

C

**CLIMATE RISKS OF EUROPEAN
BUTTERFLY SPECIES**

C.1 Species inventory and taxonomy of European butterflies

Depending on different authors, the state-of-the-art in taxonomy and its interpretation, Europe is thought to support around 450 butterfly species. For this atlas we have modelled 294 species (in some cases only species complexes). The results on individual species are shown in chapter C.2, with complete lists in Appendices 1 and 2. A further 149 species (a number which might change depending on the results of taxonomic research) are listed in chapter C.3. Species covered in C.2 and C.3 only include those from the geographical area of Europe, including the Azores, Madeira, the Canary Islands, all Greek islands, Cyprus and the European part of Turkey, but excluding territories of Belarus, Ukraine, Moldova, and Russia.

Generally, the classification of butterfly genera and species in the present work is based on that utilized in ‘The distribution atlas of European butterflies’ (Kudrna 2002). Recent progress in systematic research (incorporating biological, genetic and molecular aspects, but not ignoring traditional morphology) has led to changes in the classification of many taxa. One always has to be aware, that taxonomic categories are in principle scientific concepts and nominate taxa, here genera and species, are scientific hypotheses. Their authors may employ different views on the status of the same taxon and their views may change as time goes by, subject to the application of new methods and new research results.

Therefore the classification of European butterflies is bound to remain fluid – not only if one considers that according to Descimon & Mallet (in press) around 16% of European butterfly species are known to hybridize in the wild. About half or more of these hybrids are fertile, and show evidence of backcrossing. An example for the need of reclassification on the genus level is the heterogeneity of the genus *Plebejus* KLUG, 1802, where new molecular data by Wiemers (2003) indicate that it is not monophyletic and possibly consists of a few closely related genera).

The first draft of the original checklist used by Kudrna (2002) dates back to 1995; it contained a number of questionable (micro)species in order to facilitate research about their ranges and, perhaps, their overlapping zones. This helped, for instance, to establish, that *Euphydryas glaciegenita* is a high alpine ecological race of *E. aurinia*, not a distinct species (Pelz, unpubl.).

The nomenclature utilized here follows the International Code on Zoological Nomenclature. Unfortunately the International Commission on Zoological Nomenclature does little at present to help stabilize zoological nomenclature by using its plenary powers, the means created in the past for this purpose by the Commission. Thus, for instance, the well established generic name *Maculinea* van ECKE, 1915, must be ‘sacrificed’, as it is a junior subjective synonym of *Phengaris* DOHERTY, 1891 (e.g. Pech et al. 2004).

The main changes or adjustments for the present atlas are telegraphically reviewed here, starting with general aspects and followed by a family-wise treatment:

General:

- The authorship of all names proposed in the ‘Wiener Verzeichnis’ was erroneously attributed to DENIS & SCHIFFERMÜLLER by most of the past authors. It has been demonstrated by Kudrna & Belicek (2005) that the sole author of the work was I. SCHIFFERMÜLLER. It has been shown that many names proposed therein are nomina nuda, but except in one case they have been made available by subsequent authors.

Hesperiidae:

- *Pyrgus malvoides* is being treated as a distinct species by some and as a subspecies by other authors (e.g. Higgins 1976, de Jong 1972). Following recent recording (Kudrna 2002) and thus for technical reasons, it appears more appropriate to treat both *Pyrgus malvae* and *Pyrgus malvoides* under the *Pyrgus malvae* complex.

Pieridae:

- Following Braby (2005) and contrary to Klots (1933), *Pontia* FABRICIUS, 1807, is provisionally recognized as a genus distinct from *Pieris* SCHRANK, 1801.
- *Pontia daplidice* was divided into two species by Geiger & Scholl (1982) due to strong differences in allozyme pattern, but Porter et al. (1997) questioned their specific distinctness after proving extensive hybridization in a contact zone in Liguria, Italy. Because of these results and lack of information on the distribution of both taxa in Central Europe, both taxa are treated as a complex in the present atlas. Work on the identity and distribution of both *P. edusa* and *P. daplidice* (including molecular work with DNA markers) is in progress. It seems that *P. edusa* is more widespread in Central Europe and currently the more active migrant, while *P. daplidice* is restricted to the Western and Southern Mediterranean region (Wiemers, unpubl. data).
- *Leptidea reali* and *L. sinapis* have proven to be sibling species rather recently, but they cannot be always reliably distinguished and most of old data often cannot be referred to either species. This makes their treatment as *L. sinapis* complex unavoidable.

Lycaenidae:

- *Favonius quercus* (LINNAEUS, 1758): Shirozu & Yamamoto (1956) have shown in their taxonomic revision that *Favonius* SIBATANI & ITO, 1942, and *Quercusia* VERITY, 1943, are very closely related, whereas *Neozephyrus* is morphologically and phylogenetically very distinct. Since Shirozu & Yamamoto (1956) following the ‘fashion’ of their time afforded every species-group the status of a genus, *Quercusia* is best treated as a junior subjective synonym of *Favonius*.

- *Polyommatus eroides* is a subspecies of *P. eros* (Wiemers unpubl., Vodolazhsky & Stradomsky 2008a, 2008b).
- *Polyommatus caelestissimus* is treated as a subspecies of *P. coridon*, because there is no evidence for genetic differentiation (Descimon & Mallet in press, Wiemers 2003), therefore the UTM data points of both species have been combined into one map.
- *Plebejus glandon* and *P. aquilo* are treated as separate allopatric species in this atlas. However, many authors (e.g. Tolman & Lewington 2008) consider the latter only as a subspecies of *P. glandon*, often also including the local endemic *P. zuellichi* from Sierra Nevada (which has not been modelled due to the few data points).
- *Cyaniris semiargus* is provisionally removed from the genus *Polyommatus* LATREILLE, 1804. New molecular results indicate a closer relationship to *Plebejus* than to *Polyommatus* (Wiemers 2003).
- Some species of the genus *Scolitantides* HÜBNER, 1819, used to be placed in *Pseudophilotes* BEURET, 1958, which here is regarded as a junior subjective synonym of the former. The use of these genera however keeps changing and underlines the necessity of a revision.

Nymphalidae:

- The genus *Nymphalis* is divided into two genera: *Aglais* DALMAN, 1816, and *Nymphalis* KLUK, 1802. (Wahlberg & Nylin 2003, Wahlberg pers. comm.).
- *Argyronome* HÜBNER, [1819] is a junior subjective synonym of *Argynnis* FABRICIUS, 1807 (Simonsen 2006); thus: *Argynnis laodice*.
- *Coenonympha iphioides* is a subspecies of *C. glycerion*. (Wiemers 2007).
- *Coenonympha darwiniana* is a subspecies of *C. gardetta* (Wiemers 1998, 2007, Porter et al. 1995).
- Although *Erebia arvernensis* and *E. carmentis* are probably distinct species (Albre, et al. 2008); at present their distribution data cannot be separated from *E. cassioides* for technical reasons and thus they have to be treated as a “complex” together with the “western” *E. cassioides*.
- Kudrna (2002) followed Miller (1968) and treated his ‘series’ as monophyletic genera *Hipparchia* FABRICIUS, 1807, *Maniola* SCHRANK, 1801, *Pararge* HÜBNER [1819] and *Kirinia* MOORE, 1893. Current research however shows, that Miller’s (1968) ‘series’ are not monophyletic (Pena et al. 2006). Thus the provisional classification employed here follows Pena et al. (2006); at present there is no comprehensive revision or phylogenetic study of the higher classification of the subfamily Satyrinae. The (provisionally?) resurrected genera are: *Lasiommata* WESTWOOD, 1841, *Lopinga* MOORE, 1893, *Hyponphele* MUSCHAMP, 1915, *Pyronia* HÜBNER [1819], *Brintesia* FRUHSTORFER, [1911], *Chazara* MOORE, 1893, *Pseudochazara* LESSE, 1951, *Satyrus* LATREILLE, 1810, *Arethusana* LESSE, 1951, *Minois* HÜBNER, [1819]. Whereas some of these genera (e.g. *Hyponphele*, *Lasiommata*, *Maniola*, *Pararge*) are ‘strong’, some other genera remain ‘weak’

and their taxonomic status may change in the course of new research results becoming available. It is to be remembered that only an incomplete selection of potentially congeneric species has been examined (by molecular and other studies) so far.

- *Hipparchia alcyone* is a junior subjective synonym of *H. hermione* (VERITY 1913) (Kudrna 1977, 1984, Honey & Scoble 2001), based upon the lectotype of the latter, designated by Kudrna (1977).
- *Pseudochazara amalthea* (FRIWALDSZKY, 1845), placed by Kudrna (2002) provisionally in the genus *Hipparchia*, is a subspecies of *Pseudochazara anthelea* (LEFEBVRE, 1831), as it is already treated by many authors.

In general we agree with Descimon & Mallet (in press), that “there is justification for reviving the rather neglected (and misused) rank of subspecies, with the trend among lepidopterists to consider only more strongly distinct forms (in morphology, ecology, or genetics) as subspecies, and to lump dubious geographic forms as synonyms.” This provides “a useful compromise between descriptions of geographic variation, the needs of modern butterfly taxonomy, and Darwin’s pragmatic use of the term species in evolutionary studies.”

Although the definition of species will always be difficult, species will continue to function as useful tools in biology. “Studies of gene exchange in the many hierarchical layers of phenotype, genotype and genome in “bad” species of butterflies will illuminate the nature of speciation and evolution at the species level more than discussions on the “essence” of species.” (citations from Descimon & Mallet, in press).

C.2 Climatic fate of individual species

The present chapter is the core part of this atlas. It encompasses the largest part of the book from page 32 to page 619. Here all species will be shown as pictures taken in natural settings. Their ecology and biology is very briefly characterized, based on general field guides and text books like Tolman & Lewington (2008), but also own field experience. Information on ant-lycaenid relationships were largely drawn from Fiedler (2006). For each species we give the statistics of changes in the climatic niche distribution, the observed and modelled present distribution, the multidimensional climatic niche, and the projected climatic niche space distribution under the different scenarios SEDG, BAMBU, and GRAS for the years 2050 and 2080. On each of these maps the distribution of climatic niche space is shown that a) remains stable (orange), b) gets lost (grey), and c) is gained (dark brown). Thus it is possible to optically deduct the changes under the no and the full dispersal assumption (see chapter B.3 on page 20ff for further details on methodology).

Erynnis tages (LINNAEUS, 1758) – Dingy Skipper



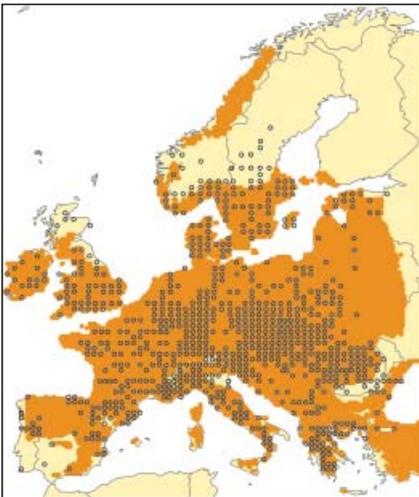
© Albert Vliegthart

		Full dispersal	No dispersal
2050	SEDG	-1786 (-10.09%)	-3203 (-18.09%)
	BAMBU	-2385 (-13.47%)	-3834 (-21.65%)
	GRAS	-2873 (-16.22%)	-4268 (-24.1%)
2080	SEDG	-4695 (-26.51%)	-6615 (-37.35%)
	BAMBU	-5429 (-30.66%)	-8408 (-47.48%)
	GRAS	-7225 (-40.8%)	-10729 (-60.59%)

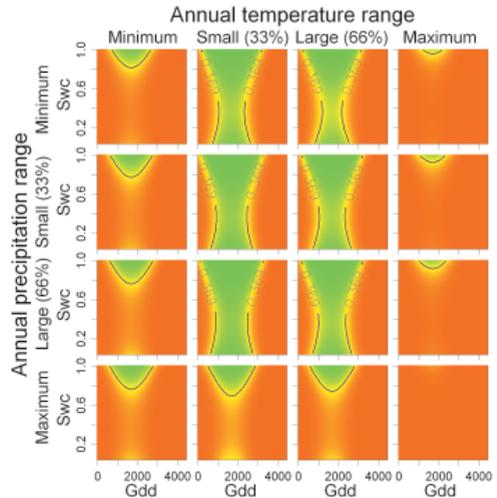
Changes in climatic niche distribution
(in $10 \times 10'$ grid cells; present niche space: 17709 cells)

The Dingy Skipper is a small, inconspicuous butterfly. It lays its eggs on the leaves of leguminous plants such as *Coronilla varia* (Crown Vetch), Horseshoe Vetch (*Hippocrepis comosa*) and Common Birdsfoot trefoil (*Lotus corniculatus*), usually choosing plants growing near bare patches. The caterpillar spins itself a small, tube-like shelter from leaves of the larval foodplant, living and feeding in it until fully grown. It then builds itself a sturdier shelter in which to pass the winter. In the spring, without further feeding, it pupates, either in the shelter, or in the moss layer. The adult butterfly is often found on Bugle (*Ajuga* spp.) and, while visiting flowers, is easily observed. The Dingy Skipper has one brood a year in central and northern Europe and two in the southern part.

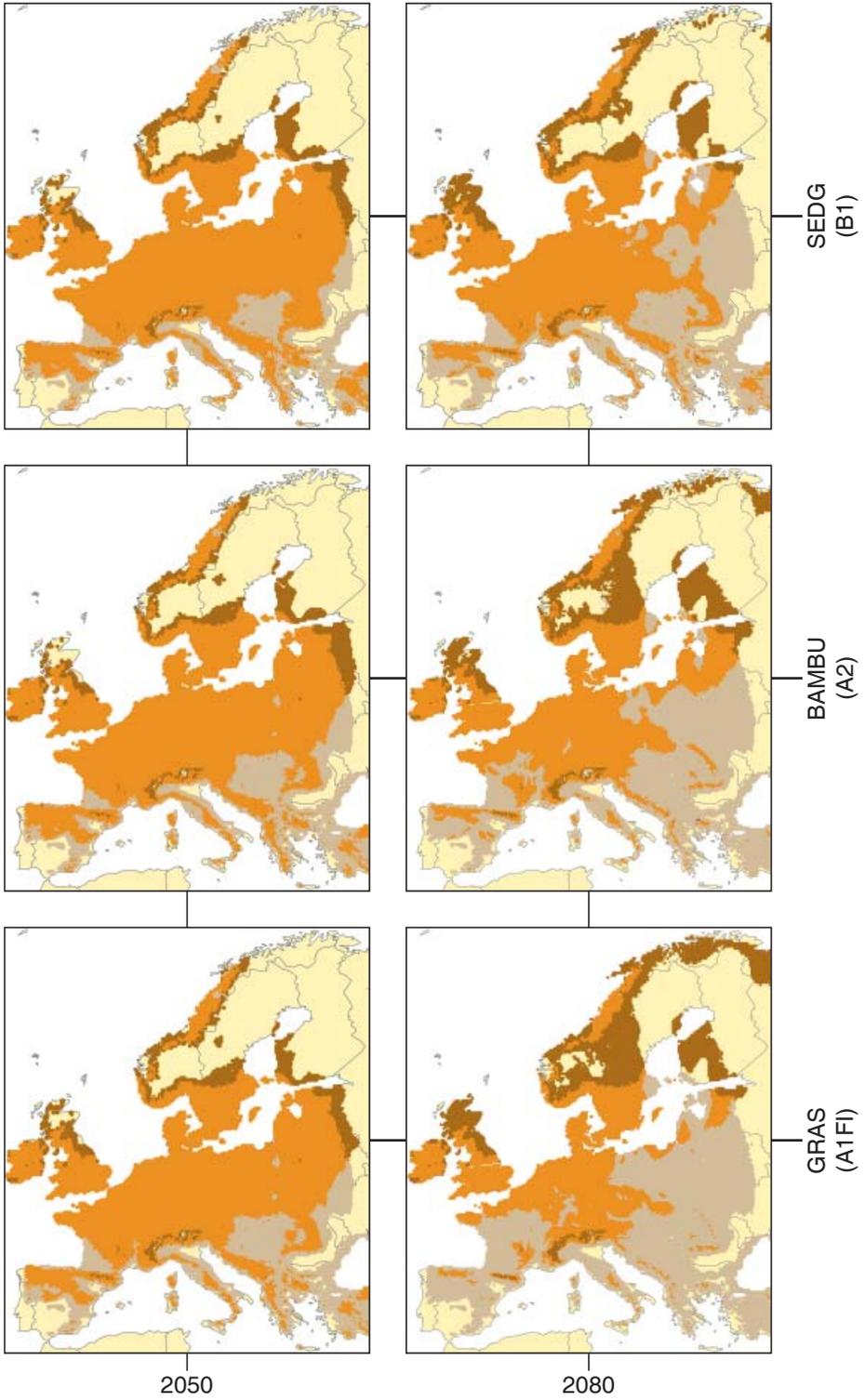
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.72). Climate risk category: PR.



Observed species distribution ($50 \times 50 \text{ km}^2$ UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Erynnis marloyi (BOISDUVAL, 1834) – Inky Skipper



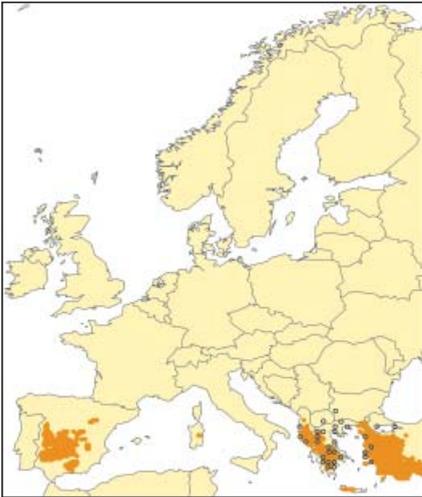
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-123 (-13.61%)	-521 (-57.63%)
	BAMBU	-240 (-26.55%)	-583 (-64.49%)
	GRAS	-222 (-24.56%)	-631 (-69.8%)
2080	SEDG	-72 (-7.96%)	-578 (-63.94%)
	BAMBU	-572 (-63.27%)	-807 (-89.27%)
	GRAS	-658 (-72.79%)	-862 (-95.35%)

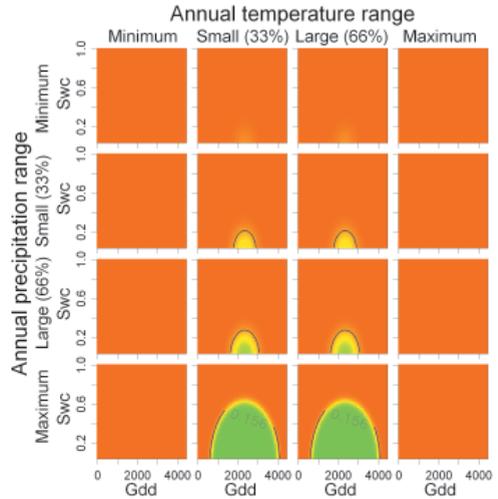
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 904 cells)

Inky Skippers are very dark little butterflies that fly rapidly, close to the ground. They are found on dry grasslands, in dried-up riverbeds, on rocky slopes, and in woodland clearings. They can often be seen basking in the sun, wings widespread, on light-coloured stones. Especially the females can also often be seen drinking nectar on thyme. The larvae feed on bushy rosaceans particularly on *Prunus spinosa* and *P. cocomilla*. The Inky Skipper has one or two broods a year.

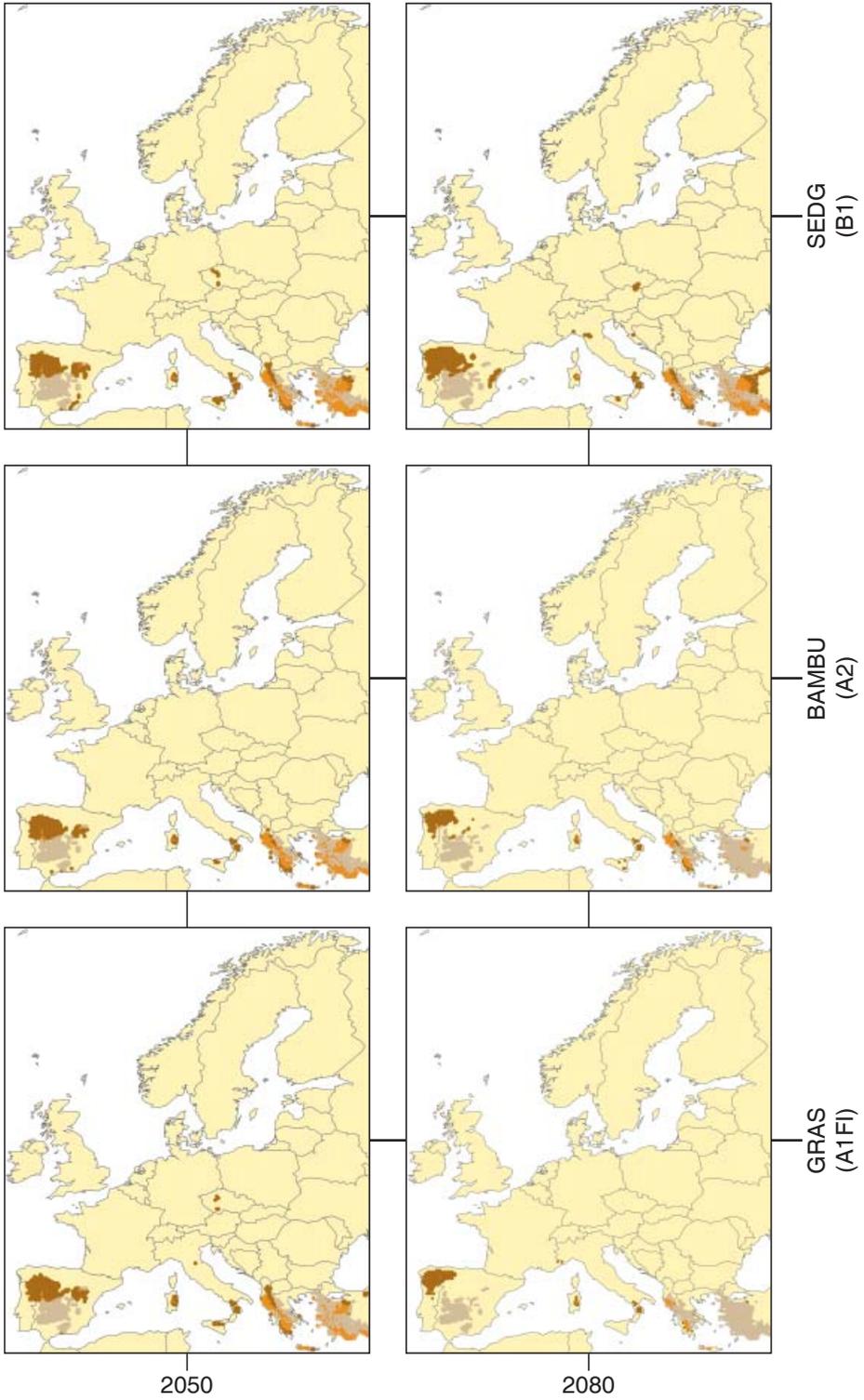
Present distribution can be very well explained by climatic variables (AUC = 0.98).
Climate risk category: HHHHR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tertile, upper tertile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Carcharodus alceae (ESPER, 1870) – Mallow Skipper



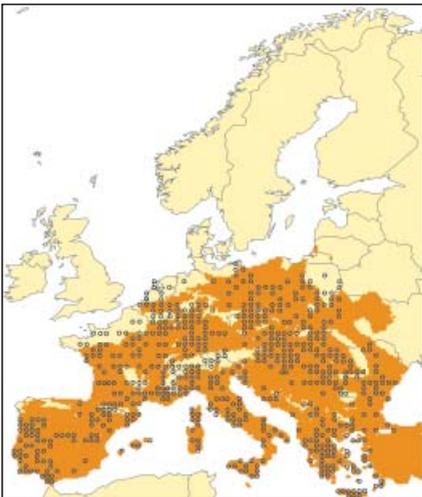
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	3884 (30.9%)	-568 (-4.52%)
	BAMBU	2554 (20.32%)	-1255 (-9.98%)
	GRAS	2940 (23.39%)	-1476 (-11.74%)
2080	SEDG	1889 (15.03%)	-2106 (-16.75%)
	BAMBU	-222 (-1.77%)	-4815 (-38.3%)
	GRAS	-1188 (-9.45%)	-6139 (-48.83%)

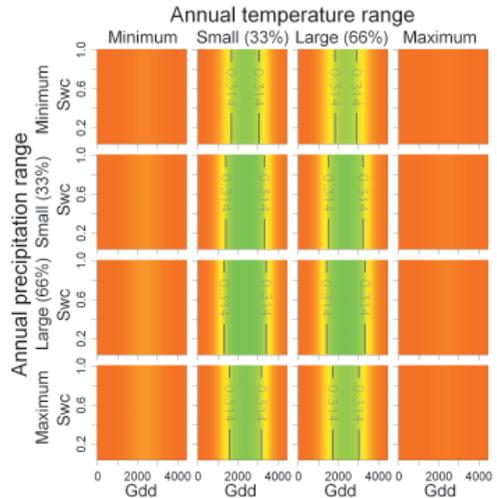
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 12571 cells)

The Mallow Skipper is a butterfly of warm, grassy places, usually with rough vegetation. It is a mobile butterfly, that strays outside its usual habitat, and thus can be met in unexpected places. In warm summers, they migrate northwards and can be seen in warm, south-facing river valleys. The resident populations are usually small. The butterflies are often seen visiting flowers for nectar. They also spend a lot of their time basking in the sun, their wings widespread, showing to full advantage their beautiful purple to olive-green metallic sheen. Eggs are laid singly on the upperside of the leaves of mallows (*Maha* spp.). The caterpillars thrive on this food, growing very quickly. This skipper has up to three or more broods per year. As winter approaches, the fully-grown caterpillars make a cocoon in the litter layer. They pupate in the spring.

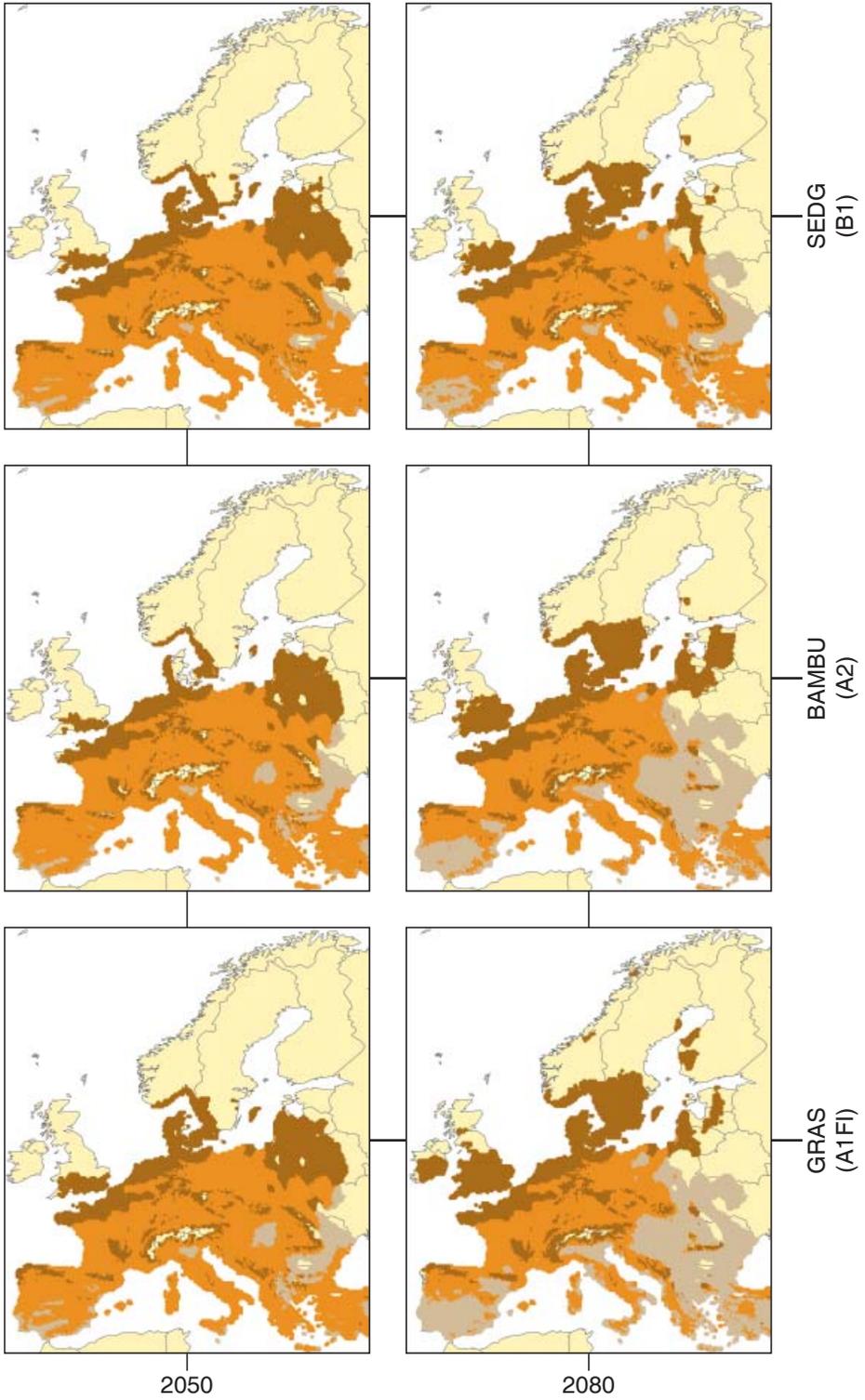
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.71). Climate risk category: PR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Carcharodus lavatherae (ESPER, 1783) – Marbled Skipper



© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-21 (-0.64%)	-1482 (-45.43%)
	BAMBU	-132 (-4.05%)	-1578 (-48.38%)
	GRAS	-379 (-11.62%)	-1893 (-58.03%)
2080	SEDG	1101 (33.75%)	-1978 (-60.64%)
	BAMBU	284 (8.71%)	-2409 (-73.85%)
	GRAS	-454 (-13.92%)	-2792 (-85.59%)

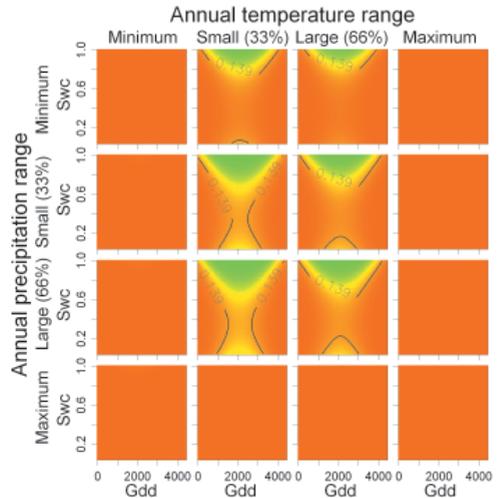
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 3262 cells)

The green sheen on the upperside of the wings and body of the Marbled Skipper distinguish it from other skippers in this genus. It lives in warm, flower-rich places. Populations are usually small, and it is exceptional to see a large number of these butterflies gathered together. On very hot days, needing to drink, they look for damp ground. The eggs are laid singly on the sepals of various woundworts (*Stachys* spp.), especially Perennial Yellow Woundwort (*S. recta*). The young caterpillars spin a loose shelter from leaves, under which they hide themselves while they feed, first eating the seeds and, later, the leaves of the plant. They hibernate in the third or fourth instar and pupate at the foot of the foodplant. The Marbled Skipper is single-brooded.

