Abundance and beta-diversity of bumble bees and wildflowers in the Berchtesgadener Alps

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DATA FILES

1. `floral_tax.csv`

Description: Supplies family-level taxonomy for the floral taxa in our study.

Columns:

1. `plant.sp` = plant species
2. `plant.genus` = plant genus
3. `plant.family` = plant family

2. `network.csv`

Description: Bumble- bee-wildflower visitation data used in all analyses of (1) bumble bee abundance, (2) bumble bee beta-diversity, and (3) interaction beta-diversity.

Columns:

1. `year` = year
2. `dayofyear` = day of year since January 1
3. `site` = site name
4. `trap.time` = time interaction was observed
5. `caste` = bumble bee caste (queen, male, worker, NA = parasitic *Psithryus*)
6. `pollen` = whether the bee had visible pollen loads
7. `bb.sp` = abbreviated bumble bee species name
8. `bb.sp.lat` = full bumble bee species name
9. `plant.sp.abb` = abbreviated plant species name
10. `plant.sp` = full plant species name
11. `plant.genus` = plant genus name
12. `day` = day of month

13. `month` = month
14. `date` = date

3. `floral_survey.csv`

Description: Floral survey data used in all analysis of (1) floral abundance and (2) floral beta-diversity.

Columns:

1. `year` = year
2. `dayofyear` = day of year since January 1
3. `site` = site name
4. `snowcover` = whether site was snow-covered
5. `plant.sp` = full plant species name
6. `plant.genus` = plant genus name
7. `flower cover` = flower cover in m^2 to the nearest 0.01 m^2
8. `day` = day of month
9. `month` = month
10. `date` = date

4. `site_data.csv`

Description: Site data including elevation, management, and geographic coordinates.

Columns:

1. `site` = site name
2. `elev.class` = elevation category (oben, mitte, unten)
3. `management` = site management (mowing, grasing, none)
4. `temp.mean` = mean temperature recorded with iButton devices
5. `elev.mean` = mean elevation
6. `transect` = transect name
7. `slope.calc` = slope calculated from min and max elevation
8. `slope.est` = estimated slope
9. `elev.min` = minimum elevation within site
10. `elev.max` = maximum elevation within site
11. `lat` = latitude (decimal degrees)
12. `lon` = longitude (decimal degrees)
13. `elev.class2` = alternative elevation binning
14. `tree_line` = whether a site was above or below the tree line; only for sites included in analysis (hence NAs)

4. `bb_traits.csv`

Description: Bumble bee trait data

Clade and subgenus classifications are based on Williams et al (2008).

Tongue length data are from Arbetman et al. (2017), Obeso (1992), and Durieux (2000)

Columns:

1. `clade` = bumble bee clade: LF = long faced, SH = short faced, M = Mendacibombus
2. `subgenus` = bumble bee subgenus
3. `bb.sp.lat` = full bumble bee species name
4. `bb.sp` = abbreviated bumble bee species name
5. `pbl.w` = worker tongue length based primarily on Arbetman et al. (2017) and supplemented where necessary from Durieux (2000) and Obeso (1992)
6. `pbl.w.class` = discretized worker tongue length
7. `pbl.w.class2` = simplified discretized worker tongue length
8. `pbl.w.ref` = reference from which pbl.w was gathered
9. `Notes` = notes on pbl.w
10. `pbl.w.durieux` = alternative set of tongue length based primarily on Durieux (2000) and supplemented where necessary from Arbetman et al. (2017) and Obeso (1992)
11. `notes_durieux` = notes on pbl.w.durieux

5. `fl_traits.csv`

Description: Kugler's (1970) floral morphotype classification for floral species

For a description of Kugler's morphotype codes, see `kugler_key.tsv`.

Data were accessed in April 2020 via the Bioflor plant trait database (Klotz et al. 2002). Missing data were manually supplemented as descrtibed in `fl_trait_proc.R`.

Columns:

1. `plant.sp` = plant species
2. `plant.genus` = plant genus
3. `plant.family` = plant family
4. `k.type` = Kugler morphotype
5. `k.type.s` = Kugler morphotype simplified to 1 decimal place
6. `k.type.ss` = Kugler morphotype simplified to 0 decimal places

6. `kugler_key.tsv`

Description: A verbal description of Kugler's (1970) floral morphotype classification

Data were accessed in April 2020 via the Bioflor plant trait database (Klotz et al. 2002).

Columns:

1. `code` = Morphotype code
2. `description` = Morphotype description

CODE FILES

1. `ms1_abundance.Rmd`

Description: R script for running abundance analyses.

2. `ms1_beta_diversity.Rmd`

Description: R script for running beta-diversity analyses.

2. `fl_trait_proc.R`

Description: R script for processing raw BIOFLOR trait data and adding traits for missing species.

References

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Arbetman MP, Gleiser G,Morales CL, Williams P, Aizen MA. 2017 Global decline of bumblebees is phylogenetically structured and inversely related to species range size and pathogen incidence. Proc. R. Soc. B 284: 20170204.

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Durieux E-A. 2000. Etude des choix floraux des bourdons (Hymenoptera, Apidae) de la commune d'eyne (france, Pyrénées-Orientales). PhD thesis, Université de Mons-Hainaut.

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