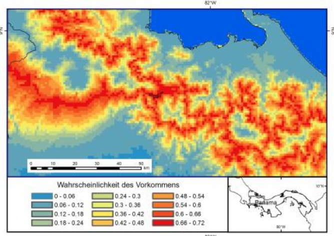
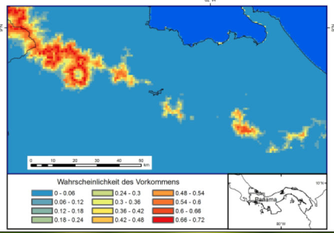






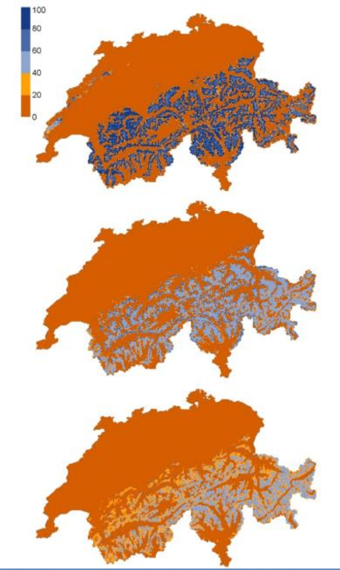
Tiere im Klimawandel

–

kommen,

gehen,

bleiben?




Sebastian Lotzkat
Senckenberg Forschungsinstitut Frankfurt


WWF

Foto: CDC / James Gathany

Foto: Boskar

Foto: Hans Hillewaert

1. Prolog:

Tierische Abhängigkeit von Umweltfaktoren

Klima beeinflusst Organismen: Verbreitung

Klima beeinflusst Organismen: Verbreitung

Klima beeinflusst Organismen: Verbreitung

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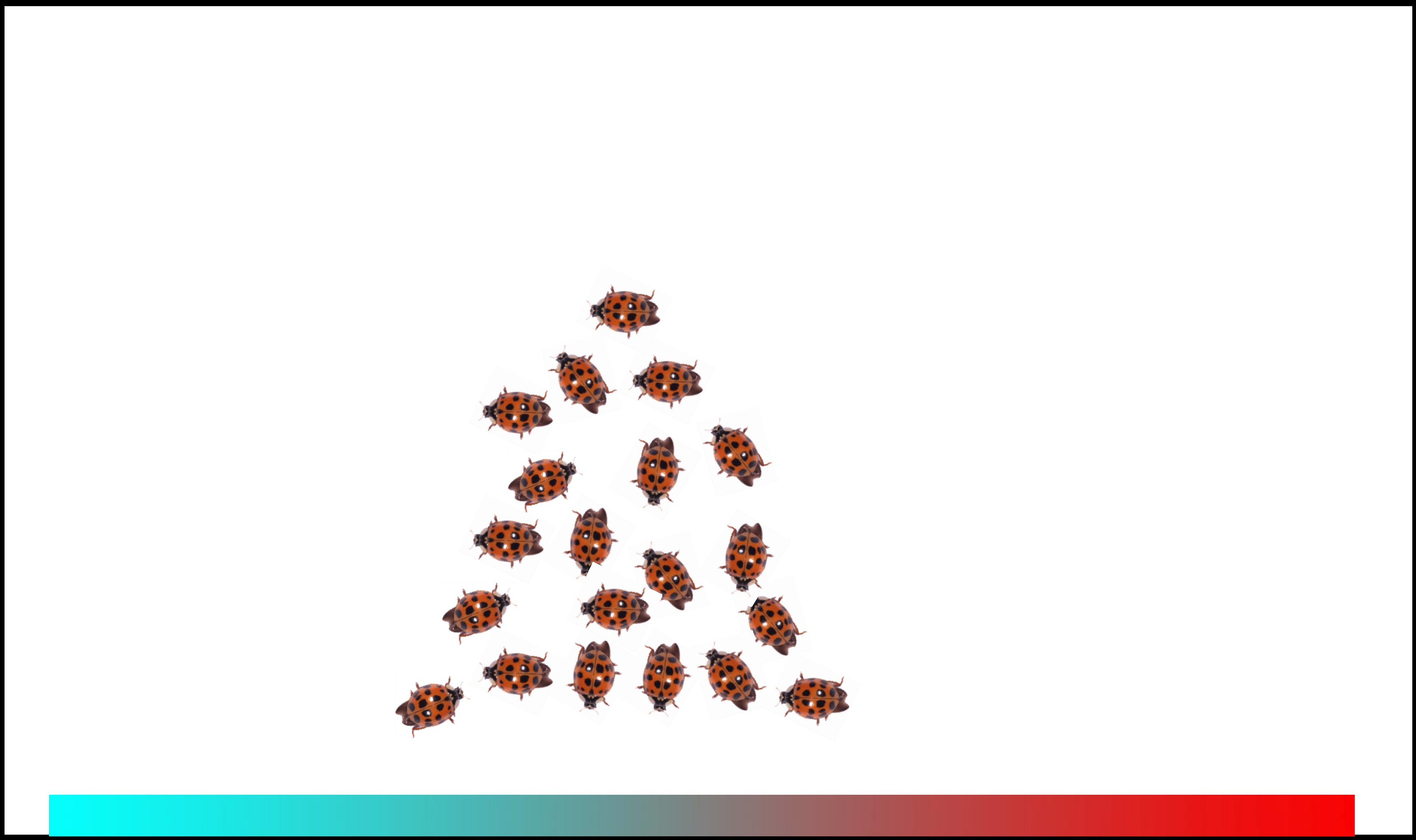
Ökologische Toleranz

Ökologische Toleranz

Ökologische Toleranz



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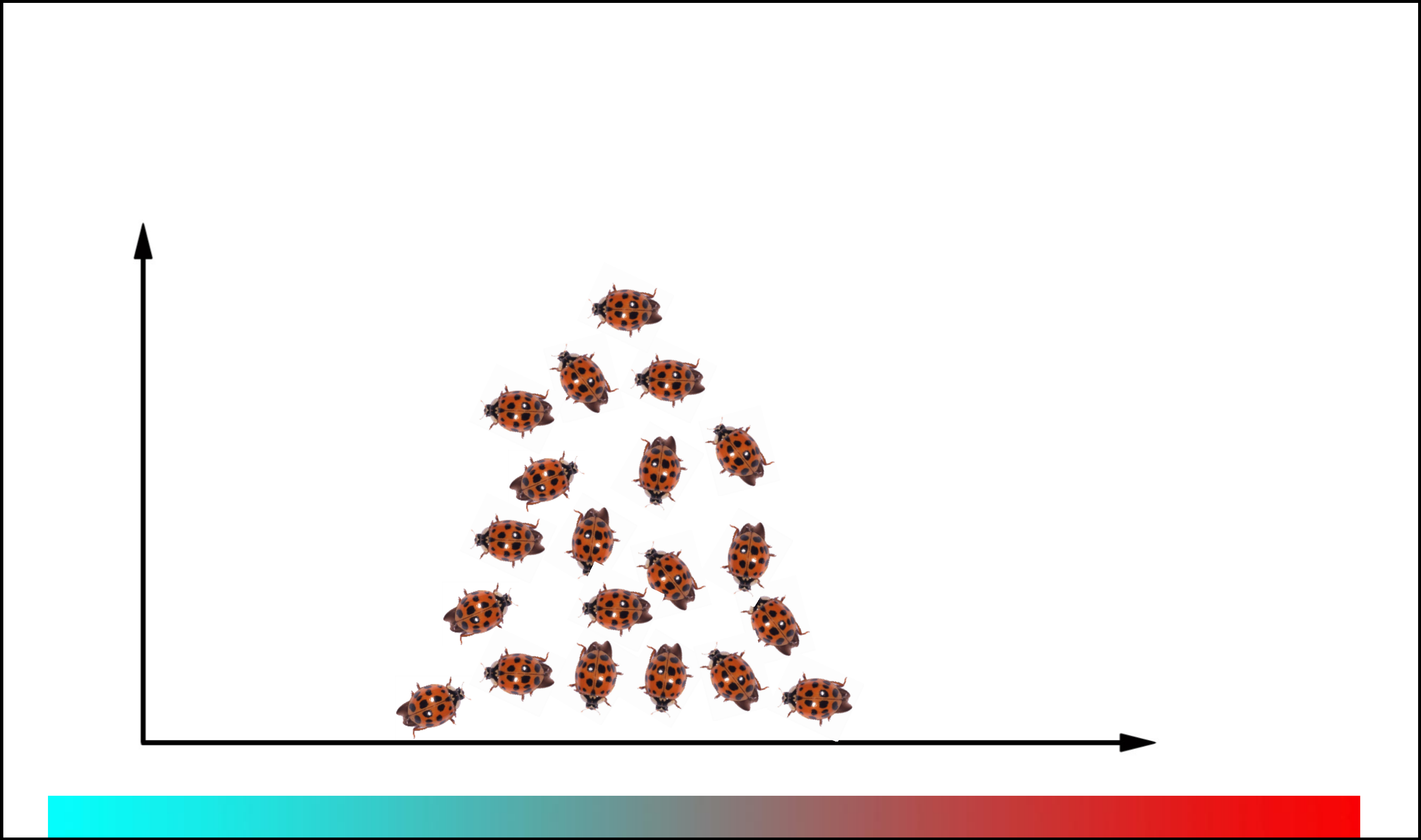

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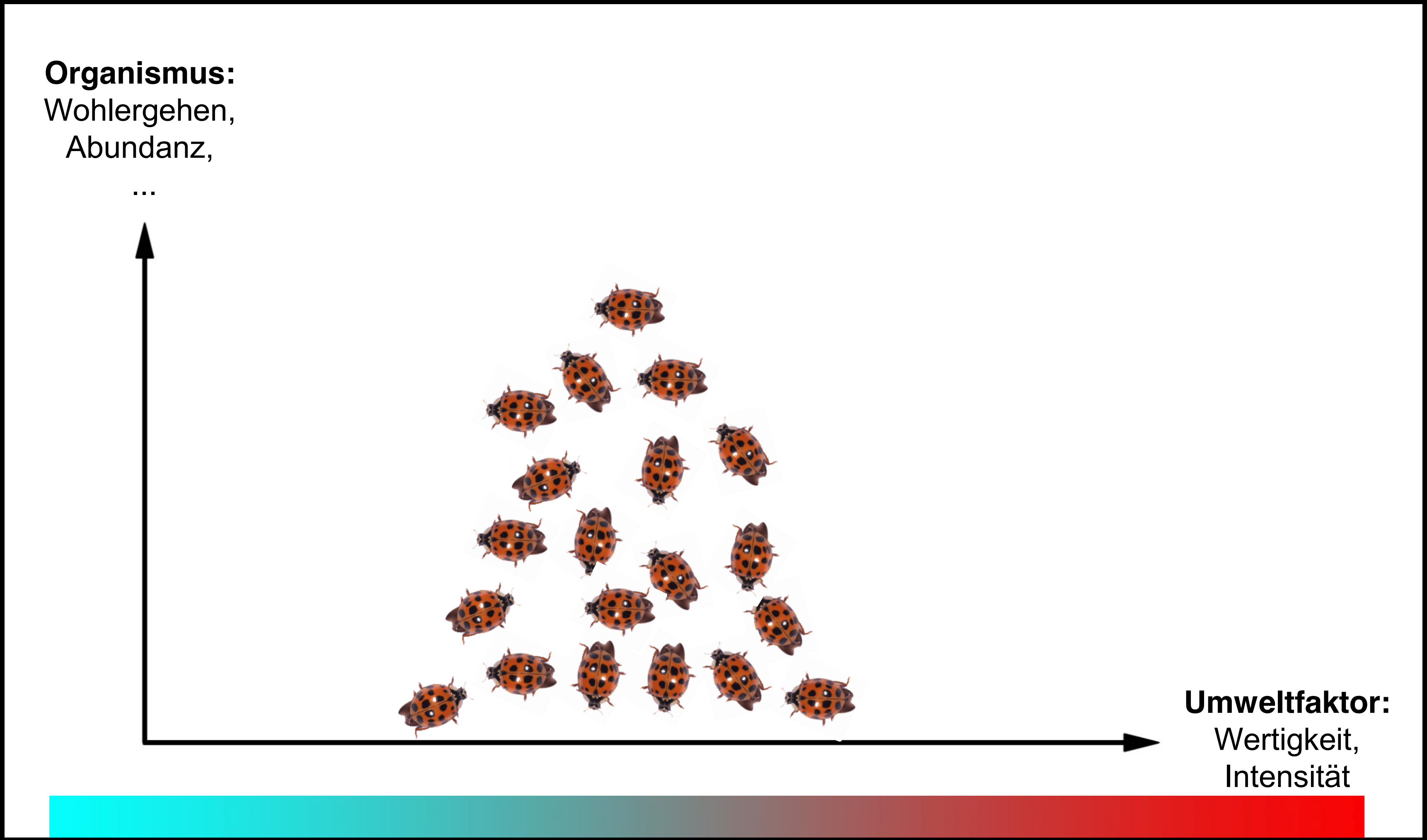

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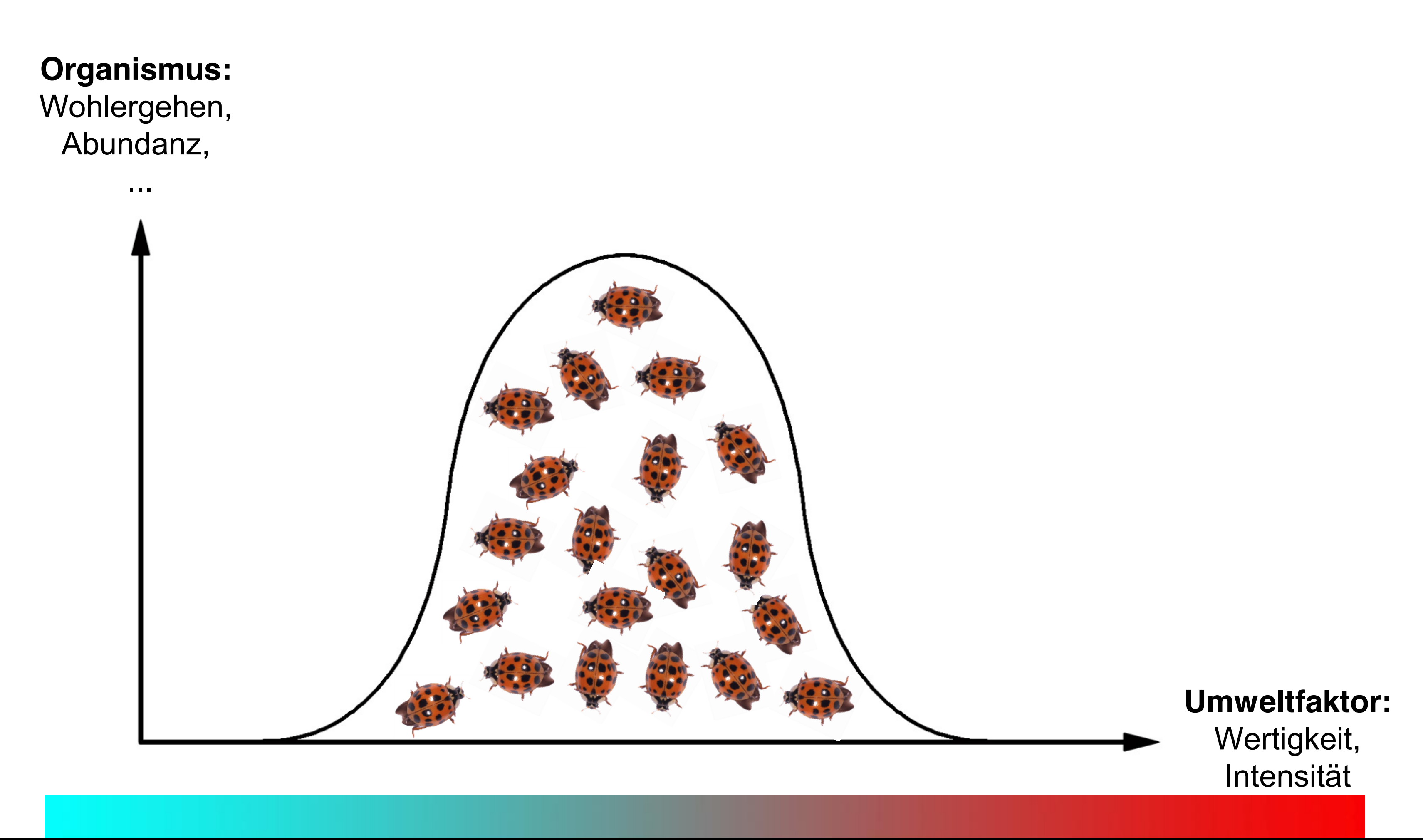