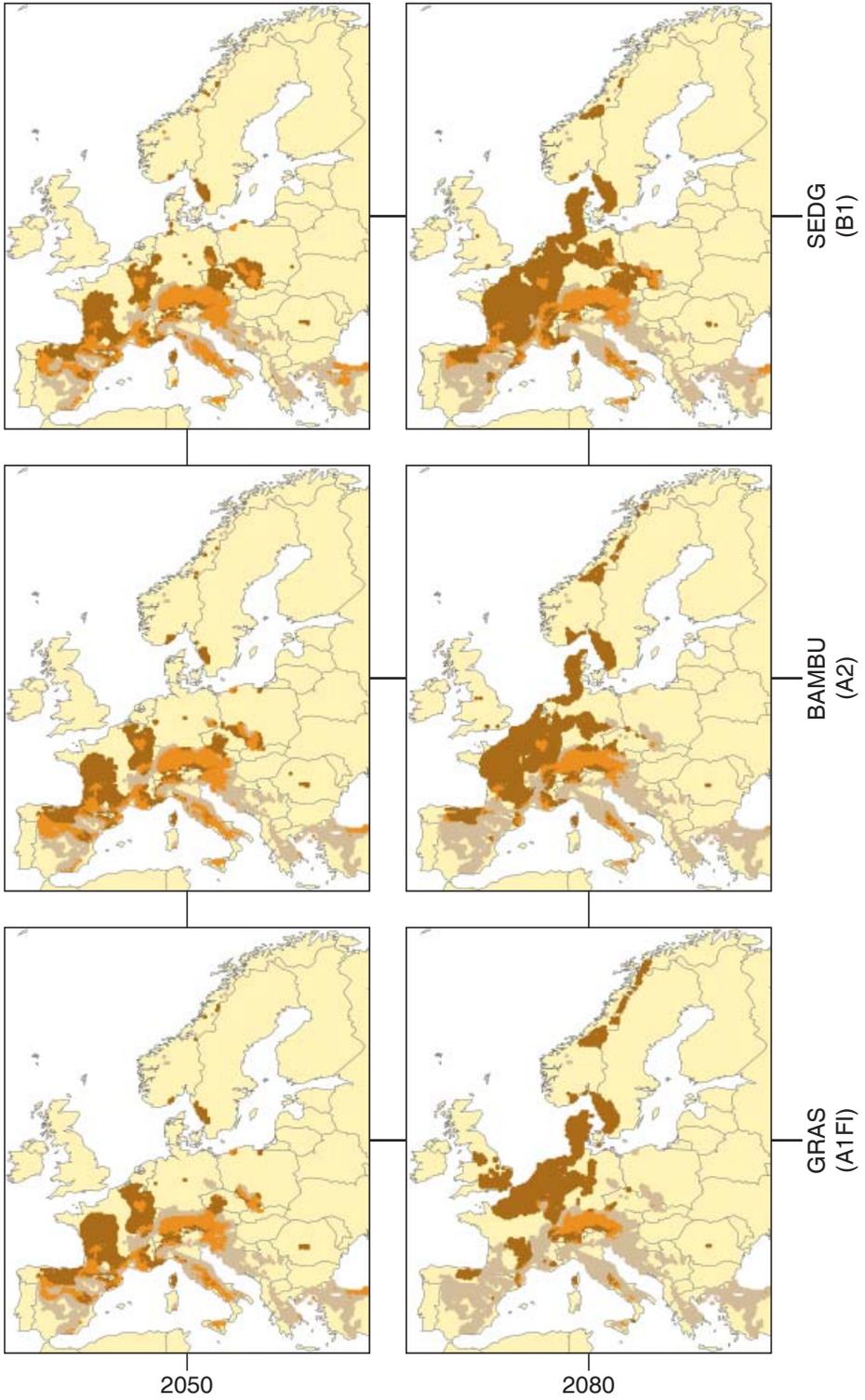
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.73). Climate risk category: PR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Carcharodus flocciferus (ZELLER, 1847) – Tufted Marbled Skipper



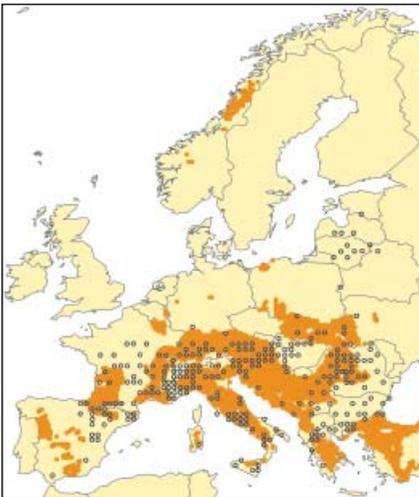
© Rudi Verovnik

		Full dispersal	No dispersal
2050	SEDG	460 (10.92%)	-1148 (-27.25%)
	BAMBU	1228 (29.15%)	-1188 (-28.2%)
	GRAS	104 (2.47%)	-1661 (-39.43%)
2080	SEDG	2641 (62.69%)	-1670 (-39.64%)
	BAMBU	2427 (57.61%)	-2346 (-55.68%)
	GRAS	2972 (70.54%)	-2925 (-69.43%)

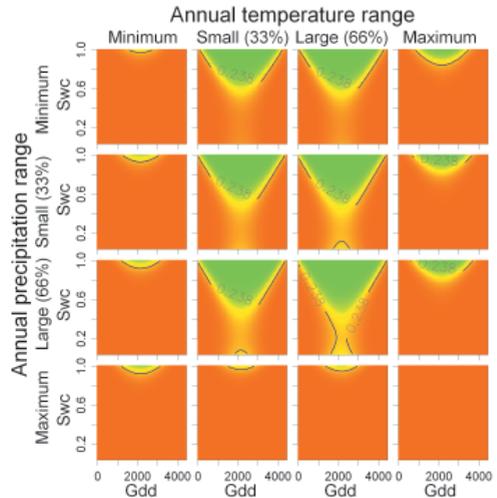
Changes in climatic niche distribution
(in $10^4 \times 10^4$ grid cells; present niche space: 4213 cells)

The Tufted Marbled Skipper can be found on flower-rich grasslands. It also occurs at the edges of woodland and in bushy vegetation. The males usually perch on a tall plant and very actively defend their territory. The female lays her eggs singly on the leaves of various woundworts (*Stachys* spp.), Betony (*S. officinalis*), but also Hedge Woundwort (*S. sylvatica*), Alpine Woundwort (*S. alpina*), and Marsh Woundwort (*S. palustris*). Species of horehounds (*Marrubium* spp.) are also considered to be larval foodplants. The young caterpillar lives in a curled-up leaf. When it is bigger, it spins two neighbouring leaves together to make a shelter where it remains during the day, coming out at night to feed on the leaves of the foodplant. It also pupates in such a shelter. This butterfly has one or two broods a year. It overwinters either as a caterpillar or a pupa.

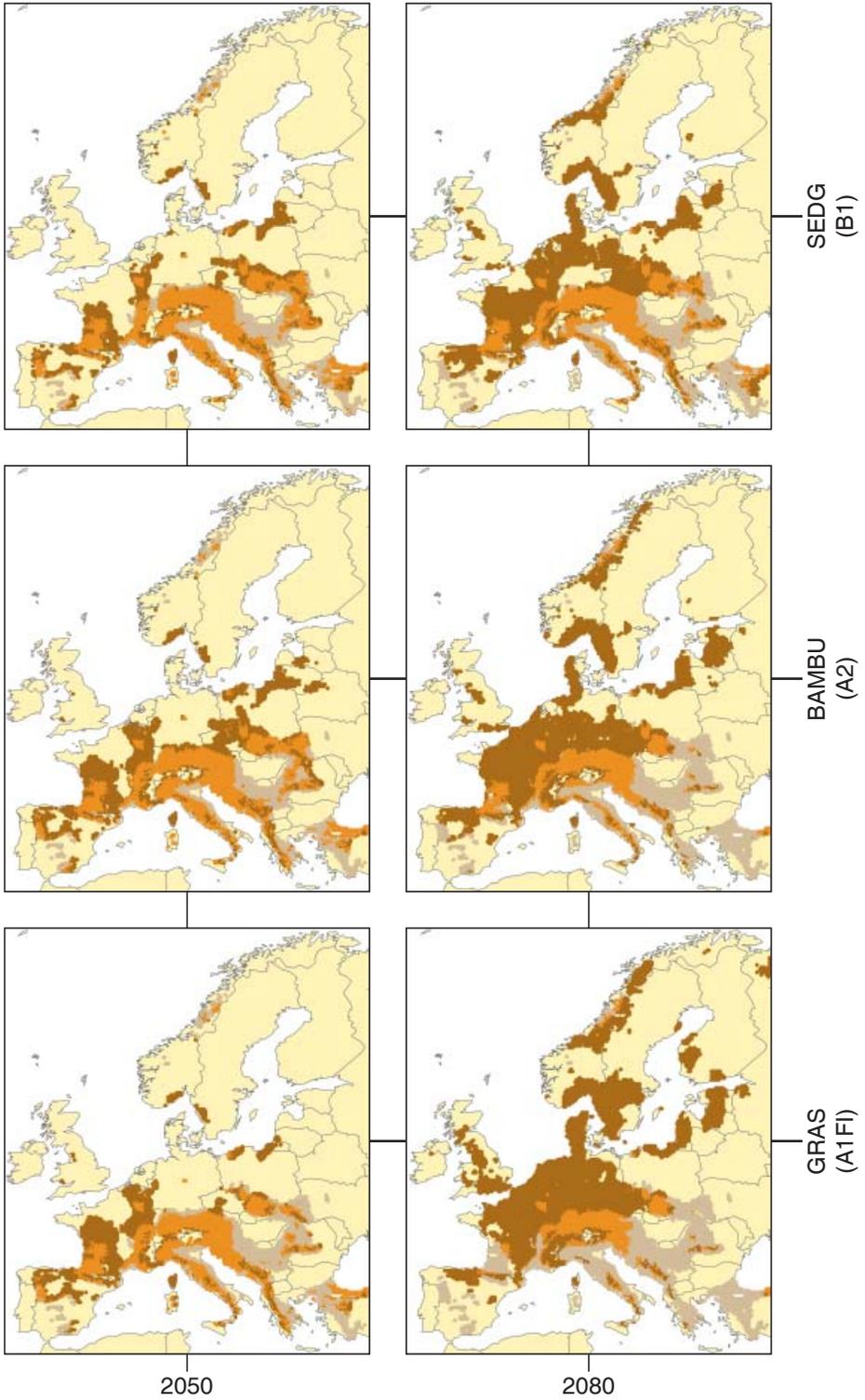
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.79).
Climate risk category: R.



Observed species distribution (50×50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Carcharodus orientalis (REVERDIN, 1913) – Oriental Marbled Skipper



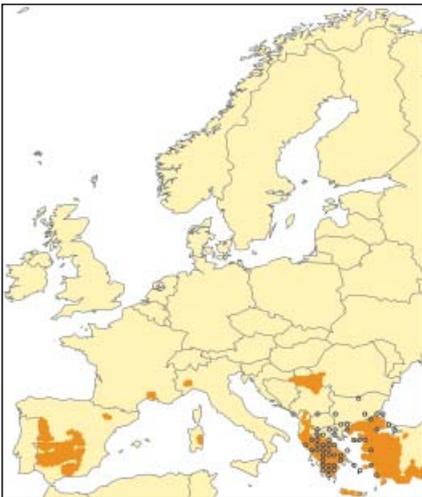
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		Full dispersal	No dispersal
2050	SEDG	-26 (-2.11%)	-611 (-49.59%)
	BAMBU	-119 (-9.66%)	-594 (-48.21%)
	GRAS	-94 (-7.63%)	-695 (-56.41%)
2080	SEDG	255 (20.7%)	-729 (-59.17%)
	BAMBU	-435 (-35.31%)	-972 (-78.9%)
	GRAS	-266 (-21.59%)	-1116 (-90.58%)

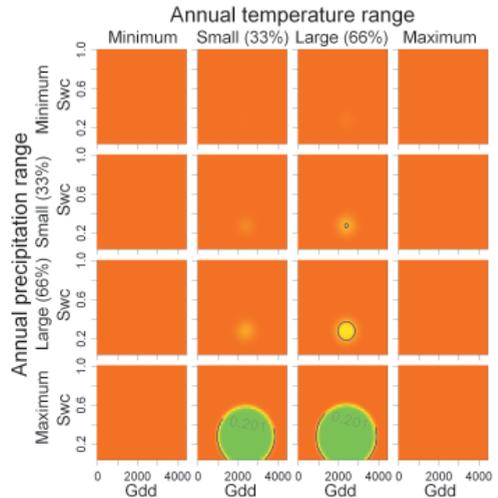
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 1232 cells)

The Oriental Marbled Skipper is mostly found on grasslands, on rocky slopes with grassy vegetation, and occasionally on bushy or on low, shrubby vegetation. The butterflies fly quickly, close to the ground. When they are at rest, they usually have their wings widely spread. Males can be commonly found drinking on dump ground. The caterpillars feed on woundworts (*Stachys* spp.). It has two to three generations a year, and hibernates as a caterpillar.

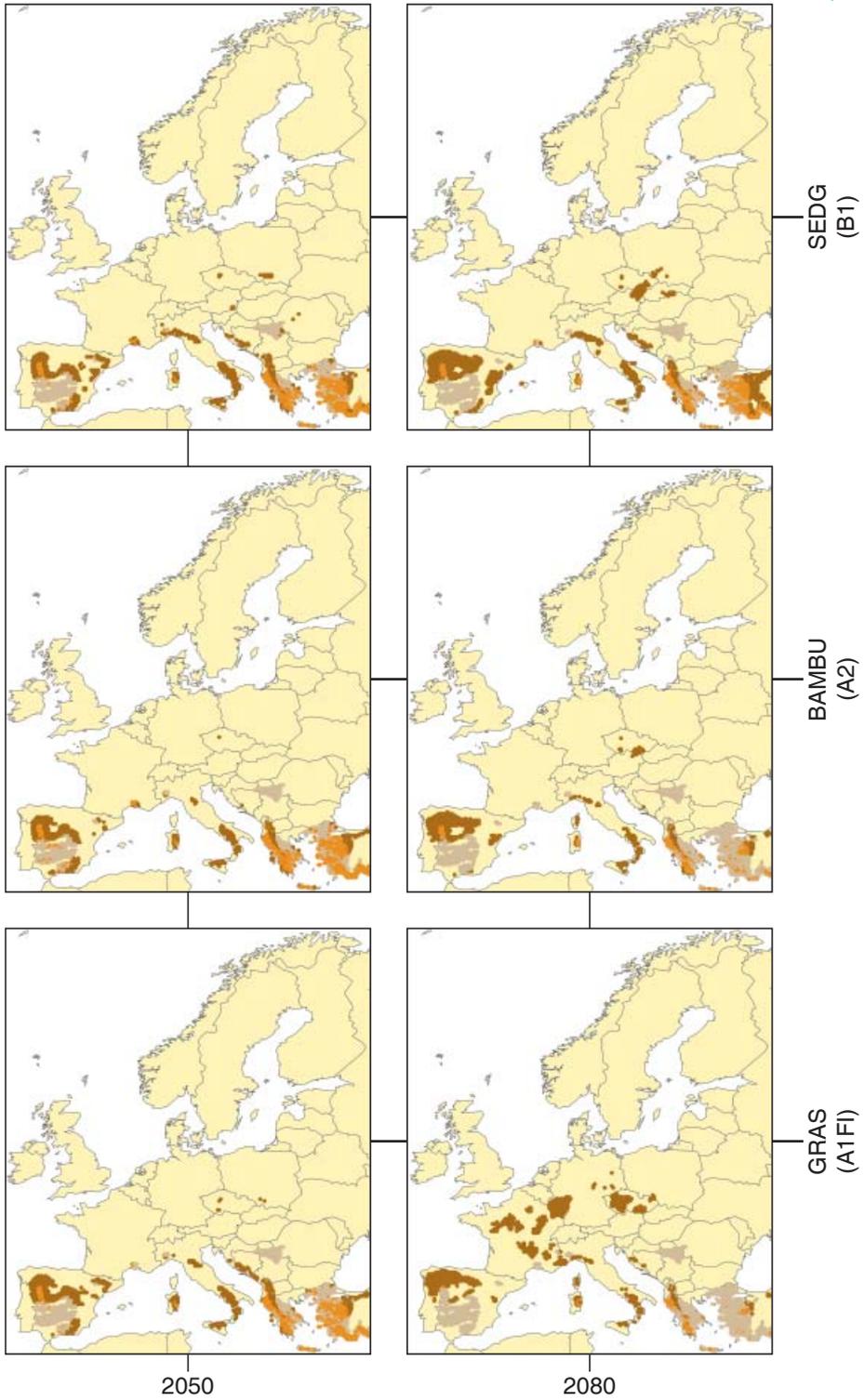
Present distribution can be well explained by climatic variables (AUC = 0.92).
Climate risk category: HHR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Carcharodus baeticus (RAMBUR, 1840) – Southern Marbled Skipper



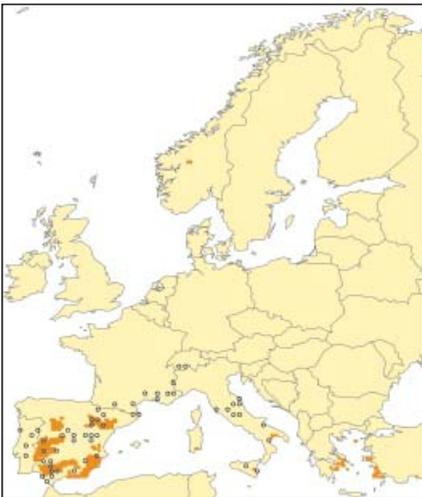
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		Full dispersal	No dispersal
2050	SEDG	88 (21.26%)	-239 (-57.73%)
	BAMBU	75 (18.12%)	-233 (-56.28%)
	GRAS	168 (40.58%)	-229 (-55.31%)
2080	SEDG	106 (25.6%)	-275 (-66.43%)
	BAMBU	138 (33.33%)	-288 (-69.57%)
	GRAS	248 (59.9%)	-293 (-70.77%)

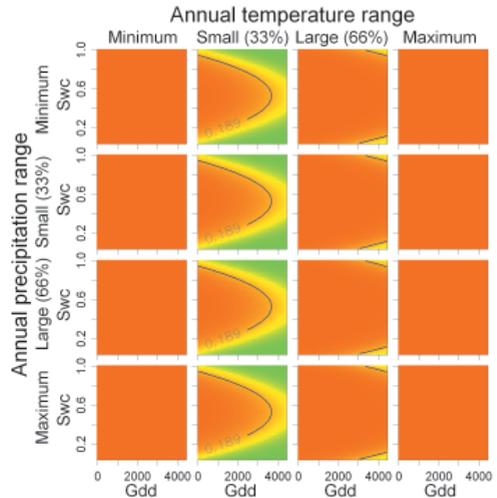
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 414 cells)

The Southern Marbled skipper occurs on dry, sparse vegetation, as found in the dunes, in dry, grassy places, and on rocky slopes. Foodplants are various horehounds, including Horehound (*Marrubium vulgare*), Black Horehound (*Ballota nigra* ssp. *foetida*), and *Ballota* spp. The female lays her eggs one by one on the leaves and shoots of the foodplant, seeming to prefer smaller plants. The small caterpillars live hidden in a spun leaf. The older, larger caterpillars spin two neighbouring leaves together to make a safe shelter. When they are fully-grown, the caterpillars go down to the foot of the foodplant, and spin a few dried leaves together in which to pupate. The species was not seen in the Alps in last 40 years, where it probably had just one generation per year, while in Spain there are two or three generations a year. It hibernates as a caterpillar.

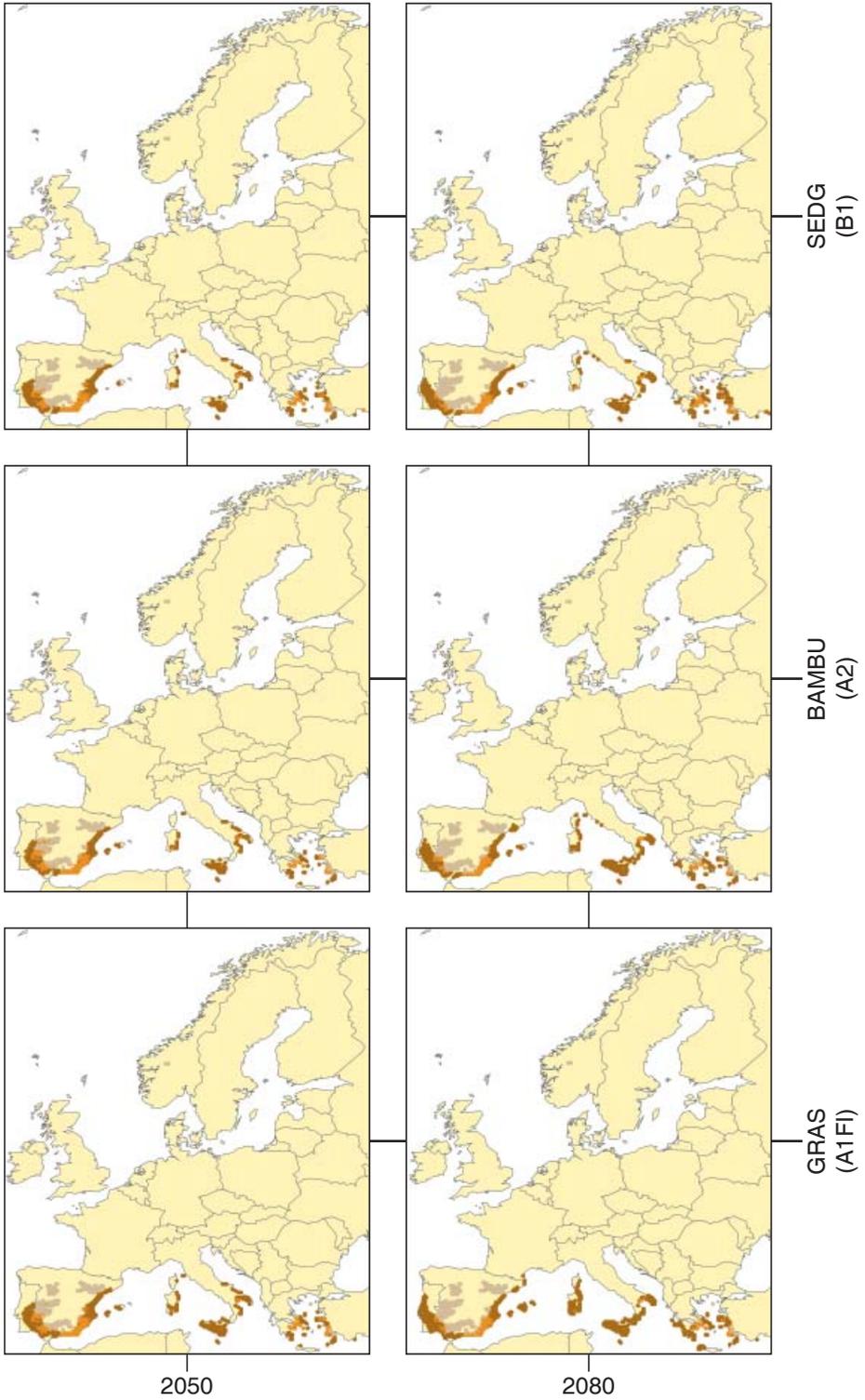
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.8).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Spialia phlomidis (HERRICH-SCHÄFFER, 1845) – Persian Skipper



© Rudi Verovnik

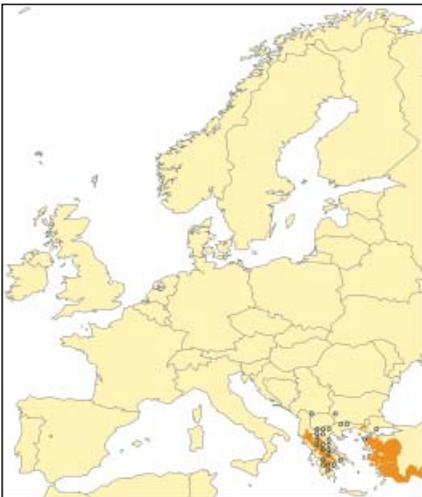
		Full dispersal	No dispersal
2050	SEDG	-59 (-15.4%)	-195 (-50.91%)
	BAMBU	-88 (-22.98%)	-228 (-59.53%)
	GRAS	-110 (-28.72%)	-260 (-67.89%)
2080	SEDG	27 (7.05%)	-229 (-59.79%)
	BAMBU	-262 (-68.41%)	-352 (-91.91%)
	GRAS	-319 (-83.29%)	-381 (-99.48%)

Changes in climatic niche distribution
(in 10⁴ × 10⁴ grid cells; present niche space: 383 cells)

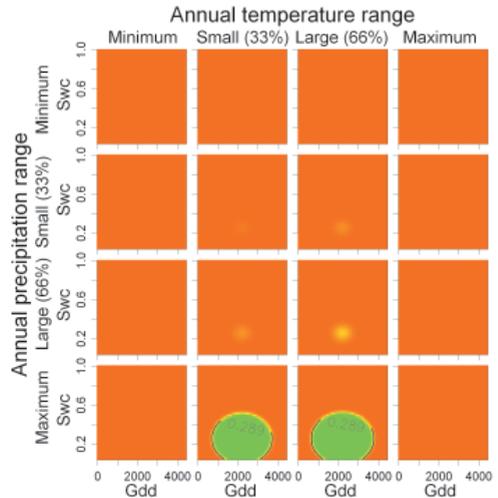
The Persian Skipper occurs on dry grasslands, on dry scrub, in rocky places and at woodland edges. On hot days males and females congregate on dump ground where they are easy to spot. Although the larval foodplant is not known for certain, probably various bindweeds (*Convolvulus* spp.) are used. Also, it is not clear how many broods it has a year, but it is probably two.

Present distribution can be well explained by climatic variables (AUC = 0.93).

