landform

The landscape is a typical example of an 'old drift' landscape: All plots are located on aeolian sand, deposited during the last ice age (Weichselien), when the region was not glaciated, but was a polar desert. Below the sand lie boulder clay deposits from the previous ice age (Saalien), when the area was glaciated. In depressions, bog formation occurs, and several plots were located on boggy soils. The elevation of the area is some 20 m above sea level.

e. Watersheds, hydrology

The area is rain fed, and has been regarded as one of the largest wet heathlands of western Europe. It is situated between two watersheds. In the North, the brooklet Dwingelderstroom drains water to the north-west. In the south, the brooklet Ruiner Aa drains to the south-west. Historically, the area was mainly wet with some dry drift sand areas. From ~1900 until the 1960s, the area was progressively drained by canalizing the brooklets. The original water table has been more recently restored, which has led some of the original sampling sites to disappear under water.

f. Site history and current management

Most of the plots (19 out of 29) in this data set are lowland heathlands, some of which were restored to heathland after agriculture. Other plots were located in forests (8) or grasslands (2) on sandy soils.

Northwestern European lowland heaths are semi-natural landscapes, meaning that they have been under human exploitation for hundreds, if not thousands, of years (mostly in the form of livestock grazing), but have not been used for crop production (except for the restored plots). These heathlands

are found on acidic, nutrient poor sandy soils and form a mosaic of successional seres that naturally flow into each other. Succession starts with blown sand, which is colonized by grasses such as *Corynephorus canescens*, after which a phase of domination of dwarf shrubs (*Calluna vulgaris* or *Erica tetralix*) follows. Tall grasses such as *Molinia caerulea* often overgrow the heather as soil nutrient concentrations increase (a process that is currently enhanced by atmospheric nitrogen deposition), and finally, tall shrubs and trees colonize the heathland, eventually replacing it with forest. Over the course of the monitoring period, successional changes occurred within individual plots.

Lowland heathlands are of high conservation value because of their richness in characteristic plant and animal species, and have strongly declined in extent in western Europe. To maintain the species rich early and middle successional stages, these heathlands are usually grazed by sheep, but additional restoration measures take place to remove nutrients from the system, typically in the form of top-soil removal by sod-cutting, or, rarely, by burning.

g. Climate

The area has a temperate oceanic climate with a mean annual temperature of 9.3°C, and an average of 812 mm rain per year.

2. Experimental or sampling design

a. Design characteristics

Ground beetle trapping was started in 1959 to study the dynamics and stability of populations in heterogeneous landscapes. For more information see Den Boer (Den Boer, 1986, 1981, 1977).

b. Permanent plots

The data set of yearly summed catches, as used here, was compiled from Den Boer (1977), Den Boer & van Dijk (1994) and the original data used for these papers: raw datasheets, and the digital database of the catches since 2002. Years during which data collection was incomplete were omitted. We included all plots where the time span between the first and last samples was 10 years or more. After exclusion of one plot where it could not be verified that the resampling took place at the same location as the earlier sampling, this left 29 plots. Thus, all plots analyzed by van Klink et al (2019) are included here, as well as ten plots from re-samplings that were previously not analyzed, and from forested plots. The maximum duration of sampling on any plot was 58 years, and a total of 424071 individual beetles were used for this analysis.

Number of plots: 29

c. Data collection period, frequency etc.

Data collection period: 1959-2016. The traps were emptied weekly throughout the year, except occasionally during winter, when they were emptied biweekly or not at all during snowfall. Sampling is ongoing.

3. Research methods

a. Field / laboratory

Ground beetles were trapped in square metal pitfall traps with a perimeter of 1 m and a depth of 30 cm. Each plot consisted of three pitfall traps, spaced 10 m apart. Two of these were live-traps, and the third contained a 3% formaldehyde solution as trapping fluid.

b. Instrumentation

none

c. Taxonomy and systematics

The research focused on population dynamics of ground beetles (Coleoptera: Carabidae). All ground beetles were identified to species level and originally recorded per week and per trap under a stereo microscope. Taxonomic harmonization was ensured by storing new data using the species codes from the 1997 data. Nomenclature changes were frequent over the full sampling period, but few new species have been split off or described. For the current data product, we only provide the summed abundance across all species.

d. Permit history

All research in the reserve has been permitted by the managing authority Natuurmonumenten.

e. Legal / organizational requirements

NA

4. Project personnel

Project initiator P.J. den Boer†

Data collectors: P.J. den Boer & Th. van Dijk (1959-1997), R. Vermeulen (2002- present) for Foundation WBBS

Field Work: 1959-1970 Gerard Sanders, Arnold Spee and Taco van Huizen 1970 - 1998, Alje Woldering 2004 - present.

Data curation: R. van Klink (roel.vanklink@gmail.com) for Foundation WBBS

5. Post sampling data processing

As described in Van Klink et al (2019), the species abundances of 34 datapoints (out of 12550) had to be imputed to correct for missing data or mistakes in data entry or identification. After compilation and selection of the data, all yearly abundances across all species were aggregated to obtain a measure of the total assemblage abundance per year.

Values in database: abundance per plot per year

5. Related publications

Den Boer, P. J. 1977. Dispersal power and survival - Carabids in a cultivated countryside. Miscellaneous papers of the Landbouw Hogeschool Wageningen 4.

Den Boer, P. J. 1981. On the Survival of Populations in a Heterogeneous and Variable Environment. Oecologia 50:39–53.

Den Boer, P. J. 1986. The present status of the competitive exclusion principle. Trends in ecology & evolution 1:25–28.

Den Boer, P. J., and T. S. Van Dijk. 1994. Carabid beetles in a changing environment. Wageningen Agricultural University Papers 6:1–30.

Bowler, D. E., C. Hof, P. Haase, I. Kröncke, O. Schweiger, R. Adrian, L. Baert, H.-G. Bauer, T. Blick, R. W. Brooker, W. Dekoninck, S. Domisch, R. Eckmann, F. Hendrickx, T. Hickler, S. Klotz, A. Kraberg, I. Kühn, S. Matesanz, A. Meschede, H. Neumann, B. O'Hara, D. Russell, A. F. Sell, M. Sonnewald, S. Stoll, A. Sundermann, O. Tackenberg, M. Türkay, F. Valladares, K. van Herk, R. van Klink, R. Vermeulen, K. Voigtländer, R. Wagner, E. Welk, M. Wiemers, K. H. Wiltshire, and K. Katrin Böhning-Gaese. 2017. Cross-realm assessment of climate-change impacts on species' abundance trends. Nature Ecology and Evolution 1:1–7.

Van Klink, R., J. Lepš, R. Vermeulen, and F. de Bello. 2019. Functional differences stabilize beetle communities by weakening interspecific temporal synchrony. Ecology 100:1–11.

DataSource_ID 1328: Hoverflies of a suburban garden in Leicester, UK (data of Dr Jennifer Owen)

Taxonomic focus: Diptera: Syrphidae

1. Site description

a. Site type

Suburban garden in Leicester, described fully in Owen (1991, 2010)

b. Geography

Decimal degrees: Latitude: 52.6436; Longitude: -1.0625

c. Habitat

Suburban garden with planted borders and a lawn

d. Geology / Landform

Leicester is located in the lowland Midlands, close to the geographical centre of England. Scraptoft is in the northeast of Leicester, on slightly acidic loam-clay soil. Where not built upon, the land was arable grassland. See Owen (2010, 1991).

e. Watersheds, hydrology

NA

f. Site history and current management

The land has been a suburban garden with flowers for decades

g. Climate

Leicester has a maritime climate with mild summers and wet winters. Rain falls throughout the year, and levels of sunshine are low. On average, 11 days per year reach 25° C or higher. Average annual rainfall is 685 mm. For more details, see Owen (2010, 1991).

2. Experimental or sampling design

a. Design characteristics

Insects were trapped with a Malaise trap at the same location every year, set up in April and taken down in autumn.

b. Permanent plots

A single Malaise trap always in the same place every year.

Number of plots: 1.

c. Data collection period, frequency etc.

Data collection period: 1972-2001. The Malaise trap catch was emptied weekly, between April 1st and October 31st. The exact start and end of the season depended on the weather. Weeks were numbered from Jan 1st.