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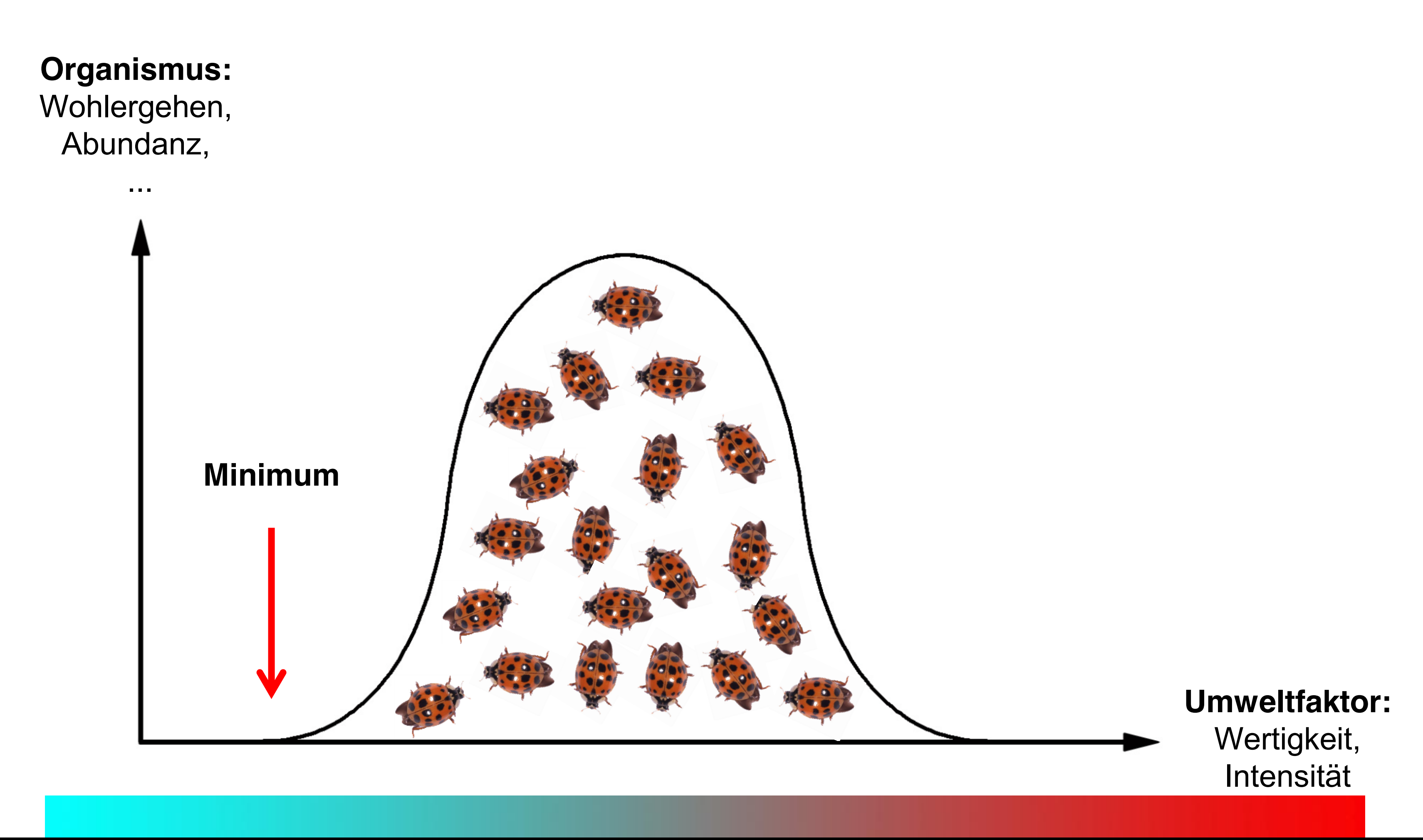

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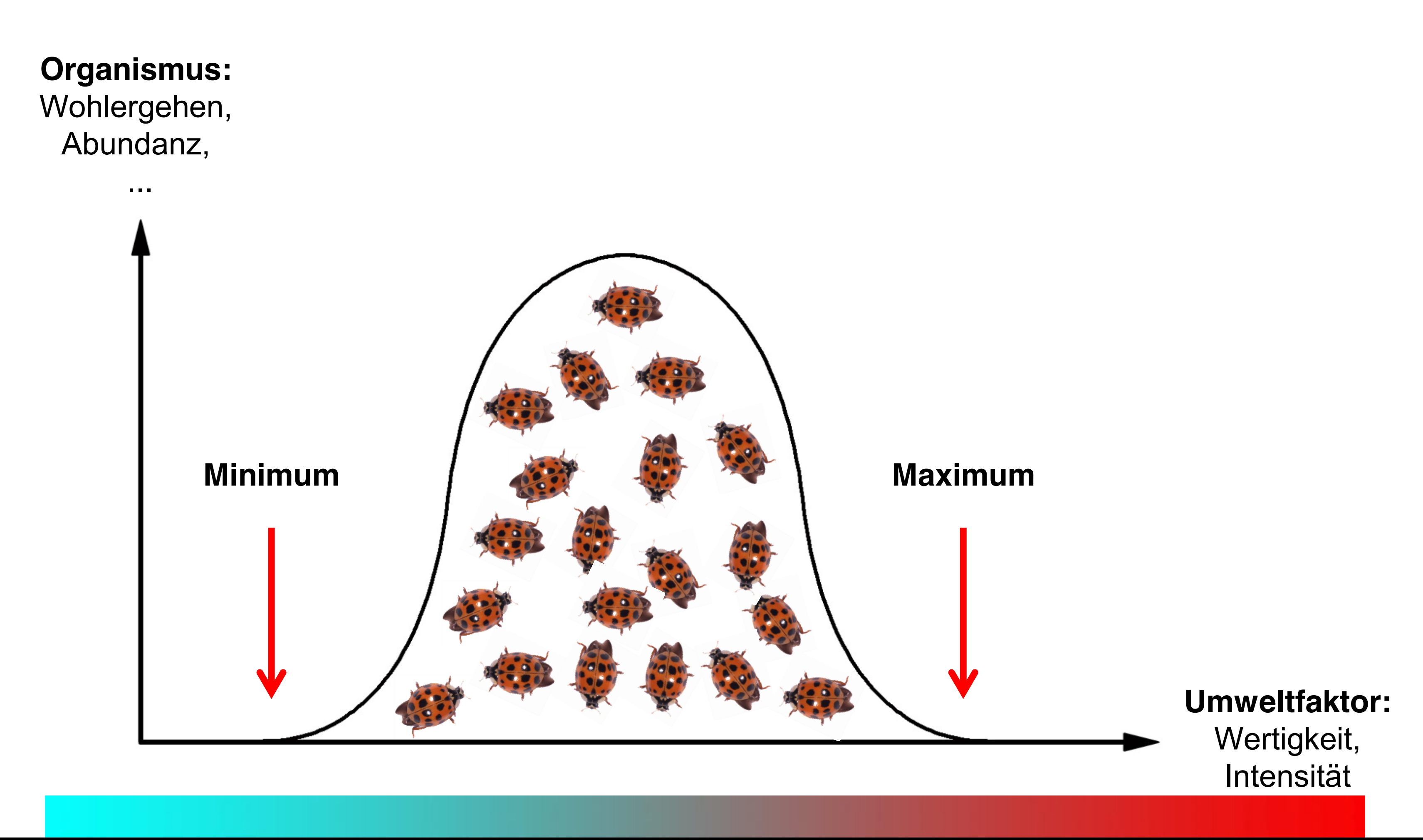

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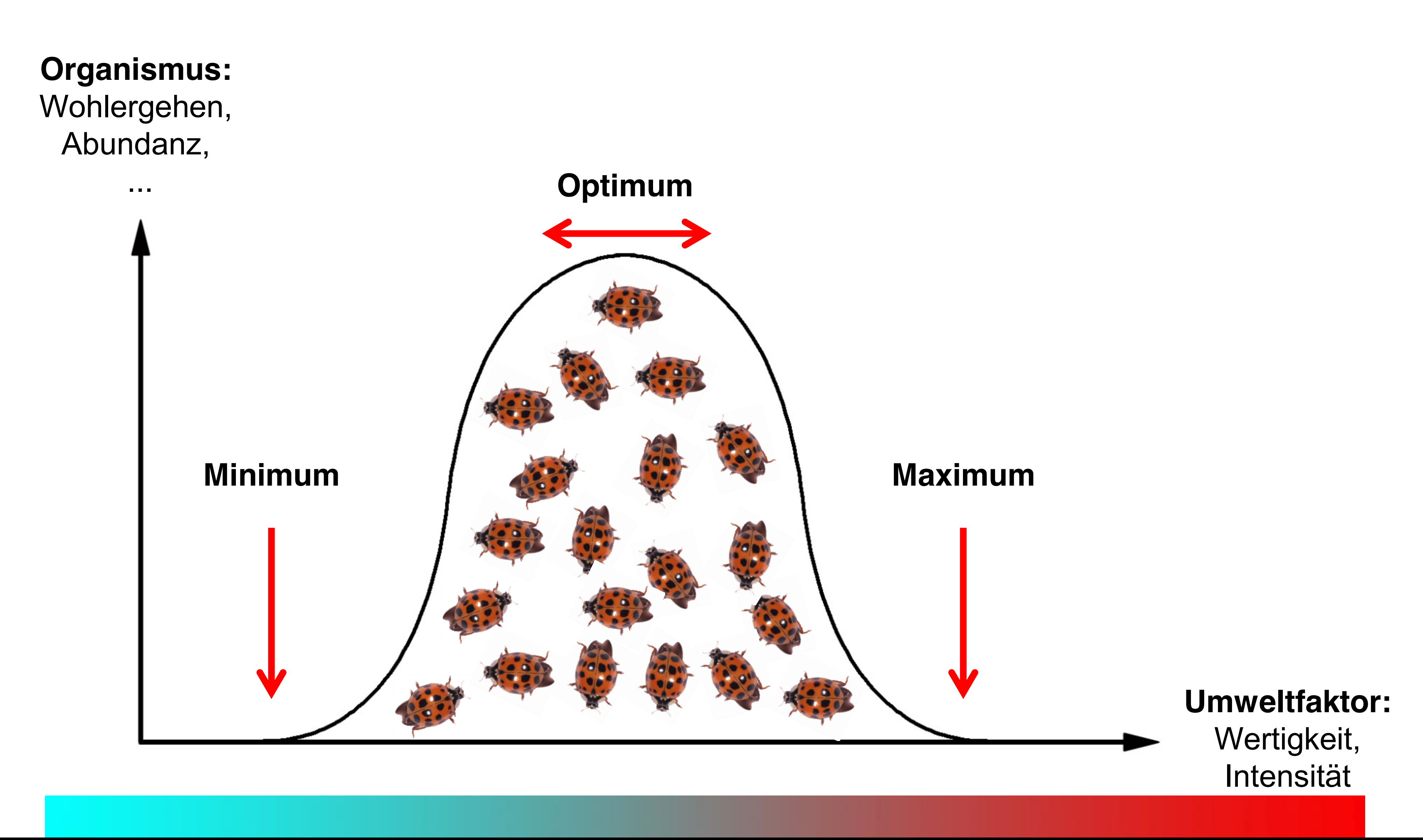
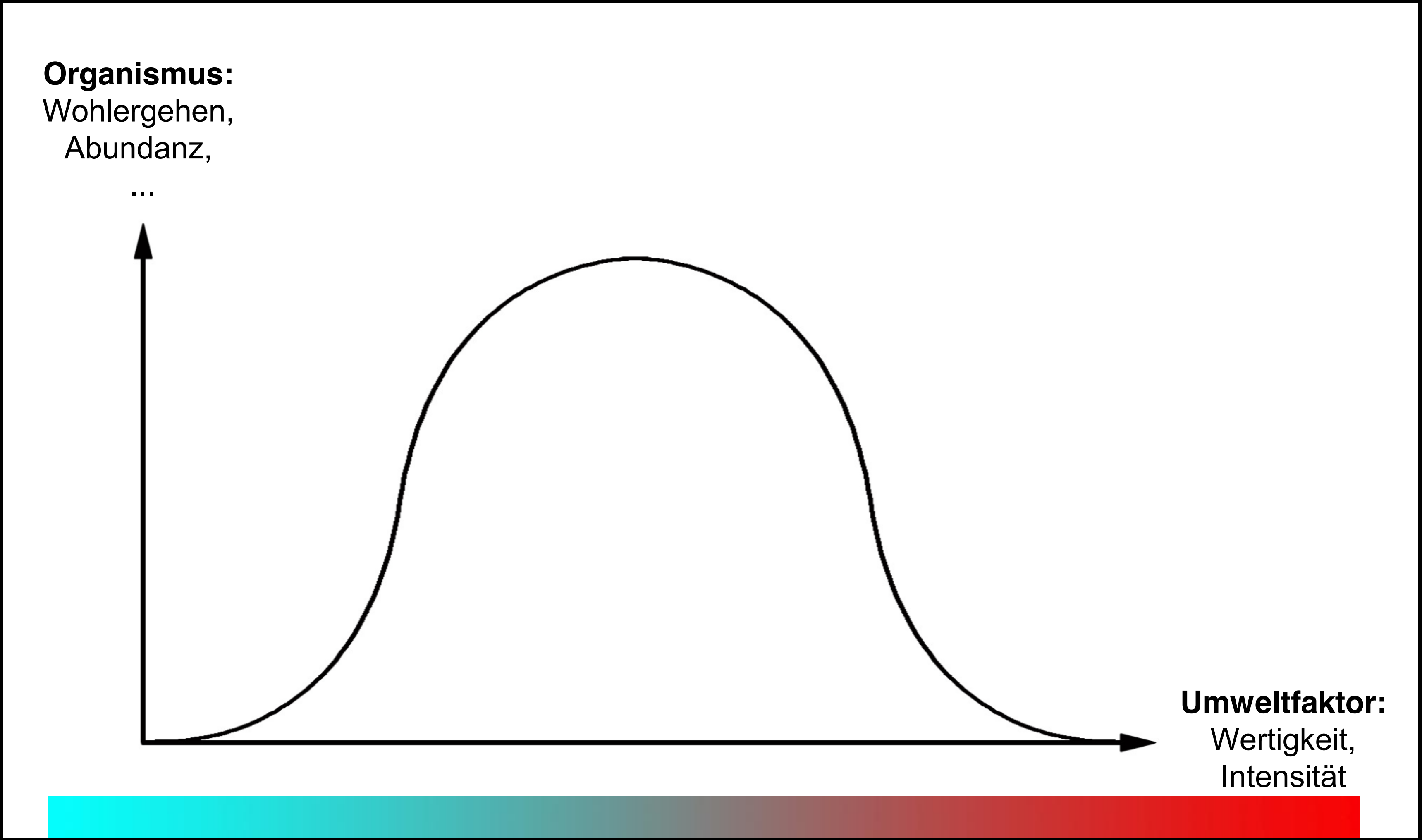
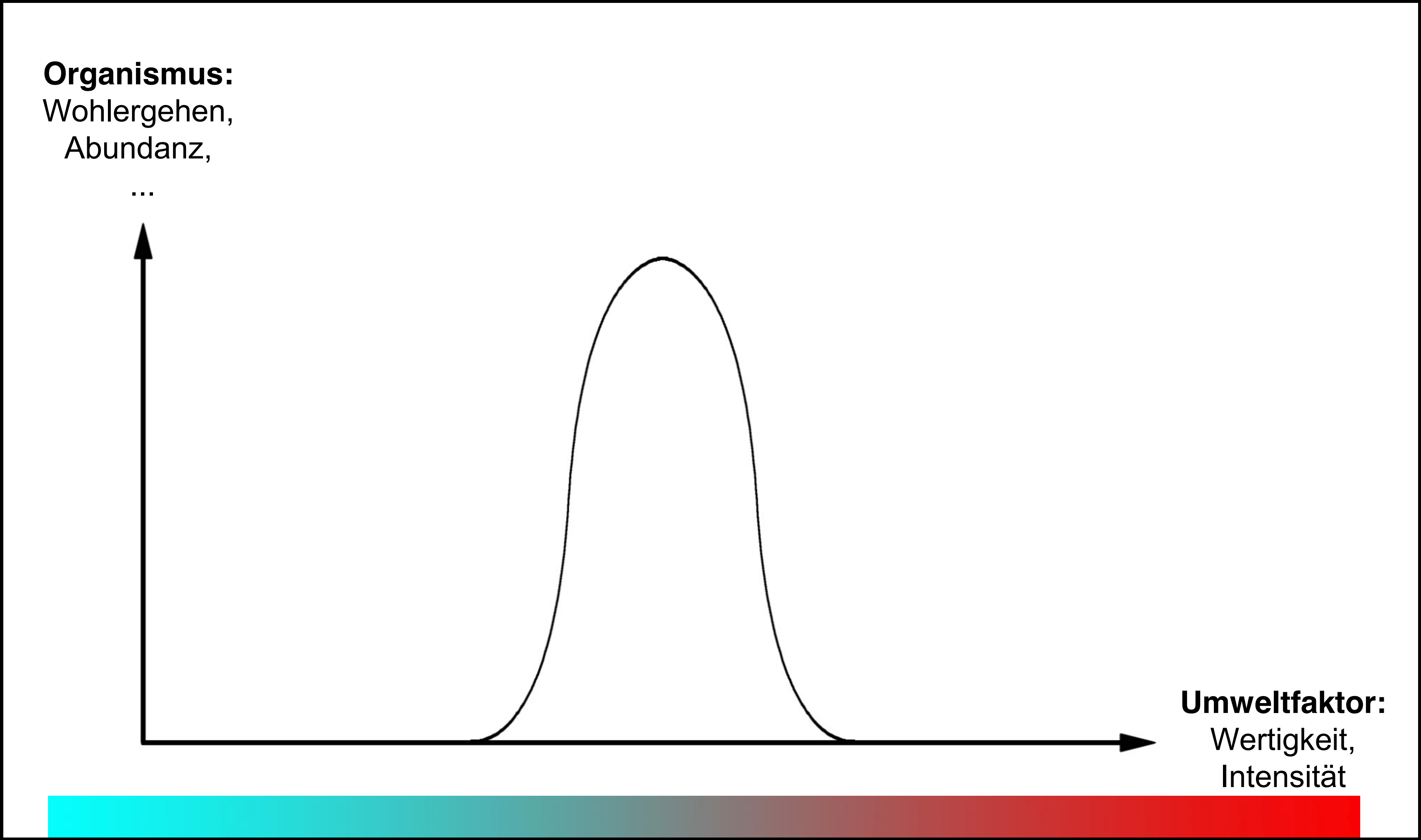


