Title:	Long-term declines in insect abundance and biomass in a subalpine habitat
Creator:	Rebecca M. Dalton
Owners of data:	***Insect data****:* Brian D. Inouye, Nora C. Underwood, Michael Soule, and David W. Inouye ***Temperature and precipitation****:* Crested Butte Weather Station (NOAA station USC00051959) https://www.ncdc.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:USC00051959/detail ***Snow data****:* b. barr (RMBL) http://www.gothicwx.org/-data.html ***Flower data:*** Brian D. Inouye, Nora C. Underwood, and David W. Inouye: https://www.bio.fsu.edu/~nunderwood/homepage/RMBLphenologyproject.html
Contacts:	Rebecca M. Dalton (rebeccadalt@gmail.com) Brian Inouye (bdinouye@fsu.edu) David Inouye (dwinouye@gmail.com)
Year of study:	1984 - 2020
Access:	These data are made publicly available on Open Science Framework upon publication of Dalton et al., “Long-term declines in insect abundance and biomass in a subalpine habitat.”
Location:	Rocky Mountain Biological Laboratory Gothic, Colorado 81224 N 38º 57.414', W 106º 59.133' Elevation: 2912 m
Keywords:	Insects, Malaise trap, subalpine habitat
Purpose:	To document insect abundance and biomass over time at the RMBL
Methodology:	We sampled insects weekly with a Malaise trap (BioQuip® Model No. 2875A/AG) in an open subalpine meadow at the Rocky Mountain Biological Laboratory in Colorado, USA from 1984 – 2019.
Empty cells:	NA
Data file names:	daltonetal-malaise-week-2020-final.csv daltonetal-malaise-year-2020-final.csv daltonetal-malaise-analysis-2022.R

daltonetal-malaise-week-2020-final.csv
Weekly data from Malaise trap sampling at the RMBL

Clean column heading:	site
Description:	Three letter abbreviation of the field site where Malaise sampling took place
Data type:	Character
Possible values:	“GRM”: Gothic Research Meadow N 38º 57.414', W 106º 59.133'

Clean column heading:	year
Description:	Year of sampling
Date type:	Year
Measurement unit:	YYYY
Possible values:	1984 – 2020

Clean column heading:	start.date
Label:	Sampling start date
Description:	Date when Malaise trap was placed in the field
Date type:	Date (US)
Measurement unit:	MM/DD/YY
Possible values:	06/30/84 – 8/26/2020

Clean column heading:	start.doy
Label:	Sampling start day of year
Description:	Day of the year when Malaise trap was placed in the field
Data type:	Numeric
Measurement unit:	Day of year (DOY)
Possible values:	135 – 273

Clean column heading:	end.date
Label:	Sampling end date
Description:	Date when Malaise trap was removed from the field
Date type:	Date (US)
Measurement unit:	MM/DD/YY
Possible values:	07/01/84 – 08/28/2020

Clean column heading:	end.doy
Label:	Sampling end day of year
Description:	Day of year when Malaise trap was removed from the field
Date type:	Numeric
Measurement unit:	Day of year (DOY)
Possible values:	137 – 274

Clean column heading:	mid.doy
Description:	Mid-point day of year of sampling. To calculate mid.doy, subtract start.doy from end.doy. The mid.doy is used to calculate days past snowmelt (see below).
Date type:	Numeric

Measurement unit:	Day of year (DOY)
Possible values:	137 – 274
Clean column heading:	total.days
Label:	Total days of insect sampling
Description:	The total number of days that the Malaise trap collected insects in the field.
Date type:	Numeric
Measurement unit:	Number of days
Possible values:	1 – 7
Clean column heading:	snowmelt
Label:	Snowmelt day of year
Description:	Day of the year when a 1 x 1m2 plot was free of snow at the RMBL. Data collected by b. barr.
Date type:	Numeric
Measurement unit:	Day of year (DOY)
Possible values:	113 – 170
Comments:	We downloaded these data on 8 August 2019 to use in this analysis. These data are publicly available at: http://www.gothicwx.org
Clean column heading:	snowpack
Label:	Total winter snowfall
Description:	Cumulative snowfall (cm) during the winter previous to sampling. Data collected by b. barr.
Date type:	Numeric
Measurement unit:	cm
Possible values:	490 – 1691
Comments:	We downloaded these data on 10 May 2021 to use in this analysis. These data are publicly available at: http://www.gothicwx.org
Clean column heading:	dps
Label:	Days after snowmelt
Description:	The number of days between the snowmelt DOY and the middle of sampling. To calculate dps, subtract mid.doy from snowmelt.
Data type:	Numeric
Measurement unit:	Number of days
Possible values:	0 –147
Comments:	We excluded this analysis to samples after date of snowmelt at the RMBL, as there were very few of these. If you would like to access data from samples before snowmelt, please contact the owners of the insect data.
Clean column heading:	mean.temp.ave.cb
Label:	Mean air temperature
Description:	Mean air temperature during the last day of sampling and six days prior the Crested Butte Weather Station (NOAA station USC00051959).
Data type:	Numeric