3. Research methods

a. Field / laboratory

Hoverflies (Diptera: Syrphidae) were extracted from the catch and identified by Dr Jennifer Owen. Many other taxa were extracted and sent to appropriate experts (e.g. bees and wasps to M.E. Archer in York).

b. Instrumentation

none

c. Taxonomy and systematics

Hoverflies (Diptera: Syrphidae) were identified using Coe (1953) and later using Stubbs & Falk (1983). Difficult specimens were checked by experts.

d. Permit history

NA

e. Legal / organizational requirements

NA

4. Project personnel

Project initiator: Dr Jennifer Owen†

Data collectors: Dr Jennifer Owen†

Data curation: Dr Francis Gilbert (francis.gilbert@nottingham.ac.uk)

5. Post sampling data processing

Samples were taken at weekly intervals. We standardized the start and end of the season by removing week numbers below 15 (early April) and above 44 (late October). The remaining weeks were grouped into 4-week periods, approximately matching the months. Months with fewer than 4 weeks were removed from the data set.

Values in database: abundance per week.

5. Related publications

Coe, R. L. 1953. Diptera: Syrphidae. Handbooks for the identification of British insects 10. Royal Entomological Society of London, London.

Hassall, C., J. Owen, and F. Gilbert. 2017. Phenological shifts in hoverflies (Diptera: Syrphidae): linking measurement and mechanism. Ecography 40:853–863.

Owen, J. 1991. The ecology of a garden - the first fifteen years. Cambridge university press, Cambridge, New York, Port Chester, Melbourne, Sydney.

Owen, J. 2010. Wildlife of a Garden: A Thirty-year Study. Royal Horticultural Society, Kew, UK.

Owen, J., and F. S. Gilbert. 1989. On the abundance of hoverflies (Syrphidae). Oikos 55:183–193.

Stubbs, A. E., and S. J. Falk. 1983. British hoverflies: an illustrated identification guide. 2nd edition. British Entomological & Natural History Society.

DataSource_ID 1353 and 1445: Ants at Portal, Arizona LTER site (bait and abundance)

Taxonomic focus: Hymenoptera: Formicidae

1. Site description

a. Site type

Desert shrubland and arid grassland mixture embedded in a semi-natural landscape.

b. Geography

Decimal degrees:

Latitude: 31.94

Longtitude: -109.08

c. Habitat

The site is a mix of woody vegetation dominated by whitethorn acacia (*Vachellia constricta,* formerly *Acacia constricta*), grasses (predominately *Bouteloua* species and *Aristida adscensionis*), and wide diversity of herbaceous plants. The proportions of these vegetation types have changed over time, with woody vegetation increasing over the decades. This desert scrub is crossed by ephemeral streams, dominated by dense stands of *Vachellia constricta*.

d. Geology / Landform

All plots are located on an alluvial plain generated by streams descending from the nearby Chiricahua Mountains. Soil at the site is sandy and very coarse, nutrient poor, and poor at holding water. The elevation is approximate 1330 m above sea level.

e. Watersheds, hydrology

NA

f. Site history

The site was part of the territory of several indigenous Apache bands before they were forcibly removed in the late 1800s. European colonists introduced livestock grazing to the area, which continues to be a dominant land use type in the region. The study site and much of the surrounding region is currently managed by the United States Bureau of Land Management, which leases the land for cattle grazing. The 20 ha study site was fenced in 1977 to exclude cattle, but large native herbivores such as deer (*Odocoileus* sp.) and javelina (*Pecari tajacu*) occasionally access the plots.

For the first decade of the study, grasses were abundant at the site and dominated by *Bouteloua aristida* and *Aristida adscensionis*. Increases in woody vegetation have shifted the habitat from a more open landscape to one dominated by shrubs.

g. Climate

Mean monthly temperature at the site is 17.1°C with monthly averages ranging from 0.98 to 31.3°C. Average annual precipitation is of 293 mm per year, which falls primarily as rain during two wet seasons occurring roughly November-March and July-September.

2. Experimental or sampling design

a. Design characteristics

The site consists of 24, 50 m × 50 m plots, several of which were included in experimental treatments manipulating rodents, plants and ants. For this data project, we only provide data for the two long-term control (unmanipulated) plots (plot 11 and 14).

b. Permanent plots

Each plot contains 49 permanently marked sampling locations arranged in a 7 x 7 grid, with 6.25 meters between each station. All plots and sampling stations have been permanently located with rebar and fencing, representing repeated surveys of the same locations.
Number of plots in this data product: DataSource_ID 1353: 2; DataSource_ID 1445: 2.

c. Data collection period, frequency etc.

Data on ants were collected at the site during a two-week period in July, each year between 1977 and 2009. At each sampling occasion, each plot was surveyed once for numbers of colonies and once for total abundance of ants.

3. Research methods

a. Field / laboratory

On each plot, colony counts were conducted in 2-m radius circles located two meters north of each station. All colony openings and the species associated with them were identified. Since a single colony can have multiple openings, colony openings of the same species within 0.5 m of each other were counted as representing a single colony. For a subset of species (*Novomessor* spp., *Pheidole desertorum*, *Pheidole militicida*, *Pogonomyrmex barbatus*, *Pogonomyrmex maricopa*, *Pogonomyrmex rugosus)* the entire plot (not just the 49 sampling circles) was surveyed for colonies. These species are large-bodied, relatively rare and otherwise frequently missed by the sampling circles. For *Solenopsis*, only the presence (1) of any colony entrance within the 2 m radius circle was recorded. To obtain abundance data for a plot, bait was placed at 25 of these stations – at every other station to create a checkerboard pattern – at dawn. After 1.5 hours, baits were surveyed and species and numbers of individuals in a 10 cm circle centered on the bait pile were recorded. For more details on the site and methods, see Ernest et al (2018).

b. Instrumentation

NA

c. Taxonomy and systematics

Species identifications were conducted initially by Dr. Diane Davidson (project initiator) and confirmed in the 1990s by Dr. Michael Kaspari.

d. Permit history

The study site operates under a land use agreement with the United States Bureau of Land Management.

e. Legal / organizational requirements

N/A

f. Post processing

For this analysis, we took the sum over all ant species per sampling date per plot. This was done separately for the bait piles (DataSource_ID 1353) and the nest counts (DataSource_ID 1445). For our analysis, we selected only the unmanipulated control plots (plots 11 and 14).

DataSource_ID 1353: removed flag = 10. Values in database: Abundance (number of ants) per plot per date.

Datsource_ID 1445: Because of differences in counting protocol we removed data with flags 5, 6, 9, and 10. Values in database: Abundance (number of ant nests) per plot per date.

4. Project personnel

Project initiators: Diane Davidson and James H. Brown

Data collectors: Diane Davidson, Ed Heske, Tom Valone.

Data curators: Morgan Ernest and Tom Valone

5. Related publications

Ernest, S. K. M. 2018. Portal Ant Data. https://github.com/weecology/PortalData/tree/master/Ants.

Kaspari, M., and T. J. Valone. 2002. On ectotherm abundance in a seasonal environment-Studies of a desert ant assemblage. Ecology 83:2991–2996.

Valone, T. J., J. H. Brown, and E. J. Heske. 1994. Interactions between rodents and ants in the Chihuahuan Desert: An update. Ecology 75:252–255.

Valone, T. J., and M. Kaspari. 2005. Interactions between granivorous and omnivorous ants in a desert grassland: Results from a long-term experiment. Ecological Entomology 30:116–121.

Datasource_ID 1388 Freshwater invertebrates in Californian mountain streams, USA

Taxonomic focus: all freshwater invertebrates, excluded here: taxa not belonging to the classes Insecta, Arachnida or Entognatha.

1. Site description

a. Site type:

Streams in Coastal California, USA

b. Geography:

All plots (decimal degrees):

KC-3: 38.8237, -122.3394

HC-7A: 38.8614, -122.4131

HC-5: 38.8271, -122.3760

HC-10: 38.8130, -122.3747

c. Habitat:

The streams are located in interior coastal woodland chaparral

d. Geology / Landform:

Serpentine predominates and antigorite and lizardite, both lamellar (sheeted) minerals, are the most common forms of serpentine at the site. The geology is well described in https://naturalreserves.ucdavis.edu/sites/g/files/dgvnsk1091/files/inline-files/MCL_geology.pdf

e. Watersheds, hydrology:

The plots studied were two first order streams (one in Hunting Creek, the other Knoxville Creek) and two second order streams, both in Hunting Creek. The Mediterranean climate of this area has cool wet winters and hot dry summers. One of the first order streams and one of the second order streams consistently went dry during the summer dry season. The other first and second order streams maintained water in pools in the dry season

f. Site history:

The site has a history of gold mining and long human inhabitance. The human history is well described in https://naturalreserves.ucdavis.edu/sites/g/files/dgvnsk1091/files/inline-files/MCL_human_history.pdf

For a detailed history of the area and other research see https://naturalreserves.ucdavis.edu/mclaughlin-reserve/natural-history-of-mclaughlin-reserve

g. Climate:

The Mediterranean climate of this area consists of wet winters and dry summers

2. Experimental or sampling design

a. Design characteristics:

Throughout the 20 years of these studies, the same person (V. Resh) collected all of the samples and the same person (E. McElravy) did all of the invertebrate identifications.

b. Permanent plots:

Two were in first order streams and two were in second order streams.