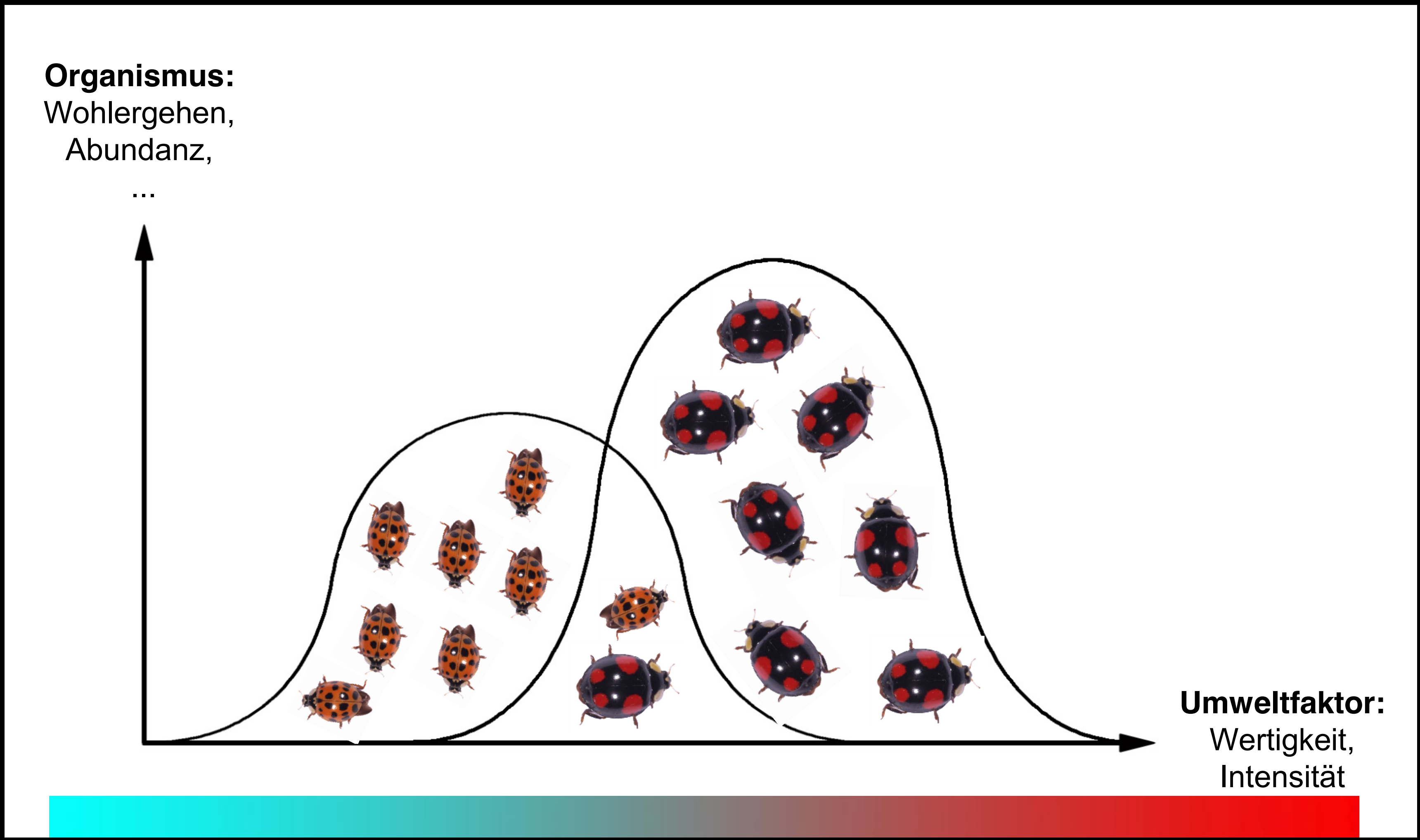
breite Toleranz: euryök



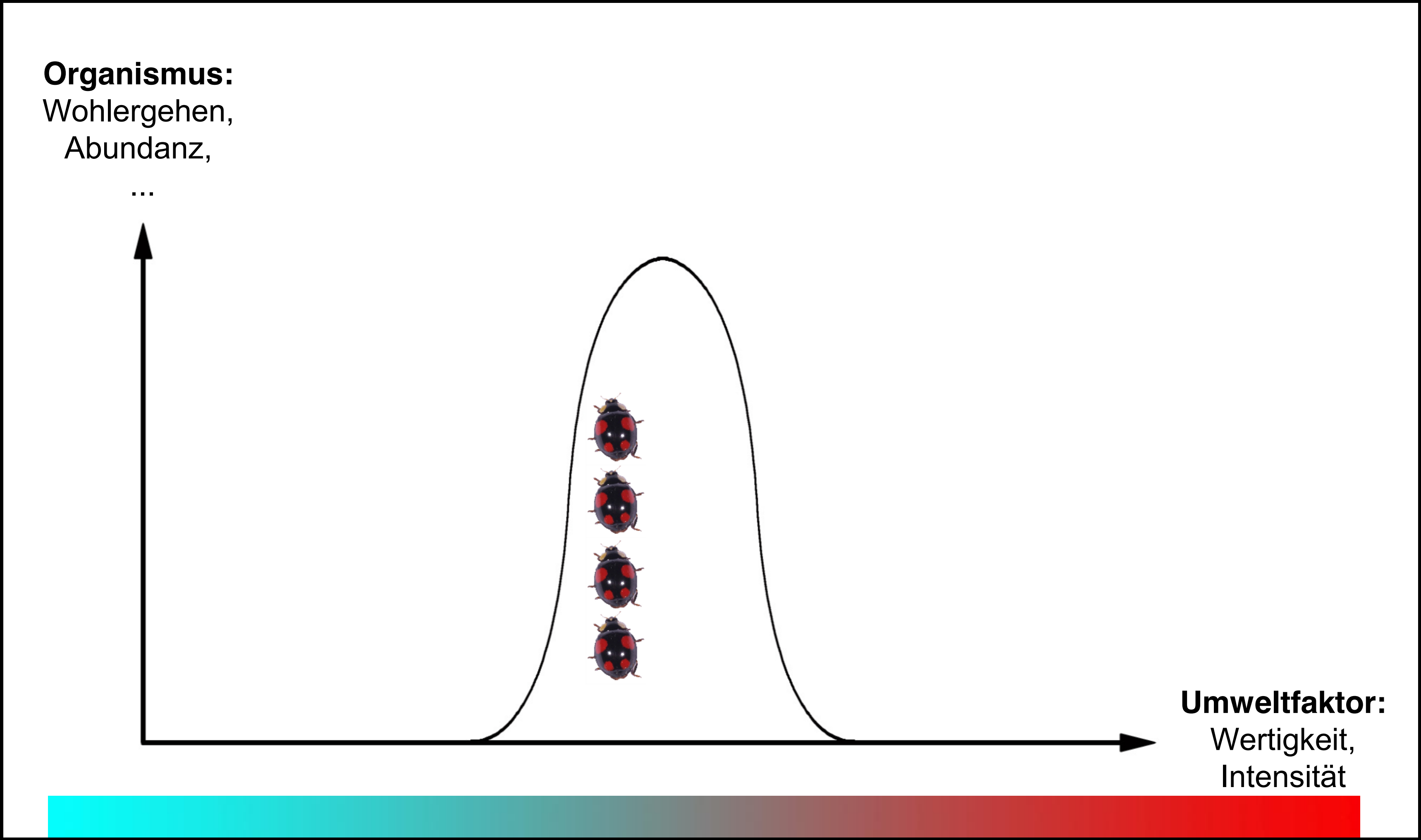
enge Toleranz: stenök



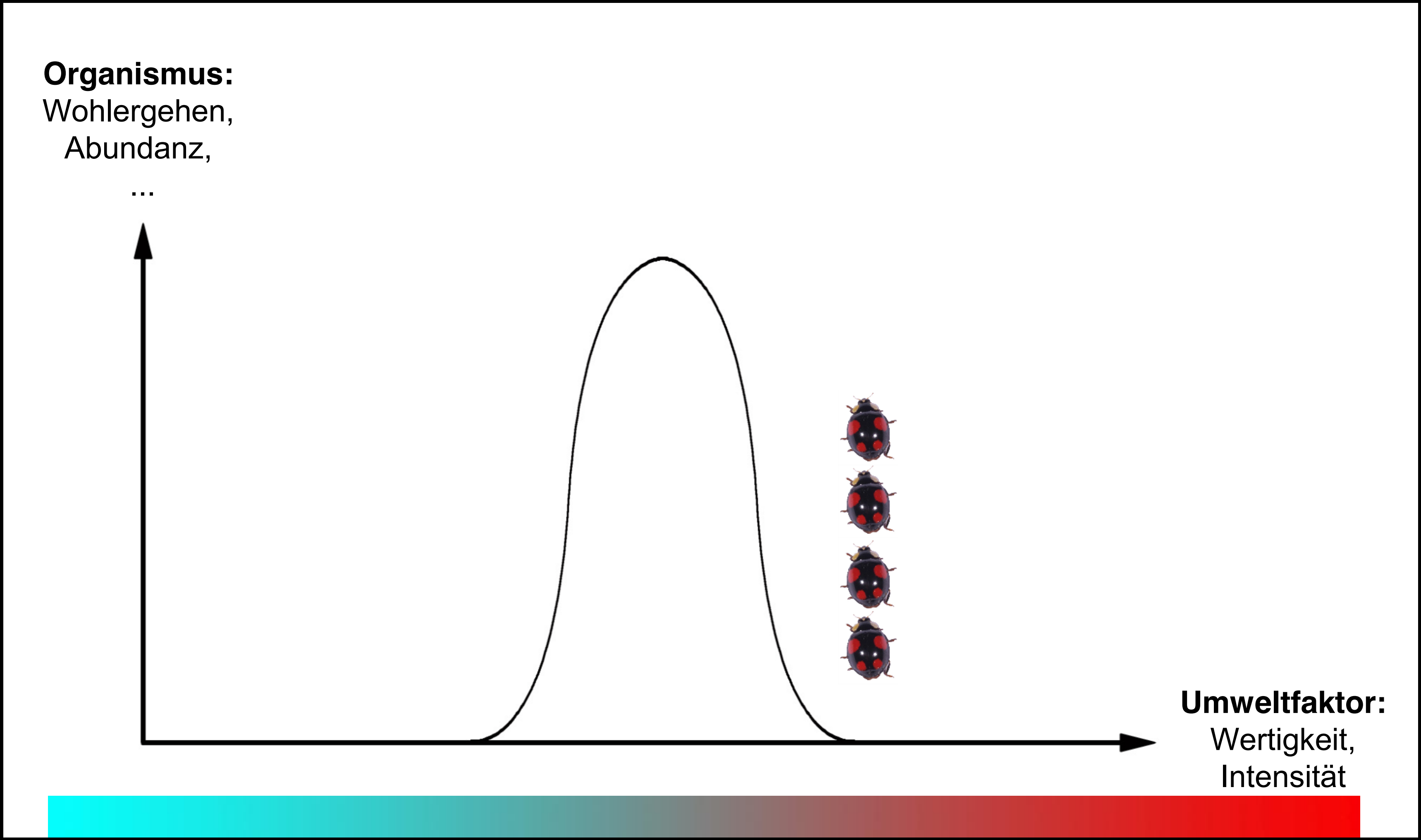
überlappende Toleranz: Gedränge



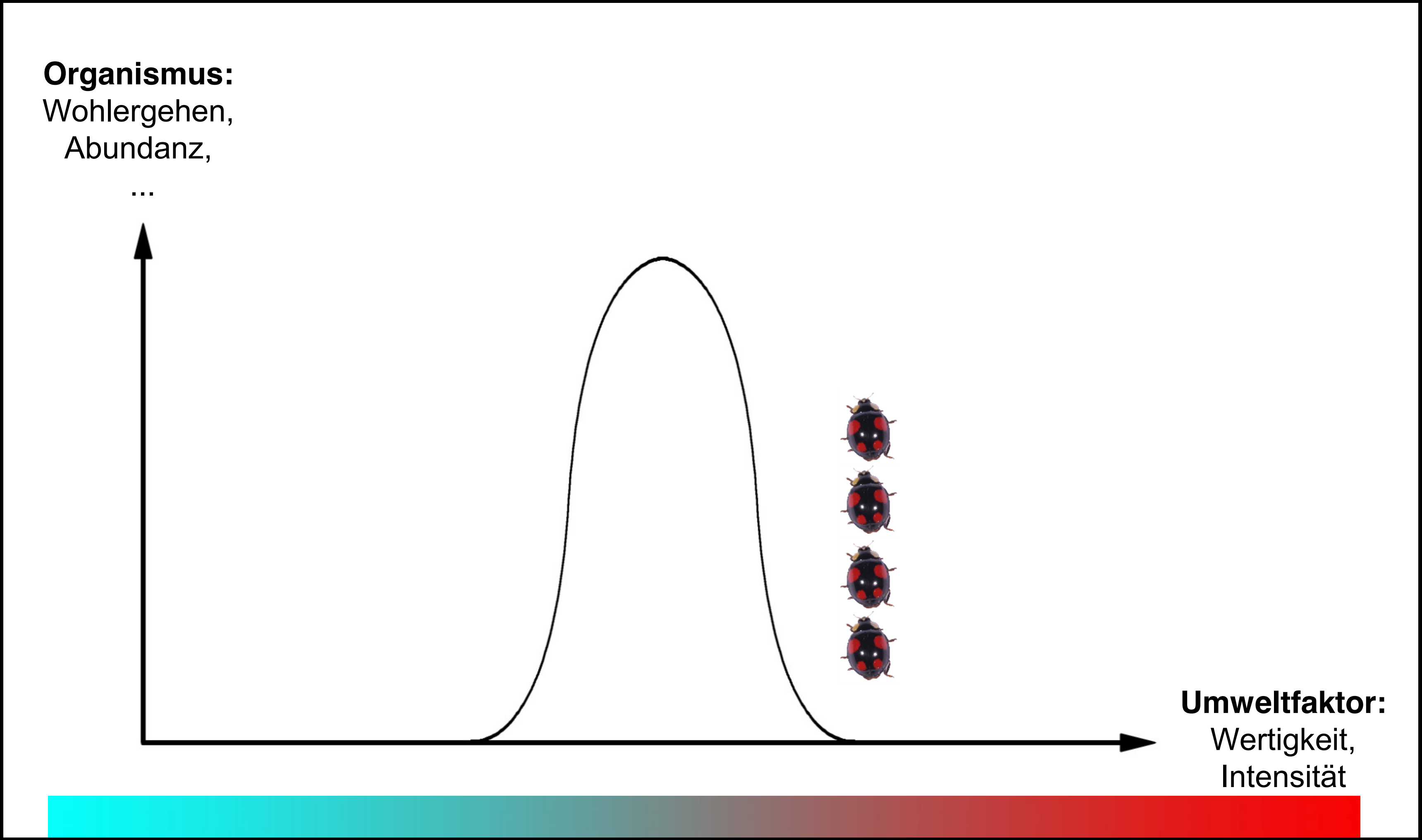
Faktor tolerabel? Gut.



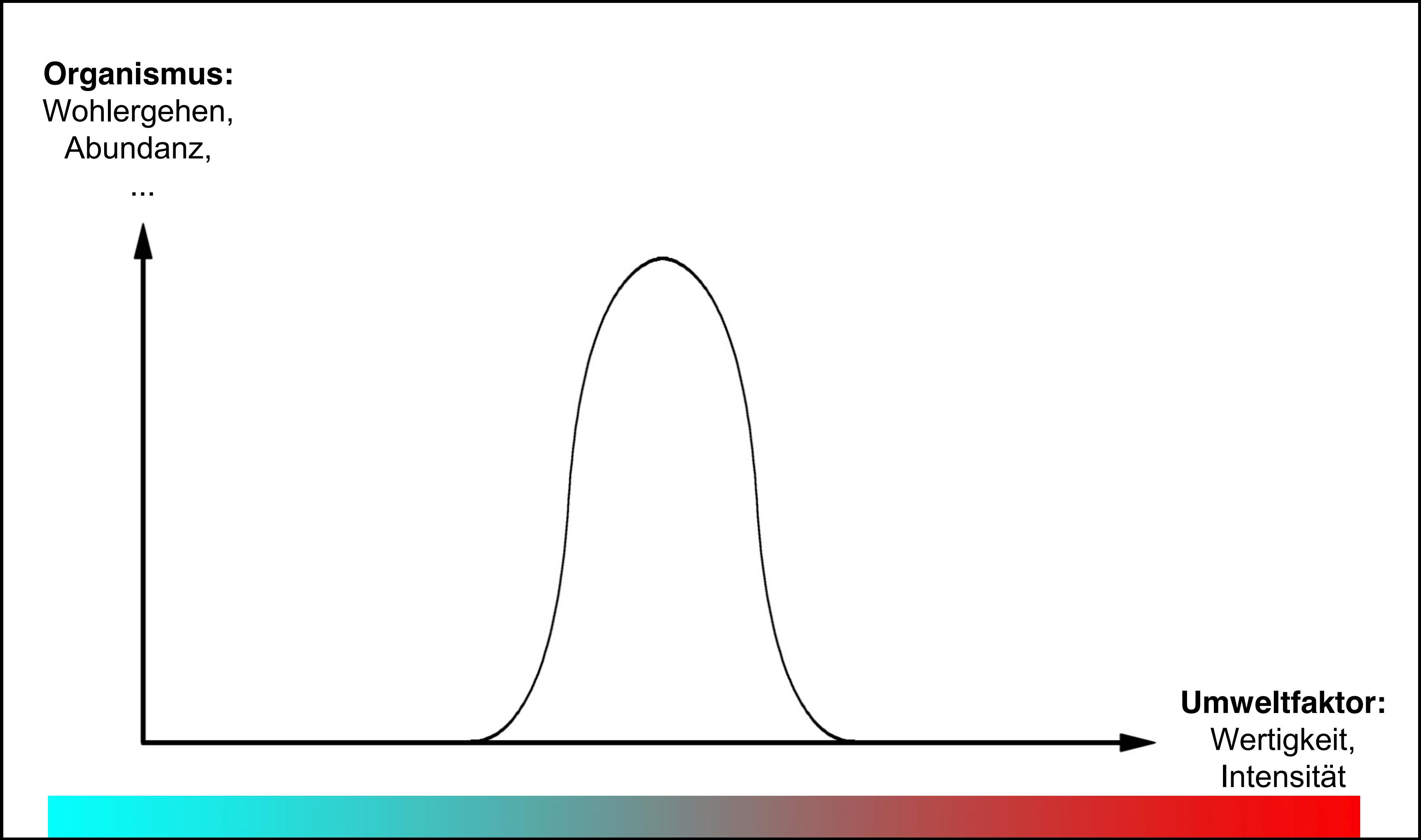
Faktor ändert sich? Nicht gut.