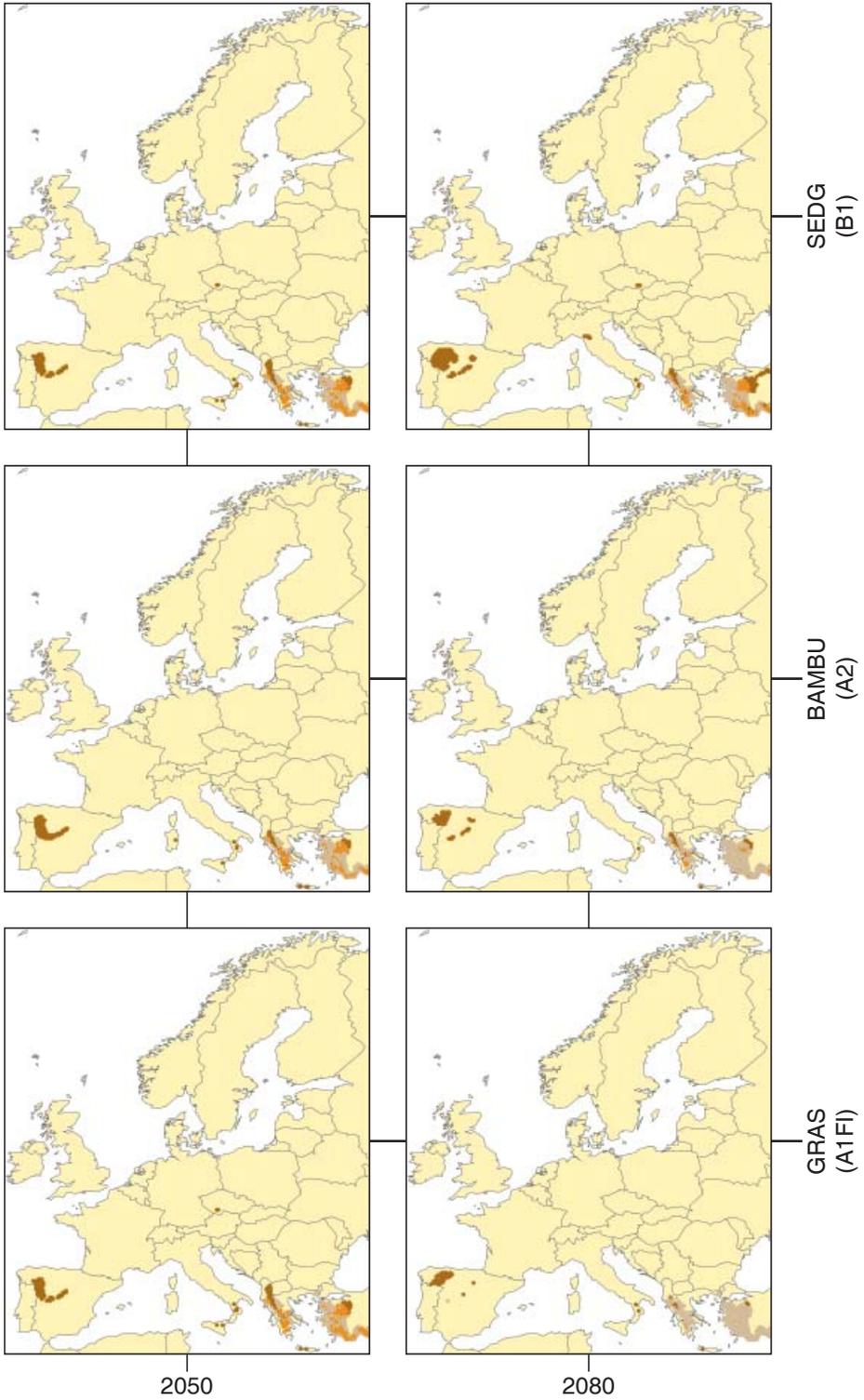
Climate risk category: HHHR



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Spialia sertorius (HOFFMANSEGG, 1804) – Red-underwing Skipper



© Chris van Swaay

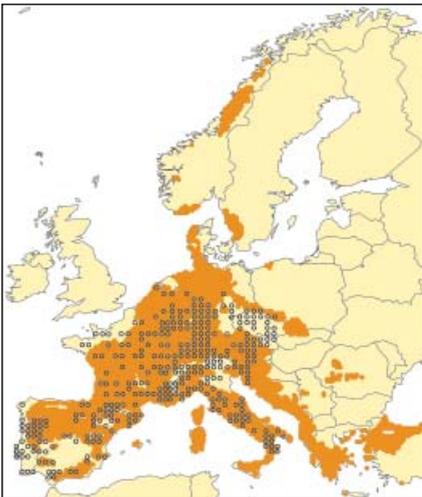
		Full dispersal	No dispersal
2050	SEDG	-426 (-6.29%)	-1771 (-26.17%)
	BAMBU	-331 (-4.89%)	-1755 (-25.93%)
	GRAS	-1114 (-16.46%)	-2425 (-35.83%)
2080	SEDG	-553 (-8.17%)	-2424 (-35.82%)
	BAMBU	-1006 (-14.86%)	-3188 (-47.1%)
	GRAS	-2218 (-32.77%)	-4639 (-68.54%)

Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 6768 cells)

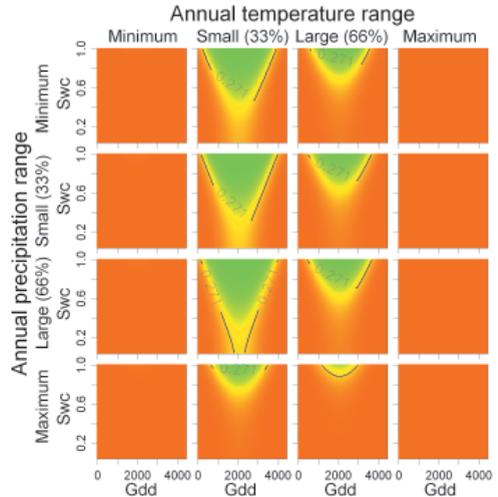
The Red-underwing Skipper is a small butterfly that likes warm habitats. It occurs on calcareous and other dry grasslands, and also in dry, rough vegetation, as long as its larval foodplant, Salad Burnet (*Sanguisorba minor*), is present. The eggs are laid between the buds on the flowerheads of this plant and the caterpillars feed on the young leaves. Hibernation takes place as a caterpillar, in warm areas when still small, and further north when fully grown. The caterpillars pupate in the litter layer, in a sturdy cocoon made from plant remains. Because of its rapid flight and unremarkable behaviour, this small butterfly is often not even noticed. However, they are often present in large numbers over quite a small area. The butterflies like visiting flowers. It has one or two broods a year, depending on the position of the breeding ground within the range.

Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.77)

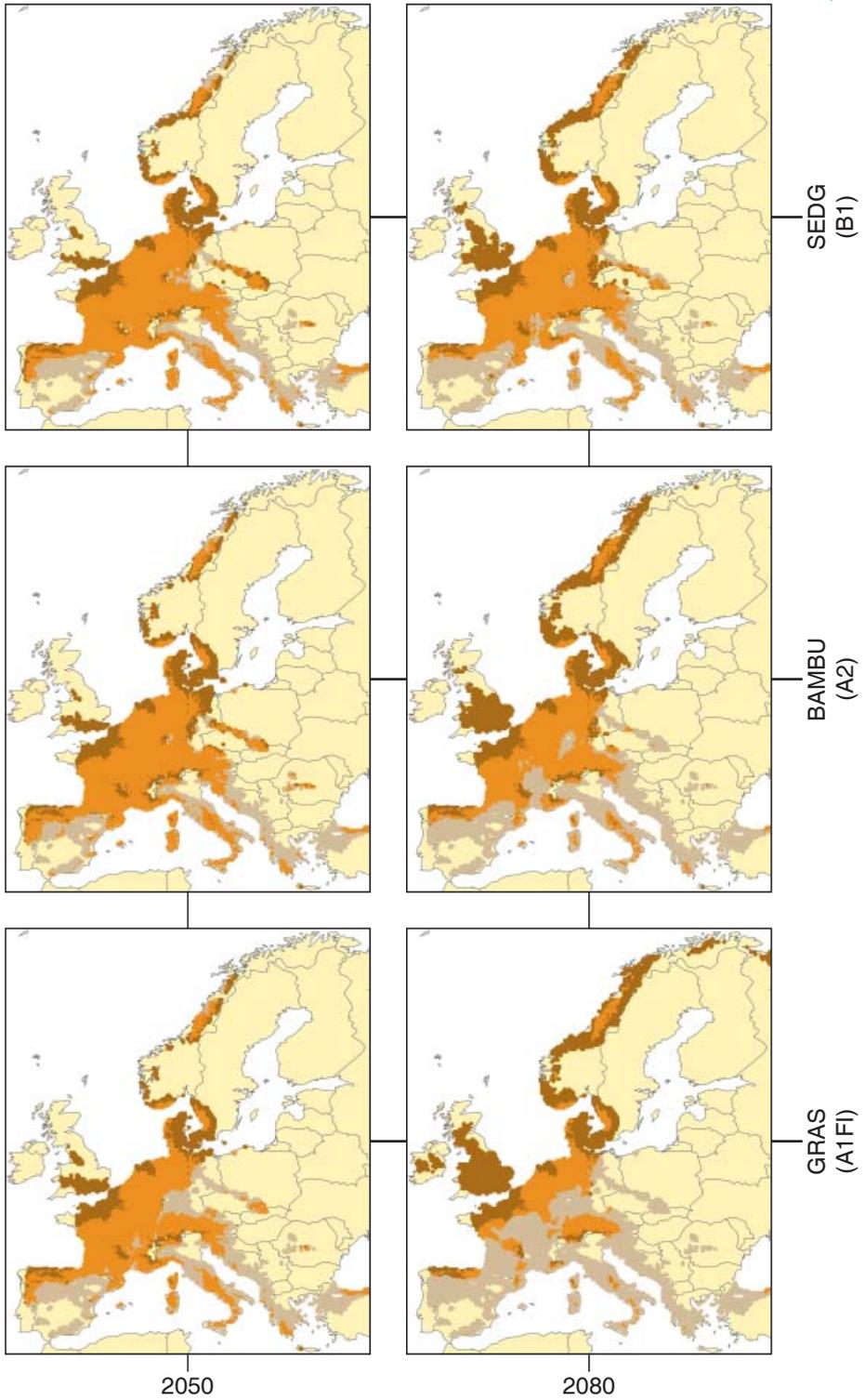
Climate risk category: R



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Spialia orbifer (HÜBNER, 1823) – Orbed Red-underwing Skipper



© Chris van Swaay

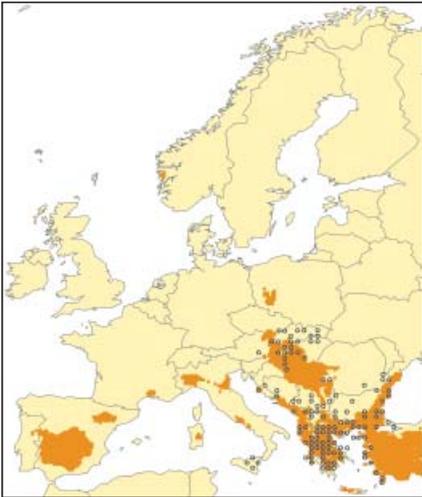
		Full dispersal	No dispersal
2050	SEDG	2229 (81.71%)	-341 (-12.5%)
	BAMBU	528 (19.35%)	-987 (-36.18%)
	GRAS	1211 (44.39%)	-976 (-35.78%)
2080	SEDG	1025 (37.57%)	-1188 (-43.55%)
	BAMBU	-59 (-2.16%)	-1848 (-67.74%)
	GRAS	1443 (52.9%)	-2000 (-73.31%)

Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 2728 cells)

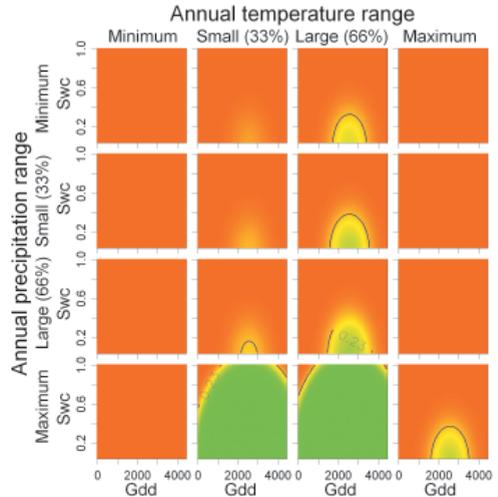
The Orbed Red-underwing Skipper occurs on dry, flower-rich grasslands, on roadside verges, at the edges of woods, on abandoned agricultural land, rocky slopes, and along dried-up river beds. The butterflies have a rapid flight, close to the ground. The eggs are laid on the flowerheads of Salad Burnet (*Sanguisorba minor*), and, in Eastern Europe, possibly also on Great Burnet (*S. officinalis*). The round flowerheads of the foodplant are the caterpillars' first food, but as they grow larger, they hide themselves between spun leaves. Hibernation takes place on the ground, in the litter layer. They also pupate in rolled-up leaves of the foodplant. This skipper is double-brooded and hibernates as a caterpillar.

Present distribution can be well explained by climatic variables (AUC = 0.89).

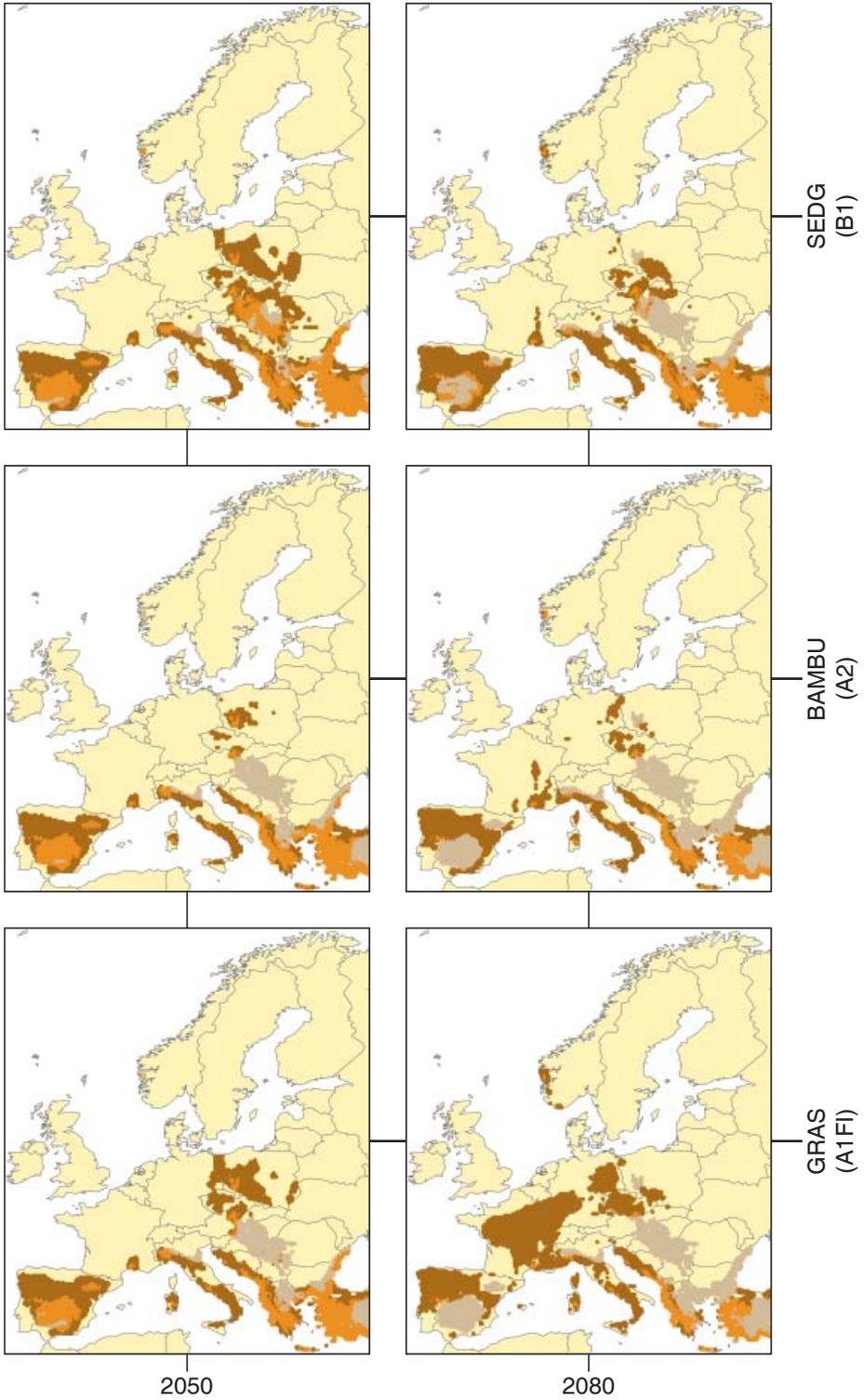
Climate risk category: HR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tertile, upper tertile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Syrichtus proto (OCHSENHEIMER, 1808) – Sage Skipper



© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-1328 (-36.22%)	-1802 (-49.15%)
	BAMBU	-1862 (-50.79%)	-2012 (-54.88%)
	GRAS	-1928 (-52.59%)	-2248 (-61.32%)
2080	SEDG	-1929 (-52.62%)	-2530 (-69.01%)
	BAMBU	-3014 (-82.21%)	-3242 (-88.43%)
	GRAS	-2945 (-80.33%)	-3553 (-96.92%)

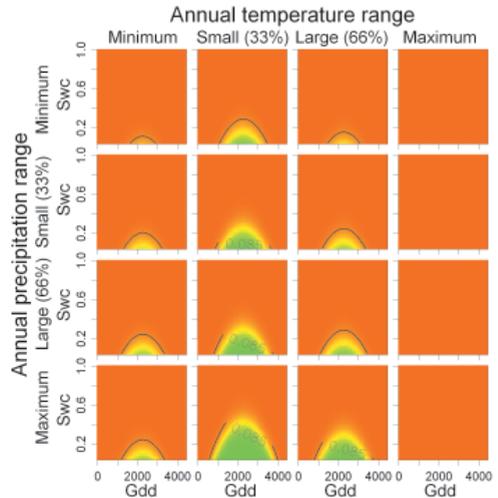
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 3666 cells)

The Sage Skipper occurs on dry, flower-rich grassland, in open scrub, on rocky ground with sparse vegetation. However, in its chosen habitat, the larval foodplants are usually abundant. Various species of *Phlomis* are used, such as Jerusalem Sage (*P. fruticosa*), *P. hychnitis*, *P. herba-venti*, and perhaps also Horehound (*Marrubium* spp.). Although there is probably only one generation a year, the butterflies of the Sage Skipper can be seen from spring until autumn, due to prolonged emergence from the pupa. This skipper passes the winter as a caterpillar inside the egg.

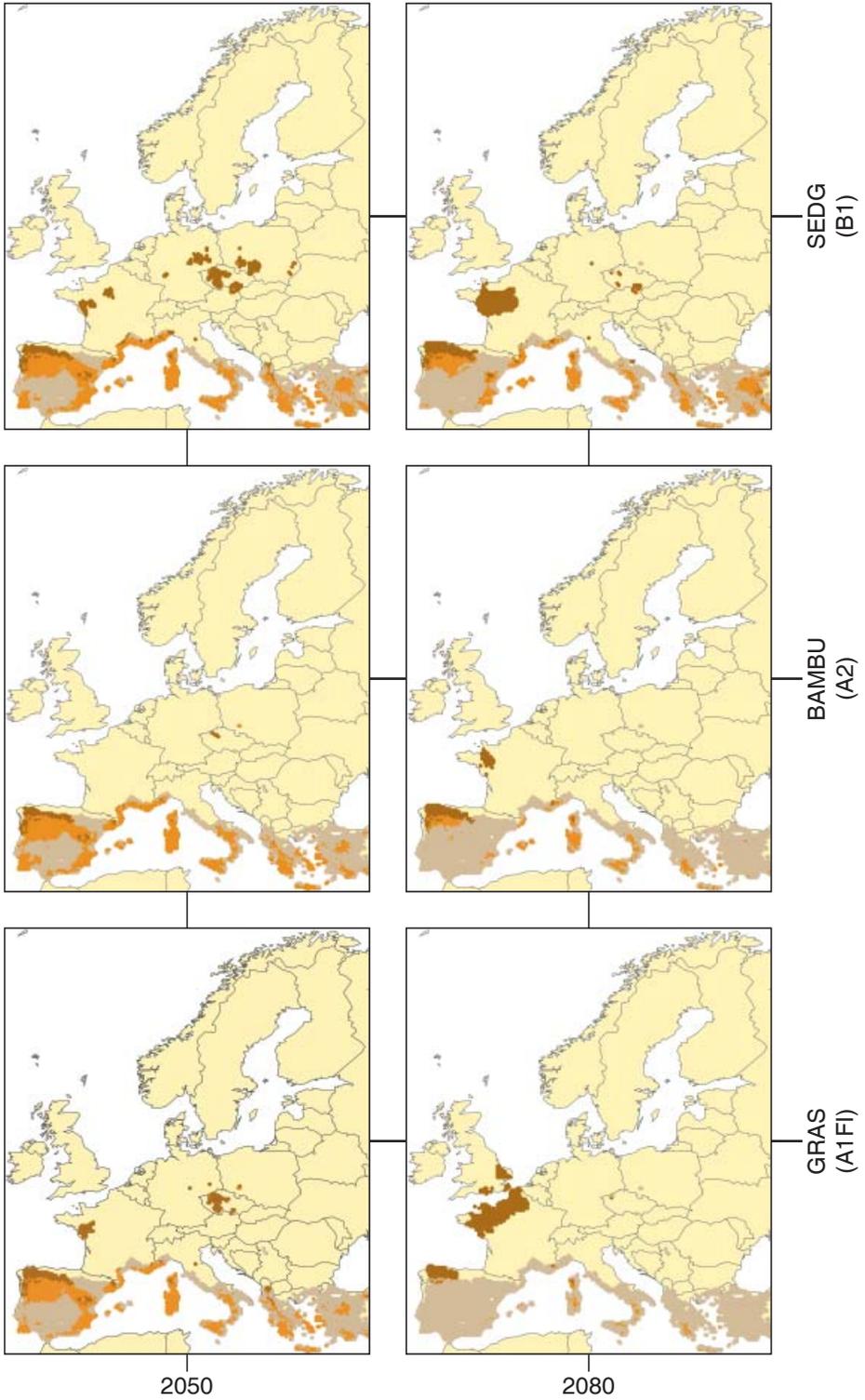
Present distribution can be well explained by climatic variables (AUC = 0.89).
Climate risk category: HHRH.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Syrichtus tessellum (HÜBNER, 1803) – Tessellated Skipper



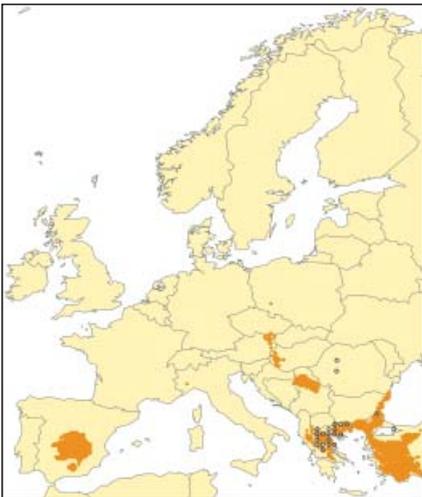
© Albert Vliegthart

		Full dispersal	No dispersal
2050	SEDG	305 (28.8%)	-806 (-76.11%)
	BAMBU	-303 (-28.61%)	-938 (-88.57%)
	GRAS	-736 (-69.5%)	-1059 (-100%)
2080	SEDG	-270 (-25.5%)	-907 (-85.65%)
	BAMBU	-755 (-71.29%)	-1058 (-99.91%)
	GRAS	-736 (-69.5%)	-1059 (-100%)

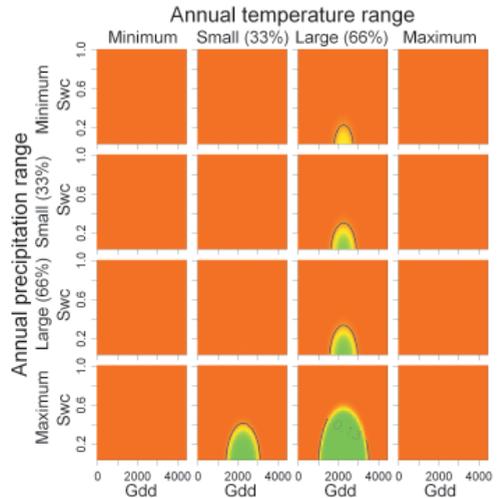
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 1059 cells)

The Tessellated Skipper occurs in open grassy and flower rich places where it feeds preferably on thymes, vetches and yarrows. The butterflies have a rapid flight, often quite close to the ground. The caterpillars feed on the labiates *Phlomis tuberosa* and *P. samia*, hiding in spun leaves. The Tessellated Skipper has one or two generations a year, and passes the winter as a small caterpillar.

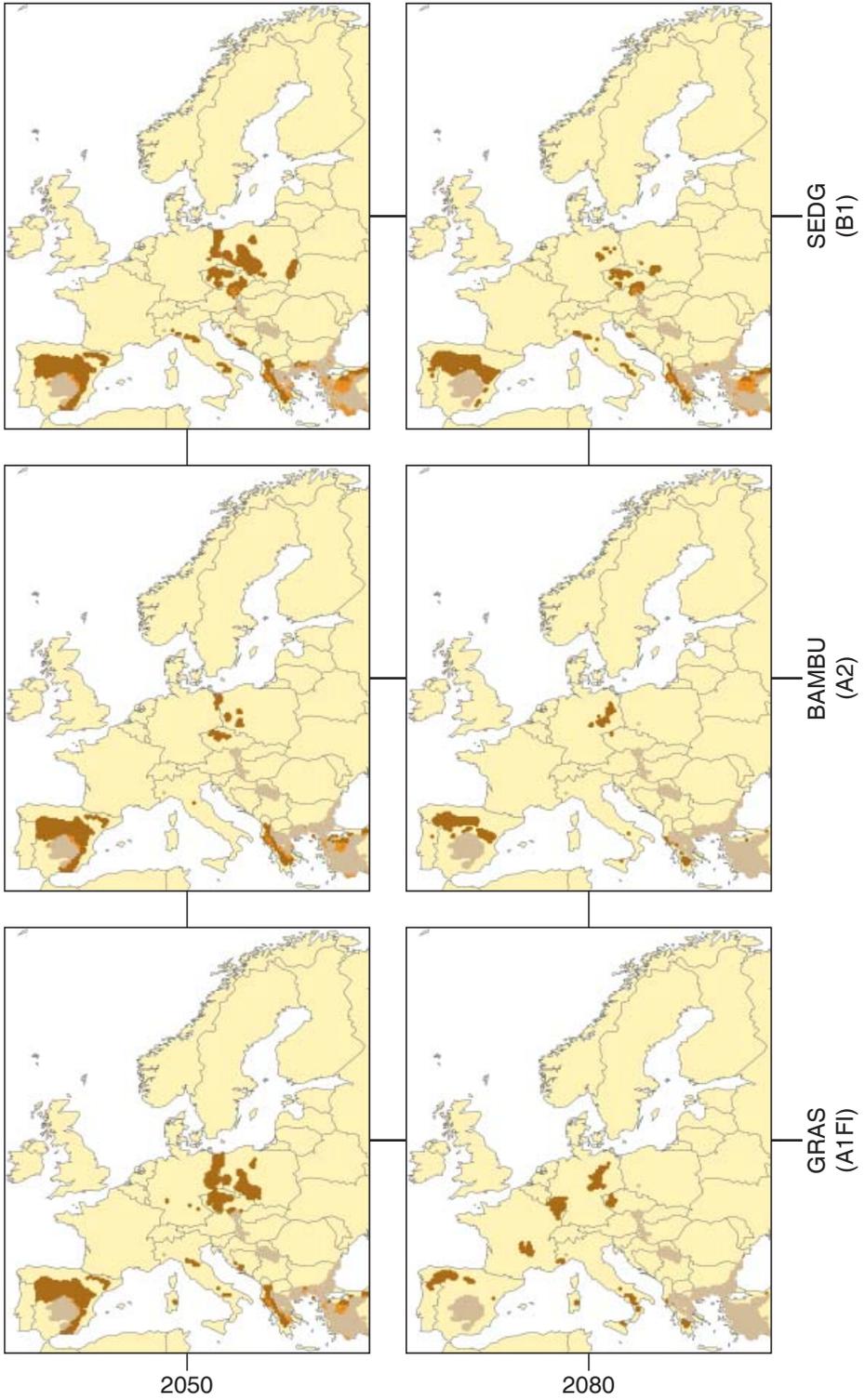
Present distribution can be well explained by climatic variables (AUC = 0.89).
Climate risk category: HHHR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Pyrgus carthami (HÜBNER, 1813) – Safflower Skipper



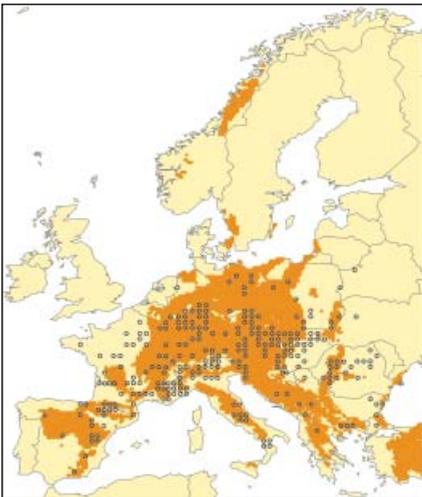
© Rudi Verovnik

		Full dispersal	No dispersal
2050	SEDG	222 (3.38%)	1952 (-29.74%)
	BAMBU	-770 (-11.73%)	-2415 (-36.8%)
	GRAS	-761 (-11.6%)	-2712 (-41.32%)
2080	SEDG	-1051 (-16.01%)	-3471 (-52.89%)
	BAMBU	-1787 (-27.23%)	-4285 (-65.29%)
	GRAS	-3285 (-50.05%)	-5563 (-84.76%)

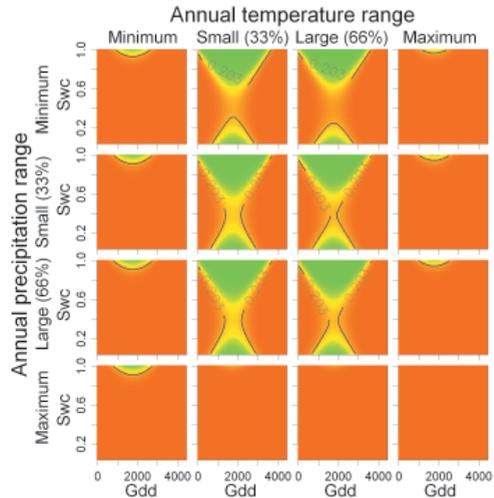
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 6563 cells)

The Safflower Skipper is the largest grizzled skipper in Central Europe. It prefers sheltered places, occurring on dry, often calcareous grasslands, and on rough vegetation in places sheltered from the wind. They often rest near bushes or at the edges of woods. They lay their eggs singly on the upperside of the leaves of cinquefoils (*Potentilla* spp.), the caterpillar later using leaves as food. However, the caterpillars are difficult to find, because they hide away in plant cushions during the day, in order to survive the summer heat. The caterpillars hibernate in spun leaves in the litter layer, probably in the last larval instar. However, in breeding experiments, each stage was found to be capable of hibernating. Before they pupate, the caterpillars make a sturdy cocoon. The Safflower Skipper is single-brooded.