Number of plots: 4

c. Data collection period, frequency etc:

Samples were collected annually from 4 plots in the wet season (April) for aquatic invertebrates and fish. One plot was sampled annually in the summer dry season (August) for aquatic invertebrates. Plots were sampled for 19-20 years

3. Research methods

a. Field / laboratory:

Surber samplers (1 square foot) were used to collect 5 replicate samples per plot

b. Instrumentation

NA

c. Taxonomy and systematics:

Invertebrates were generally identified to genus. Fish data are also available.

d. Permit history**:**

Permits were granted

e. Legal / organizational requirements:

Permission was granted by the property owner

f. Post processing:

Data were stored in excel spread sheets and are available at https://nature.berkeley.edu/reshlab/longtermdata.htm.

In the current data product, only the invertebrate data from Hunting Creek and Knoxville Creek are included.

4. Project personnel

Project initiator: Vincent H. Resh and Peter Connors

Data collectors: Vincent H. Resh., Eric P. McElravy, Peter Connors and many technicians

Data curator: Vincent H. Resh see https://nature.berkeley.edu/reshlab/longtermdata.htm

5. Related publications

Resh et al. 1988, 2005, 2013, Bêche et al. 2006, 2009, Bêche and Resh 2007a, 2007b, Mazor et al. 2009, Lawrence et al. 2010, Milner et al. 2016

Bêche, L. A., P. G. Connors, V. H. Resh, and A. M. Merenlender. 2009. Resilience of fishes and invertebrates to prolonged drought in two California streams. Ecography.

Bêche, L. A., E. P. McElravy, and V. H. Resh. 2006. Long-term seasonal variation in the biological traits of benthic-macroinvertebrates in two Mediterranean-climate streams in California, U.S.A. Freshwater Biology.

Bêche, L. A., and V. H. Resh. 2007a. Biological traits of benthic macroinvertebrates in California mediterranean-climate streams: Long-term annual variability and trait diversity patterns. Fundamental and Applied Limnology.

Bêche, L. A., and V. H. Resh. 2007b. Short-term climatic trends affect the temporal variability of macroinvertebrates in California 'Mediterranean' streams. Freshwater Biology 52:2317–2339.

Lawrence, J. E., K. B. Lunde, R. D. Mazor, L. A. Bêche, E. P. McElravy, and V. H. Resh. 2010. Long-term macroinvertebrate responses to climate change: Implications for biological assessment in mediterranean-climate streams. Journal of the North American Benthological Society.

Mazor, R. D., A. H. Purcell, and V. H. Resh. 2009. Long-Term variability in bioassessments: A twenty-year study from two northern california streams. Environmental Management.

Milner, A. M., A. Woodward, J. E. Freilich, R. W. Black, and V. H. Resh. 2016. Detecting significant change in stream benthic macroinvertebrate communities in wilderness areas. Ecological Indicators.

Resh, V. H., L. A. Bêche, J. E. Lawrence, R. D. Mazor, E. P. McElravy, A. P. O'Dowd, D. Rudnick, and S. M. Carlson. 2013. Long-term population and community patterns of benthic macroinvertebrates and fishes in Northern California Mediterranean-climate streams.

Resh, V. H., L. A. Bêche, and E. P. McElravy. 2005. How common are rare taxa in long-term benthic macroinvertebrate surveys?

Resh, V. H., J. K. Jackson, and E. P. McElravy. 1988. The use of long-term ecological data and sequential decision plans in monitoring the impact of geothermal energy development on benthic

macroinvertebrates. Verhandlungen International Vereinigung fur Theoretische und Angewandte Limnologie 23:1142–1146.

DataSource_ID 1474: Grasshoppers, true bugs, and plant- and leafhoppers in different grassland types in Germany

Taxonomic focus: Orthoptera, Hemiptera: Heteroptera, Hemiptera: Auchenorrhyncha

1. Site description

a. Site type

Temperate grassland (dry, mesic and moist) on sandy or loamy soil.

b. Geography

Decimal degrees: Longitude: 9.07 - 9.17

Latitude: 52.48 - 52.57

c. Habitat

The plots were located in a variety of settlement structures within the community borders of the municipalities of Stolzenau and Leese, in the north-western German state of Lower Saxony. Their habitat types range from mainly dry *Arrhenatherethum elatioris* communities to moist *Phragmiteteum australis* communities. Most plots were mown twice a year and some were grazed by livestock (sheep, horse or cattle).

d. Geology / Landform

Generally, the landscape is a typical 'old drift' landscape consisting of aeolian sandy soils deposited during the last ice age. These sand soils are interspersed with bogs, and at the edges show marshland on clay soil. All plots are located close to the Weser river and are influenced by the geology of the Middle Weser Region. Plots were located on sandy and loamy soils. The elevation of the area is about 30 meter above sea level.

e. Watersheds, hydrology

NA

f. Site history

The original work had the aim to investigate insect communities along a moisture gradient. Thus, the plots differed considerably in their abiotic conditions. Two of them were dry grasslands on sandy substrate, 4 were mesic on loamy substrate, and three were moist on loamy substrate.

The sites were located in a mixed-use landscape (urban, cropland, pastures and forest), typical of the region. The original publications provided brief description of land-use practises of all plots. Most of them were mown twice a year or grazed until 1951. Following that, and until the 2009 resurveys reported here, management was less consistent.

g. Climate

The area has a temperate climate with a mean annual temperature between 8.7 and 9.2 °C and annual precipitation ranging between 751 and 812 mm (1951/2009).

2. Experimental or sampling design

a. Design characteristics

The long-term data were collected as part of a study resampling sites first collected by Marchand (1953). In 2009, nine out of twelve plots studied by Marchand were resampled using the same methods. Three plots had been converted into arable fields, and were not resampled. For more information see Schuch et al (2012).

b. Permanent plots

Number of plots: 9

c. Data collection period, frequency etc.

In 1951, plots were sampled eight times from the beginning of May to September; samples in 2009 matched these sampling dates as close as possible.

3. Research methods

a. Field / laboratory

Insects were collected using a sweep net (30 cm in diameter; 100 beats per visit) during each sampling event in both sampling periods (Marchand, 1953) .

b. Instrumentation

none

c. Taxonomy and systematics

The research focussed on long-term dynamics in insect communities of grasshoppers (Orthoptera), true bugs (Heteroptera), and leafhoppers and planthoppers (Auchenorrhyncha) within the Hemiptera. All individuals were identified to species level (Auchenorrhyncha and Orthoptera by Sebastian Schuch, Heteroptera by Julian Bock) and recorded per sampling event under a stereo microscope. Taxonomic harmonization was ensured by storing new data using the species codes from the 1951 data (revised species names were changed).

d. Permit history

Access to all plots was granted by the property owners.

e. Legal / organizational requirements

NA

f. Post processing

Raw data were obtained as species × date matrices. Species names were corrected and harmonized across all data. Plots and dates that were not resampled were removed. The raw data are also available at the website of the Georg-August University Göttingen (CC-BY-ND).

Number of plots: 9

Values in database: Abundance of all taxa combined per plot per date.

4. Project personnel

Project initiator: Christoph Leuschner and Matthias Schaefer

Data collectors: Sebastian Schuch, Julian Bock, Karsten Wesche

Data curator: Sebastian Schuch (sschuch@gwdg.de)

5. Related publications

Marchand 1953, Schuch et al. 2012a

Marchand, H. 1953. Die Bedeutung der Heuschrecken und Schnabelkerfe als Indikatoren verschiedener Graslandtypen. Betragen zur Entomologie 3:116–162.

Schuch, S., J. Bock, B. Krause, K. Wesche, and M. Schaefer. 2012a. Long-term population trends in three grassland insect groups: A comparative analysis of 1951 and 2009. Journal of Applied Entomology 136:321–331.

DataSource_ID 1475: Leafhoppers and planthoppers (Auchenorrhyncha) in different dry grassland types in Germany

Taxonomic focus: Hemiptera: Auchenorrhyncha

1. Site description

a. Site type

Temperate dry grassland on sandy, loamy or calcareous substrate.

b. Geography

Dry grasslands were located within the borders of three federal states of Eastern Germany: Brandenburg, Saxony, and Thuringia.