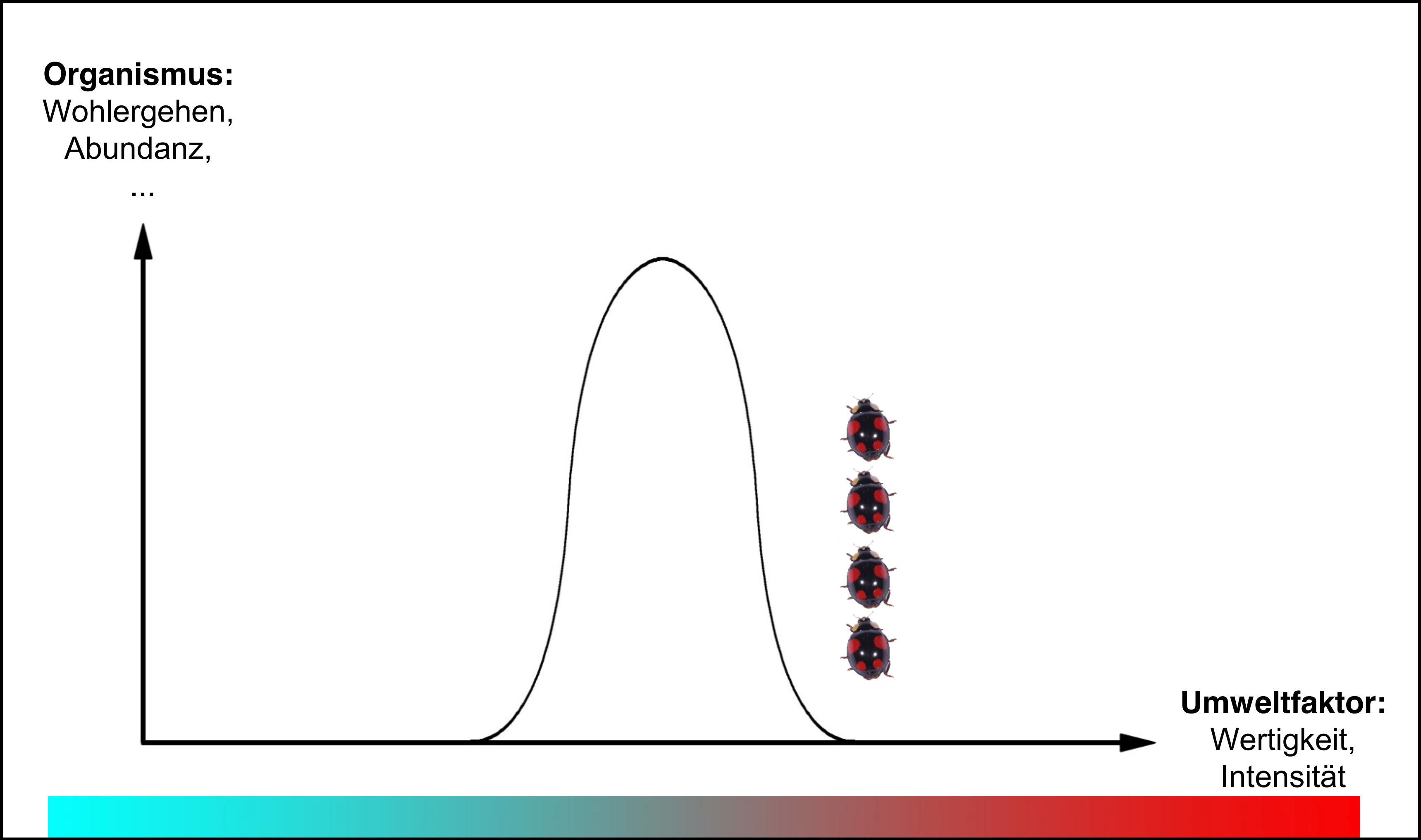
Faktor ändert sich? ➔ Zugrunde gehen



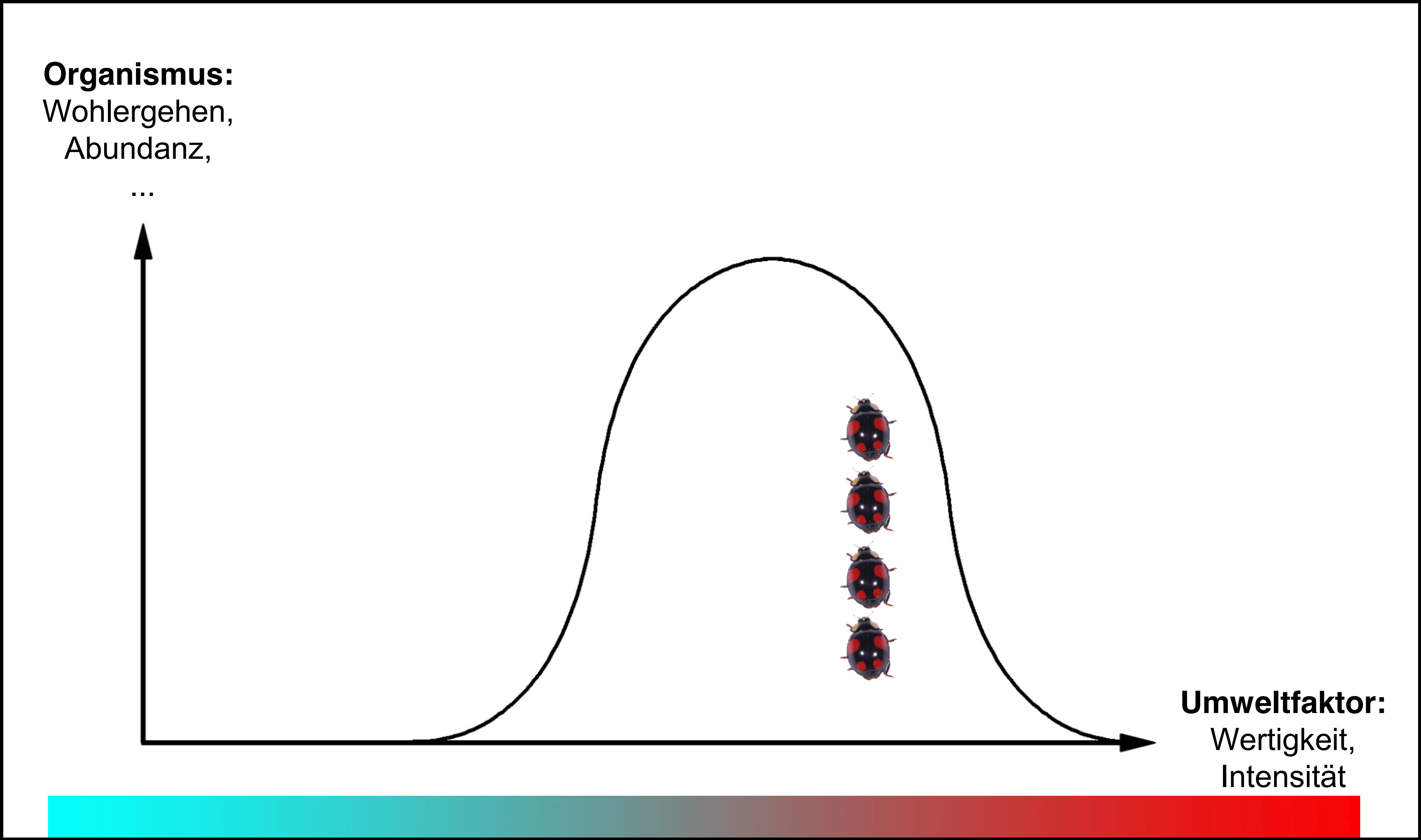
Faktor ändert sich? ➔ Zugrunde gehen



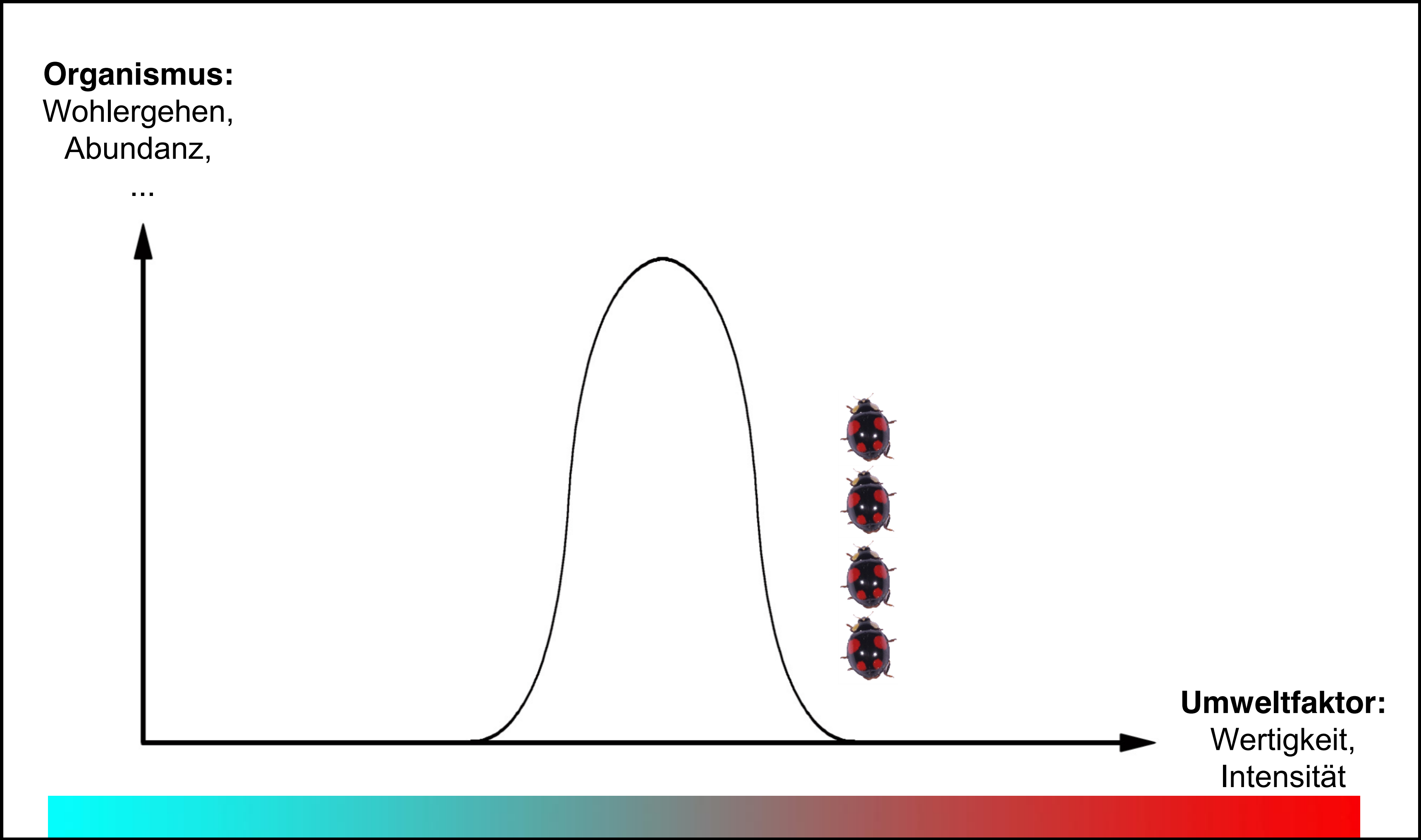
Faktor ändert sich? ➔ Anpassen



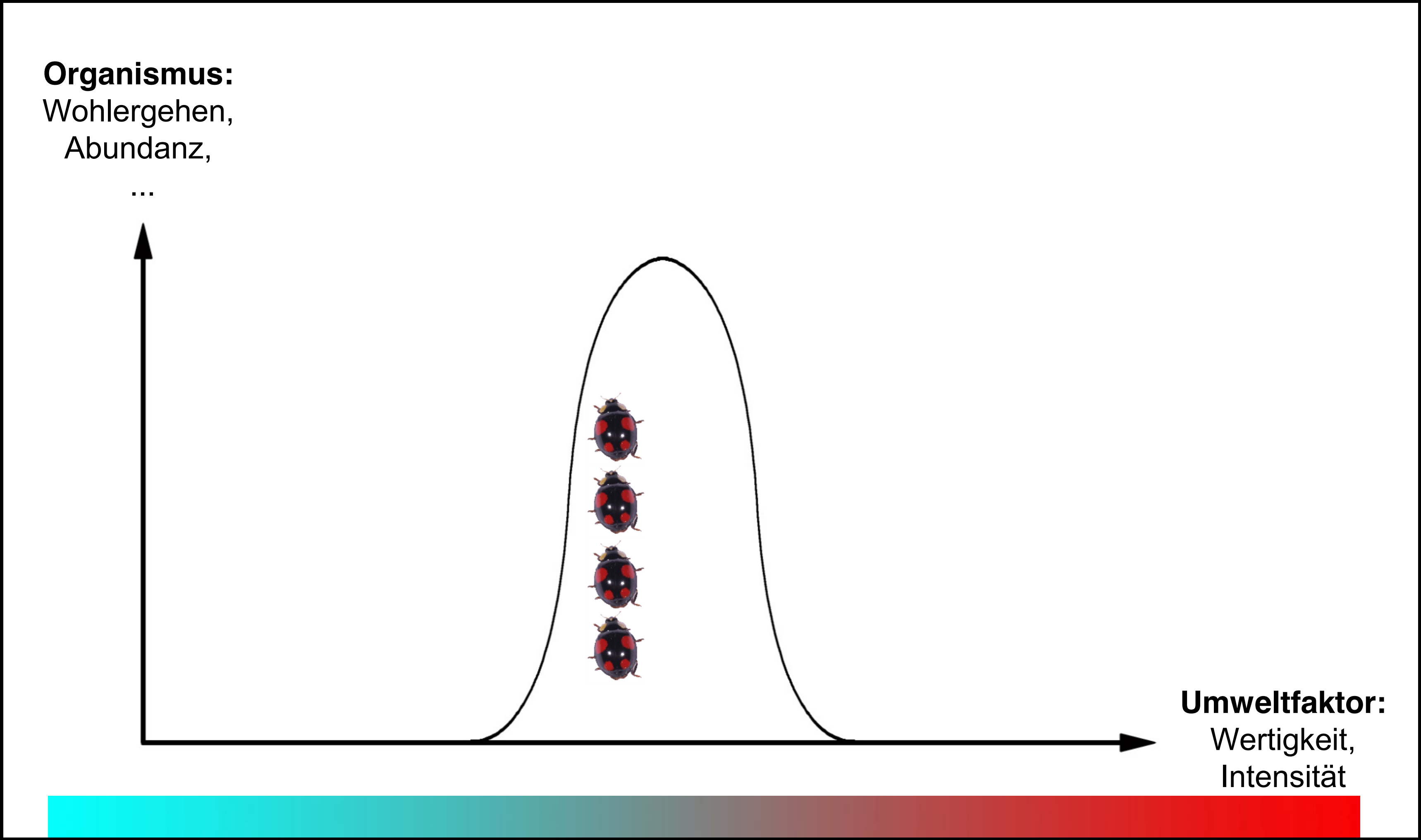
Faktor ändert sich? ➔ Anpassen



Faktor ändert sich? → Ausweichen



Faktor ändert sich? ➔ Ausweichen



Klima beeinflusst Tiere.

Wandel dann wohl auch.

2. Tiere im Klimawandel:

was wir wirklich wissen

Arealverschiebungen

OPEN ACCESS Freely available online

PLOS | ONE

Plants, Birds and Butterflies: Short-Term Responses of Species Communities to Climate Warming Vary by Taxon and with Altitude

Tobias Roth[1,2,3]*, Matthias Plattner[1], Valentin Amrhein[2,3]

1 Hintermann & Weber AG, Reinach, Switzerland, **2** University of Basel, Zoological Institute, Basel, Switzerland, **3** Research Station Petite Camargue Alsacienne, Saint-Louis, France

Abstract

As a consequence of climate warming, species usually shift their distribution towards higher latitudes or altitudes. Yet, it is unclear how different taxonomic groups may respond to climate warming over larger altitudinal ranges. Here, we used data from the national biodiversity monitoring program of Switzerland, collected over an altitudinal range of 2500 m. Within the short period of eight years (2003–2010), we found significant shifts in communities of vascular plants, butterflies and birds. At low altitudes, communities of all species groups changed towards warm-dwelling species, corresponding to an average uphill shift of 8 m, 38 m and 42 m in plant, butterfly and bird communities, respectively. However, rates of community changes decreased with altitude in