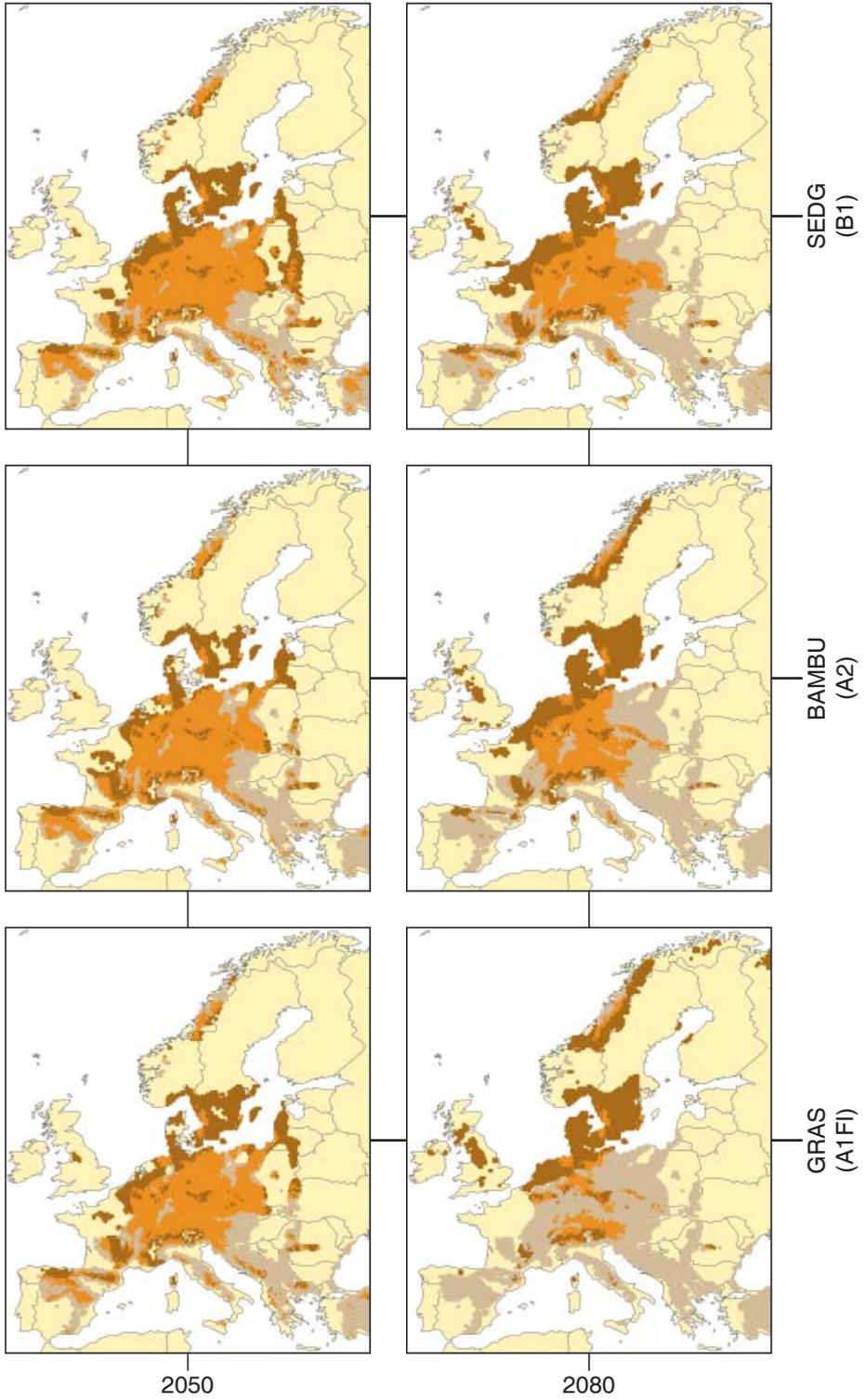
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.76). Climate risk category: HR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Pyrgus sidae (ESPER, 1782) – Yellow-banded Skipper



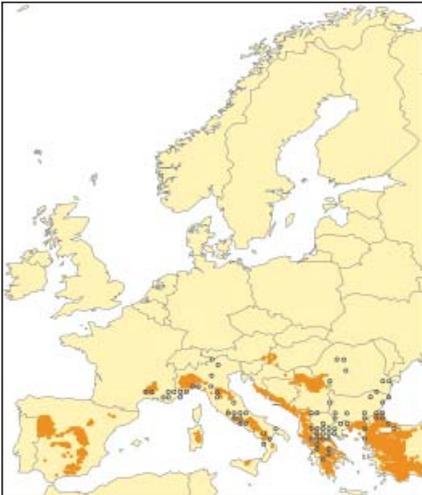
© Albert Vliegthart

		Full dispersal	No dispersal
2050	SEDG	33 (2.46%)	-831 (-61.88%)
	BAMBU	-427 (-31.79%)	-917 (-68.28%)
	GRAS	-352 (-26.21%)	-981 (-73.05%)
2080	SEDG	-178 (-13.25%)	-1051 (-78.26%)
	BAMBU	-808 (-60.16%)	-1286 (-95.76%)
	GRAS	-384 (-28.59%)	-1328 (-98.88%)

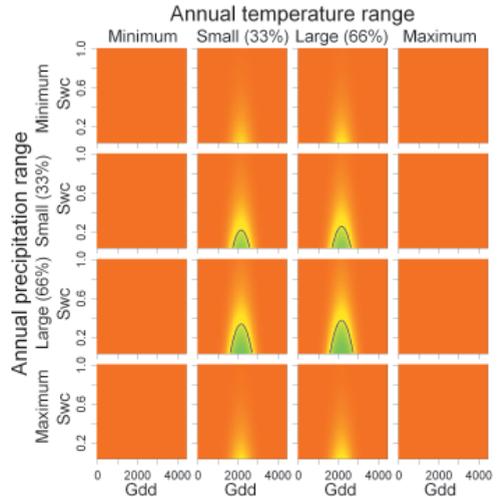
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 1343 cells)

The yellow and white bands on the underside of its hindwing make the Yellow-banded Skipper unmistakable. These skippers can be found on flower-rich grasslands, flower-rich stony slopes in gullies, and in open scrub. The butterflies fly slowly, close to the ground. Sulphur Cinquefoil (*Potentilla recta*), *Potentilla hirta*, and perhaps also *Abutilon theophrasti* are used as larval foodplants. It hibernates as a caterpillar and has one brood a year.

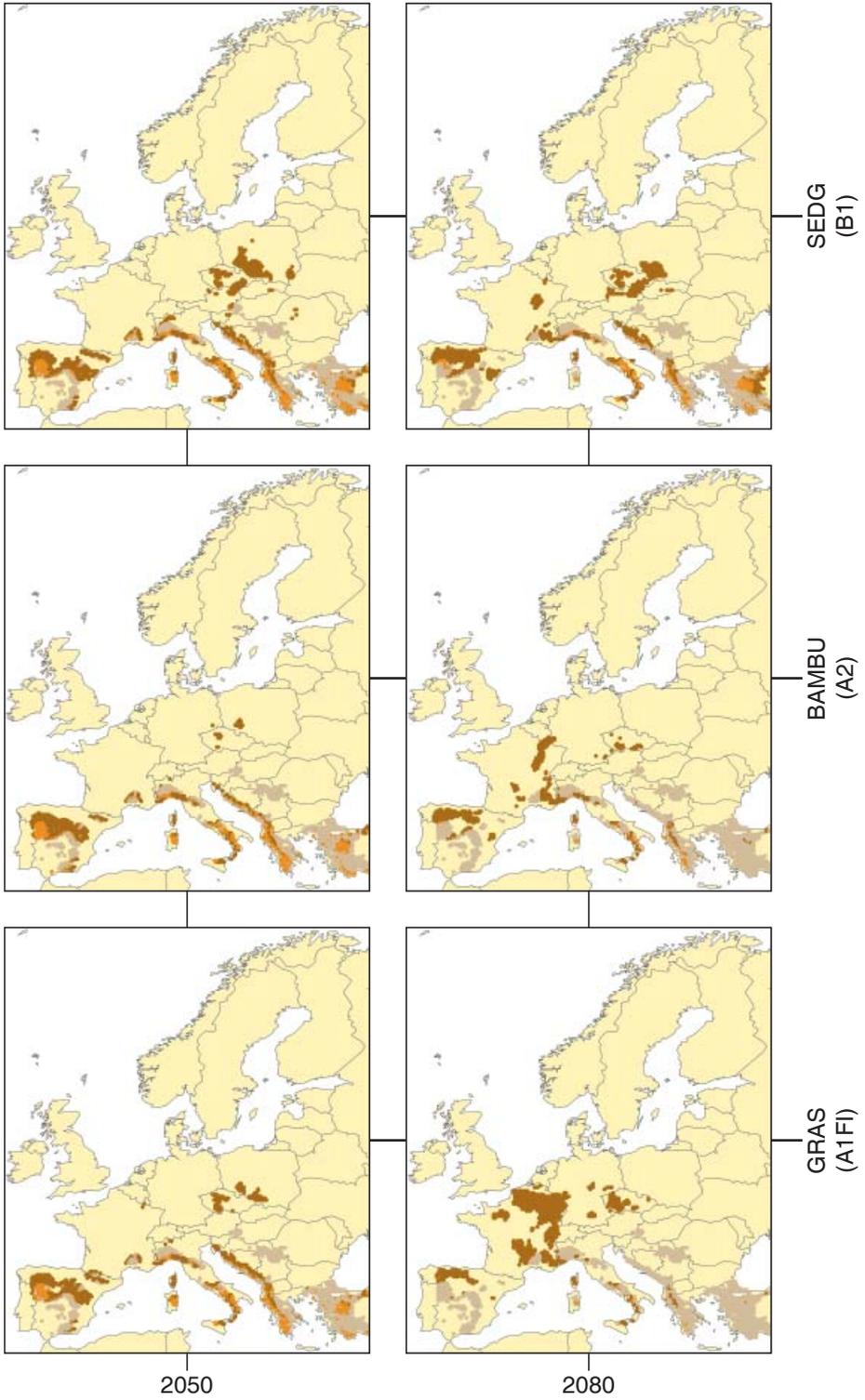
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.85). Climate risk category: HHHHR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Pyrgus andromedae (WALLENGREN, 1853) – Alpine Grizzled Skipper



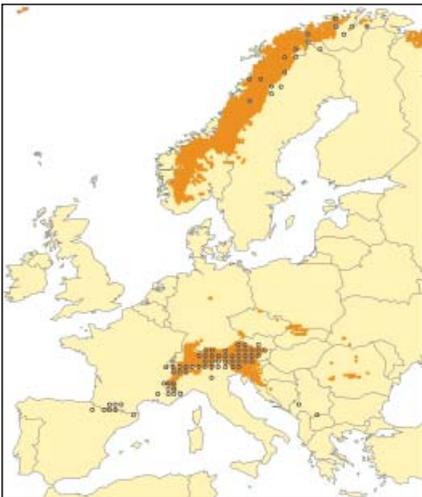
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-432 (-22.37%)	-517 (-26.77%)
	BAMBU	-280 (-14.5%)	-356 (-18.44%)
	GRAS	-511 (-26.46%)	-546 (-28.28%)
2080	SEDG	-425 (-22.01%)	-586 (-30.35%)
	BAMBU	-306 (-15.85%)	-542 (-28.07%)
	GRAS	-584 (-30.24%)	-777 (-40.24%)

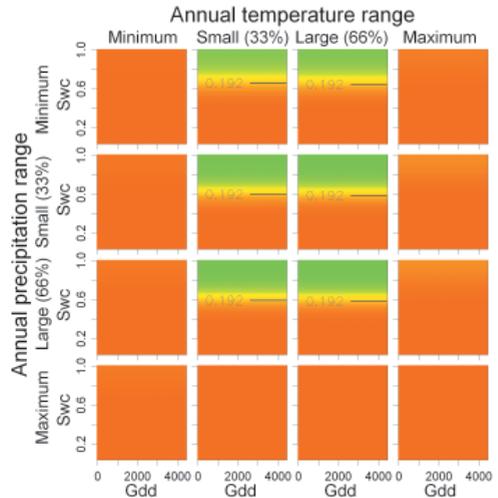
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 1931 cells)

The Alpine Grizzled Skipper occurs in damp, moist, grassy places, often near streams or bogs in the Alps and Pyrenees. In Scandinavia, they are seen on dwarf scrub vegetation and also in rocky places on steep slopes. The only reported foodplant is *Dryas octopetala*. The caterpillars live in a communal shelter of spun leaves. They hibernate, pupating in a similar shelter the following spring. The species' development takes two years.

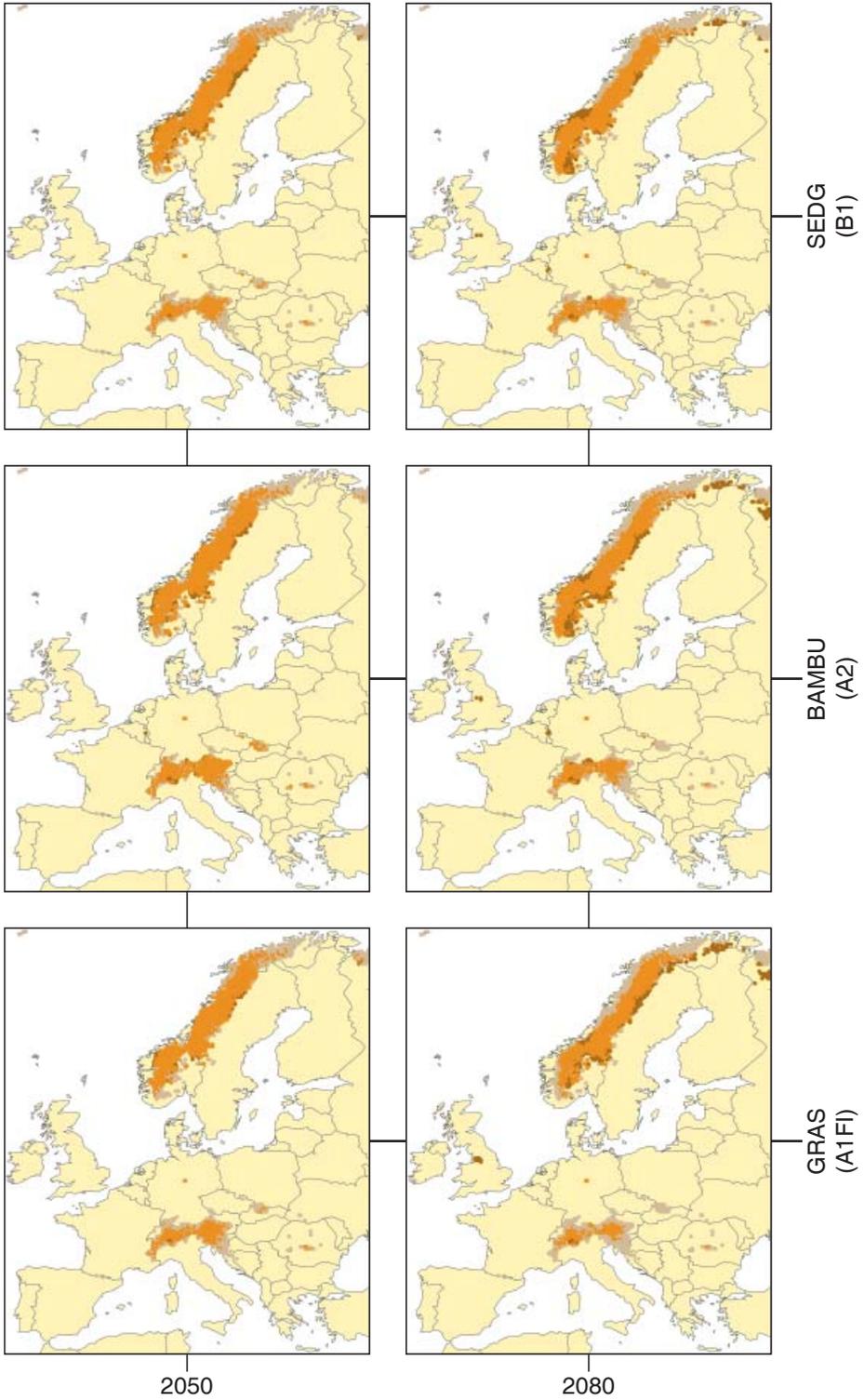
Present distribution can be well explained by climatic variables (AUC = 0.87).
Climate risk category: LR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Pyrgus cacaliae (RAMBUR, 1840) – Dusky Grizzled Skipper



© Kars Veling

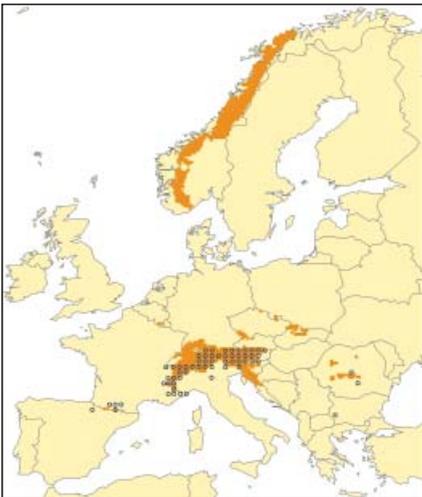
		Full dispersal	No dispersal
2050	SEDG	-272 (-23.59%)	-368 (-31.92%)
	BAMBU	-207 (-17.95%)	-320 (-27.75%)
	GRAS	-312 (-27.06%)	-400 (-34.69%)
2080	SEDG	-514 (-44.58%)	-630 (-54.64%)
	BAMBU	-336 (-29.14%)	-538 (-46.66%)
	GRAS	-523 (-45.36%)	-719 (-62.36%)

Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 1153 cells)

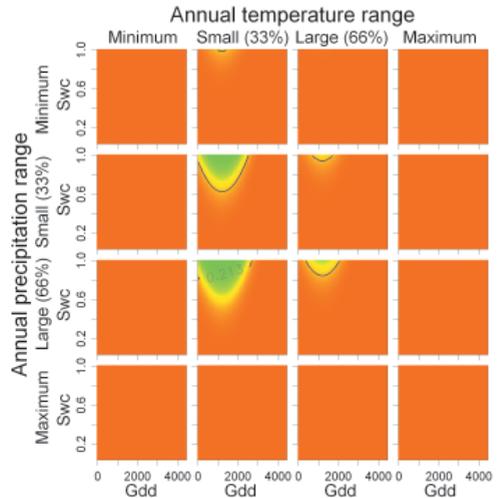
Damp grassland, at the edge of bogs or streams, is the habitat of the Dusky Grizzled Skipper, although they sometimes occur on dry grasslands. The male show marked territorial behaviour. The female lays her eggs on various species of cinquefoil (*Potentilla* spp.), such as Tormentil (*P. erecta*), and Alpine Cinquefoil (*P. crantzii*), and also on *Sibbaldia* species. She prefers plants growing on drier places, such as on hummocks in damp habitats, or at a little distance from its habitat. The caterpillars live hidden between spun leaves, and it is in this stage that the Dusky Grizzled Skipper hibernates. The development takes two years.

Present distribution can be well explained by climatic variables (AUC = 0.92).

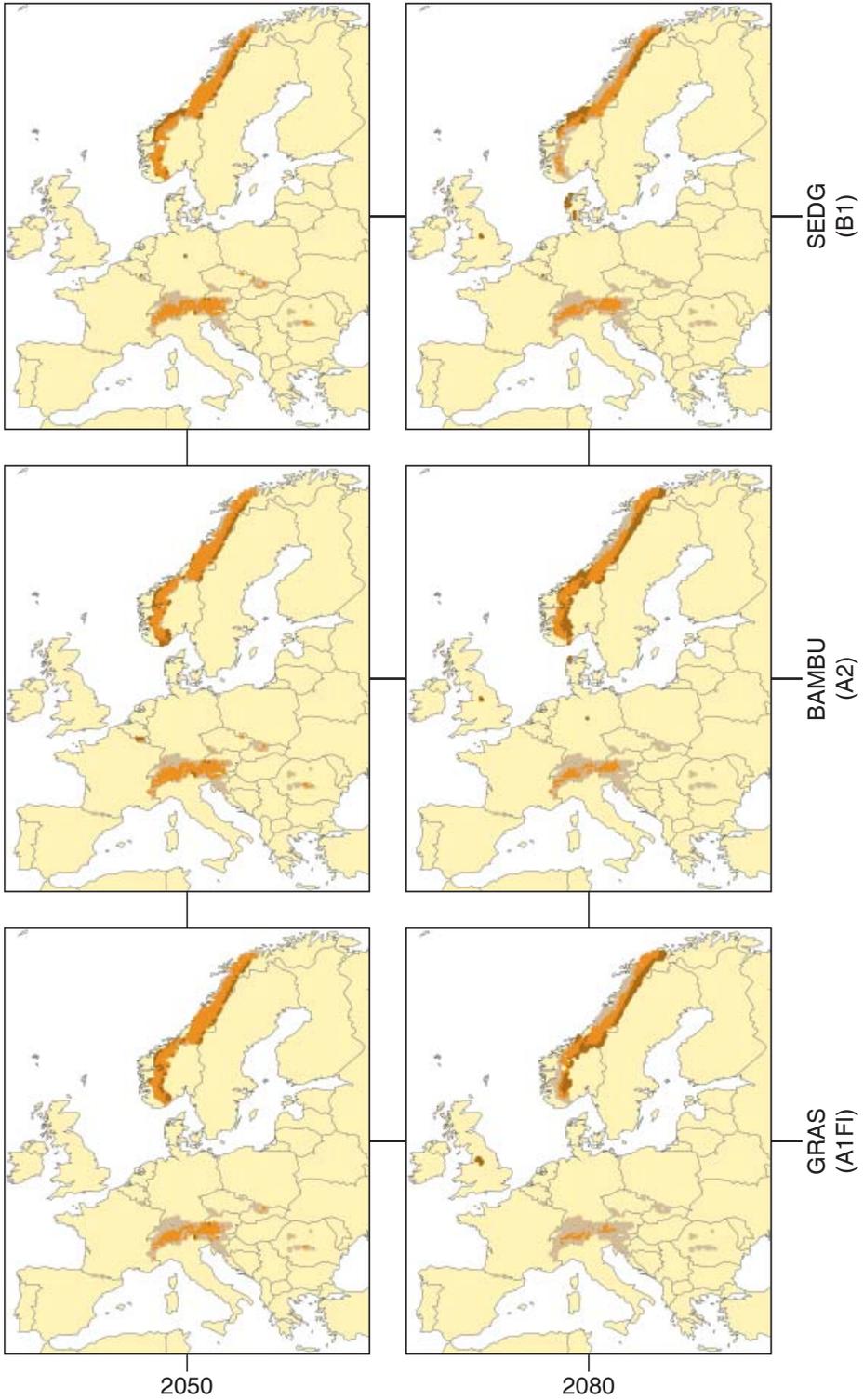
Climate risk category: R.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Pyrgus centaureae (RAMBUR, 1840) – Northern Grizzled Skipper



© Bernard Franssen

		Full dispersal	No dispersal
2050	SEDG	-1313 (-22.8%)	-1372 (-23.82%)
	BAMBU	-1446 (-25.1%)	-1465 (-25.43%)
	GRAS	-1565 (-27.17%)	-1588 (-27.57%)
2080	SEDG	-1836 (-31.87%)	-2073 (-35.99%)
	BAMBU	-2932 (-50.9%)	-3022 (-52.47%)
	GRAS	-3722 (-64.62%)	-3811 (-66.16%)

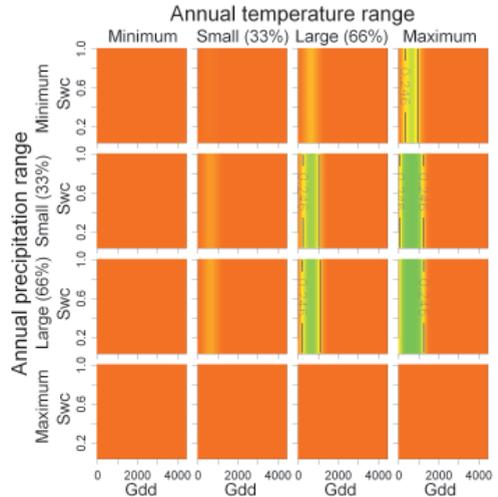
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 5760 cells)

The Northern Grizzled Skipper prefers damp, moist and wet places. It is mostly found in open areas of bogs or swamps, in scrub near swamps, and above the tree-line on stretches of wet ground with dwarf shrubs. With its inconspicuous colours and rapid flight, the butterflies of this grizzled skipper are difficult to follow. The female lays her eggs on Cloudberry (*Rubus chamaemorus*). Little is known about the way the caterpillars live. This species is single-brooded.