Measurement unit:	Celsius
Possible values:	5.63 – 17.81
Comments:	We downloaded these data on 08 March 2021 to use in this analysis. These data are publicly available at: https://www.ncdc.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:USC00051959/detail
Clean column heading:	sum.precip.cb
Label:	Cumulative preciptiation
Description:	Cumulative precipitation from during the last day of sampling and six days prior at the Crested Butte Weather Station (NOAA station USC00051959).
Data type:	Numeric
Measurement unit:	cm
Possible values:	0 – 5.49
Comments:	We downloaded these data on 08 March 2021 to use in this analysis. These data are publicly available at: https://www.ncdc.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:USC00051959/detail
Clean column heading:	flower.wk.sum
Label:	Total number of open flowers
Description:	Cumulative number of open non-graminoid flowers during the last day of sampling and six days prior at the RMBL.
Date type:	Numeric
Measurement unit:	Number of open flowers
Possible values:	23 – 31810
Comments:	We recorded the total number of open flowers in 23, 2 x 2m2 plots around the RMBL. Flowering data were not collected in 1990. These data can be requested at: https://www.bio.fsu.edu/~nunderwood/homepage/RMBLphenologyproject.html
Clean column heading:	mean.flw.day
Label:	Mean number of open flowers per day
Description:	The mean number of open non-graminoid flowers per day during the last day of sampling and six days prior at the RMBL. These data were calculated by taking the flower.wk.sum and diving by the number of days that phenology data was collected during the week.
Data type:	Numeric
Measurement unit:	Number of flowers
Possible values:	7.67 – 8404
Clean column heading:	total.no
Label:	Total insect number
Description:	Total number of all insects collected in the sample. This is a summed value of all Diptera, Hymenoptera, and other insects collected during sampling.
Data type:	Numeric
Measurement unit:	Number of insects

Possible values:	0 – 1665
Clean column heading:	total.g
Label:	Total insect biomass
Description:	72-hour dry weight (grams) of all insects collected in the sample. This is a summed value of the number Dipteran, Hymenopteran, and other insects collected during sampling.
Data type:	Numeric
Measurement unit:	Grams
Possible values:	0.05 – 3.31
Clean column heading:	diptera.no
Label:	Diptera number
Description:	Total number of Diptera collected in the sample. This is a summed value of the number of all Dipteran samples (Syrphidae, Bombyliidae, Calliphoridae, Tephritidae, Robberflies, Tabanidae, etc.)
Data type:	Numeric
Measurement unit:	Number of insects
Possible values:	0 – 1665
Clean column heading:	diptera.g
Label:	Diptera biomass
Description:	72-hour dry weight (grams) of total number of Diptera collected in the sample. This is a summed value of the number of all Dipteran samples (Syrphidae, Bombyliidae, Calliphoridae, Tephritidae, Robberflies, Tabanidae, etc.)
Data type:	Numeric
Measurement unit:	Grams
Possible values:	0.05 – 3.31
Clean column heading:	hymenoptera.no
Label:	Hymenoptera number
Description:	Total number of Hymenopteran collected in the sample. This is a summed value of the number of bumblebees, other bees, ants, wasps, sawflies, and others.
Data type:	Numeric
Measurement unit:	Number of insects
Possible values:	0 – 146
Clean column heading:	hymenoptera.g
Label:	Hymenoptera biomass
Description:	72-hour dry weight (grams) of Hymenopteran collected in the sample. This is the total biomass of all This is a summed value of the number of bumblebees, other bees, ants, wasps, sawflies, and others.
Data type:	Numeric
Measurement unit:	Grams
Possible values:	0 – 1.04
Clean column heading:	other.no
Label:	Other number (non-Dipteran and non-Hymenopteran)