plants and butterflies, while bird communities changed towards warm-dwelling species at all altitudes. We found no decrease in community variation with respect to temperature niches of species, suggesting that climate warming has not led to more homogenous communities. The different community changes depending on altitude could not be explained by different changes of air temperatures, since during the 16 years between 1995 and 2010, summer temperatures in Switzerland rose by about 0.07°C per year at all altitudes. We discuss that land-use changes or increased disturbances may have prevented alpine plant and butterfly communities from changing towards warm-dwelling species. However, the findings are also consistent with the hypothesis that unlike birds, many alpine plant species in a warming climate could find suitable habitats within just a few metres, due to the highly varied surface of alpine landscapes. Our results may thus support the idea that for plants and butterflies and on a short temporal scale, alpine landscapes are safer places than lowlands in a warming world.

Citation: Roth T, Plattner M, Amrhein V (2014) Plants, Birds and Butterflies: Short-Term Responses of Species Communities to Climate Warming Vary by Taxon and with Altitude. PLoS ONE 9(1): e82490. doi:10.1371/journal.pone.0082490

Arealverschiebungen

Foto: CDC / Jerzy Strzelecki

Arealverschiebungen

Foto: Harri Mauria

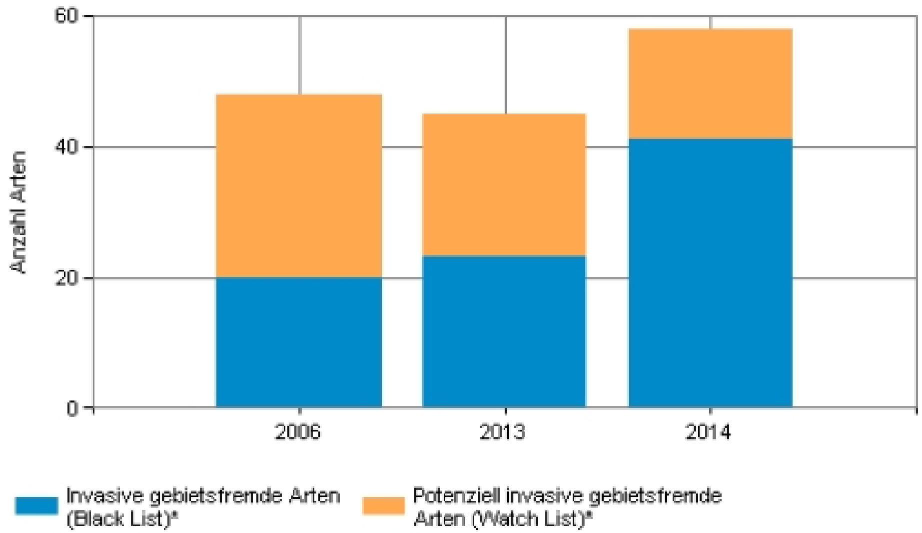
Arealerweiterungen: invasive Arten

Foto: CDC / James Gathany

Arealerweiterungen: invasive Arten

Bewertung des Zustandes schlecht
Bewertung der Entwicklung negativ

Graphik 1



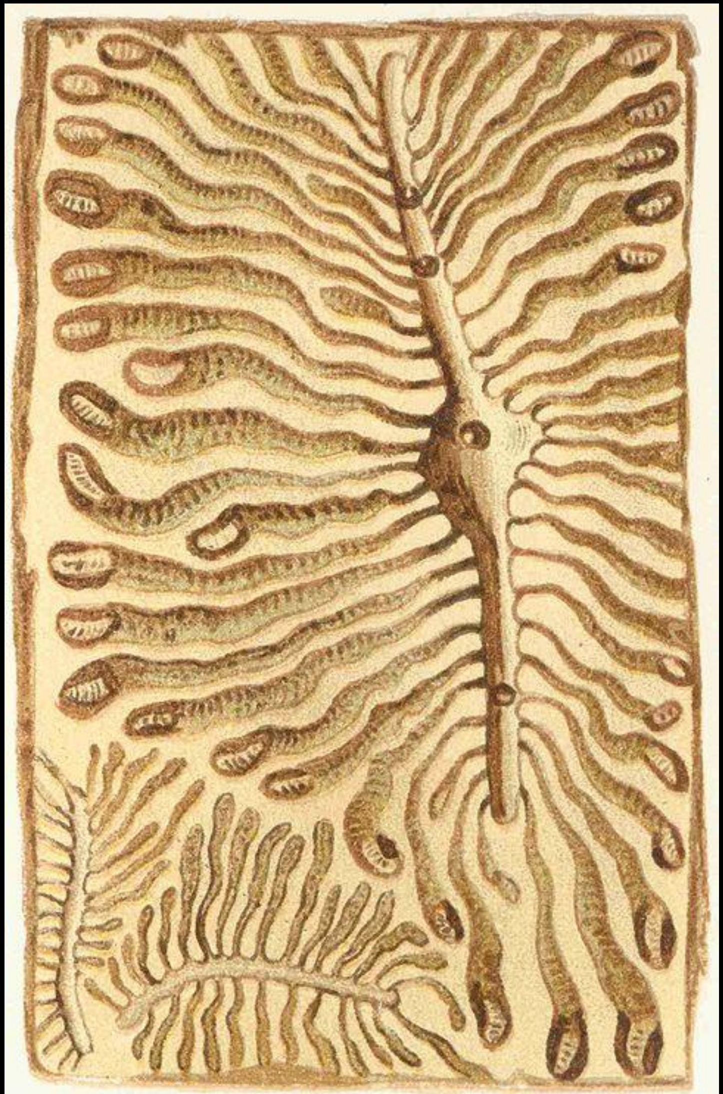
* Zur Zeit liegen Angaben nur für Pflanzen vor