Decimal degrees: Latitude: 50.89 – 53.24

Longitude: 10.95 – 14.57

c. Habitat

The plots were located in a variety of dry grassland biotopes spread over Eastern Germany. They represent the range of dry grassland on sandy (mainly in Brandenburg), loamy (in Saxony), and calcareous (in Thuringia) substrates. Most of the plots were part of a *Stipa capillata* steppe or a subcontinental dry grassland site; three were *Corynephorus canescens* sandy grasslands. In the more recent sampling period, some plots had become encroached by small shrubs (*Prunus sp.* and *Rosa* sp.).

d. Geology / Landform

Plots in Brandenburg are located on aeolian sand deposits from the last ice age (Weichselien), when the region was not glaciated. The elevation of the plots ranges from 6 to 45 m above sea level.

Plots in Saxony are either on loamy or sandy substrate from different origins. Half of the plots were close to the river Elbe, thus their soil was influenced by alluvial deposits. One plot is located in the Ore Mountains on loamy substrate. The rest of the plots are on sandy substrate mixed with organic input, originally also formed by the last ice age. The elevation of the plots ranges from 106 to 240 m above sea level.

Most of the plots in Thuringia are located in the Kyffhäuser region on calcareous substrate. Their gypsum-rich and weathered karst subsoil impair forest growth. The rest of the plots are located on the Schwellenburg, a Keuper hill which exhibits quite similar substrate conditions. The elevation of the plots ranges from 170 to 227 m above sea level.

e. Watersheds, hydrology

NA

f. Site history

Management history differed between sites and is best described as inconsistent. Most of the plots were irregularly grazed by sheep (some by cattle or goats), some were mown once or twice a year, and other were just trimmed periodically to control shrub encroached edges. One plot located on the Schwellenburg is burned every two to three years in recent times. When plots were first surveyed in the 1960s, management of the plots was not recorded.

During the first investigation period (1964-1966), 4 plots were located in protected sites. During the following decades, more sites gained protection status. In the recent investigation period (2008-2010), only three plots were not located in protected sites.

g. Climate

Eastern Germany has a temperate climate with continental influence. The mean annual temperature of 1964 to 1966 was 8.0 °C, and of 2008 to 2010 it was 8.8 °C. Mean annual precipitation of 1964 to 1966 was 862 mm, and of 2008 to 2010 it was 789 mm.

2. Experimental or sampling design

a. Design characteristics

The long-term data were collected as part of a resampling study of the work of Schiemenz (1969). In 2008-2010, 27 plots were resampled using the same methodology. For more information, see Schuch et al (2012b).

b. Permanent plots

Number of plots: 27

c. Data collection period, frequency etc.

Data collection in the first investigation period was done between 1962 and 1967. The number of sampling events differed between plots. Some plots were sampled up to three times each year in spring, summer, and autumn. Others were only sampled for one year (or two consecutive years) with fewer sampling events per year. Most sampling took place in Saxony and Thuringia.

Data collection in the more recent investigation period was done from 2008 to 2010. All plots were sampled in summer and autumn of 2008 and in spring, summer and autumn of 2009. Four plots in Saxony and five plots in Thuringia were more intensively sampled in the first period, and thus again sampled in spring, summer and autumn of 2010.

3. Research methods

a. Field / laboratory

Leafhopper and planthopper communities were sampled using a sweep net (30 cm in diameter; 200 beats per visit).

b. Instrumentation

none

c. Taxonomy and systematics

The research focussed on long-term dynamics in insect communities of leafhoppers and planthoppers (Auchenorrhyncha). All individuals were identified to species level (by Sebastian Schuch with support of Herbert Nickel) and originally recorded per sampling event under a stereo microscope. Taxonomic harmonization was ensured by storing new data using the species codes from the 1960s data (revised species names were changed).

d. Permit history

Access to all plots was either granted by the responsible nature conservation agency or (in two cases) by the property owners.

e. Legal / organizational requirements

NA

f. Post processing

An analysis of the data is published in Schuch et al. (2012b). After compilation and selection of the data, the abundances across all species were aggregated to obtain a measure of the total assemblage abundance per sampling date. The raw data are available at http://hdl.handle.net/11858/00-1735-0000-0006-AE2A-6 (CC-BY-ND).
Number of plots: 27
Values in database: Abundance per plot per date.

4. Project personnel

Project initiator: Christoph Leuschner and Matthias Schaefer

Data collectors: Sebastian Schuch, Karsten Wesche

Data curator: Sebastian Schuch (sschuch@gwdg.de)

5. Related publications

Schiemenz, H. 1969. Die Zikadenfauna mitteleuropäischer Trockenrasen (Homoptera, Auchenorrhyncha): Untersuchungen zu ihrer Phänologie, Ökologie, Bionomie und Chorologie. Faunistische Abhandlungen Staatliches Museum für Tierkunde in Dresden 6:201–280.

Schuch, S., K. Wesche, and M. Schaefer. 2012b. Long-term decline in the abundance of leafhoppers and planthoppers (Auchenorrhyncha) in Central European protected dry grasslands. Biological Conservation 149:75–83.

DataSource_ID 1476: butterflies in grasslands, Wisconsin USA

DataSource_ID 1477: butterflies in barrens, Wisconsin USA

DataSource_ID 1478: butterflies in sphagnum bogs, Wisconsin USA

Taxonomic focus: Lepidoptera: Rhopalocera.

1. Site description

a. Site type

Grasslands: ranging from sites with primarily non-native flora to sites with high-quality native prairie. Soils include limestone, clay, silt, and a few sandy sites.

Barrens: Relatively dry open to semi-open sites with primarily native flora usually including ericaceous shrubs, mainly on sandy soils.

Sphagnum bogs: Moist depressions with a sphagnum mat and usually significant ericaceous shrubs throughout northern Wisconsin and 1 site in central Wisconsin.

b. Geography

Decimal degrees

Grasslands	Latitude: 42.69 – 44.41;	Longitude: -91.02 – -89.49
Barrens	Latitude: 43.55 – 46.62;	Longitude: -94.95 – -88.25
Bogs	Latitude: 44.34 – 46.86;	Longitude: -92.10 – -88.95

c. Habitat

Grassland plots sampled representative areas in two habitat types. All sites were agricultural lands of some sort within the last century.

Prairies: mostly mesic to very dry open to shrub-steppe preserve areas with mainly native plants that have not been tilled; a few sites included areas as wet as sedge meadows.

Oldfield grasslands: primarily dry-mesic to wet-mesic non-native flora on open areas of wildlife lands, usually on former intensive agricultural lands.

Barrens were of three habitat types that were generally less degraded or with less surrounding habitat degradation than grasslands:

Dry open to closed savannas with wild lupine (*Lupinus perennis*) in central and northwestern Wisconsin on sandy soil.

Dry open to closed savanna without lupine in south-central Wisconsin on sandy soil.

Mesic to dry heaths (open or closed savannas) in northern Wisconsin with a moister microclimate than other barrens but usually on sandy soil.

Bogs were of 3 habitat types that appear to be the least altered habitats in Wisconsin:

Muskeg bogs: black spruce *Picea mariana*–Cottongrass *Eriophorum spissum–Carex oligosperma*–Sphagnum savanna similar in elevation to surrounding uplands. This bog type is drier and has bigger hummocks than the other bog types.

Kettleholes: Sphagnum moss (*Sphagnum fuscum*)-leatherleaf (*Chamaedaphne calyculata*) mats usually with abundant Small Cranberry (*Vaccinium oxycoccos*) floating on lakes or sunk in deep depressions.

Coastal peatland: Very wet sites with sedge mats, usually more Tamarack (*Larix laricina*) trees than spruces, and some ridges of muskeg-like vegetation in estuaries along the Lake Superior coast.

d. Geology / Landform

Prairie grasslands in southwestern Wisconsin were mainly on hilly sites in "The Driftless Area" not glaciated during the last major Ice Age. Some have limestone beneath them. Oldfield grasslands in southcentral and central Wisconsin are relatively level and on clay or silt soils with limited sand. All grassland sites are approximately 200-300 meters above sea level.

Most barrens were glaciated in the last Ice Age and have sandy soils from glacial outwash or because they were in or near an ancient glacial lake. Elevations about 200-400 meters.

Bogs seem to be on mucky soils and all have been glaciated numerous times. Some are probably formed in depressions where ice blocks sank into the ground to make depressions. Some botanists believe that bogs in some of these locations are Pleistocene relicts that only continue to exist because of ecological inertia. Elevations range from coastal peatlands equal to adjacent Lake Superior (180 m) to 400 meters.

e. Watersheds, hydrology

Grasslands: Most sites were well above surface water except the parts next to small streams in a few sites. All are in the Mississippi River watershed.