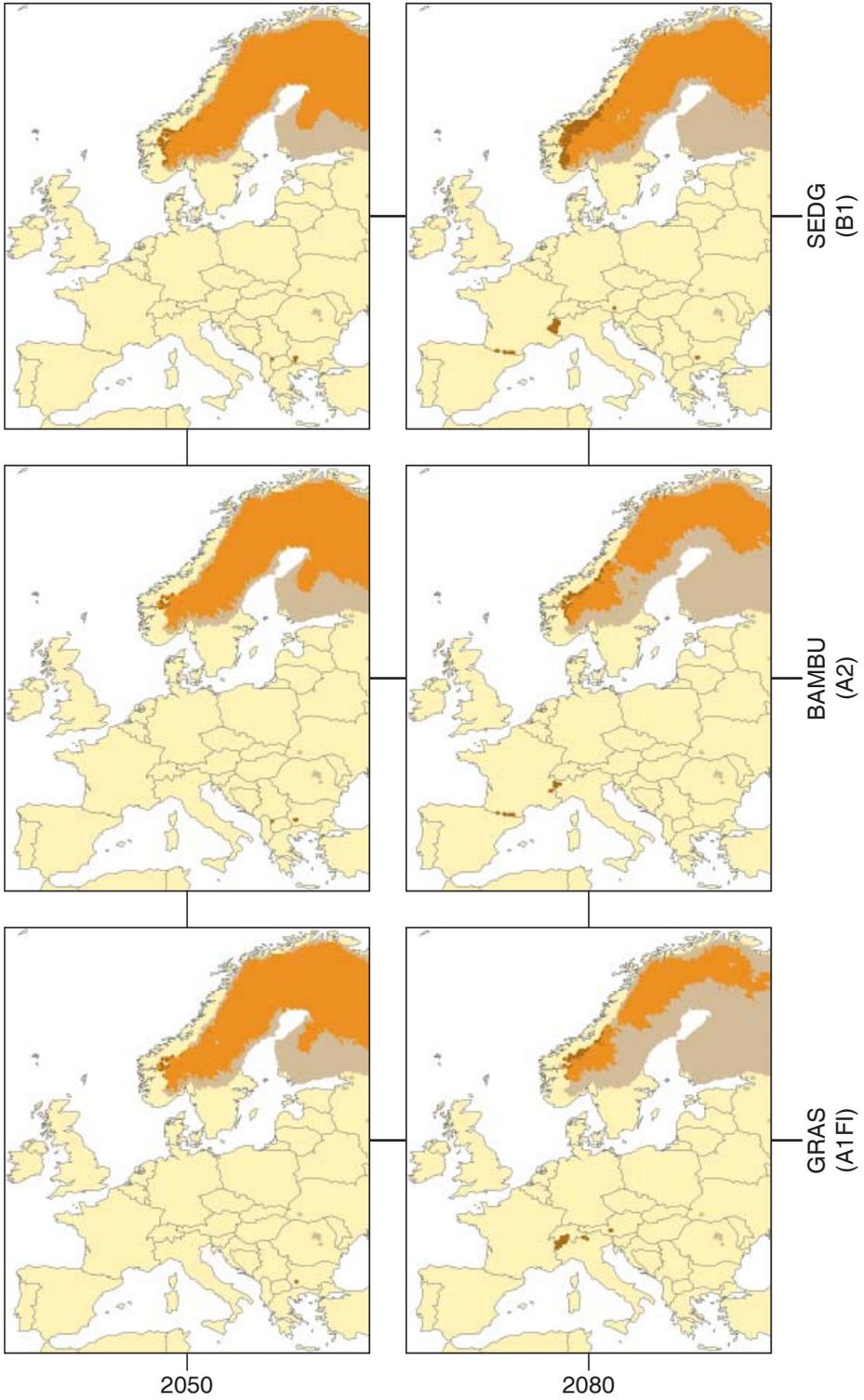
Present distribution can be very well explained by climatic variables (AUC = 0.96).
Climate risk category: R.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Pyrgus malvae (LINNAEUS, 1758) / *malvoides*
(ELWES & EDWARDS, 1897) (complex) – Grizzled Skipper



© Rudi Verovnik

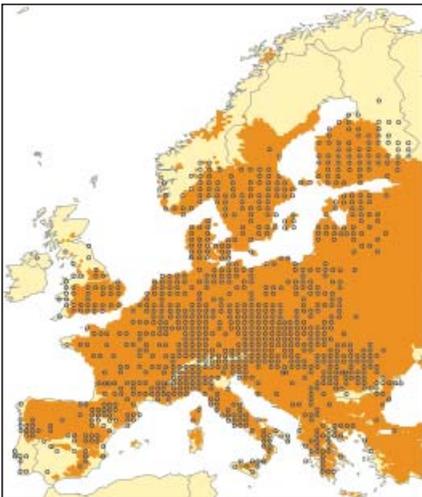
		Full dispersal	No dispersal
2050	SEDG	-2638 (-12.91%)	-4159 (-20.35%)
	BAMBU	-2324 (-11.37%)	-3586 (-17.54%)
	GRAS	-1529 (-7.48%)	-3197 (-15.64%)
2080	SEDG	-5554 (-27.17%)	-10058 (-49.21%)
	BAMBU	-4212 (-20.61%)	-7735 (-37.84%)
	GRAS	-2288 (-11.19%)	-5349 (-26.17%)

Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 20440 cells)

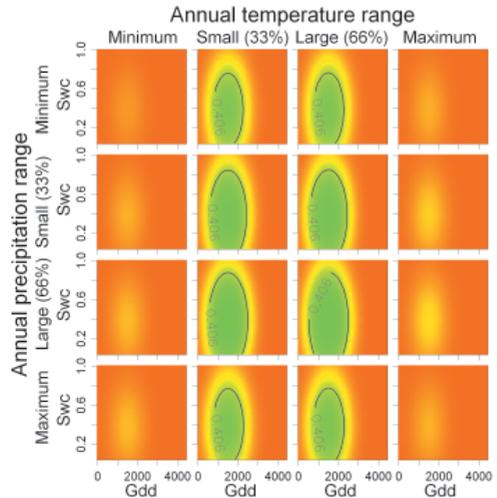
Due to data availability we here treat both *Pyrgus malvae* (LINNAEUS, 1758) and *P. malvoides* (ELWES & EDWARDS, 1897) as the Grizzled Skipper species complex, knowing that *Pyrgus malvoides* is mostly recognised as a distinct species.

The Grizzled Skipper occurs in many different habitats, mostly on dry, as well as moist, flower-rich grasslands, and also on calcareous grasslands and heaths. The eggs are laid on the underside of the leaves of cinquefoils (*Potentilla* spp.) and strawberries (*Fragaria* spp.). The caterpillar builds a small shelter from a leaf, in which it stays hidden, feeding on the leaves of the foodplant. The sturdy cocoon in which it pupates is spun from plant remains. This species has one to two broods.

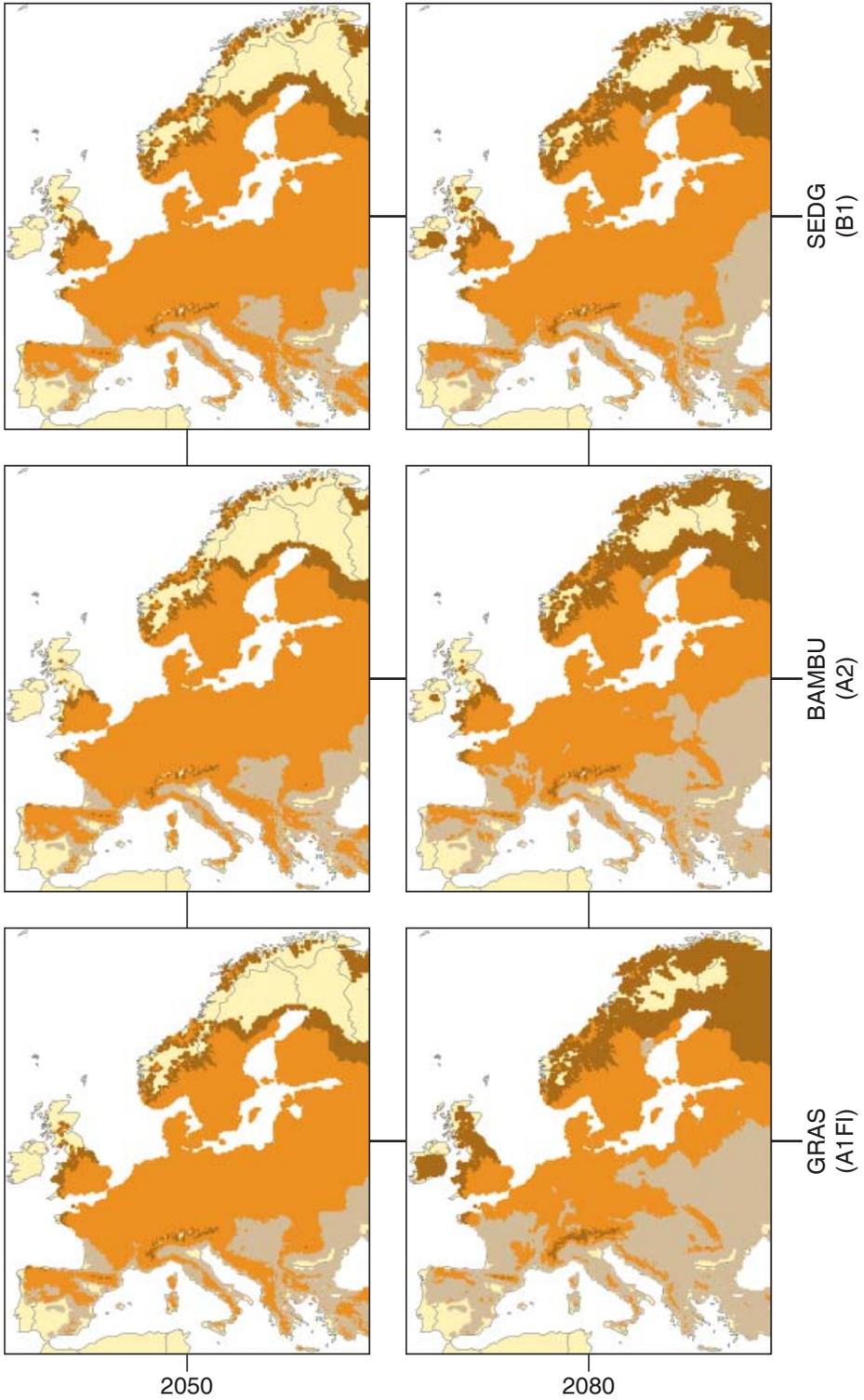
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.71).
Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tertile, upper tertile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Pyrgus serratulae (RAMBUR, 1840) – Olive Skipper



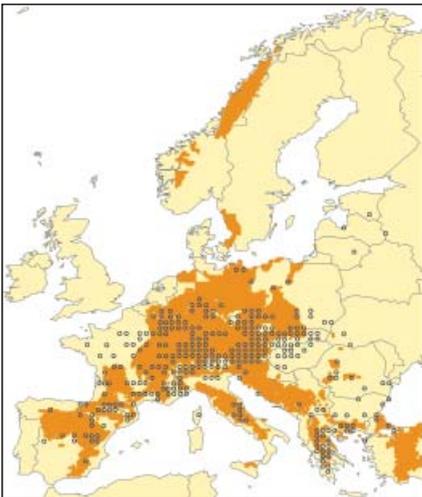
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	52 (0.84%)	-1871 (-30.1%)
	BAMBU	-450 (-7.24%)	-2061 (-33.16%)
	GRAS	-638 (-10.27%)	-2411 (-38.79%)
2080	SEDG	-759 (-12.21%)	-2952 (-47.5%)
	BAMBU	-1483 (-23.86%)	-3798 (-61.11%)
	GRAS	-3008 (-48.4%)	-4947 (-79.6%)

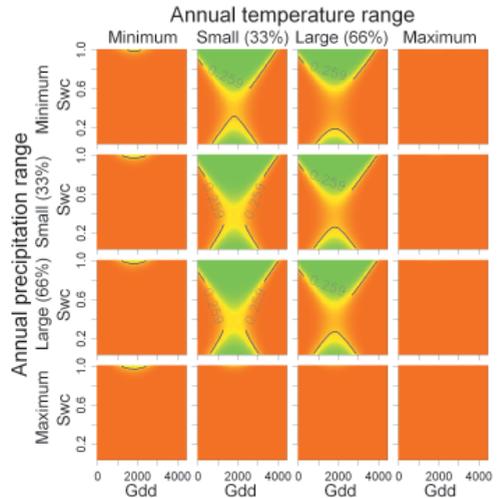
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 6215 cells)

The Olive Skipper occurs in areas that do not become too hot in the summer, on poor to rough, flower-rich grasslands, which are either open or surrounded by woodland. The butterfly of the Olive Skipper is quite mobile, and may be seen in unexpected places. The eggs are deposited on the underside of the leaves of cinquefoils (*Potentilla* spp.), and master-worts (*Astrantia* spp.). The caterpillar lives in a small shelter, spun from a rolled-up leaf, feeding on the leaves of the foodplant. It passes the winter in a cocoon, and pupates the following spring at the base of the foodplant. This skipper is single-brooded.

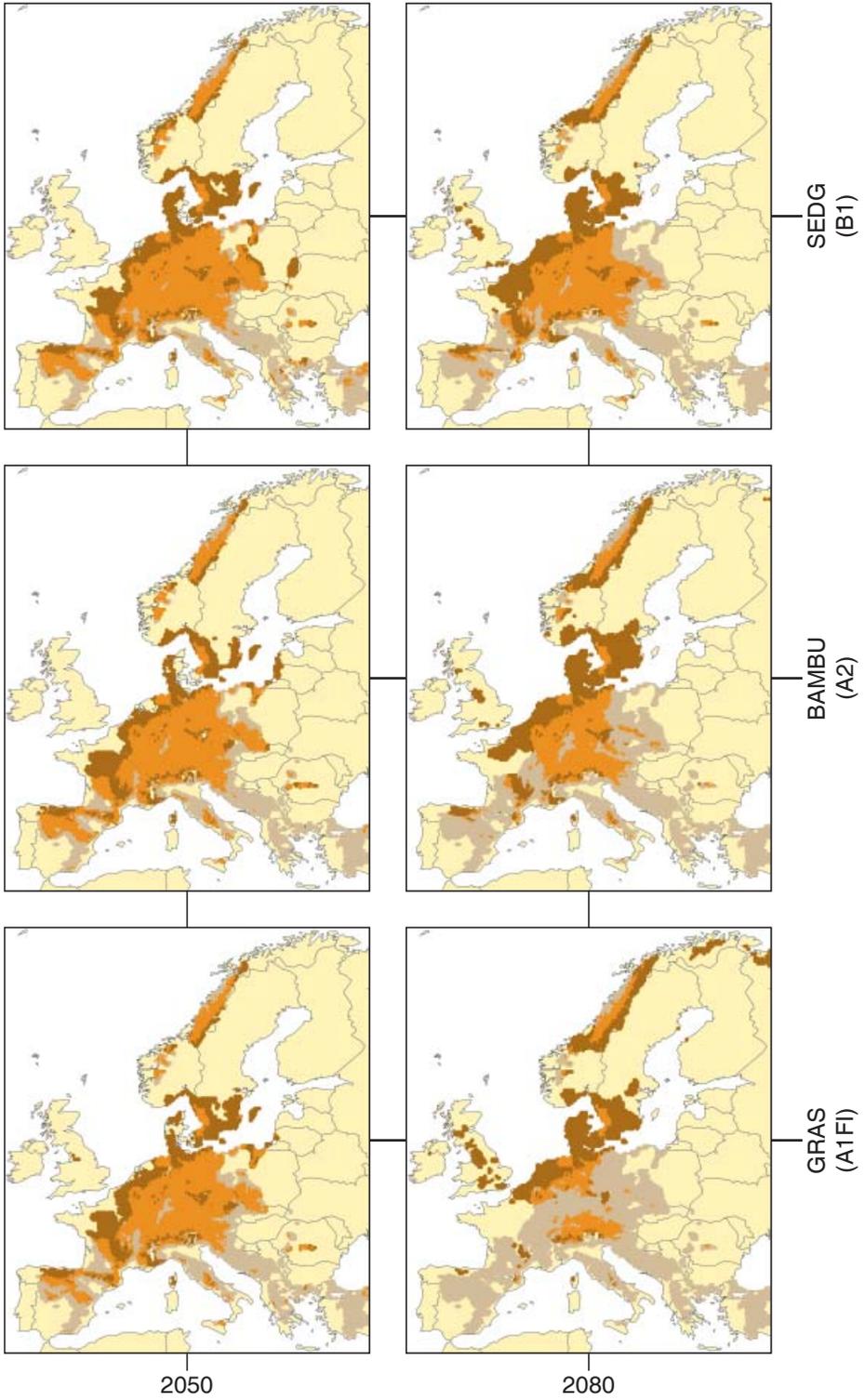
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.82).
Climate risk category: HR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Pyrgus onopordi (RAMBUR, 1840) – Rosy Grizzled Skipper



© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	279 (-12.86%)	-1032 (-47.58%)
	BAMBU	-306 (-14.11%)	-1069 (-49.29%)
	GRAS	-449 (-20.7%)	-1312 (-60.49%)
2080	SEDG	88 (4.06%)	-1395 (-64.32%)
	BAMBU	-98 (-4.52%)	-1602 (-73.86%)
	GRAS	-373 (-17.2%)	-2079 (-95.85%)

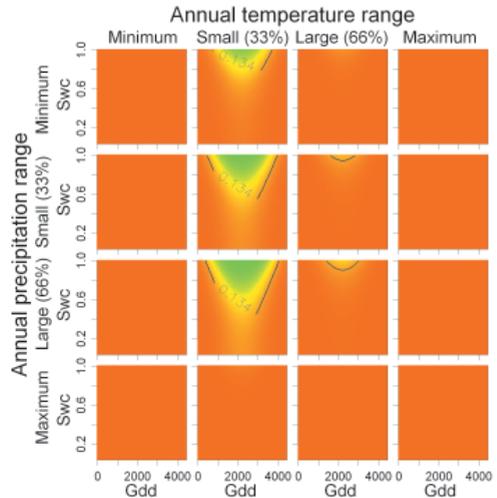
Changes in climatic niche distribution
(in $10^4 \times 10^4$ grid cells; present niche space: 2169 cells)

The Rosy Grizzled Skipper has a characteristic anvil-shaped spot on the underside of its hindwing. These butterflies can be seen on different types of grassy vegetation and on rocky slopes. Different foodplants are used in different parts of its range. In Switzerland the eggs are laid on rockroses (*Helianthemum* spp.) and cinquefoils (*Potentilla* spp.), in Spain, mallows (*Malva* spp.) are used. In most places, the Rosy Grizzled Skipper has two broods a year and in some places three. It hibernates as a caterpillar.

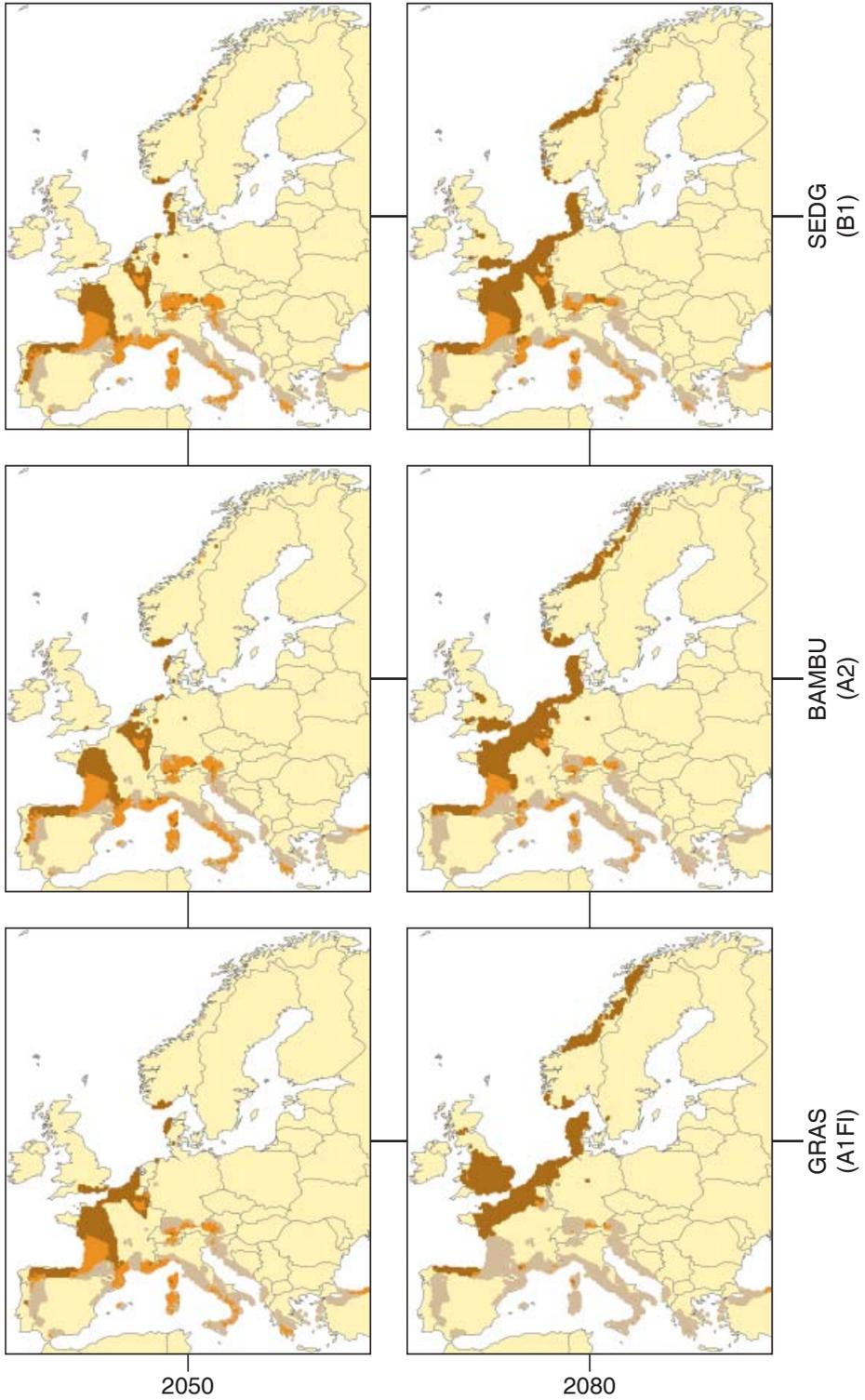
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.78).
Climate risk category: HHRH.



Observed species distribution (50×50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Pyrgus carlinae (RAMBUR, 1840) – Carline Skipper



© Albert Vliegenthart

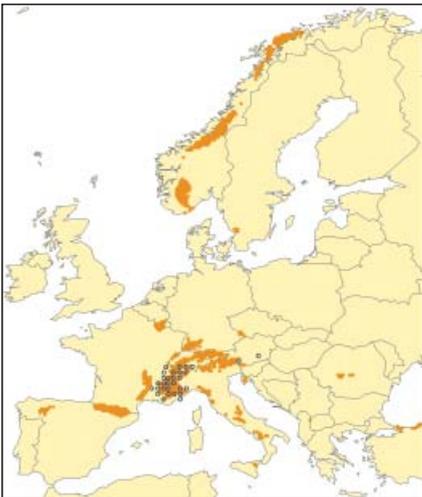
		Full dispersal	No dispersal
2050	SEDG	-100 (-12.22%)	-481 (-58.8%)
	BAMBU	22 (2.69%)	-419 (-51.22%)
	GRAS	-133 (-16.26%)	-506 (-61.86%)
2080	SEDG	-231 (-28.24%)	-714 (-87.29%)
	BAMBU	-197 (-24.08%)	-614 (-75.06%)
	GRAS	-362 (-44.25%)	-703 (-85.94%)

Changes in climatic niche distribution
(in $10^4 \times 10^4$ grid cells; present niche space: 818 cells)

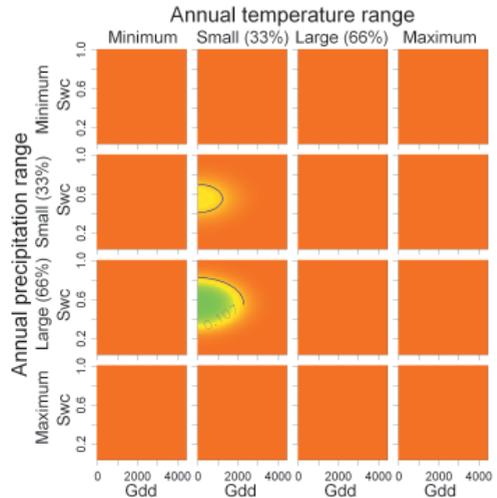
The Carline Skipper prefers dry, south-facing slopes with quite short vegetation. However, they can also be seen on damp grasslands, and in very open larch woods. Large numbers can sometimes occur locally. The female lays her eggs singly on the underside of the leaves of various cinquefoils (*Potentilla* spp.). The caterpillar remains in the egg during the winter, emerging in the spring. It then spins a shelter by attaching a leaf of the foodplant to the ground, in which it lives, hidden. It pupates close to the ground, and has one generation a year.

Present distribution can be well explained by climatic variables (AUC = 0.9).

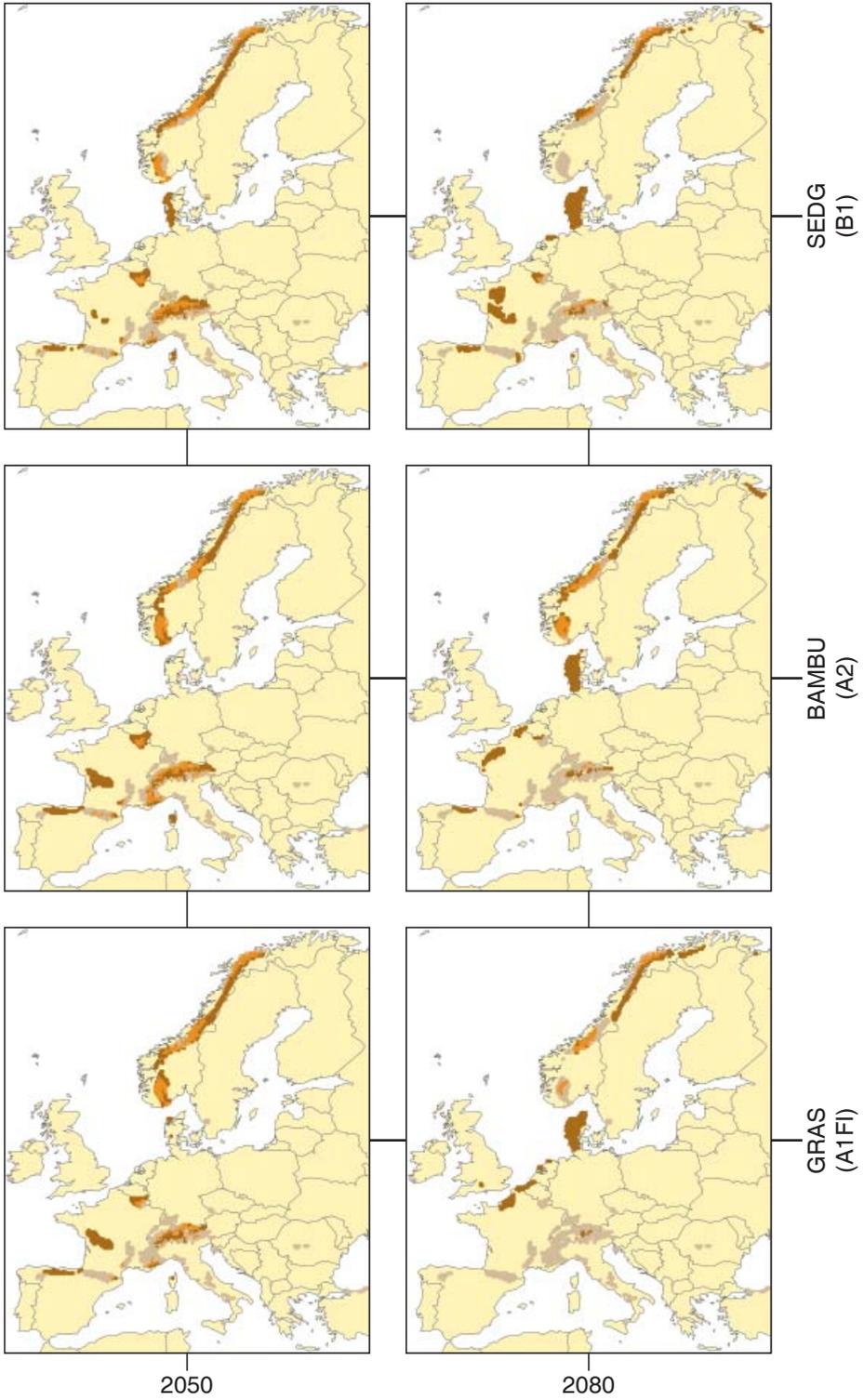
Climate risk category: HHR.



Observed species distribution (50×50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Pyrgus cirsii (RAMBUR, 1840)

© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-472 (-10.85%)	-1306 (-30.01%)
	BAMBU	-524 (-12.04%)	-1326 (-30.47%)
	GRAS	-1107 (-25.44%)	-1933 (-44.42%)
2080	SEDG	-947 (-21.76%)	-1936 (-44.49%)
	BAMBU	-1773 (-40.74%)	-2764 (-63.51%)
	GRAS	-3080 (-70.77%)	-3713 (-85.32%)

Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 4352 cells)

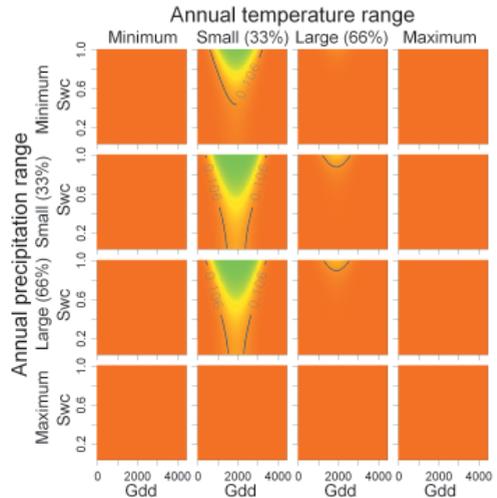
This grizzled skipper occurs on warm, flower-rich grasslands, preferring those in sheltered situations, for example, on slopes, or near shrubs or woodland. In the northern part of its range, it is only found in very warm places. The female lays her eggs singly on the underside of the leaves of various cinquefoils (*Potentilla* spp.), choosing the smaller plants. This butterfly hibernates as a very tiny caterpillar in the egg, in which it remains until the spring. It then emerges and spins itself a small shelter from leaves. In the last larval instar, this is replaced by a parchment-like shelter. It pupates in a cocoon. It is single-brooded.

Present distribution can be well explained by climatic variables (AUC = 0.9).