Daten zur Grafik: Excel

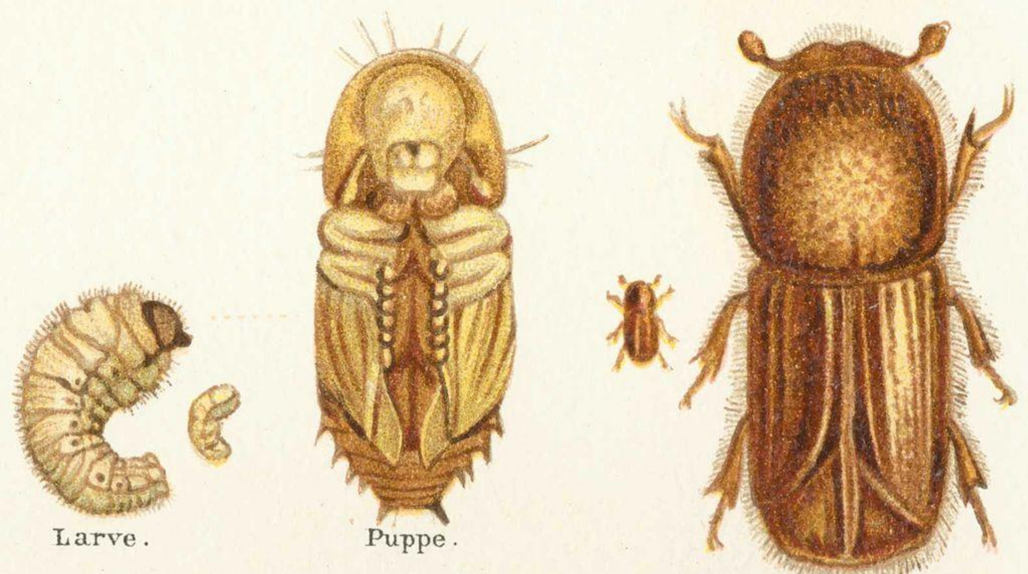
Quelle: Infoflora

Veränderungen der Bestandsdichten

Veränderungen der Bestandsdichten



Brutkolonie des Fichtenborkenkäfers.



Fichtenborkenkäfer (Bostrichus typographus). 7/1.
(Art. *Borkenkäfer.*)

Veränderungen der Bestandsdichten

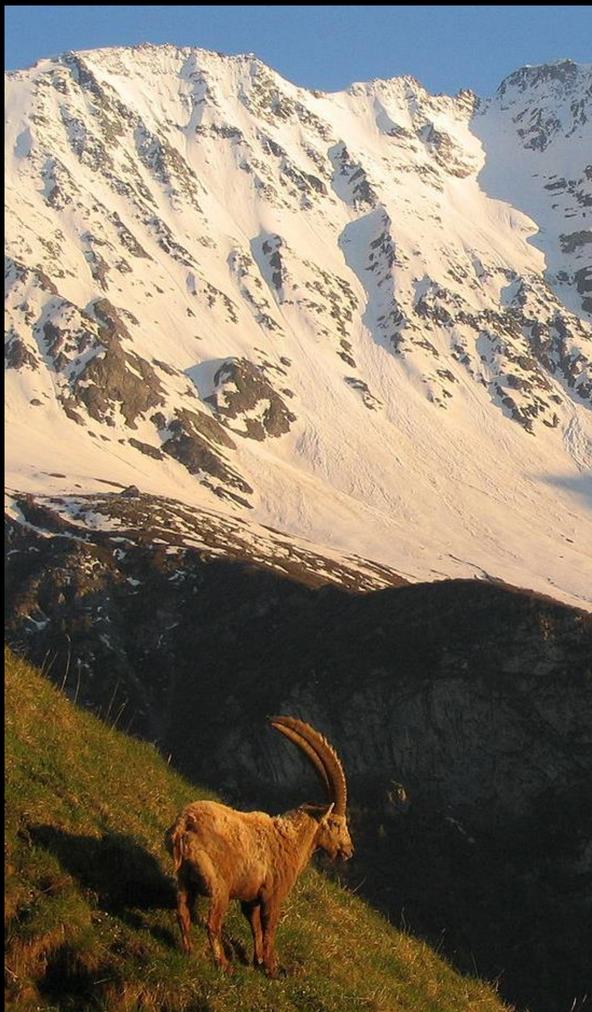


Foto: Eltouristo

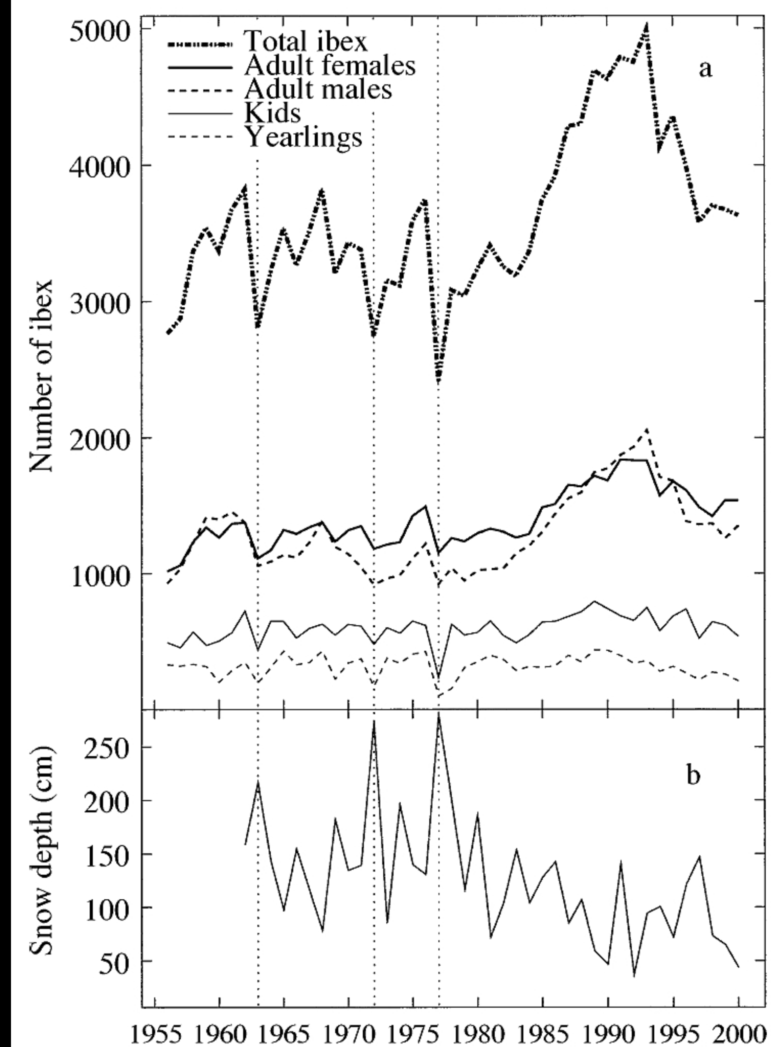


FIG. 1. Alpine ibex population classes and average winter snow depth. (a) Total population of Alpine ibex and sizes of the individual population classes counted during the autumn census in the Gran Paradiso National Park, Italy. (b) Average winter snow depth at Serrù station. Vertical dotted lines in-

Jacobson et al. 2008

Veränderungen der Bestandsdichten

Foto: Boskar

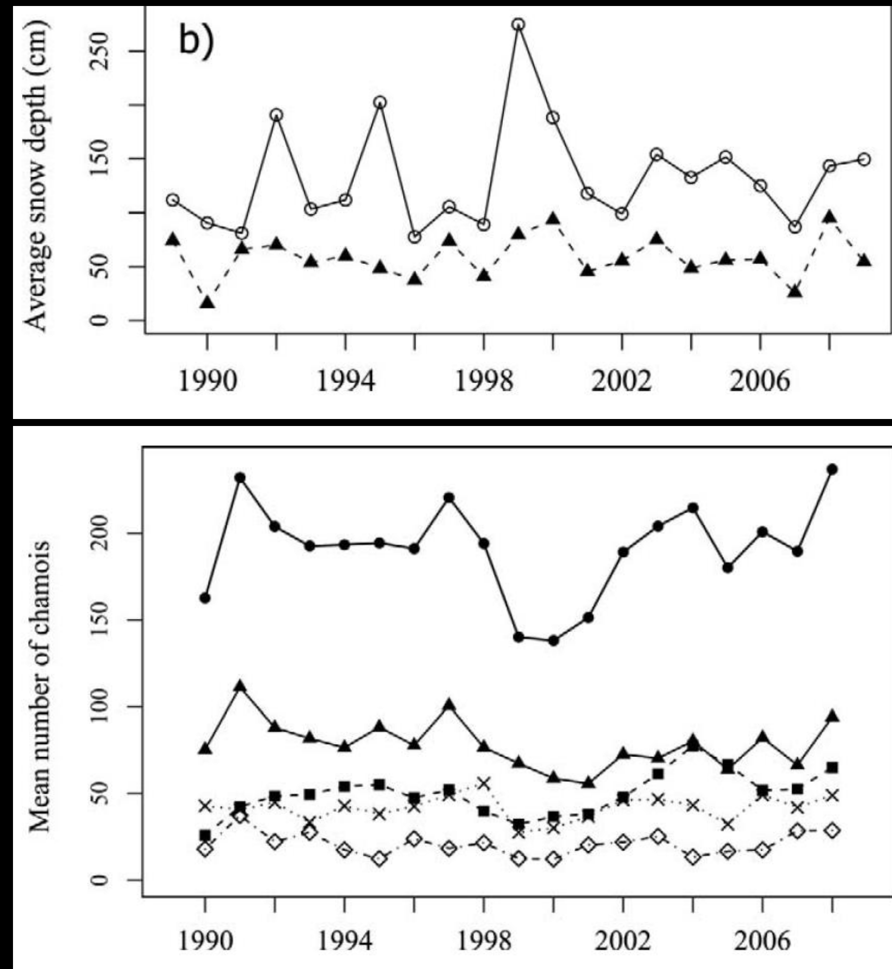


Fig. 2.—The average number of Alpine chamois (*Rupicapra rupicapra*) in the Augstmatthorn National Game Reserve, Switzerland detected per year and within each sex–age class between 1990 and 2008: total of all observed animals (filled circles), adult females (filled triangles), adult males (filled squares), yearlings (open diamonds), and juveniles (x-signs).

Willisch et al. 2013

Änderungen in der Phänologie

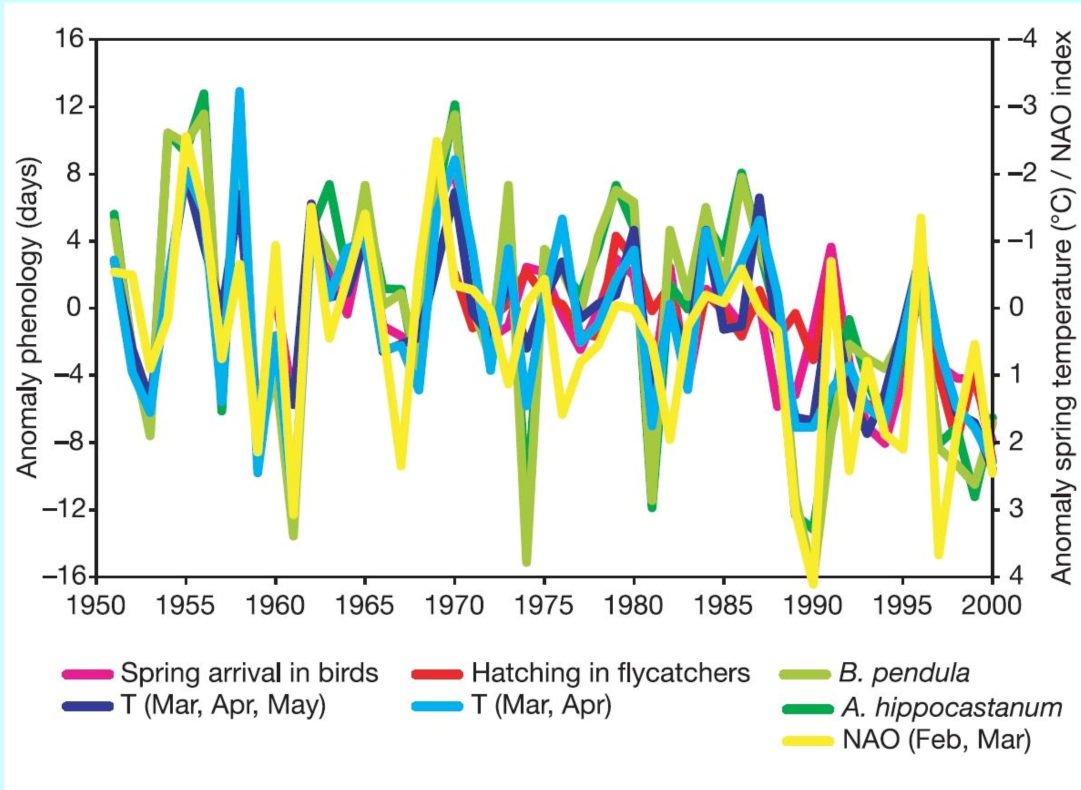


Figure 2 Anomalies of different phenological phases in Germany correlate well with anomalies of mean spring air temperature *T* and NAO index (by P. D. Jones, http://www.cru.uea.ac.uk/cru/data/nao.htm). Temperature taken from 35 German climate stations. Phenological phases used: spring arrival in birds, island of Helgoland, North Sea; hatching in flycatchers (*Ficedula hypoleuca*), Northern Germany; and mean onset of leaf unfolding of *Aesculus hippocastanum* and *Betula pendula*.