Barrens: Sites were well above surface water and rather dry. These sites fell within all three major watersheds in the region: Lake Superior and Lake Michigan watersheds, which flow into the St. Lawrence Seaway, and the Mississippi River watershed.

Bogs: Most are in the Lake Superior or Lake Michigan drainages; A few bogs are in the Mississippi River basin. Some bogs appear to be the bottom of their own small watershed, flowing to nowhere else.

Most muskegs are not associated with major streams but have ditches by them and occasionally have indistinct diffuse streams flowing very slowly through them.

Some Kettleholes have no outflows; others have small streams draining out of them

Coastal peatlands are directly connected to the water of Lake Superior 100-500 meters away through stream mouths (3 sites) or groundwater beneath the beach by the Lake (1 site)

f. Site history and current management

All grassland sites were formerly used for agriculture and they are located in the part of the study area with the highest human population density.

Non-native oldfield grasslands were usually cropped or heavily grazed then abandoned 5-70 years ago and bought by governments as wildlife lands. These are managed in diverse ways to promote populations of a number of animal species (especially game and rare species): mix of small amounts of tree and brush cutting, haying, and burning at both site complexes, with large amounts of low-intensity grazing and periodic haying at the larger site complex.

Prairie sites were grazed with some haying until 20-70 years ago, and were semi-natural with mainly native flora when the study began. Most of these sites have become more degraded because of encroachment by shrubs and non-native plants since becoming preserves. Most are managed with fire (3-5 year average rotation) and with brush cutting and herbiciding to control shrubs and weeds. Two sites had much less burning than the others, two sites had significant cattle or goat grazing, and one site had extensive annual mowing or haying of draws and weedy patches.

Barrens are located in a working landscape of periodically logged forests and savannas. The land is not usually suitable for more intensive agriculture than forestry. These habitats are more resilient than grasslands against past human disturbances and their flora does well on sandy soils as long as sites are not repeatedly scarified. Nearly all barrens had periodic tree and brush cutting to keep them open. Some barrens had evidence of a number of herbivorous mammals (deer, rodents, rabbits) preventing most trees seedlings and saplings from establishing. Most open barrens had periodic or once-only burning during the study. Some

sites were burned in a large accidental spring wildfire in 1977 and another in 1989. Some sites were road corridors, partially mowed 1-2 times a year. Some were powerline corridors with brush cutting and herbiciding only every 5-10 years. Some barrens on county forest or state forest land are logged areas gradually re-growing into mature forest under which the barrens butterfly fauna stops persisting after a while.

Bogs: Besides logging nearby and ditches where bogs meet roads, these sites are relatively pristine.

g. Climate

Grasslands, Barrens, and most Bogs have a temperate continental climate without much influence of the nearby large lakes (Lake Superior or Lake Michigan). Coastal bogs remain much cooler than all inland sites until early July because of the lag time for Lake Superior's water to warm up after the ice melts in April and May.

All sites are subject to extremes of a continental climate: Annual temperature ranges are large.

Grasslands have a mean January temperature of -7 to -10°C, a mean July temperature of 21 to 23°C, and an average of 800-920 mm of precipitation (rain and snow) per year.

Barrens have a mean January temperature of -8 to -12°C, a mean July temperature of 19 to 22°C, and an average of 750-900 mm of precipitation (rain and snow) per year.

Bogs have a mean January temperature of -9 to -12°C, a mean July temperature of 18 to 22°C, and an average of 750-850 mm of precipitation (rain and snow) per year.

2. Experimental or sampling design

a. Design characteristics

The aim of the monitoring program was to investigate the long-term effects of nature management on butterflies in prairies, pine barrens and bogs. Each of these habitats had a number of focal species, but at all occasions, all butterfly species were identified and recorded. The sites were all located on conserved and other public lands. In the prairies and barrens, sites with a wide range of habitat quality were chosen (i.e. a gradient of degraded to high quality sites), with the restriction that sites were clumped to optimize traveling time.

b. Permanent plots

Survey routes were approximately repeatable on each visit.

Number of plots:

Grasslands (DataSource_ID 1476): 56

Barrens (DataSource_ID 1477): 47

Bogs (DataSource_ID 1478): 35

c. Data collection period, frequency etc.

Surveys were in 1987-2017 in grasslands, 1988-2017 in barrens, and 1990-2017 in bogs.

Sampling was targeted to the times of year and sites when specialized butterflies of each habitat type could be sampled in their main flight periods (adult life stage). The overall goal was to optimize the number of observations over time for the focal species that were rare, declining, or of restricted range. This usually required several visits per warm season to get opportunities to get counts during each specialist's flight.

3. Research methods

a. Field / laboratory

Sampling effort (time and distance), time of day, and the weather were recorded at all sample occasions. All individuals of all butterfly species were counted. We subdivided our route into units (or segments, typically 200-800 m long) based on differences in vegetation and management history (type and year). We counted all butterflies seen within the unit in unlimited width transects with the aid of binoculars. We did not capture butterflies.

b. Instrumentation

None

c. Taxonomy and systematics

Butterflies were identified to species using Cassie et al. (2001) as the taxonomic reference. Few nomenclatural changes occurred during the study. One focal species, Karner Blue, was elevated to the full species *Lycaeides samuelis* during the study (Forister et al., 2011), whereas it had been listed as a subspecies *L. melissa samuelis* before.

d. Permit history

No permits were needed because all of our surveys were on public land or on private land where we had permission to survey, and we used methods of unobtrusive "nature study" (no animal handling) permissible for all site visitors.

e. Legal / organizational requirements

NA

4. Project personnel

Project initiator: Ann B. Swengel and Scott Swengel

Data collectors: Ann B. Swengel and Scott Swengel

Data curator: Ann B. Swengel and Scott Swengel

5. Post sampling data processing

Each of the data sets was delivered in several parts. These were combined into one file per data set, and duplicates were removed. In each of the data sets, a number of standardizations had to take place before the data could be used: First we homogenized the date format and the plot and unit (sections) names. After transforming the files to long format, we homogenized species names and removed the summed values for species of which the sexes were counted separately. We removed any day-active Noctuidae from the data, as these were not recorded consistently. Over the course of the investigation, some transects were split, and the different parts recorded separately, because some management change had occurred. For this analysis, these transect parts were merged back together. The plots were spread over a number of reserves and other public lands. We added a column with a grouping variable for plots within a location which can be used as random factor for analyses. Finally, because the transect length was not always exactly equal (although quite close), we divided the number of butterflies by transect length.

Values in database: abundance per mile per sampling date.

5. Related publications

Cassie, B., J. Glassberg, A. B. Swengel, and G. Tudor. 2001. North American Butterfly Association (NABA) checklist and English names of North American butterflies. Morristown, NJ.

Forister, M. L., Z. Gompert, J. A. Fordyce, and C. C. Nice. 2011. After 60 years, an answer to the question: What is the Karner blue butterfly? Biology Letters 7:399–402.

Swengel, A. B., and S. R. Swengel. 2001. A ten-year study to monitor populations of the regal fritillary, Speyeria idalia, (Lepidoptera : Nymphalidae) in Wisconsin, USA. Great Lakes Entomologist 34:97–115.

Swengel, A. B., and S. R. Swengel. 2015a. Grass-skipper (Hesperiinae) trends in midwestern USA

grasslands during 1988–2013. Journal of Insect Conservation 19:279–292.

Swengel, S. R., and A. B. Swengel. 2015b. Assessing abundance patterns of specialized bog butterflies over 12 years in northern Wisconsin USA. Journal of Insect Conservation 19:293–304.

DataSource_ID 1479: Invertebrates in moorland in Tasmania, Australia

Taxonomic focus: all arthropods. Myriapods and crustaceans are excluded for this data product

1. Site description

a. Site type

Temperate moorland on shallow peat

b. Geography

Decimal degrees:

Latitude: -42.84°

Longitude: 146.24°

c. Habitat

Moorland was dominated by sedges, (primarily *Gymnoschoenus sphaerocephalus* and shrubs (e.g. *Leptospermum nitidum* and *Bauera rubioides*).

d. Geology / Landform

The site sits within a plain of buttongrass (*Gymnoschoenus sphaerocephalus)* moorland which is underlain by Precambrian sediments. The elevation of the area is 320 m

e. Watersheds, hydrology

NA

f. Site history

The lowland site was last burned by a wildfire in 1972 (27 years before sampling commenced). It is also believed to have burned at least three other times in recent history (1898, 1933 and 1964), and likely by Aboriginal people before European colonization. As part of the study, the site was burned in 2001.

g. Climate

The study site has a cool temperate maritime climate. Based on the nearest (18 km) weather station at Strathgordon (Australian Bureau of Meteorology Station Number 097053), the mean annual rainfall is 1,951 mm, with rainfall highest in winter and lowest in January–March. Minimum temperatures in February is 9.2°C; and in July is 3.2°C. Maximum temperatures in summer are 19–20°C and in winter is 10.0°C.