Description:	Total number of non-Dipteran and non-Hymenopteran collected in the sample. This is a summed value of the number of beetles, butterflies, moths, grasshoppers, leaf hoppers, spiders, caddisflies, stoneflies, lacewings, snakeflies, etc.
Data type:	Numeric
Measurement unit:	Number of insects
Possible values:	0 – 693
Clean column heading:	other.g
Label:	Other number (non-Dipteran and non-Hymenopteran) biomass
Description:	72-hour dry weight (grams) of non-Dipteran and non-Hymenopteran collected in the sample. This is the total biomass of all beetles, butterflies, moths, grasshoppers, leaf hoppers, spiders, caddisflies, stoneflies, lacewings, snakeflies, etc.
Data type:	Numeric
Measurement unit:	Grams
Possible values:	0 – 2.84
Clean column heading:	notes
Raw column heading:	Notes
Description:	Temporary features of sampling period. For example, “trap was found knocked over during sampling” or “mice ate samples
Date type:	Character

daltonetal-malaise-year-2020-final.csv

Yearly data from Malaise trap sampling at the RMBL

Clean column heading:	site
Description:	Three letter abbreviation of the field site where Malaise sampling took place
Data type:	Character
Possible values:	“GRM”: Gothic Research Meadow N 38º 57.414', W 106º 59.133'
Clean column heading:	year
Description:	Year of sampling
Date type:	Year
Measurement unit:	YYYY
Possible values:	1984 – 2020
Clean column heading:	yr.total.g
Label:	Summed total insect biomass
Description:	72-hour dry weight (grams) of all insects collected in the sampling year. This is a summed value of the number Dipteran, Hymenopteran, and other insects.
Data type:	Numeric
Measurement unit:	Grams
Possible values:	0.96 – 19.40
Clean column heading:	yr.total.no
Label:	Summed total insect abundance

Description:	Total number of all insects collected in the sampling year. This is a summed value of all Diptera, Hymenoptera, and other insects.
Data type:	Numeric
Measurement unit:	Number of insects
Possible values:	245 – 9159
Clean column heading:	yr.samples
Label:	Yearly sample number
Description:	The total number of times the Malaise trap was deployed during the year
Data type:	Numeric
Measurement unit:	Number of weekly samples
Possible values:	3 – 19
Comments:	These values may not match the row count of the weekly data file, as we excluded this analysis to only samples occurring after snow melted at the RMBL. Therefore, yr.samples may be higher than the number of rows of data in daltonetal-malaise-week-2020.csv. To access these earlier samples, please request the data from the owners.
Clean column heading:	yr.days
Label:	Yearly number of days
Description:	The total number of days the Malaise trap was deployed during the year
Data type:	Numeric
Measurement unit:	Number of days
Possible values:	6 – 43
Clean column heading:	summer.temp.cb
Label:	Mean summer air temperature
Description:	Mean daily air temperature during May, June, July, and August in the year of sampling at the Crested Butte Weather Station (NOAA station USC00051959).
Data type:	Numeric
Measurement unit:	Celsius
Possible values:	9.71 – 13.02
Comments:	We downloaded these data on 8 March 2021 to use in this analysis. These data are publicly available at: https://www.ncdc.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:USC00051959/detail
Clean column heading:	summer.precip.cb
Label:	Cumulative precipitation
Description:	Cumulative precipitation during May, June, July, and August in the year of sampling at the Crested Butte Weather Station (NOAA station USC00051959).
Data type:	Numeric
Measurement unit:	cm
Possible values:	8.23 – 27.25
Comments:	We downloaded these data on 8 March 2021 to use in this analysis. These data are publicly available at:

	https://www.ncdc.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:USC00051959/detail
Clean column heading:	snowpack
Label:	Total winter snowfall
Description:	Cumulative snowfall (cm) during the winter previous to sampling. Data collected by b. barr.
Date type:	Numeric
Measurement unit:	cm
Possible values:	490 – 1691
Comments:	We downloaded these data on 10 May 2021 to use in this analysis. These data are publicly available at: http://www.gothicwx.org
Clean column heading:	snowmelt
Label:	Snowmelt day of year
Description:	Day of the year when a 1 x 1m2 plot was free of snow at the RMBL. Data collected by b. barr.
Date type:	Numeric
Measurement unit:	Day of year (DOY)
Possible values:	113 – 170
Comments:	We downloaded these data on 8 August 2019 to use in this analysis. These data are publicly available at: http://www.gothicwx.org
Clean column heading:	yr.floral.count
Label:	Total number of open flowers
Description:	Cumulative number of open non-graminoid flowers from the second week of May (DOY:128, mean first day of flowering) until the end of August at the RMBL.
Date type:	Numeric
Measurement unit:	Number of open flowers
Possible values:	19091 – 260247
Comments:	We recorded the total number of open flowers in 23, 2 x 2m2 plots around the RMBL. Flowering data were not collected in 1990. These data can be requested at: https://www.bio.fsu.edu/~nunderwood/homepage/RMBLphenologyproject.html

daltonetal-malaise-analysis-2022.R

This R script runs the analyses presented in Dalton et al., “Long-term declines in insect abundance and biomass in a subalpine habitat” using the “daltonetal-malaise-week-2020-final.csv” and “daltonetal-malaise-year-2020-final.csv.”