Walther et al. 2002

Änderungen in der Phänologie

THE ROYAL SOCIETY

doi 10.1098/rspb.2000.1363

Warmer springs disrupt the synchrony of oak and winter moth phenology

Marcel E. Visser* **and Leonard J. M. Holleman**

Netherlands Institute of Ecology, PO Box 40, 6666 ZG Heteren, The Netherlands

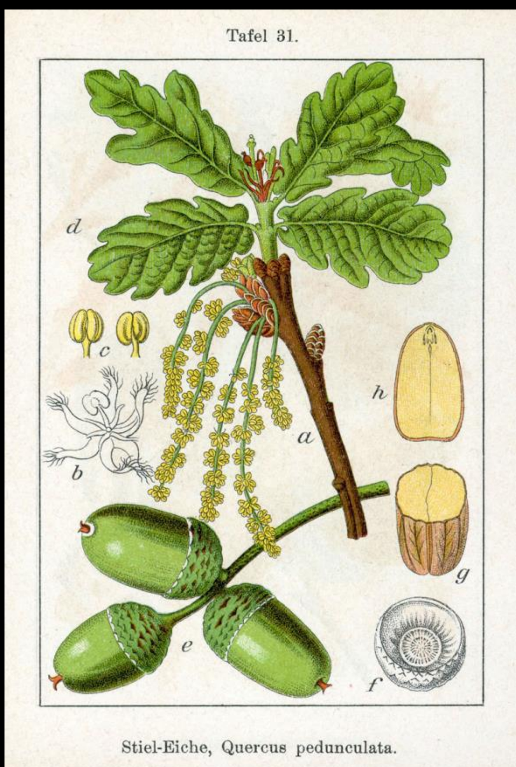


Foto: Entomart

Foto: Gyorgy Csoka

Foto: Gyorgy Csoka

Änderungen in der Phänologie

Foto: Steve Garvie

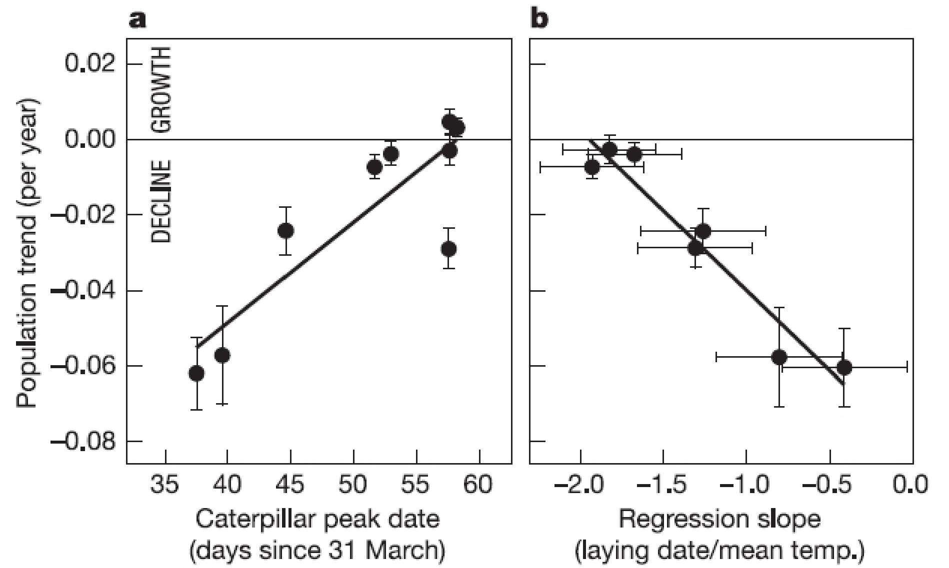


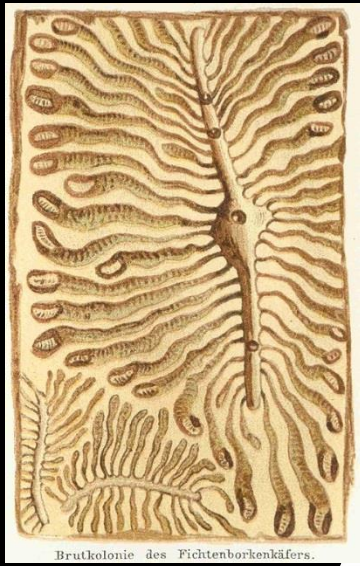
Figure 1 | Population trends of Dutch pied flycatcher populations. **a**, **b**, Trends in response to the local date of the caterpillar peak (in days since 31 March) (Spearman rank correlation: $r_s = 0.80$, $n = 9$, $P = 0.013$) (**a**), and the slope of annual median laying date on spring (16 April–15 May) temperature ($r_s = -0.86$, $n = 7$, $P = 0.03$) (**b**). Populations of pied flycatchers with an early food peak and a weak response declined most strongly. Population trend is the slope of the regression of the log number of breeding pairs against year. In **b**, the *x* axis shows the slope of a linear regression of median laying date against mean temperature from 16 April–15 May. Error bars represent the standard errors of the slopes of the regression lines. All points in **b** are also in **a**, except for one point, for which we had no data regarding the caterpillar peak.

Both et al. 2006

Änderungen in der Phänologie

Auswirkungen auf Physiologie, Verhalten, ...

Foto: Olaf Leillinger



Auswirkungen auf Physiologie, Verhalten, ...


Foto: Joao Pedrosa


Foto: Joao Pedrosa

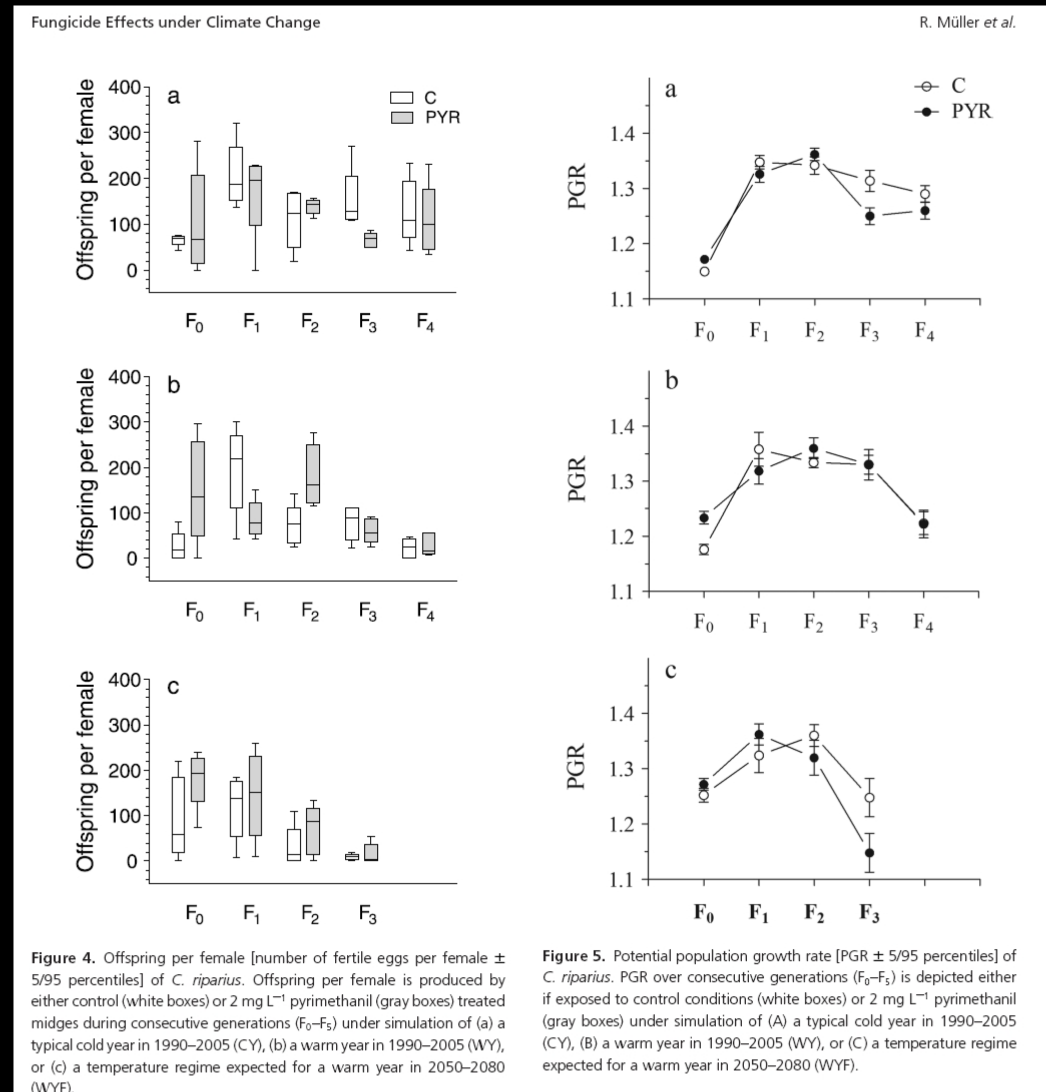

Fungicide Effects under Climate Change R. Müller *et al.*

Figure 4. Offspring per female [number of fertile eggs per female ± 5/95 percentiles] of *C. riparius*. Offspring per female is produced by either control (white boxes) or 2 mg L^{-1} pyrimethanil (gray boxes) treated midges during consecutive generations (F_0–F_5) under simulation of (a) a typical cold year in 1990–2005 (CY), (b) a warm year in 1990–2005 (WY), or (c) a temperature regime expected for a warm year in 2050–2080 (WYF).

Figure 5. Potential population growth rate [PGR ± 5/95 percentiles] of *C. riparius*. PGR over consecutive generations (F_0–F_5) is depicted either if exposed to control conditions (white boxes) or 2 mg L^{-1} pyrimethanil (gray boxes) under simulation of (A) a typical cold year in 1990–2005 (CY), (B) a warm year in 1990–2005 (WY), or (C) a temperature regime expected for a warm year in 2050–2080 (WYF).

Müller et al. 2012

Auswirkungen auf Physiologie, Verhalten, ...

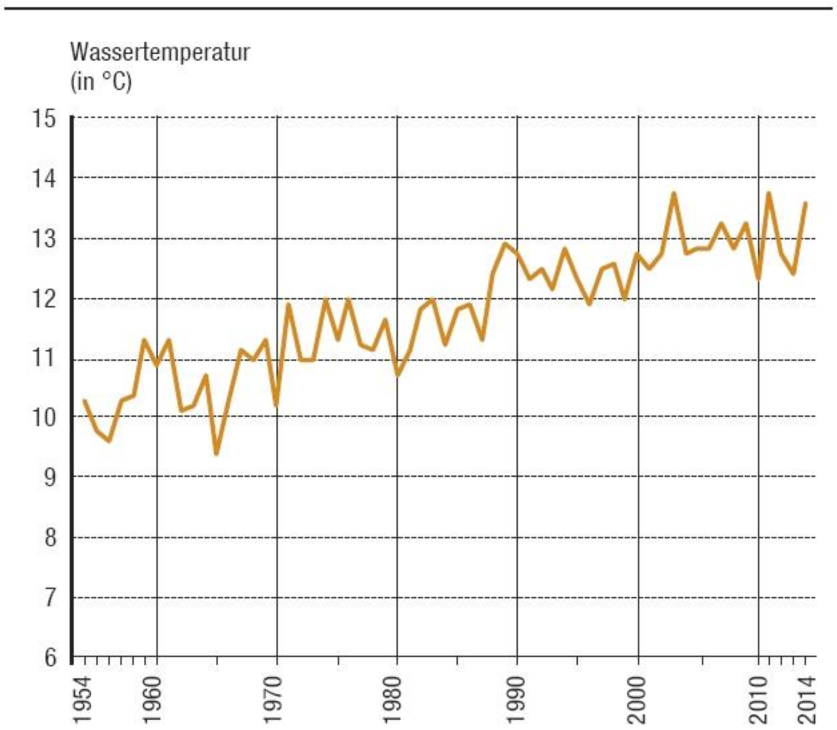


Abb. 41 *Temperatur im Rhein bei Basel (Jahresmittel). Quelle: BAFU*

Abb. 42 *Die Marmorierte Forelle zählt zu einer grossen Gruppe von Wasserlebewesen, die vom Aussterben bedroht sind.*

Auswirkungen auf Physiologie, Verhalten, ...

Die Lage spitzt sich für die Äschen weiter zu

4. August 2018
Maria Gerhard

An manchen Stellen hat der Rhein über 27 Grad: Damit erhöht sich noch einmal deutlich der Druck auf bestimmte Fischbestände, wie etwa Äschen und Forellen.

Diese Äschen suchen am Rheinfallbecken den Rand auf, wo vom Hang kühles Grundwasser kommt. Bild: Samuel Gründler

Schaffhauser Nachrichten

Foto: David Grob

Auswirkungen auf Physiologie, Verhalten, ...