2. Experimental or sampling design

a. Design characteristics

Six 30 by 30 m plots were established with three plots randomly allocated for a low intensity burn in 2001 (two years after the start of sampling). Invertebrates were sampled using pitfall traps and sweep nets pre- and post-treatment burns

b. Permanent plots

Six permanent contiguous 30 x 30 m plots were established in a south-east to north-west alignment Plots 4 to 6 were offset from plots 1 to 3 to account for variability in vegetation and topography at the site. The highest point of plot 1 was at an altitude of 351 m (south-eastern corner), while the lowest point was at 347 m asl at plot 6 (north-eastern corner). As part of the study, plots 1, 4 and 6, along with much of the plain surrounding all six plots, were burned on 23rd of April 2001.
Number of plots: 6

c. Data collection period, frequency etc.

Invertebrates were sampled on three occasions, spanning three years prior to the treatment burns and then on six occasions spanning 1-14 years, after the burns. Sampling was conducted in March and in this data product the samples from 1999 – 2015 are included.

3. Research methods

a. Field / laboratory

Insects and arachnids were sampled using pitfall traps (225 ml drinking cup with a 7 cm opening, containing 100 ml of 70% ethanol and a dash of glycerol, inserted into a PVC tube, with a roof to prevent rain from entering). 16 pitfall traps were used per plot in a 4 by 4 grid, with 4–5 m between traps. Insects were also sampled using sweep nets (45.6 cm diameter hoop with a white funnel tapered net that was 81 cm long with a 0.9 by 0.3 mm mesh size. A sweep sample comprised 100 passes of the net across the top of vegetation. One sweep of the net would occur at every pace of the collector. Four sweep samples were taken each survey, two each on separate days. A sweep sample would involve three traverses of the plot at the lowland site and two traverses at the montane site. To ensure the same part of the plot was not swept more than once within a survey, imaginary lines across the plot were identified and randomly selected for each sweep sample. At the completion of each sample, all large twigs that were collected in the net were beaten against the inside of the net and removed. Insects in the net were transferred into a sample jar (50 by 50 by 80 cm) containing 70% ethanol. Sweep samples were performed between 10:00-18:00 h on sunny days, with the temperature ranging between 18 and 25°C.

b. Instrumentation

NA

c. Taxonomy and systematics

Insects and arachnids were sorted to major taxonomic groups (predominantly order) by using a dissecting microscope at 10× magnification, and the number of specimens were counted and stored in separate vials for each pitfall and sweep sample. The predominant collections of holometabolous and hemimetabolous insects were adults. Larvae of Lepidoptera, Diptera, Hymenoptera and Coleoptera were identified and counted separately from adults because they have markedly different ecological roles. For taxa with similar-looking immatures and adults (e.g. arachnids, paurometabolous insects) these life stages were counted together. Formicidae were counted separately from other Hymenoptera because ants are widely studied as indicator insects responsive to environmental change.

d. Permit history

All research was conducted with an authority issued under the Tasmania *National Parks and Reserved Land Regulations 1999*.

e. Legal / organizational requirements

NA

f. Post processing

The data were provided as two taxon × plot × date matrices, one for the pitfall traps and one for the sweep-net samples. The pitfall matrix provided mean abundances, averaged over 16 pitfall traps. The sweep-net matrix contained mean abundances, averaged over 4 sweep-net transects. For each method, the abundances of all taxa were summed.

Values in database: abundance per plot per stratum (soil surface (pitfall traps), or foliage layer (sweep net samples) in table *InsectAbundanceBiomass-Data.csv*) per year

4. Project personnel

Project initiator: Michael M. Driessen

Data collectors: Michael M. Driessen

Data curator: Michael M. Driessen

5. Related publications

Driessen, M. M. 2016. Are Moorland Invertebrates Resilient to Fire? PhD Thesis. University of Tasmania.

DataSource_ID 1480: Altitudinal monitoring of invertebrates, Warra–Mt Weld, Tasmania, Australia

Taxonomic focus: ground dwelling arthropods. Myriapods and crustaceans are excluded for this data product

1. Site description

a. Site type

Temperate lowland wet forests through scrubby subalpine woodlands to alpine heaths

b. Geography

Decimal degrees:

Latitude: -42.99° – -43.07°

Longitude: 146.57° – 146.73°

c. Habitat

The vegetation from lowland wet forests through scrubby subalpine woodlands to alpine heaths. The wet forests vary from climax cool temperate rainforest dominated by *Nothofagus cunninghamii* to various sclerophyllous fire sere communities dominated by the genus *Eucalyptus* spp.

d. Geology / Landform

Study area occurs on Jurassic dolerite and landforms include low slopes, mid slopes, upper slopes and ridges

e. Watersheds, hydrology

NA

f. Site history

At the commencement of sampling in 2000/2001, plots had not been burned for at least 65 years (range 65–600 years). There was no history of logging at the sites.

g. Climate

The climate is cool temperate. Climate varies along the altitudinal gradient. Temperature and rainfall recorded at a nearby weather station (Station Number 097024) at an altitude of 495 m are as follows: mean annual precipitation is 1760 mm with mean rainfall totals highest in July–September (199, 240, 193 mm) and lowest in January–February (97, 77 mm). Summer temperatures peak in January (min. 8.4°C – max 19.7°C) with winter temperatures reaching their lowest in July (min 2.6°C – max 8.64°C).

2. Experimental or sampling design

a. Design characteristics

Altitudinal transect ranging from 100 to 1300 m with a sampling plot at each ~100 m contour

b. Permanent plots

Permanent plots were established at every ~100 m of elevation from 100 m to 1300 m asl. Description of plots and sampling regime given in: Bashford et al (2001), Doran et al. (2003), Grove et al. (2004), Driessen and Mallick (2013).

Number of plots: 14

c. Data collection period, frequency etc.

Sampling took place monthly from February to April 2001 and October 2001–April 2002, and was repeated December 2011 till March 2012.

3. Research methods

a. Field / laboratory

At each altitude, six pitfall traps (425 ml plastic cups) were set in PVC sleeves (15 cm length of 9 cm diameter). To protect the traps from rain and debris, plastic lids were supported 3 cm above the ground on bamboo skewers. Each cup was filled with 100 ml of 33% (353 g/l) ethylene glycol for sheltered sites (below the treeline: 100–1000 m), and undiluted (1075 g/l) ethylene glycol for exposed sites (above the treeline: 1100–1300 m). 5% glycerine/glycerol was added to the pitfall mix to improve the condition of specimens recovered for identification. Pitfall traps were emptied monthly, with the exact date of the collection of the samples dependent on weather and helicopter availability. On collection, the ethylene glycol in the traps was replaced. The specimens were collected by filtering the ethylene glycol through a 0.9 by 0.3 mm mesh and preserving the sample material in 70% alcohol.

b. Instrumentation

NA

c. Taxonomy and systematics

The samples were sorted predominantly to order level, with each order for each pitfall trap given a separate vial. Selected orders were then passed on to specialists to identify specimens to species or morphospecies (Acarina, Amphipoda, Chilopoda, Collembola, Coleoptera, Diplopoda, Formicidae, Gastropoda, Orthoptera, Pseudoscorpiones, Thysanoptera).

d. Permit history

All research was conducted with an authority issued under the Tasmania *National Parks and Reserved Land Regulations 1999*.

e. Legal / organizational requirements

NA

f. Post processing

The data were provided as a taxon × plot × date matrix, with mean abundances per taxon over the available traps per plot. This matrix was first transformed to the long format, and zeroes were removed. Then all taxa were summed for each date.

Values in data: abundance per plot per month

4. Project personnel

Project initiators: Richard Bashford, Niall E. Doran, Michael M. Driessen, Alastair M. M. Richardson, and Robert J. Taylor

Data collectors: Michael M. Driessen and Niall E. Doran

Data curator: Michael M. Driessen

5. Related publications

Bashford, R., R. Taylor, and M. Driessen. 2001. Research on invertebrate assemblages at the Warra LTER Site. Tasforests 13:109–118.