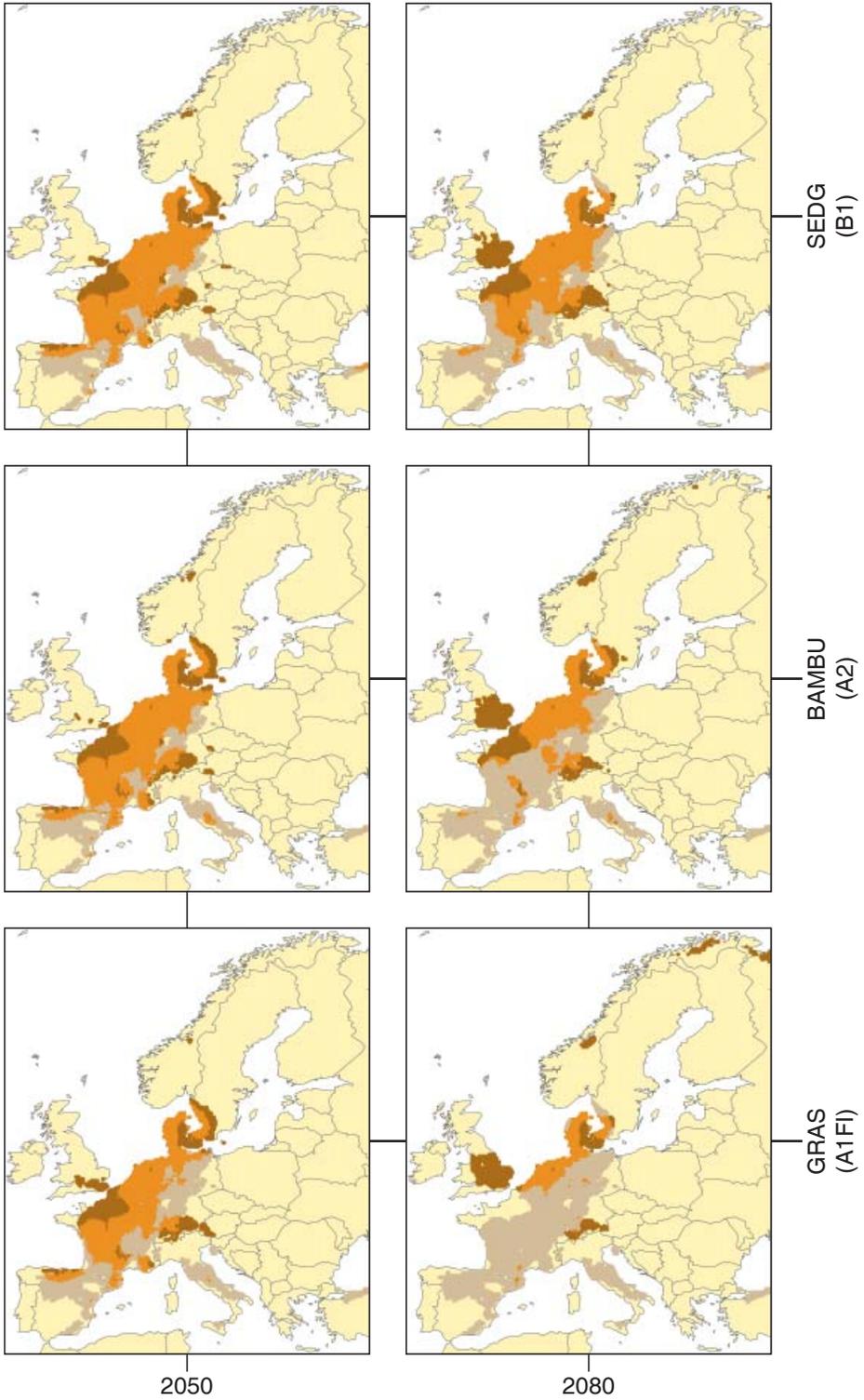
Climate risk category: HHR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Pyrgus armoricanus (OBERTHÜR, 1910) – Oberthür’s Grizzled Skipper



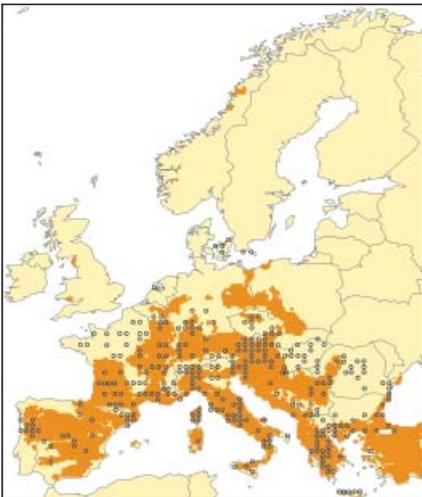
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	1076 (16.16%)	-2050 (-30.79%)
	BAMBU	362 (5.44%)	-2404 (-36.11%)
	GRAS	386 (5.8%)	-2691 (-40.42%)
2080	SEDG	987 (14.82%)	-3082 (-46.29%)
	BAMBU	67 (1.01%)	-4177 (-62.74%)
	GRAS	-402 (-6.04%)	-5276 (-79.24%)

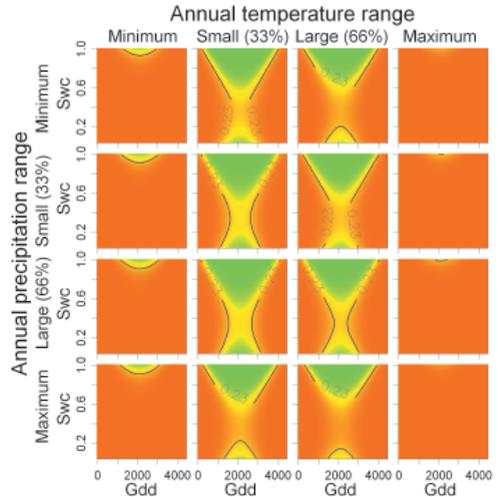
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 6658 cells)

Oberthür’s Grizzled Skipper is generally limited to unimproved grasslands. In the north of its range, the populations are small, but large numbers of butterflies make up the southern populations. The butterflies can often be seen visiting flowers and seem to be especially fond of *Globularia*. The female lays her eggs singly on the underside of the leaves of cinquefoils (*Potentilla* spp.) and rockroses (*Helianthemum* spp.). The caterpillars of the first instar only eat the surface layer, leaving translucent “windows” in the leaf. The larger caterpillars eat the whole leaf, and live in a tent-like shelter, spun from one or more leaves. It is the caterpillar that hibernates. It pupates in a cocoon on the ground and there are two to three generations a year.

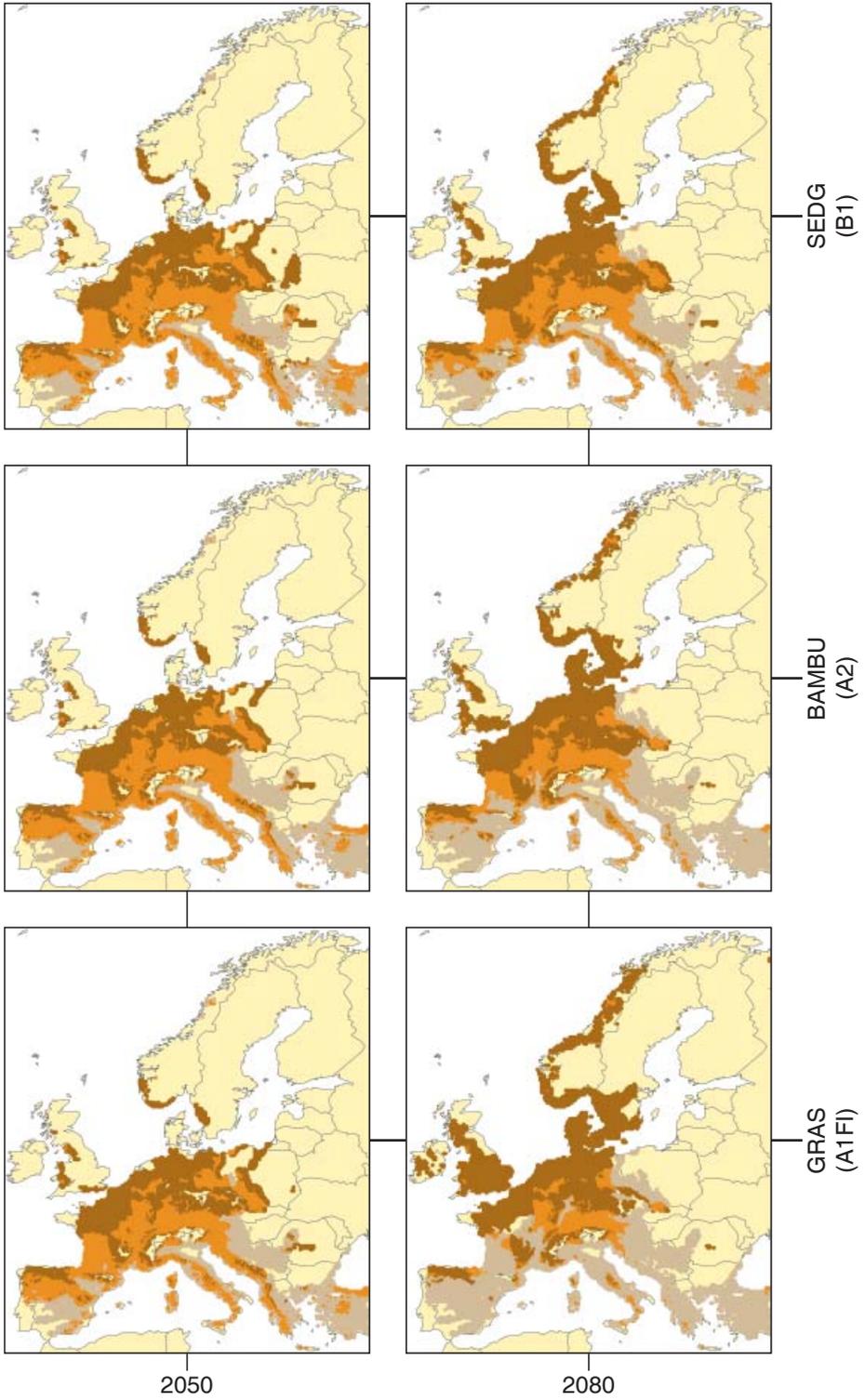
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.78). Climate risk category: HR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Pyrgus alveus (HÜBNER, 1803) (complex) – Large Grizzled Skipper



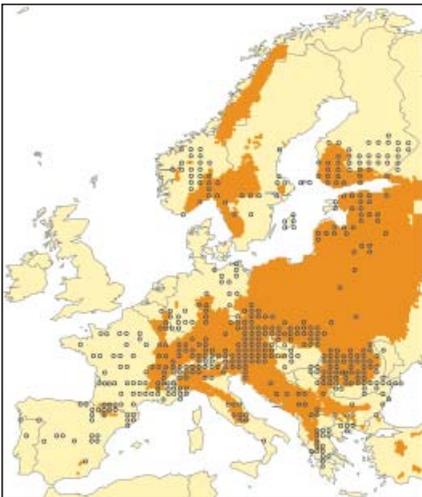
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-102 (-0.93%)	-2549 (-23.36%)
	BAMBU	580 (5.32%)	-2013 (-18.45%)
	GRAS	-1796 (-16.46%)	-3665 (-33.59%)
2080	SEDG	2539 (23.27%)	-3680 (-33.72%)
	BAMBU	1087 (9.96%)	-4815 (-44.13%)
	GRAS	246 (2.25%)	-6117 (-56.06%)

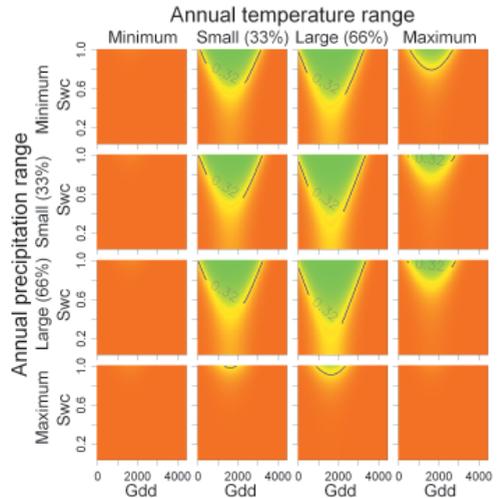
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 10912 cells)

Due to data availability and resolution we include *P. trebevicensis*, *P. accretus* and *P. alveus* in this complex, while we are aware that these taxa are often treated separately. The Large Grizzled Skipper is usually found in mountainous areas on dry, poor, flower-rich grassland, and rough vegetation. Quick-flying and alert, it also likes basking on the ground and drinking from wet mud. It is a very variable butterfly with many different subspecies and forms, making identification difficult. Choosing the smaller leaves, the female lays her eggs singly on various rock-roses (*Helianthemum* spp.). At first, the caterpillar lives between spun leaves on plants, later on it spins a tent-like shelter on the ground. It passes the winter in this stage and builds a special tube-like structure in which to pupate. There are one or two generations a year.

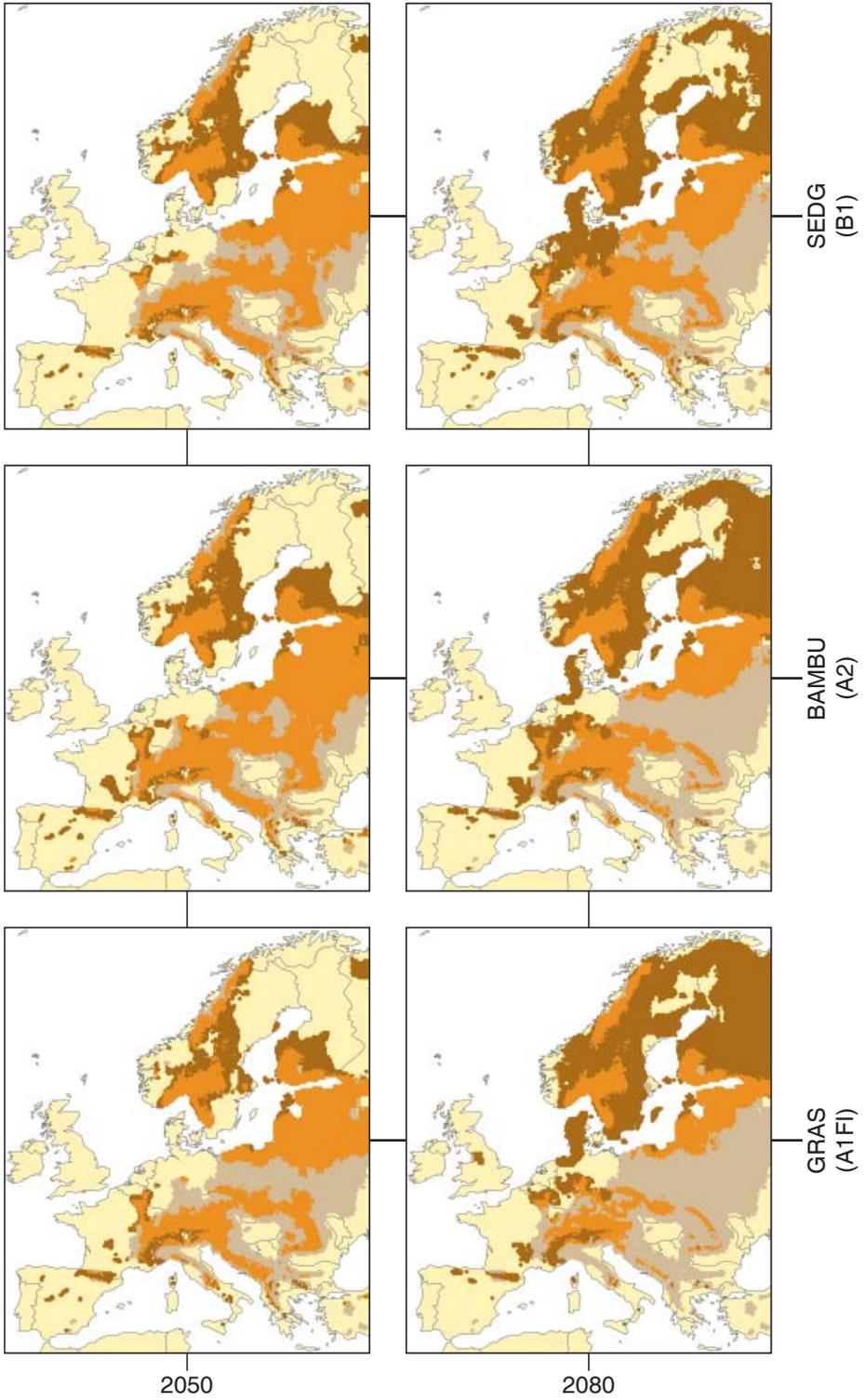
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.73). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tertile, upper tertile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Pyrgus bellieri (OBERTHÜR, 1910) – Foulquier’s Grizzled Skipper



© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-180 (-44.33%)	-356 (-87.68%)
	BAMBU	-172 (-42.36%)	-338 (-83.25%)
	GRAS	-109 (-26.85%)	-369 (-90.89%)
2080	SEDG	242 (59.61%)	-395 (-97.29%)
	BAMBU	-60 (-14.78%)	-404 (-99.51%)
	GRAS	-113 (-27.83%)	-406 (-100%)

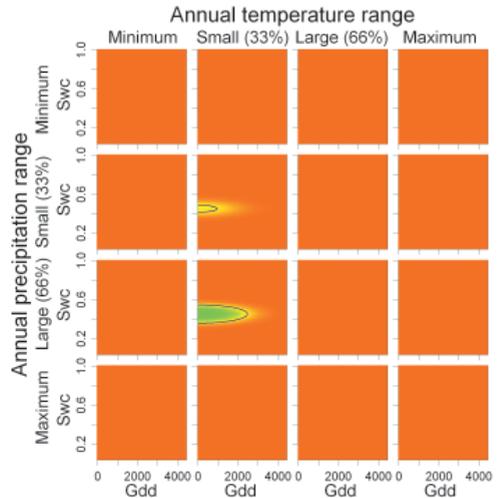
Changes in climatic niche distribution
(in 10⁴ × 10⁴ grid cells; present niche space: 406 cells)

This grizzled skipper likes flower-rich, grassy vegetation. It occurs on sub-alpine and alpine grasslands as well as on damp, sometimes rough, grassy vegetation. Various cinquefoils (*Potentilla* spp.) are used as foodplant, including Tormentil (*P. erecta*), Silverweed (*P. anserina*), Spring Cinquefoil (*P. tabernaemontani*), and Creeping Cinquefoil (*P. reptans*). This butterfly hibernates in the larval stage and has one generation a year.

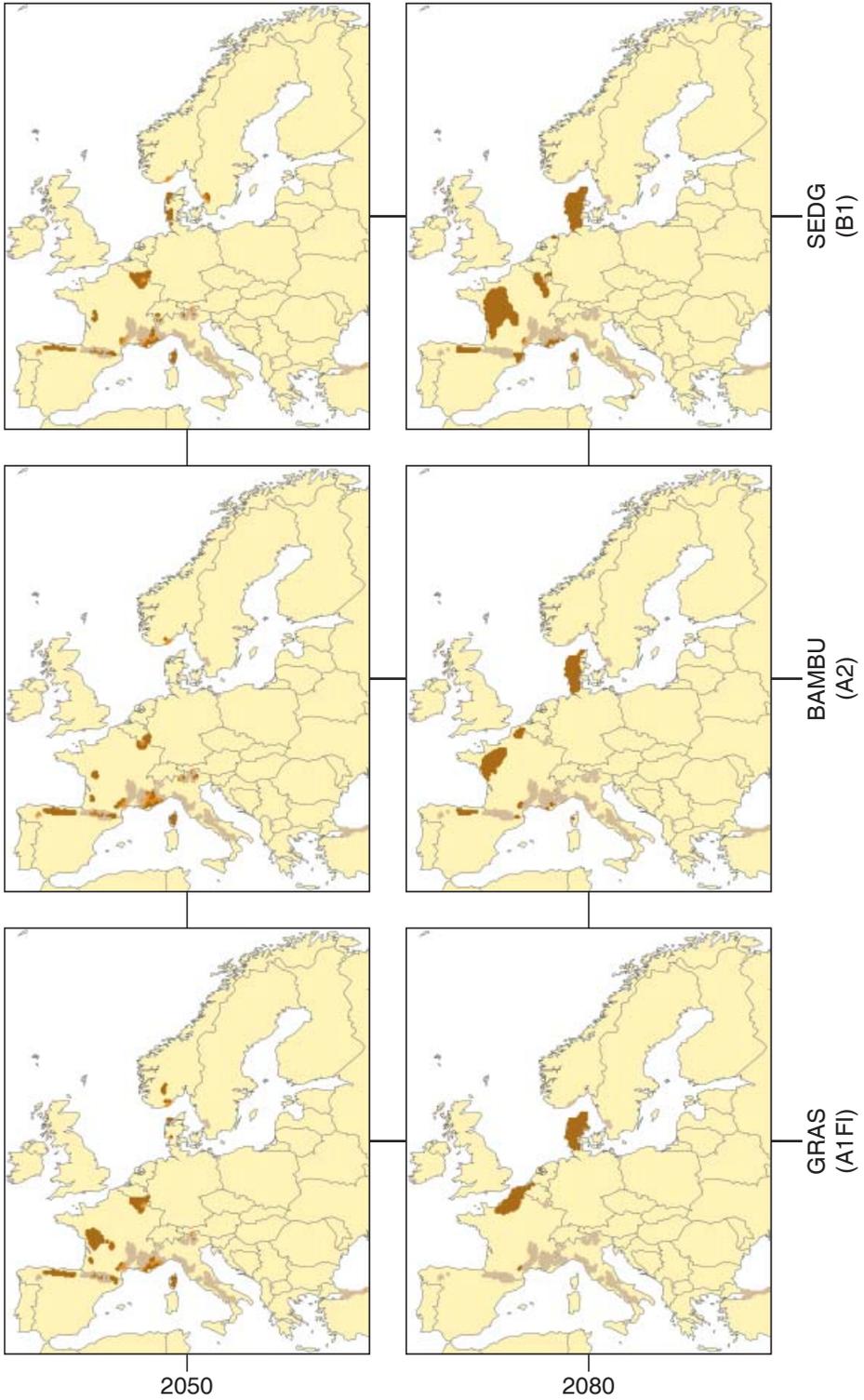
Present distribution can be well explained by climatic variables (AUC = 0.94).
Climate risk category: HHHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Pyrgus warrenensis (VERITY, 1928) – Warren’s Skipper



© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-447 (-31.81%)	-568 (-40.43%)
	BAMBU	-437 (-31.1%)	-541 (-38.51%)
	GRAS	-537 (-38.22%)	-644 (-45.84%)
2080	SEDG	-725 (-51.6%)	-954 (-67.9%)
	BAMBU	-655 (-46.62%)	-834 (-59.36%)
	GRAS	-796 (-56.65%)	-997 (-70.96%)

Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 1405 cells)

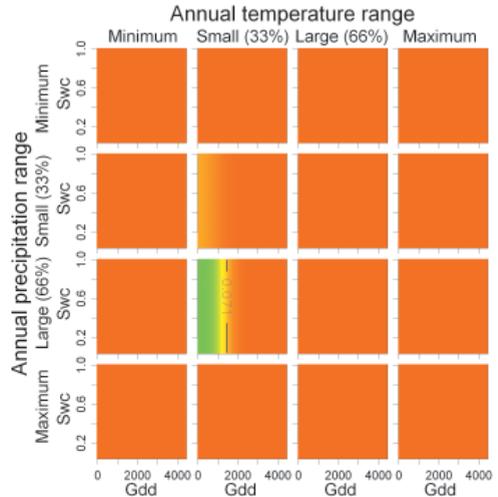
Warren’s Skipper occurs mostly on flower-rich alpine grasslands. The males fly where flowers are most abundant, along mountain streams, for example. From a perch on a bush or tall plant, they also defend their territory. The females meanwhile are often found on warm, dry patches near bushes, where they lay their eggs one by one on the rockrose *Helianthemum alpestre*, preferring the smaller plants. The small caterpillar lives hidden in a spun leaf, while caterpillars of later stages spin two leaves together, and finally, make a larger shelter from several leaves. The Warren’s Skipper is single-brooded and passes the winter as a caterpillar.

Present distribution can be very well explained by climatic variables (AUC = 0.99).

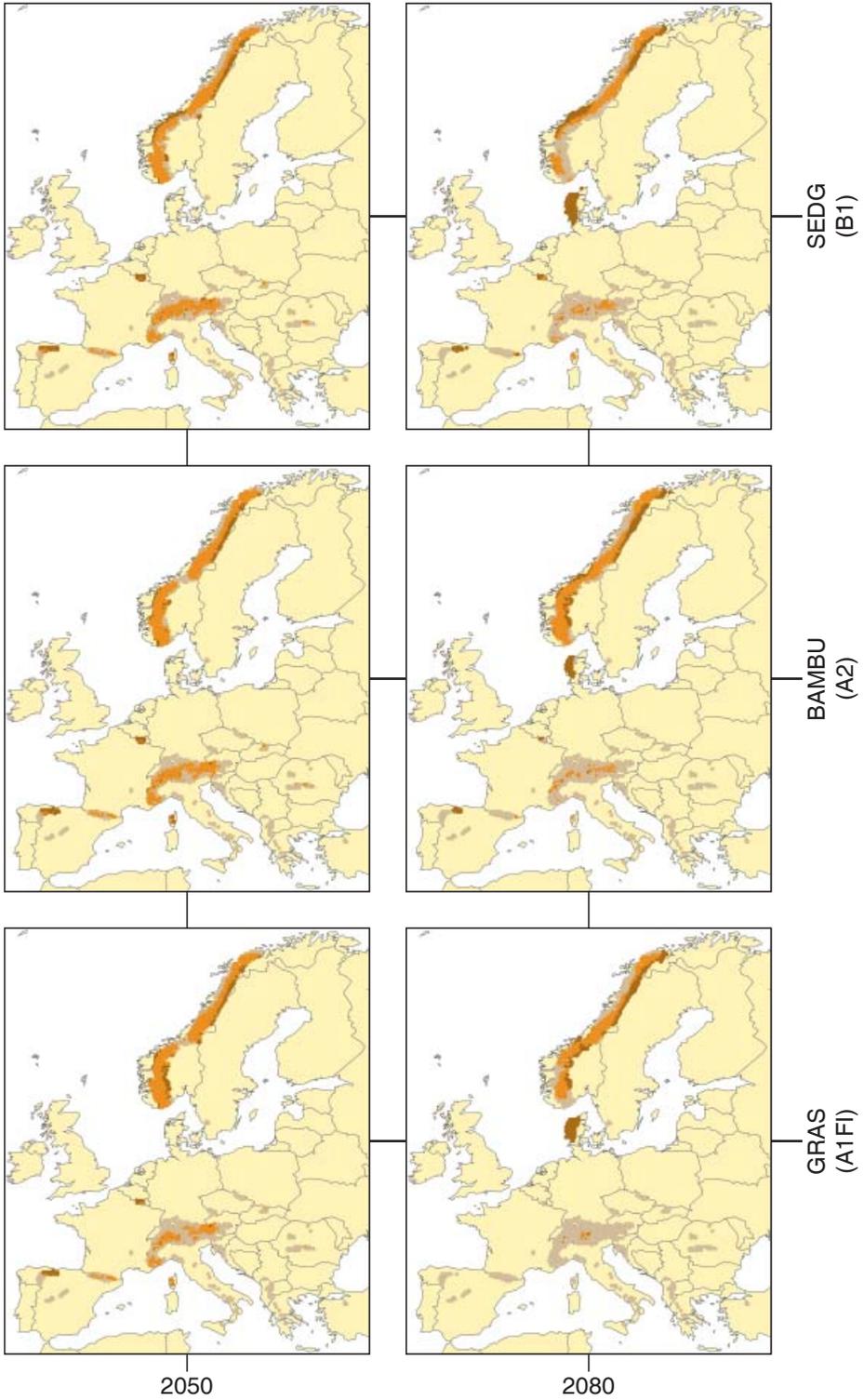
Climate risk category: HR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Heteropterus morpheus (PALLAS, 1771) – Large Chequered Skipper



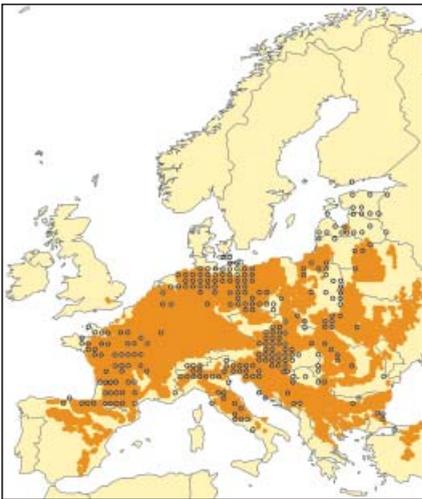
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	1974 (26.11%)	-568 (-40.43%)
	BAMBU	4028 (53.29%)	-541 (-38.51%)
	GRAS	2282 (30.19%)	-644 (-45.84%)
2080	SEDG	1760 (23.28%)	-954 (-67.9%)
	BAMBU	2305 (30.49%)	-834 (-59.36%)
	GRAS	819 (10.83%)	-997 (-70.96%)

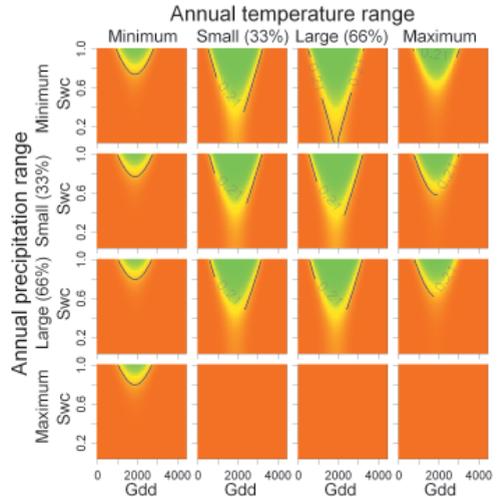
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 7559 cells)

The conspicuous pattern on the underside of the wings of the Large Chequered Skipper is unlike that of any other European butterfly. Furthermore, it has a characteristic, bouncing flight, low over the vegetation. It occurs in damp, rough, grassy places, such as grasslands, road verges, edges of streams, at the edges of raised bogs, and in woodland clearings. The eggs are laid singly or in small batches on the blades of grasses, such as Purple Moor-grass (*Molinia caerulea*) or Purple Smallreed (*Calamagrostis canescens*). The caterpillar makes a tubular shelter from grass, at first using a folded blade, and later using spun grass-blades. It leaves its shelter in search of food. The caterpillars pass the winter in the shelter. Pupation takes place in spring. The Large Chequered Skipper has one generation a year.