Doran, N. E., J. Balmer, M. Driessen, R. Bashford, S. Grove, A. M. Richardson, J. Griggs, and D. Ziegeler. 2003. Moving with the times: baseline data to gauge future shifts in vegetation and invertebrate altitudinal assemblages due to environmental change. Organisms Diversity & Evolution 3:127–149.

Driessen, M. M., and S. A. Mallick. 2013. The Distributions of Invertebrate Species Along the Warra-Mt Weld Altitudinal Transect in 2001-2002 and Identification of Taxa Restricted by Altitude. Nature Conservation Report 13/4. Hobart.

Grove, S., N. E. Doran, and M. M. Driessen. 2004. Warra – Mount Weld altitudinal transect, ecotonal and baseline altitudinal monitoring plots (BAMPs): report. Hobart.

DataSource_ID 1481 Butterflies in Israel (Israel Butterfly Monitoring Scheme)

Taxonomic focus: Lepidoptera: Rhopalocera.

1. Site description

a. Site type

Mediterranean and semi-arid region of Israel.

b. Geography

Decimal degrees:

Latitude: 31.27° – 33.03° N

Longitude: 34.82° – 35.39° E

c. Habitat

The transects were located along grasslands, scrublands, forests, and botanical and ornamental gardens. Most transects cover one habitat type.

d. Geology / Landform

Mostly Terra-Rosa soils, brown and light rendzina, and a few Hamra and gromosoils.

e. Watersheds, hydrology

These transects are in the western watershed of Mediterranean Israel, i.e. streams are flowing from east to west into the Mediterranean Sea. One transect is inside a wetland nature reserve.

f. Site history

The Mediterranean region of Israel has been cultivated and grazed for millennia, to various extents. The 20th century saw large demographic growth, followed by cultivation, urbanization and suburban sprawl, as well as extensive afforestation. Many of the sites in this set are small nature reserves, ecological remnants of uncultivated and undeveloped land near cities and towns. Two transects are within settlements (one is a botanical garden and the other is along ornamental vegetation inside a village). Even the sites in nature reserves are likely in areas that were cultivated and/or grazed sometime in history, but where land was abandoned.

g. Climate

Most transects were located in the Mediterranean region of Israel. Winters are short, cool and rainy, while summers are long, hot and arid. Mean precipitation at these sites ranges from 434 to 825 mm per annum, and mean annual temperature ranges from 16.35° to 19.75° C. One site, Be'er Sheva, is located in the semi-arid region of Israel with a mean annual precipitation of 195 mm and an average temperature of 20.7° C

2. Experimental or sampling design

a. Design characteristics

Butterflies were counted using the Pollard transect method (Pollard, 1977), along 300-500 meter long transect in an imaginary 5 by 5 by 5 meters cube: 5 meters in front of the observer, 2.5 meters to each side and up to 5 meters above the ground. All butterfly species are recorded per 50-meter section. Monitoring takes place in weather favorable to butterfly activity (sunny and warm – over 13° C) between 9:00 – 15:00 h.

b. Permanent plots

Here we used all transects in which the time since the first visit to the last was at least nine calendar years.

Number of transects: 10

c. Data collection period, frequency etc.

Data collection started in 2009 and is ongoing. For this analysis, data are given for 2009-2018. Transects were normally visited twice per month, from October to June, but actual frequency depends on the observer. Some observers conduct observations year-round.

3. Research methods

a. Field / laboratory

Field only. See above.

b. Instrumentation

NA

c. Taxonomy and systematics

Lepidoptera: Rhopalocera. Counts of all butterflies were pooled across all species.

d. Permit history

All research is done in close collaboration and under permits from The Nature and Parks Authority.

e. Legal / organizational requirements

NA

f. Post processing

The number of sampling events was not consistent each year, so the weekly samples were analyzed. All species were summed to obtain the analyzed numbers.

Data in database: abundance per sampling date

4. Project personnel

Project initiators: R. Schwartz-Tzachor, D. Benyamini, G. Pe'er

Data collectors: G. Israel, R. Schwartz-Tzachor, A. Oz, G. Ish-Am, I. Pe'er, M. Gross, D. Mosko, H. Libreider, R. Rodich, S. Talal, M. Shmueli, Y. Avraham, I. Namir, A. Sviri and R. Gil.

Data curator: I. Pe'er

5. Related publications

Comay, O., O. Ben Yehuda, D. Benyamini, R. Schwartz-Tzachor, I. Pe'er, T. Melochna, and G. Pe'er. 2020. Analysis of monitoring data where butterflies fly year-round. Ecological Applications:1–17.

Pollard, E. 1977. A method for assessing changes in the abundance of butterflies. Biological Conservation 12:115–134.

DataSource_ID 1518 Butterflies in Ohio, USA

Taxonomic focus: Lepidoptera: Rhopalocera.

1. Site description

a. Site type

The state of Ohio in the Midwestern USA (116,100 km^2 land area).

b. Geography

Decimal degrees for survey locations:

Latitude: 38.65° to 41.81°

Longitude: -84.75° to -81.08°

c. Habitat

Ohio has a mixture of habitat types due to its partially glaciated history and its place at the confluence of Midwestern prairies, the Appalachian Mountains, and the boreal forest. Only remnants of wetland and prairie habitat remain in the state due to human modification of the landscape. Agriculture and pastures (50%), forest (30%), and urban development (10%) are the predominant land-use/land cover classes across the entire state.

d. Geology / Landform

Plots vary depending on their location within Ohio. State elevation ranges from 139 to 472 meters above sea level. Most of Ohio was glaciated, except for the southeast region.

e. Watersheds, hydrology

The Northern 1/3 of Ohio drains into Lake Erie. Southern areas into the Ohio River/Mississippi River and eventually into the Gulf of Mexico.

f. Site history

Site history and current management varies. Monitoring sites are concentrated near populated areas and most sites are on parks or preserves. On average, within a radius of 2 kilometers, monitoring sites have 24% cropland and pasture, 34% forest, and 30% urban land-use, an overrepresentation of urban land-use compared to the state as a whole (Wepprich et al., 2019).

g. Climate

The state of Ohio has a temperate continental climate with a mean annual temperature of 10.8°C and mean annual precipitation of 1048 mm during the 1990-2019 30-year period (NOAA National Centers for Environmental information, Climate at a Glance: Statewide Time Series, published February 2020, retrieved on March 1, 2020 from https://www.ncdc.noaa.gov/cag/).

2. Experimental or sampling design

a. Design characteristics

Numerous trained volunteers contributed 24,405 butterfly surveys from 1996 to 2016 as part of the Ohio Lepidopterists Long-term Monitoring of Butterflies program. Surveyors used the Pollard walk (or transect) method to count every species within an approximate 2.5 meters on either side, and 5 meters ahead and above the observer (Pollard, 1977). Volunteers selected the fixed transect route to be representative of their location and to cross multiple habitat types. The mean time duration to complete weekly surveys was 76 minutes.

b. Permanent plots

For the original analysis (Wepprich et al., 2019), 104 monitoring sites were selected if they had three or more years of 10 or more weekly surveys. For the current data product, 60 plots with a duration of 10 or more years were included.
Number of plots: 60

c. Data collection period, frequency etc.

Data collection period: 1996-2016 for analysis, monitoring continues to current year. Weekly surveys were the targeted frequency. Each plot had up to 30 surveys per year from April 1 through October 31.

3. Research methods

a. Field / laboratory

See above

b. Instrumentation

none

c. Taxonomy and systematics

Butterflies were identified to species level by sight, and when needed by netting, photography or rarely vouchering by the monitoring volunteers. Species naming conventions in the monitoring program follow those used in Opler and Krizek (1984) and Iftner et al (1992) except for combining all counts of *Celastrina ladon* (Spring Azure) and *Celastrina neglecta* (Summer Azure) as an unresolved species complex.

d. Permit history

NA

e. Legal / organizational requirements

Guidance on how to establish a transect and training on butterfly identification was provided by experts annually about late March. There are no requirements for attendance, however most individuals doing long term monitoring have been to one or more training sessions.

f. Post processing

Further description of data analysis to interpolate missing surveys and estimate population indices is available in Wepprich et al (2019) with code in the associated Dryad repository (https://doi.org/10.5061/dryad.cf78420).

4. Project personnel

Project initiator: Jerome Wiedmann

Data collectors: Hundreds of volunteers, up to 200 individuals in any year.

Data curators: Jerome Wiedmann, Tyson Wepprich

5. Related publications

Iftner, D. C., J. . Shuey, and J. V. Calhoun. 1992. Butterflies and skippers of Ohio.

Opler, P. A., and G. O. Krizek. 1984. Butterflies east of the Great Plains: an illustrated natural history. John Hopkins University Press, Baltimore, Maryland.

Pollard, E. 1977. A method for assessing changes in the abundance of butterflies. Biological Conservation 12:115–134.

Wepprich, T., J. R. Adrion, L. Ries, J. Wiedmann, and N. M. Haddad. 2019. Butterfly abundance declines over 20 years of systematic monitoring in Ohio, USA. PLOS ONE 14:e0216270.

DataSource_ID 1519 Mosquito surveys in New York and New Jersey, USA

DataSource_ID 1527 Mosquito surveys in California, USA

1. Site description

a. Site type

Temperate forest, freshwater wetlands, salt marshes, farmland, Mediterranean-type open woodland

b. Geography

Suffolk County, New York, USA (40.8°, -73.0°)

Ocean County, New Jersey, USA (39.9°, -74.2°)

Sutter and Yuba Counties, California, USA (39.13, -121.65)

c. Habitat

A variety of wooded and open habitat near freshwater and saltwater wetlands. Human-impacted habitat with single-housing units. Suffolk and Ocean counties: Coastal plain topography with low elevation and numerous freshwater and tidal saltwater or brackish wetlands. Suburban, residential developments. Sutter and Yuba counties: Extensively farmed Central Valley of California. The landscape consists of urban core and outlying agricultural lands interspersed with rice fields, orchards, freshwater wetlands, and protected natural areas.

d. Geology / Landform

Suffolk County, NY, USA: An island. Glacial moraine with a large, sandy outwash plain with many freshwater and saltwater wetlands. Atlantic coast with barrier islands and large lagoonal systems of open bay and salt marsh.

Ocean County, NJ, USA: Coastal gravel, sand and silt deposits whose geological origins are derived from both marine and non-marine sedimentary episodes. Atlantic coast with barrier islands and large lagoonal systems of open bay and salt marsh.

Sutter and Yuba Counties, CA, USA: Quaternary alluvium and marine deposits, with some pyroclastic and volcanic mudflow deposits. Central Valley of California. The landscape consists of urban core and outlying agricultural lands interspersed with rice fields, orchards, freshwater wetlands, and protected natural areas.

e. Watersheds, hydrology

Suffolk County, NY, USA and Ocean County, NJ, USA: Atlantic coast with numerous freshwater and saltwater wetlands and small coastal streams. Barrier islands and extensive lagoonal systems of open bay and salt marsh.

Sutter and Yuba Counties, CA, USA: Several permanent rivers and ephemeral streams during the rainy season. Major rivers form floodplains. Many natural waterways have been impacted and modified by human activity.

f. Site history

Suffolk County, NY, USA and Ocean County, NJ, USA: Historically, both counties experienced fast population growth starting in the late 1940s, changing from mostly rural and agricultural to mostly suburban and residential. The current population of Suffolk County (NY) is 1.49 million with density of 632 residents per sq. km, whereas Ocean County (NJ) has a population of 0.58 million with density of 350 residents per sq. km.

Sutter and Yuba Counties, CA, USA: Both are located in the extensively farmed Central Valley. Historically, the Sutter-Yuba area underwent rapid conversion to agriculture in the early 20th century with the accompanying draining or reclamation of wetlands. The current population of the area is approximately 165,000 people with density of approximately 50 residents per sq. km.

g. Climate

Suffolk County, NY, USA and Ocean County, NJ, USA: The climate features hot, humid summers with convective thunderstorms, mild spring and fall weather, and cool to cold winters with a mix of snow and rain. Precipitation is distributed fairly uniformly throughout the year, with approximately 70–100 mm on average during each month to about 1,200 mm total. Average yearly snowfall varies considerable from none to 900 mm. The coldest month is January, when average temperatures range from −4 to 5 °C, and the warmest month is July, when average temperatures range from 24 to 29 °C. The Köppen Climate Classification subtype for this climate is "humid subtropical climate".

Sutter and Yuba Counties, CA, USA: The climate is characterized by hot, dry summers and cool winters. The mean annual precipitation is approximately 460 mm. Temperatures range from an average of 35.5 °C in summer to 2.2°C in winter. Flood-producing rain storms occur between November and April. Under the Köppen Climate Classification - "dry-summer subtropical" climates are often referred to as "Mediterranean".

2. Experimental or sampling design

a. Design characteristics

Mosquito surveillance was carried out by county mosquito control commissions since the 1930s (Suffolk County, NY and Ocean County, NJ) or 1950s (Sutter and Yuba Counties, CA). Permanent mosquito monitoring sites were established in the proximity of habitats producing biting mosquitoes. In NY and NJ those habitats included saltwater or brackish tidal wetlands and the adjacent forested areas containing freshwater wetlands. In CA, the trap sites were established in low and medium-

density developed areas surrounded by large-scale agriculture representative of the Central Valley of California.

b. Permanent plots

The mosquito trap sites were relatively permanent, although some trap relocations have occurred. Number of plots: DataSourse_ID 1519: 2; DataSource_ID 1527: 1

c. Data collection period, frequency etc.

Adult mosquitoes were collected by New Jersey type light traps, which consist of a 25 watt incandescent light bulb as the mosquito attractant, and a fan to draw the mosquitoes into a collection jar containing an insecticide for specimen knockdown. The traps were deployed during the mosquito season (April-October) and operated every night. In Suffolk County, NY, a total of 12 plots in five geographically proximate clusters were used for the analyses. Annual summaries were obtained from published reports and Suffolk County Vector Control records for the years 1938-2012 (with 1939 and 1975-76 missing). In Ocean County, NJ, a total of 7 permanent plots were used in the analyses with the annual summaries for the years 1932-2012 obtained from the Ocean County Mosquito Extermination Commission. In Sutter and Yuba Counties, CA, a total of 4 permanent plots were used in the analysis with the annual summaries obtained for the years 1954-2006.

3. Research methods

a. Field / laboratory

The traps were deployed during the mosquito season (April-October) and operated every night. Specimens were retrieved 1-3 times per week, brought to the laboratory, and identified by trained entomologists under a microscope using published morphological keys. Only female mosquitoes were included in the data.

b. Instrumentation

New Jersey type light traps which consist of a 25 watt incandescent light bulb as the mosquito attractant, and a fan to draw the mosquitoes into a collection jar containing an insecticide for specimen knockdown. The original trap design and sampling protocols have been relatively unchanged since the 1930s.

c. Taxonomy and systematics

Mosquitoes (Diptera: Culicidae). Morphologically indistinguishable species with similar geographic ranges were combined together: *Culex pipiens* and *Culex restuans* as *Culex pipiens-restuans*; *Aedes stimulans*, *Aedes excrucians*, and *Aedes fitchii* as *Aedes stimulans* group; and *Anopheles crucians* and *An. bradleyi* as *Anopheles crucians* group.

d. Permit history

Permits, when required, were secured by the local mosquito control districts.

e. Legal / organizational requirements

NA

f. Post processing

The trap collections were standardized by trapping effort - the total number of females of each mosquito species caught in each trap was divided by the number of nights the trap was operated. Trapping effort was relatively consistent from year to year. If the trapping effort data were missing, the number of nights was interpolated from the previous and the following year. To avoid issues of spatial autocorrelation in abundance, all plots within each region were averaged to produce a single value expressed as an average number per trap per night for each species annually. Two recently introduced exotic species, *Aedes japonicus* (the Asian bush mosquito) and *Aedes albopictus* (the Asian tiger mosquito) were not counted. For further details see: Rochlin et al. (2016).

4. Project personnel

Project initiator Ilia Rochlin, Center for Vector Biology, Rutgers University, ilia.rochlin@gmail.com and co-authors (A. Faraji, D.V. Ninivaggi, C.M. Barker, and A.M. Kilpatrick, see Rochlin et al. 2016)

Data collectors: Various, the bulk of the data set came from historical data obtained from local mosquito control districts with numerous personnel involved in data collection. More recently: NJ mosquito data - Rich Candeletti and the staff of Ocean County Mosquito Extermination Commission; CA mosquito data-Michael Kimball and Debra Lemenager, Sutter-Yuba Mosquito and Vector Control District; NY mosquito data -James Dantonio and Malgorzata Kawalkowski , Suffolk County Vector Control.

Data curator: Ilia Rochlin, Center for Vector Biology, Rutgers University, ilia.rochlin@gmail.com

5. Related publications

Rochlin, I., A. Faraji, D. V. Ninivaggi, C. M. Barker, and A. M. Kilpatrick. 2016. Anthropogenic impacts on mosquito populations in North America over the past century. Nature Communications 7:1–14.