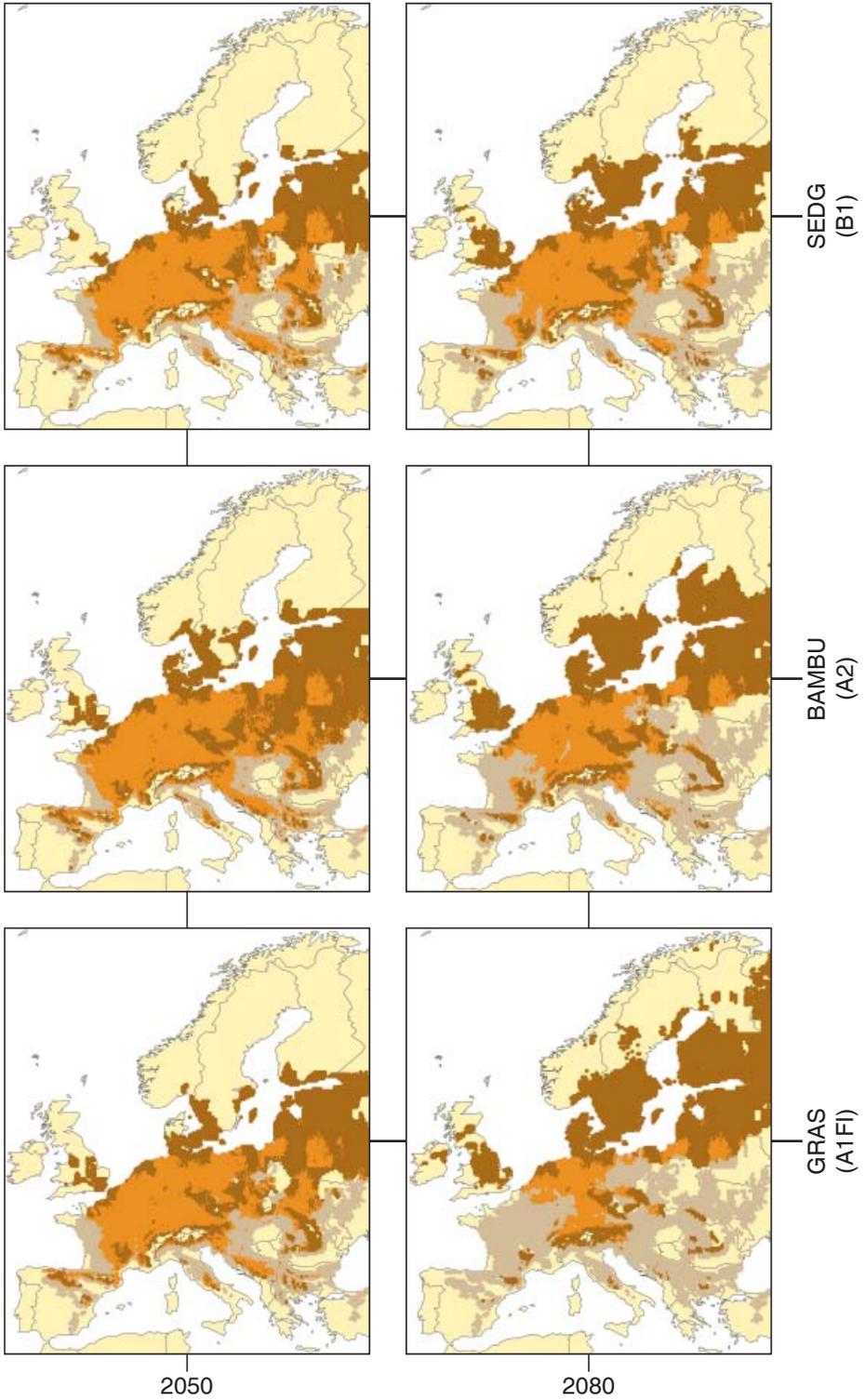
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.78).
Climate risk category: HR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Carterocephalus palaemon (PALLAS, 1771) – Chequered Skipper



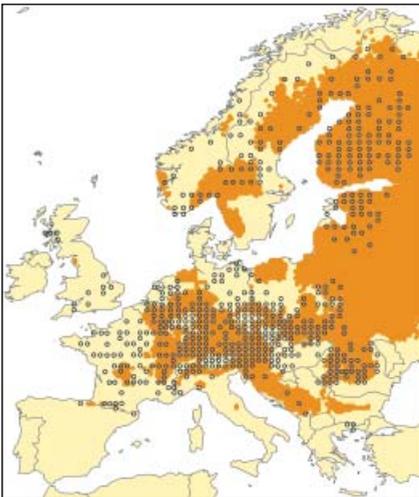
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-1722 (-15.33%)	-3397 (-30.24%)
	BAMBU	113 (1.01%)	-2117 (-18.85%)
	GRAS	-1877 (-16.71%)	-3570 (-31.78%)
2080	SEDG	696 (6.2%)	-2961 (-26.36%)
	BAMBU	41 (0.37%)	-3528 (-31.41%)
	GRAS	-748 (-6.66%)	-4725 (-42.07%)

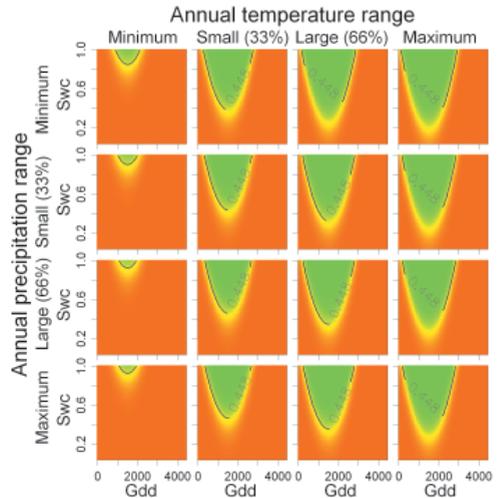
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 11232 cells)

The Chequered Skipper usually occurs on damp grassland at woodland margins, or where there is woodland nearby, including road verges, also on the drier areas of raised bogs and at their edges. Breeding grounds are also known in somewhat drier locations at higher altitudinal levels. Populations are usually small. The female lays her eggs one by one on the blades of coarse-leaved grasses. The caterpillars spin folded grass leaves together into a little tube, in which they spend most of their life, leaving it only to feed. Those who know what to look for, can find their traces, small half-moons nibbled away from the edge of the grass-blade. The caterpillars hibernate in a more substantial tube-like shelter. It pupates, its papery, pale-yellow pupa is suspended from withered grass by a silken girdle. The Chequered Skipper is single-brooded.

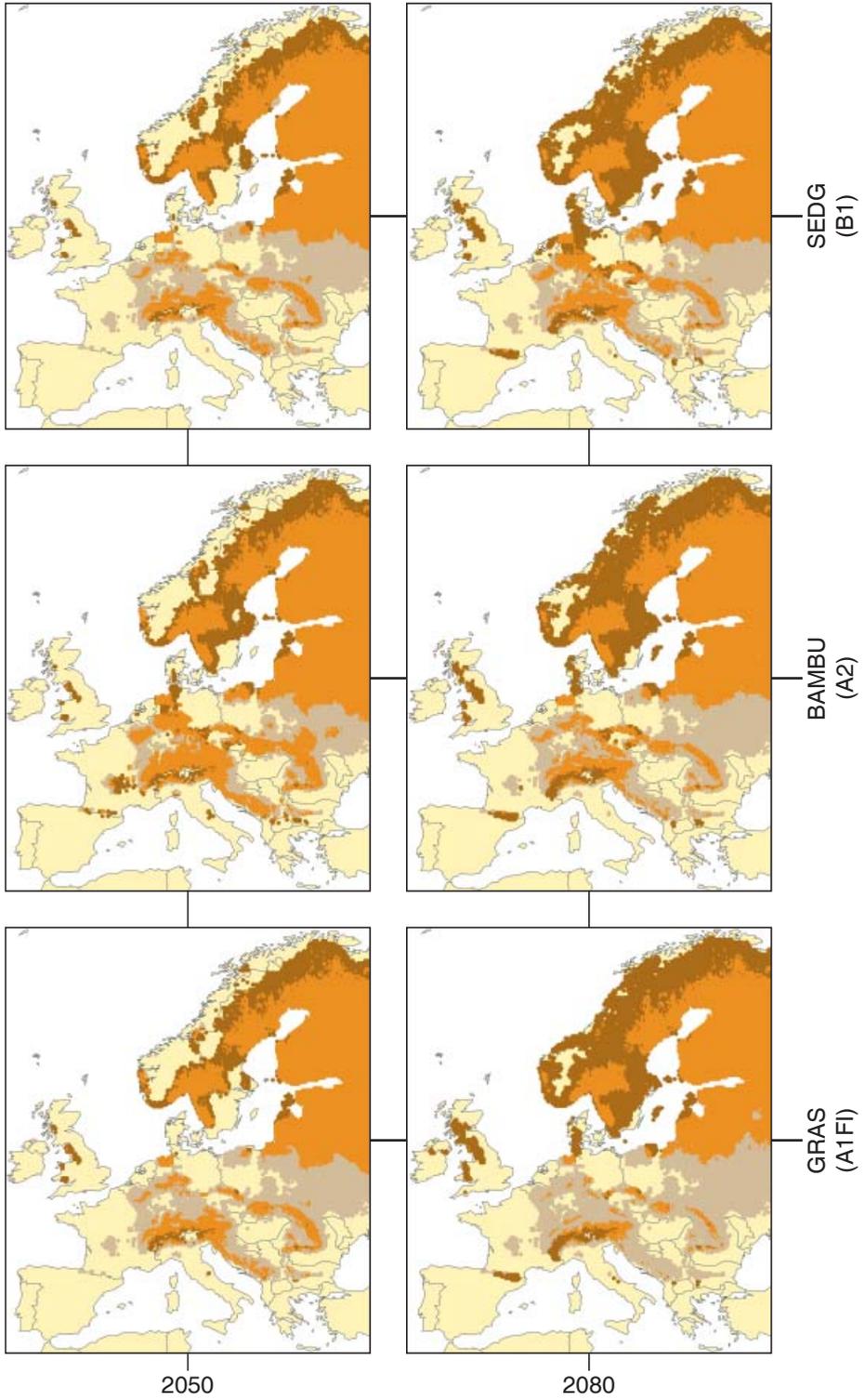
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.79). Climate risk category: LR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Carterocephalus silvicolus (MEIGEN, 1829) – Northern Chequered Skipper



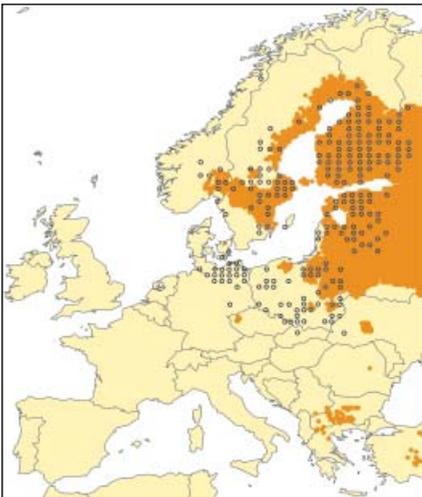
© Otakar Kudrna

		Full dispersal	No dispersal
2050	SEDG	-1008 (-18.35%)	-2364 (-43.04%)
	BAMBU	-919 (-16.73%)	-2273 (-41.38%)
	GRAS	-599 (-10.9%)	-2200 (-40.05%)
2080	SEDG	-1928 (-35.1%)	-3609 (-65.7%)
	BAMBU	-1746 (-31.79%)	-3780 (-68.81%)
	GRAS	-2565 (-46.7%)	-4642 (-84.51%)

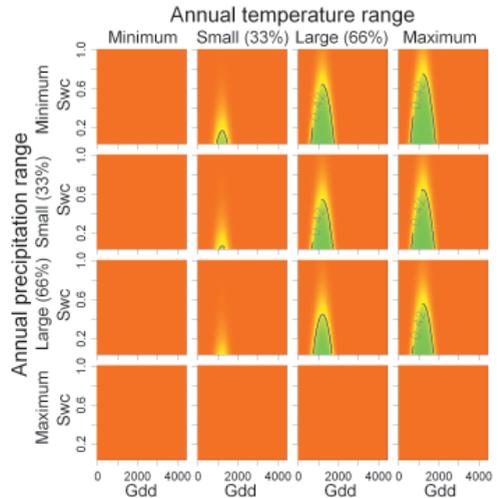
Changes in climatic niche distribution (in 10'x10' grid cells; present niche space: 5493 cells)

The Northern Chequered Skipper can be found flying on the damp, flower-rich grass of woodland rides. They can often be seen drinking nectar from various speedwells (*Veronica* spp.). The eggs are laid on various coarse-leaved grasses. The caterpillar lives in a shelter spun from a blade of grass. In the last larval instar, the caterpillar makes a shelter from withered leaves in which it hibernates. The pale-yellow pupa is suspended in a silken girdle in the vegetation. It pupates in the spring. The Northern Chequered Skipper is single-brooded.

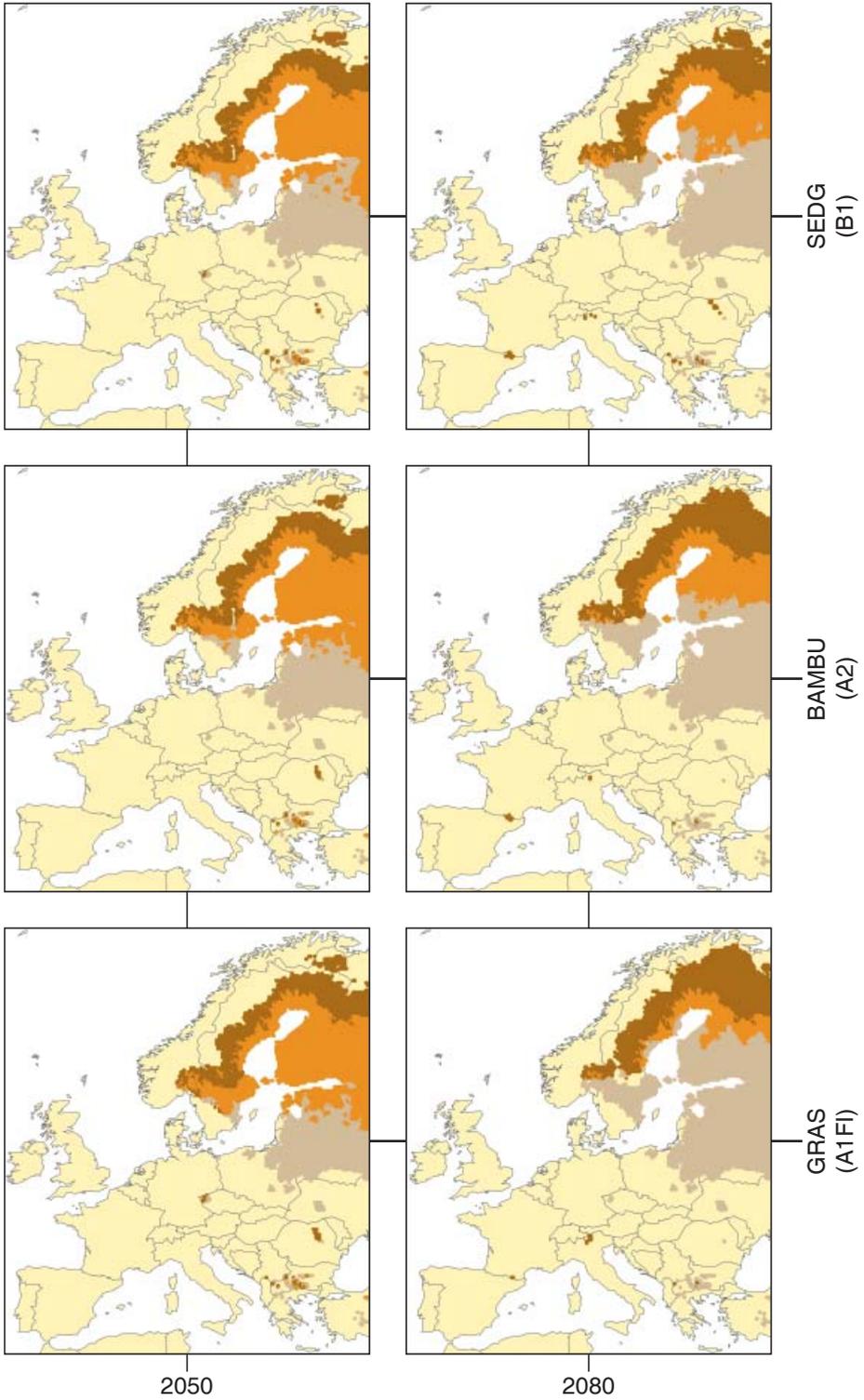
Present distribution can be well explained by climatic variables (AUC = 0.93).
Climate risk category: HR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Thymelicus lineola (OCHSENHEIMER, 1806) – Essex Skipper



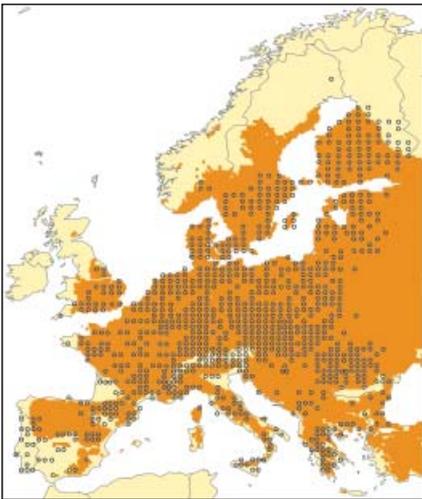
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		Full dispersal	No dispersal
2050	SEDG	-1906 (-9.81%)	-3176 (-16.35%)
	BAMBU	-2572 (-13.24%)	-3506 (-18.04%)
	GRAS	-2839 (-14.61%)	-4045 (-20.82%)
2080	SEDG	-3425 (-17.63%)	-5330 (-27.43%)
	BAMBU	-5580 (-28.72%)	-7891 (-40.61%)
	GRAS	-7605 (-39.14%)	-10551 (-54.3%)

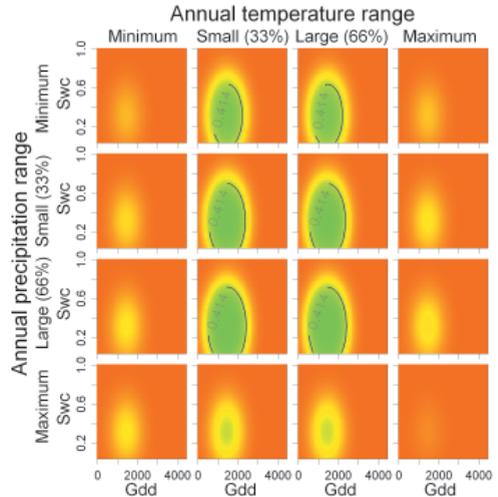
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 19431 cells)

The Essex Skipper occurs in many sorts of flower-rich places with tall grass, such as grasslands, road verges and on banks of streams. Because these butterflies need quite a lot of nectar, they can often be seen drinking on thistles, knapweeds and other purple or pink flowers rich in nectar. The female deposits her eggs in groups in the leaf-sheaths of coarse grasses, and lays them when the foodplants are already withered. It is the eggs that hibernate. The development of the caterpillar takes place the following spring. At first, the caterpillar only feeds during the day, but later also at night. They pupate in the vegetation. The pupa may be suspended from a grass blade by a silken girdle, but also just by the tip. The Essex Skipper is single-brooded.

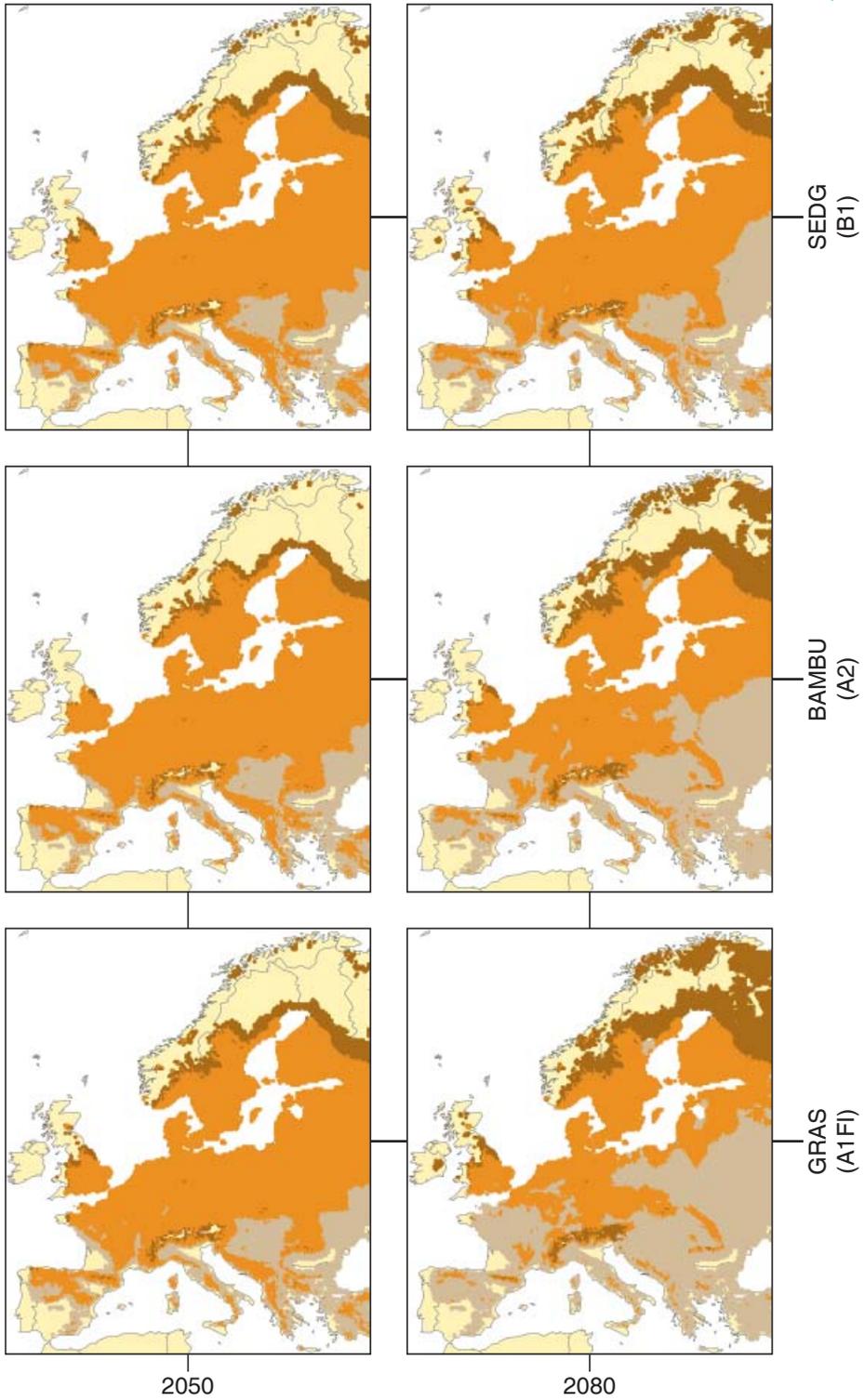
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.75). Climate risk category: PR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Thymelicus sylvestris (PODA, 1761) – Small Skipper



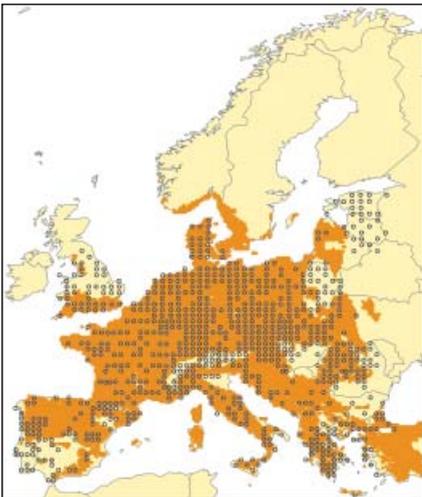
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-979 (-7.94%)	-2907 (-23.58%)
	BAMBU	-1880 (-15.25%)	-3492 (-28.32%)
	GRAS	-2283 (-18.52%)	-4097 (-33.23%)
2080	SEDG	-3060 (-24.82%)	-4995 (-40.51%)
	BAMBU	-4395 (-35.65%)	-6533 (-52.99%)
	GRAS	-5406 (-43.85%)	-8045 (-65.25%)

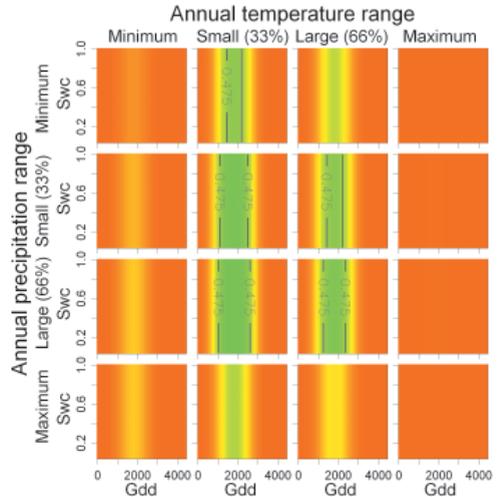
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 12329 cells)

The Small Skipper occurs in all sorts of flower-rich places with tall grass, such as grasslands, road verges and edges of streams. The butterflies are fond of visiting thistles, knapweeds and other purple or pink flowers for their nectar. The female deposits her eggs in batches of three to twenty in the leaf-sheaths of coarse-leaved grasses. Unlike the Essex Skipper, she only uses young, green leaves. After about three weeks, the eggs hatch and the small caterpillars begin spinning a shelter straightaway in which to hibernate. Only the next spring do they begin to feed and grow. At first, they only feed during the day and later also at night. They pupate in a web of loosely spun white threads. The Small Skipper is single-brooded, but the butterflies emerge over a long period.

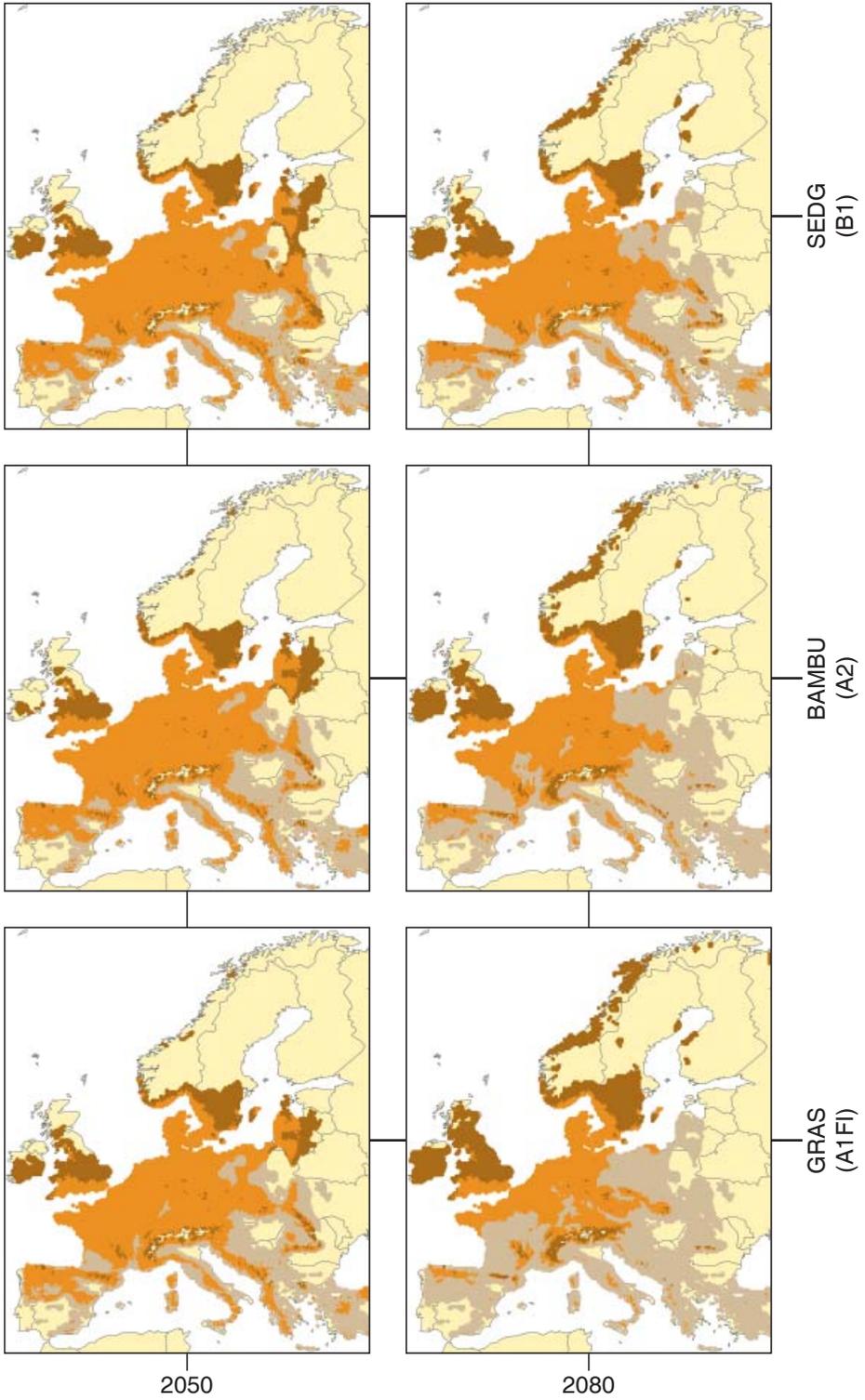
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.72). Climate risk category: PR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Thymelicus acteon (ROTTEMBERGER, 1775) – Lulworth Skipper



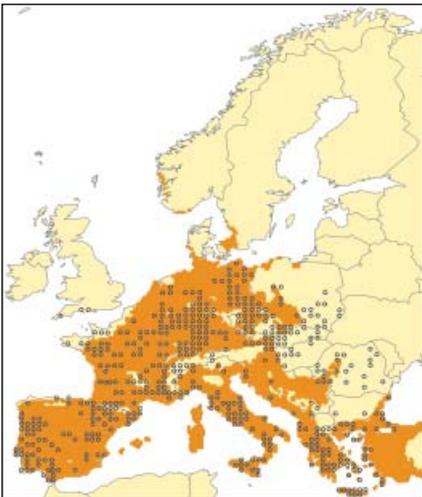
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	222 (2.27%)	-1744 (-17.79%)
	BAMBU	-456 (-4.65%)	-2089 (-21.31%)
	GRAS	-445 (-4.54%)	-2359 (-24.07%)
2080	SEDG	-827 (-8.44%)	-2875 (-29.33%)
	BAMBU	-2148 (-21.92%)	-4352 (-44.4%)
	GRAS	-2860 (-29.18%)	-5473 (-55.84%)

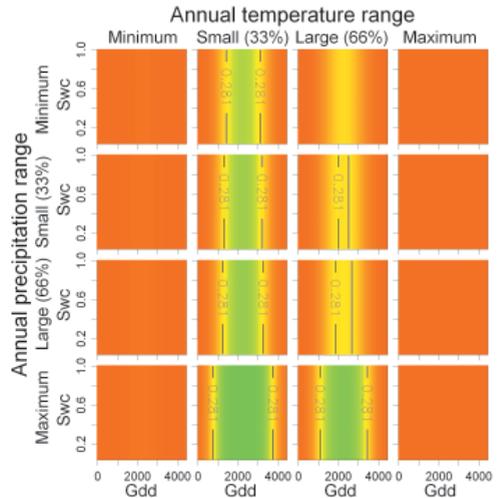
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 9801 cells)

The Lulworth Skipper can be found on warm, dry grassland, with bushes or scrub nearby, or at the edge of woodland. In the north of its range, it is mostly found on calcareous grassland. Eggs are laid on the withered leaves of many grasses. Directly after hatching, the small caterpillar spins itself a cocoon in which to hibernate. It does not begin to eat and grow until the following spring. It then builds itself a shelter by spinning blades of grass together, which it only leaves when looking for food. When fully grown, it pupates, changing into a green pupa suspended in the vegetation by a silken girdle. The Lulworth Skipper is mostly single-brooded.

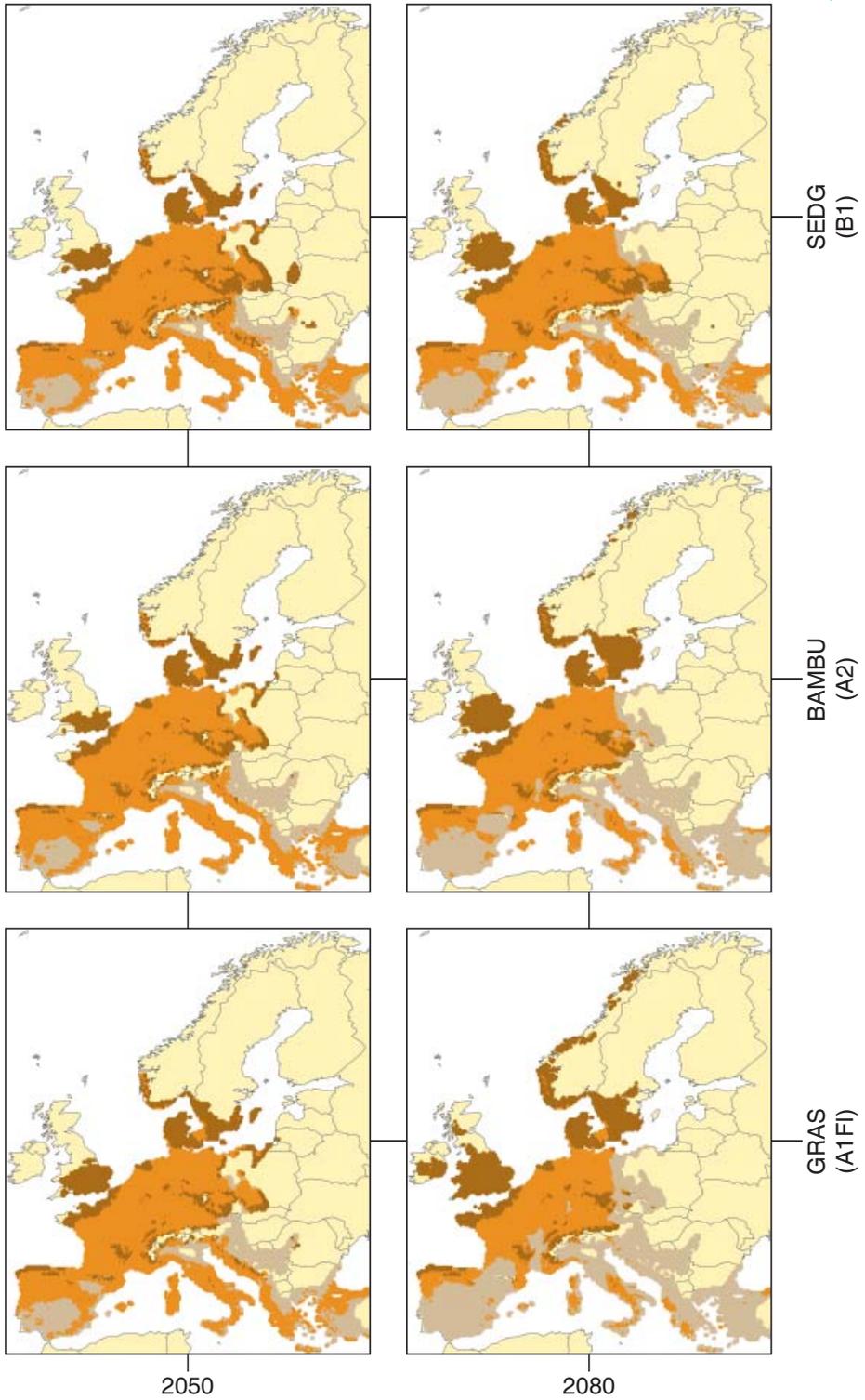
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.76).
Climate risk category: R.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Hesperia comma (LINNAEUS, 1758) – Silver-spotted Skipper



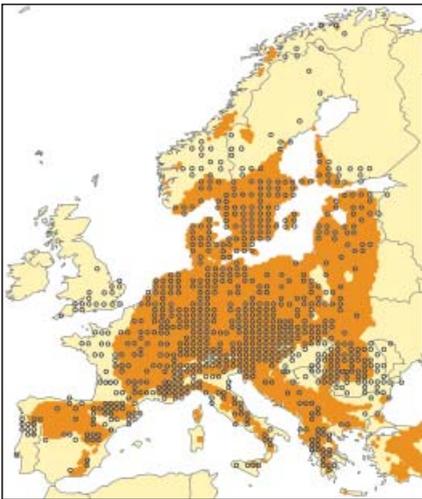
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-1980 (-16.77%)	-3034 (-25.7%)
	BAMBU	-2321 (-19.66%)	-3408 (-28.87%)
	GRAS	-2913 (-24.67%)	-4003 (-33.91%)
2080	SEDG	-4598 (-38.95%)	-6026 (-51.04%)
	BAMBU	-5466 (-46.3%)	-7294 (-61.78%)
	GRAS	-7069 (-59.88%)	-9066 (-76.79%)

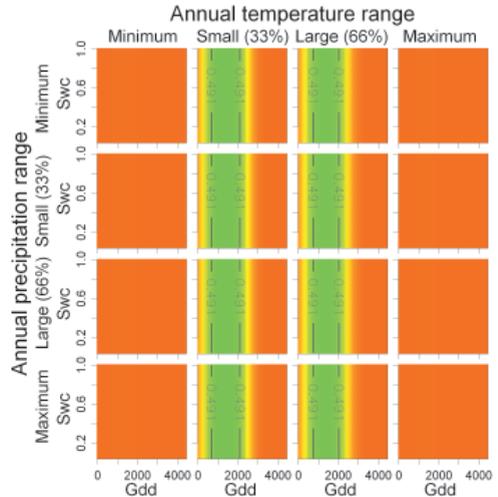
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 11806 cells)

The Silver-spotted Skipper occurs on open, poor grasslands, heathlands, and on sparsely covered blown sand. The habitat varies from dry to moist, but is never rich in nutrients. However, in their search for nectar, the skippers do visit nutrient-rich areas where flowers are growing, usually not so far from their breeding ground. Eggs are laid on various fine-leaved grasses, passing the winter in this stage. In the spring, the caterpillars emerge and spin a shelter from blades of grass in which they spend most of their time, usually coming out to feed at night. When fully-grown, the caterpillar spins a cocoon of silk and grass blades near the ground in which it pupates. The Silver-spotted Skipper has one generation a year.

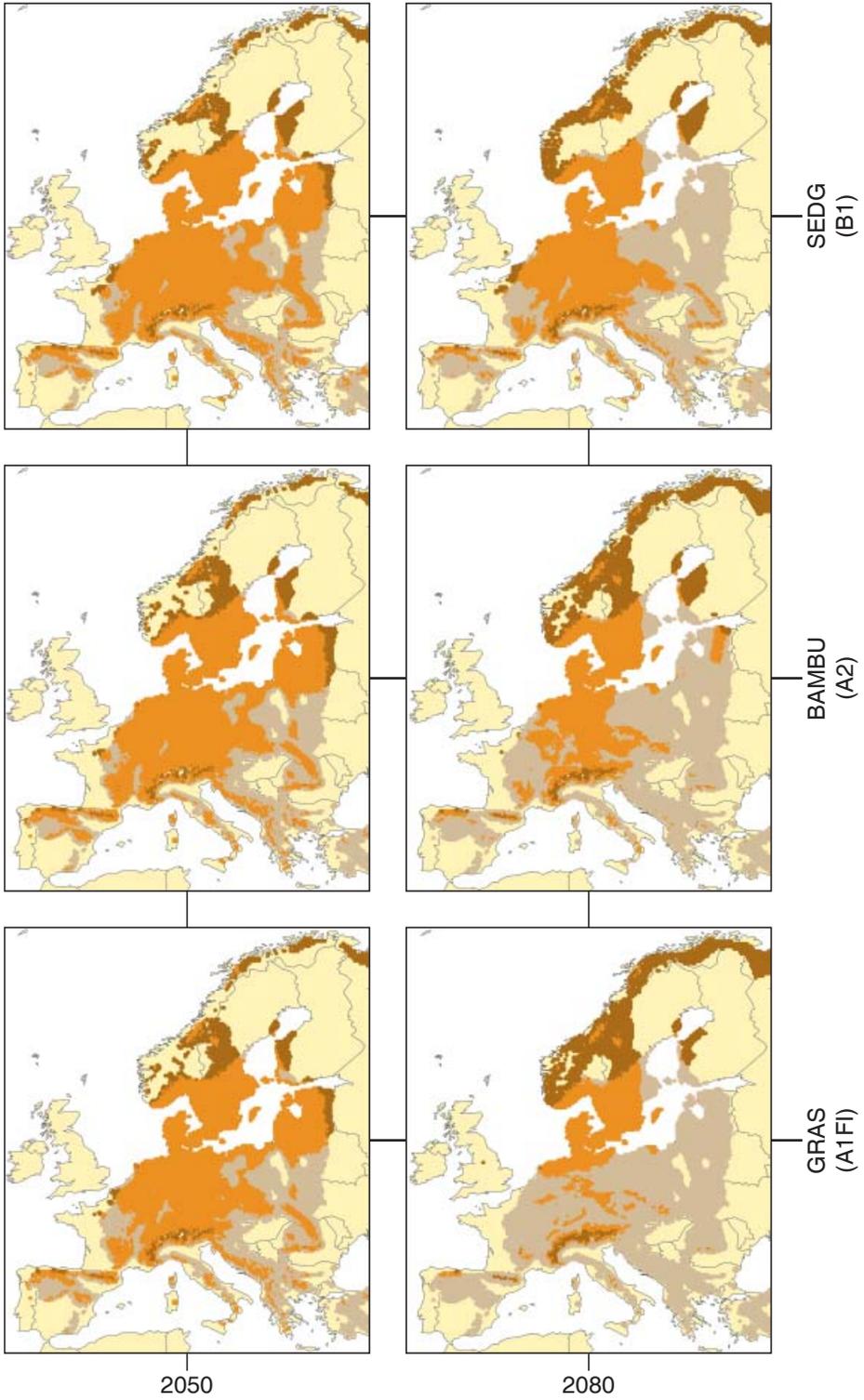
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.77).
Climate risk category: HR.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Ochlodes sylvanus (ESPER, 1777) – Large Skipper



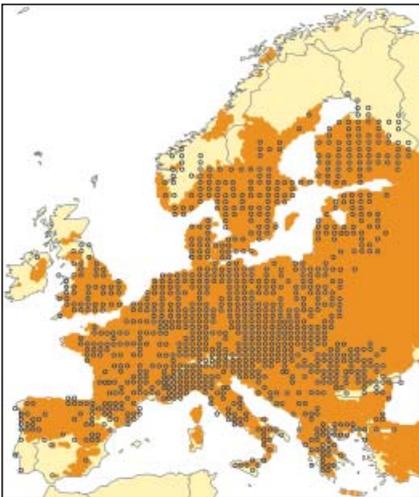
© Peter Ginzinger

		Full dispersal	No dispersal
2050	SEDG	-726 (-3.53%)	-3276 (-15.94%)
	BAMBU	-953 (-4.64%)	-3309 (-16.1%)
	GRAS	-1398 (-6.8%)	-4058 (-19.74%)
2080	SEDG	-750 (-3.65%)	-4881 (-23.75%)
	BAMBU	-2082 (-10.13%)	-6893 (-33.54%)
	GRAS	-3892 (-18.94%)	-9349 (-45.49%)

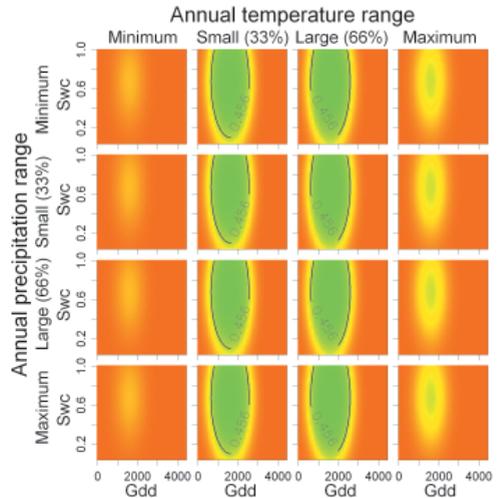
Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 20554 cells)

The Large Skipper is found on sunny, grassy vegetation in or near woods and scrub. It often visits flowers, and the development of some rough vegetation close to the breeding ground is thus favourable. They are especially fond of bramble blossom for nectar. The female deposits her eggs onto the blades of coarse-leaved grasses one by one. The caterpillars make a shelter by spinning blades of grass together, and pass the winter in the third larval instar. When fully grown, they also spin leaves and silk together, to form a tube-like shelter in which to pupate. The Large Skipper is single-brooded.

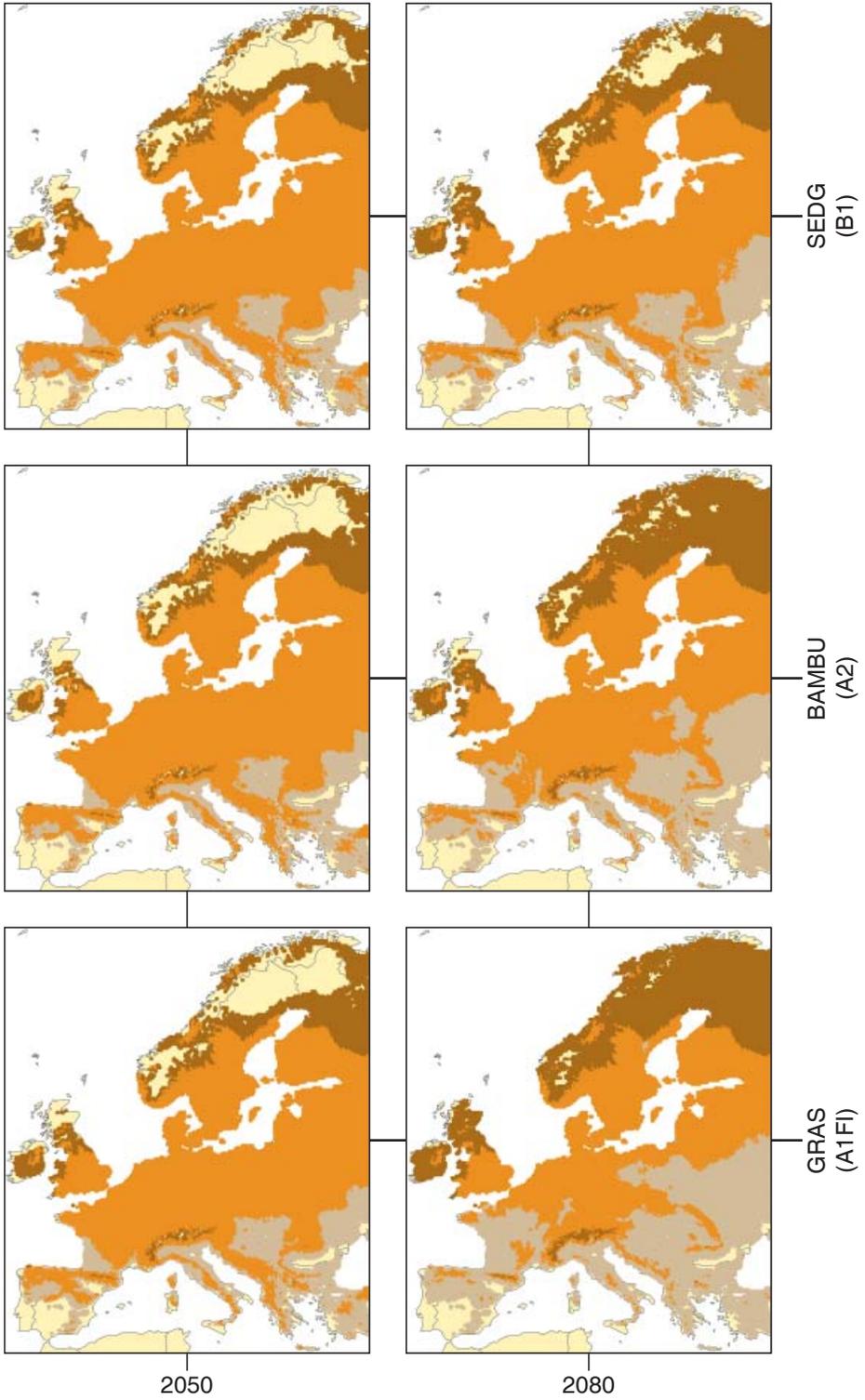
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.75).
Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Gegenes pumilio (HOFFMANSEGG, 1804) – Pigmy Skipper



© Albert Vliegenthart

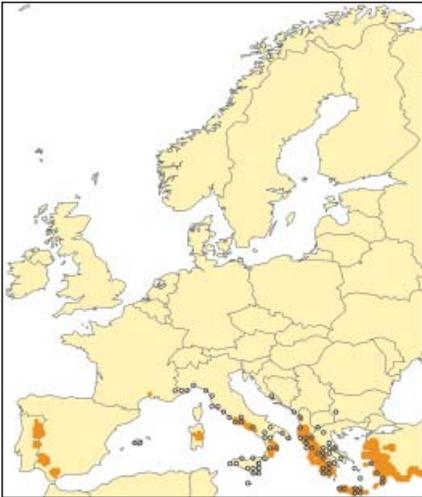
		Full dispersal	No dispersal
2050	SEDG	-11 (-2.1%)	195 (-37.14%)
	BAMBU	-15 (-2.86%)	-201 (-38.29%)
	GRAS	-39 (-7.43%)	-239 (-45.52%)
2080	SEDG	90 (17.14%)	-220 (-41.9%)
	BAMBU	-123 (-23.43%)	-342 (-65.14%)
	GRAS	-223 (-42.48%)	-420 (-80%)

Changes in climatic niche distribution
(in 10⁴ × 10⁴ grid cells; present niche space: 525 cells)

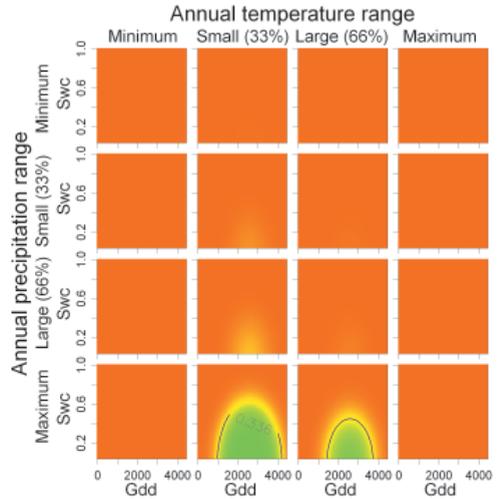
The Pigmy Skipper occurs in the same types of habitat as the Mediterranean Skipper (*Gegenes nostradamus*). Dry gullies, rocky slopes, sandy or stony riverbanks with sparse vegetation, dry grassland and low scrub near the coast are all places where these butterflies can be seen, often basking in the sun on stones and bare soil. In spring, there are fewer butterflies than in the summer and autumn. The larvae feed on the grasses *Hyparrhenia birta* and *Sorghum halepensis*. The Pigmy Skipper has two to three generations a year.

Present distribution can be very well explained by climatic variables (AUC = 0.96).

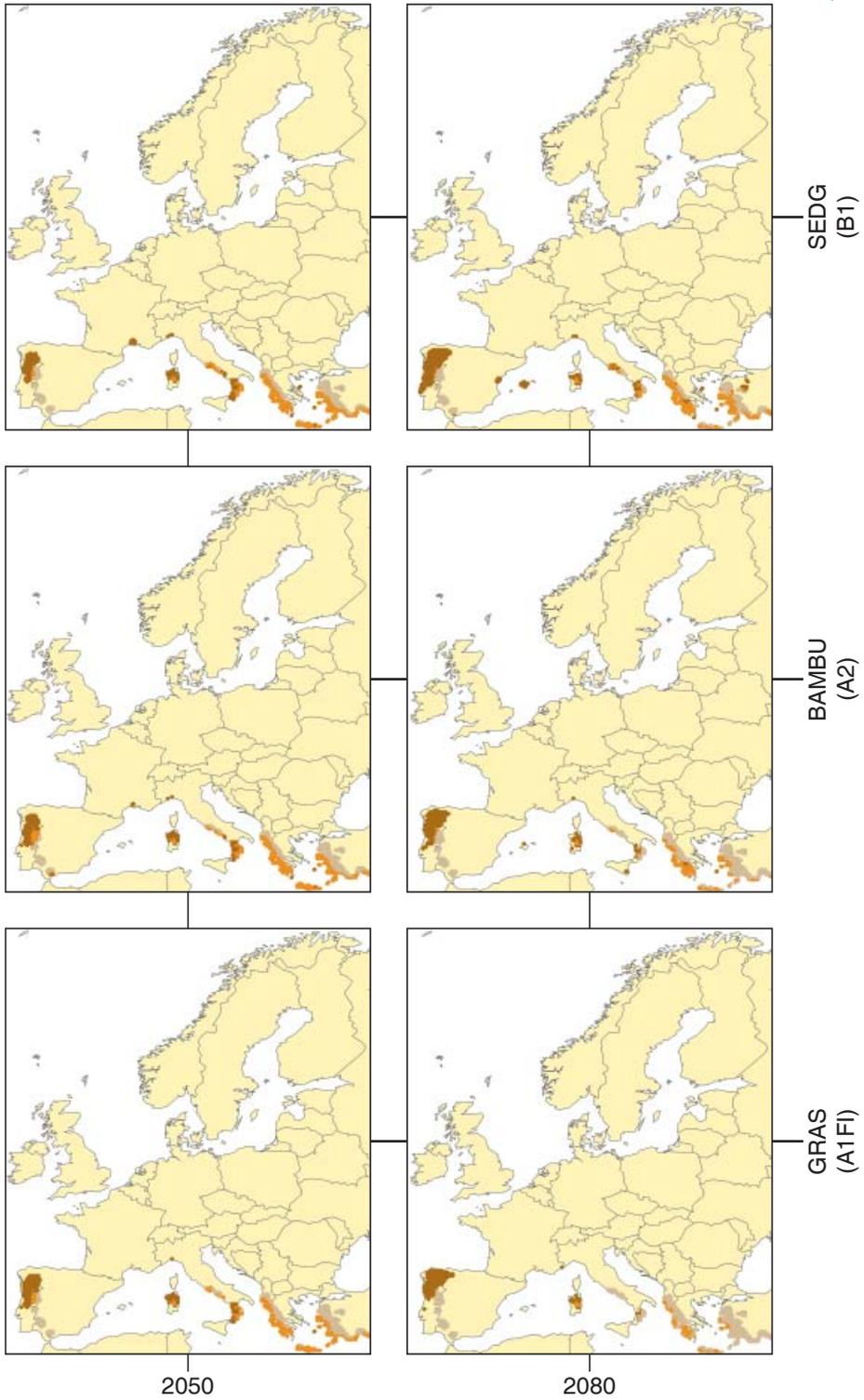
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold



Gegenes nostradamus (FABRICIUS, 1793) – Mediterranean Skipper



© Thomas Kissling

		Full dispersal	No dispersal
2050	SEDG	-628 (-51.27%)	-805 (-65.71%)
	BAMBU	-626 (-51.1%)	-828 (-67.59%)
	GRAS	-718 (-58.61%)	-927 (-75.67%)
2080	SEDG	-731 (-59.67%)	-1005 (-82.04%)
	BAMBU	-912 (-74.45%)	-1142 (-93.22%)
	GRAS	-1035 (-84.49%)	-1216 (-99.27%)

Changes in climatic niche distribution
(in 10'x10' grid cells; present niche space: 1225 cells)

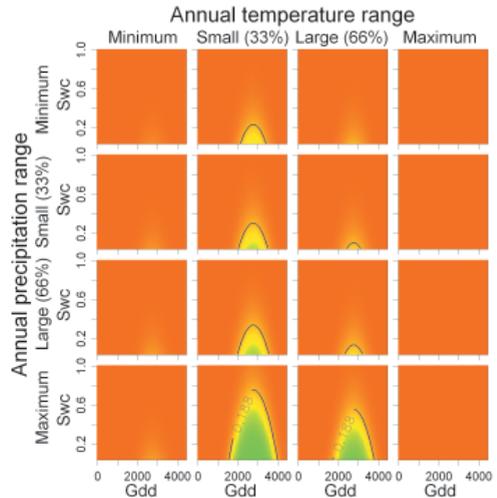
Like the Pigmy Skipper (*G. pumilio*), the Mediterranean Skipper can be found in rocky or stony places, such as dried-up riverbeds, on dry, grassy vegetation or in thickets, and low scrub along the coast. The males defend their territory perched on a stone or on the ground, returning to the same spot if disturbed. These butterflies fly fast and close to the ground. The larvae feed on Reed (*Phragmites australis*) and the grass *Saccharum ravennae*. It has one to three generations a year. There are far fewer butterflies in the spring than in the summer or autumn.

Present distribution can be well explained by climatic variables (AUC = 0.94).

Climate risk category: HHRH.



Observed species distribution (50 x 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold