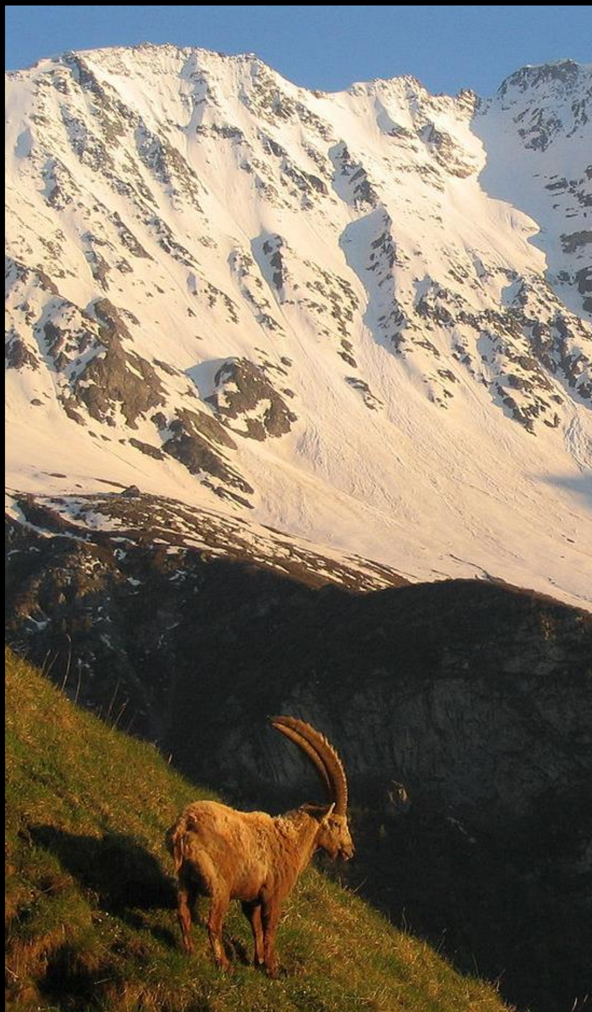


Foto: Eltouristo

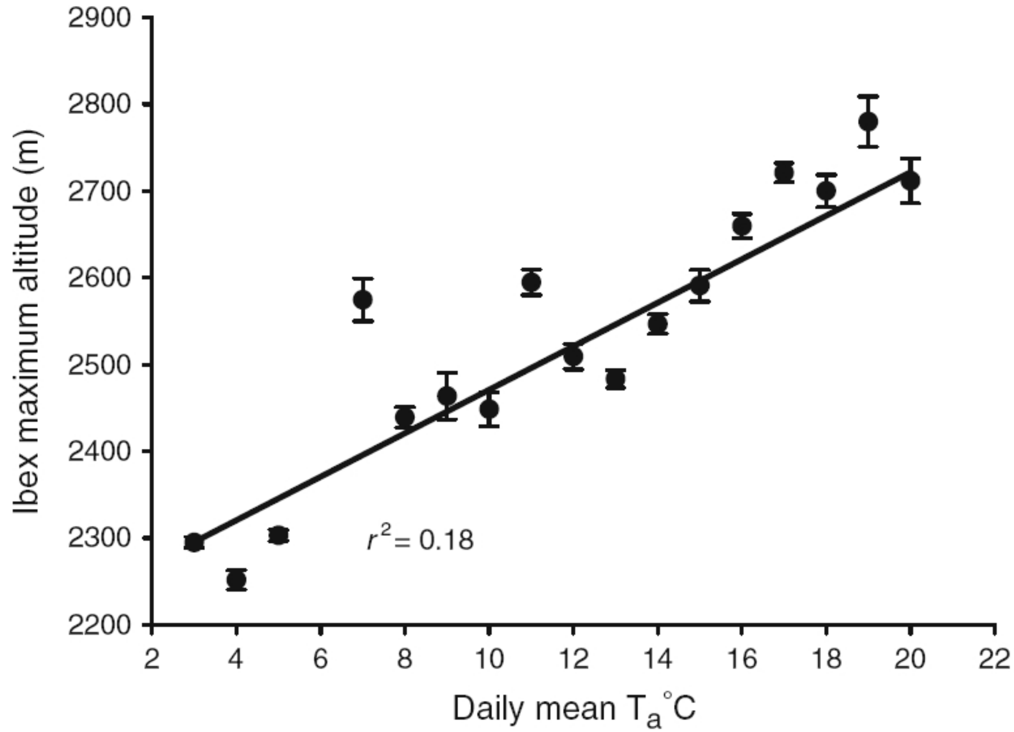


Fig. 3 Mean daily maximum altitude (±SE) reached by male Alpine ibex under different ambient temperature (T_a) conditions in their summer range in 2003–2004, Levionaz, Italy. Although points show averages for each degree, the r^2 and the regression line are for all observations

Aublet et al. 2008

Auswirkungen auf Physiologie, Verhalten, ...

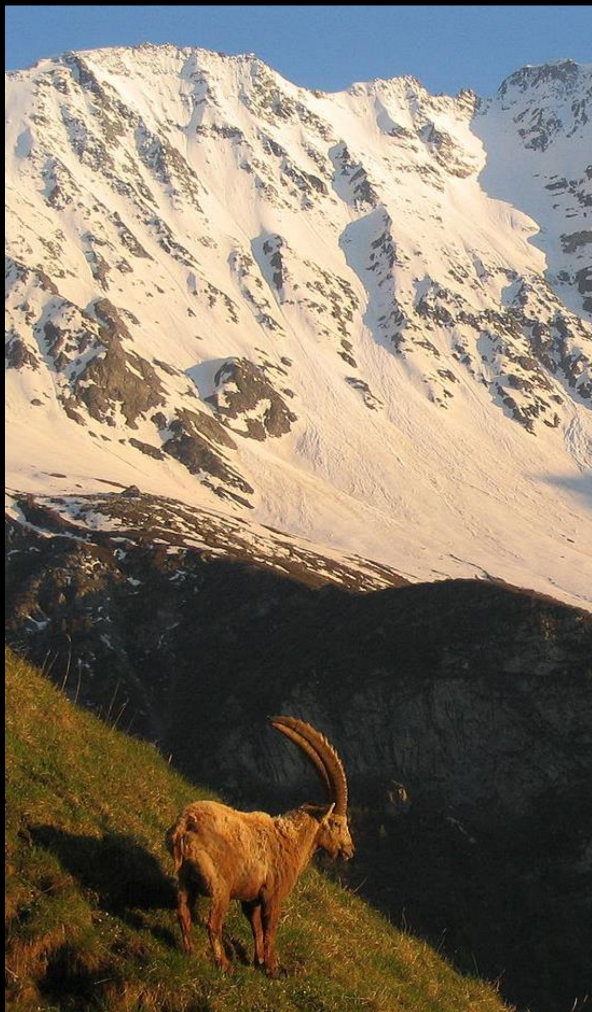


Foto: Eltouristo

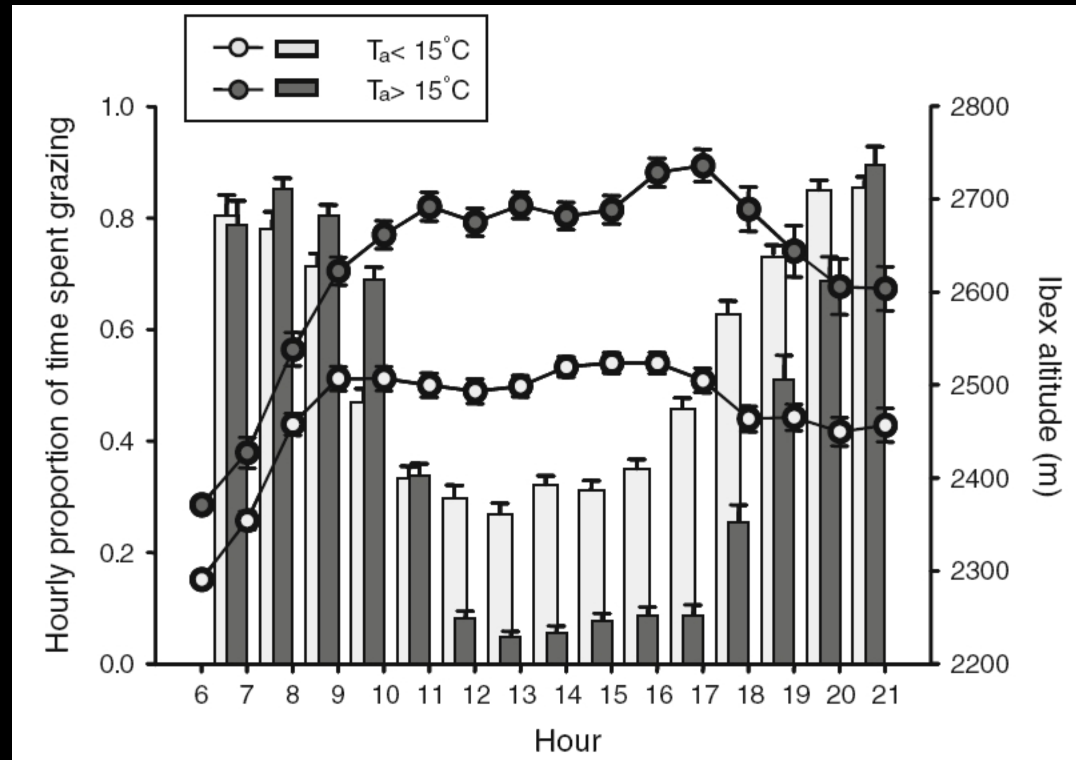
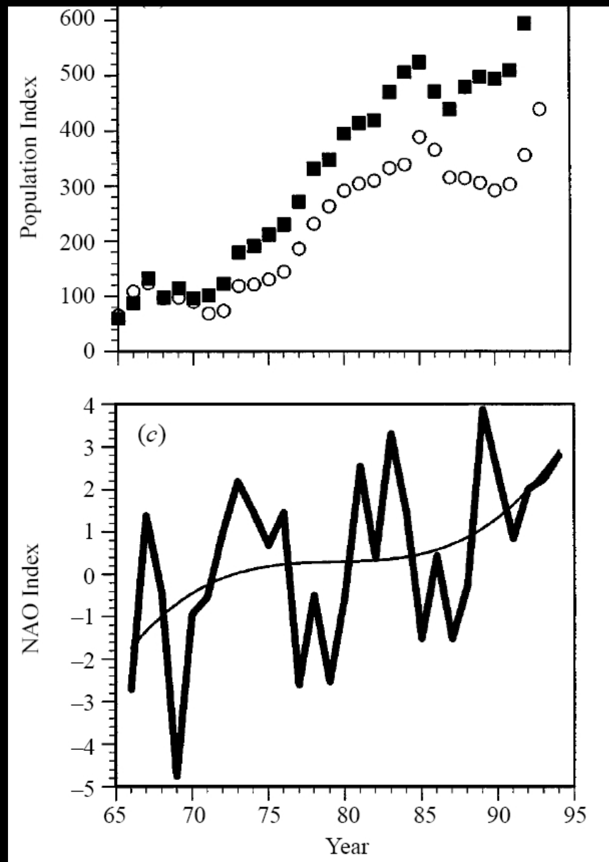


Fig. 1 Mean ± SE hourly proportion of time spent grazing (*histograms*) and mean ± SE hourly altitude (*circles*) of male Alpine ibex between 06:00 and 21:00 h for days when mean ambient temperature (T_a) was below (*light grey*) and above (*dark grey*) 15°C. Data from summers 2003–2004 at Levionaz, Italy

Aublet et al. 2008

phänotypische Plastizität



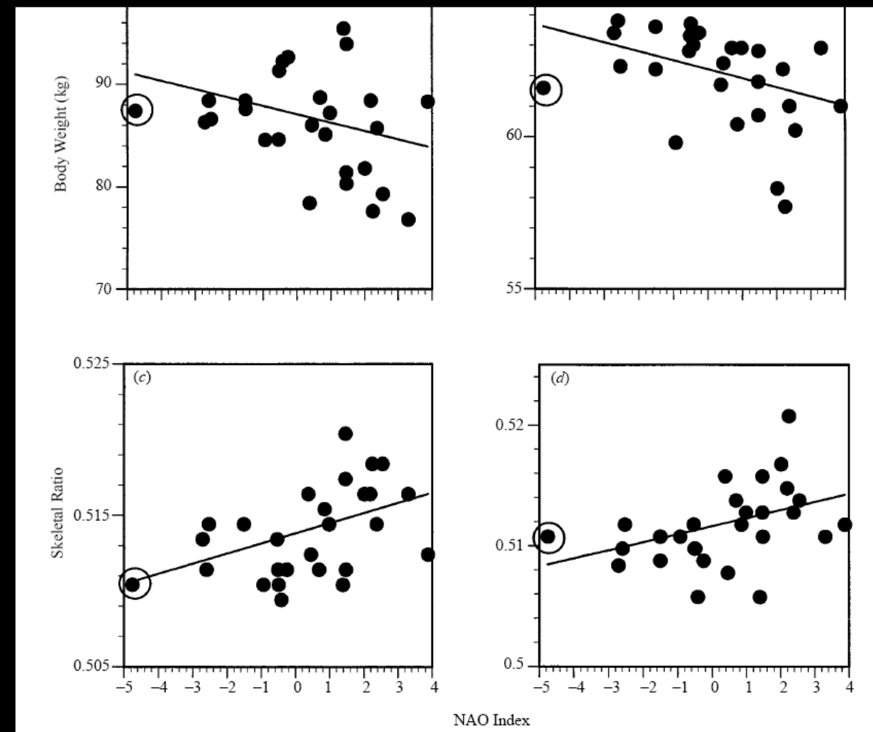


Figure 3. Relationships between the NAO index and body weights (kg) (*a*,*b*) and skeletal ratios (*c*,*d*) of adult (two years old and older) male (*a*, *c*) and female (*b*, *d*) red deer shot in Norway between the years 1971–1995. Cohort-specific mean body weights and skeletal ratios are plotted against the NAO index of the winter cohorts were *in utero*, for cohorts born in years 1966–1993. The circled point on each plot corresponds to the NAO index for 1969, which is the lowest value of the entire 133-year series, and which appears in most cases to be an outlier. Station data upon which the 1969 value is based are, however, reliable (J. Hurrell, personal communication).

Post et al. 2008

genetisches Anpassungspotential

Bisher leider nur vereinzelte Hinweise...

- Zugunruhe kann über wenige Generationen verloren gehen (Bsp. Mönchsgrasmücke, Pulido & Berthold 2010)
- erhöhte Temperaturtoleranz o.ä. bisher nicht nachgewiesen

➔ abseits der Klimawandelforschung zeigen einzelne Studien, dass Evolution sehr schnell ablaufen kann...

2. Prognosen für die Zukunft:

was wir glauben

(möglichst) gesicherte Daten

+

Korrelation mit unabhängigen (Klima-)variablen

↓

Modelle & Vorhersagen

Effekte verstärken sich

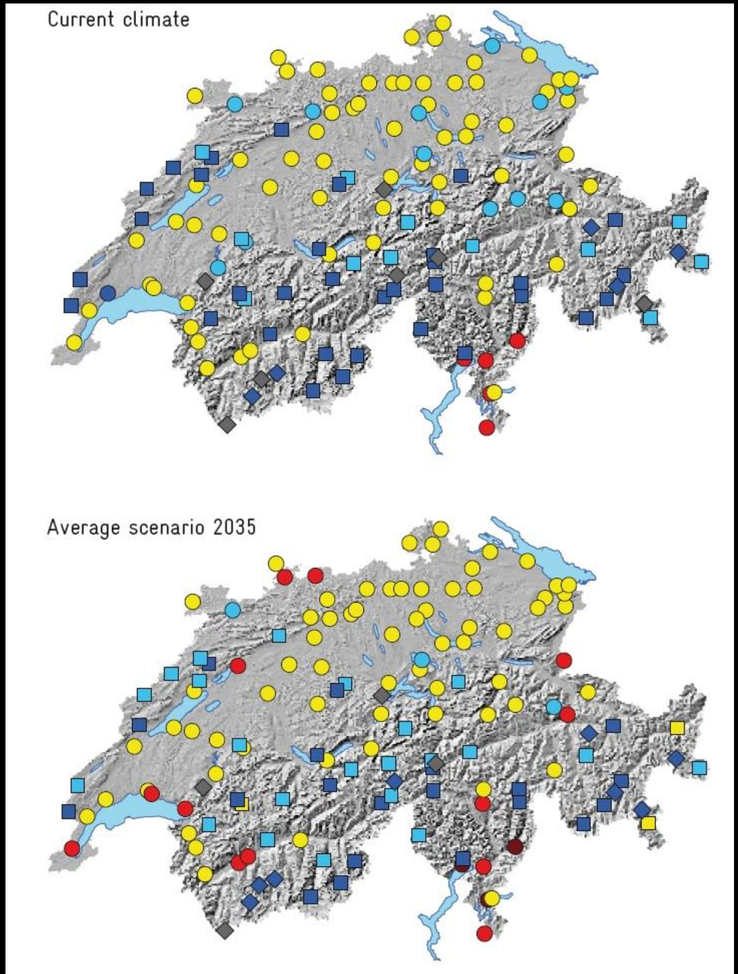
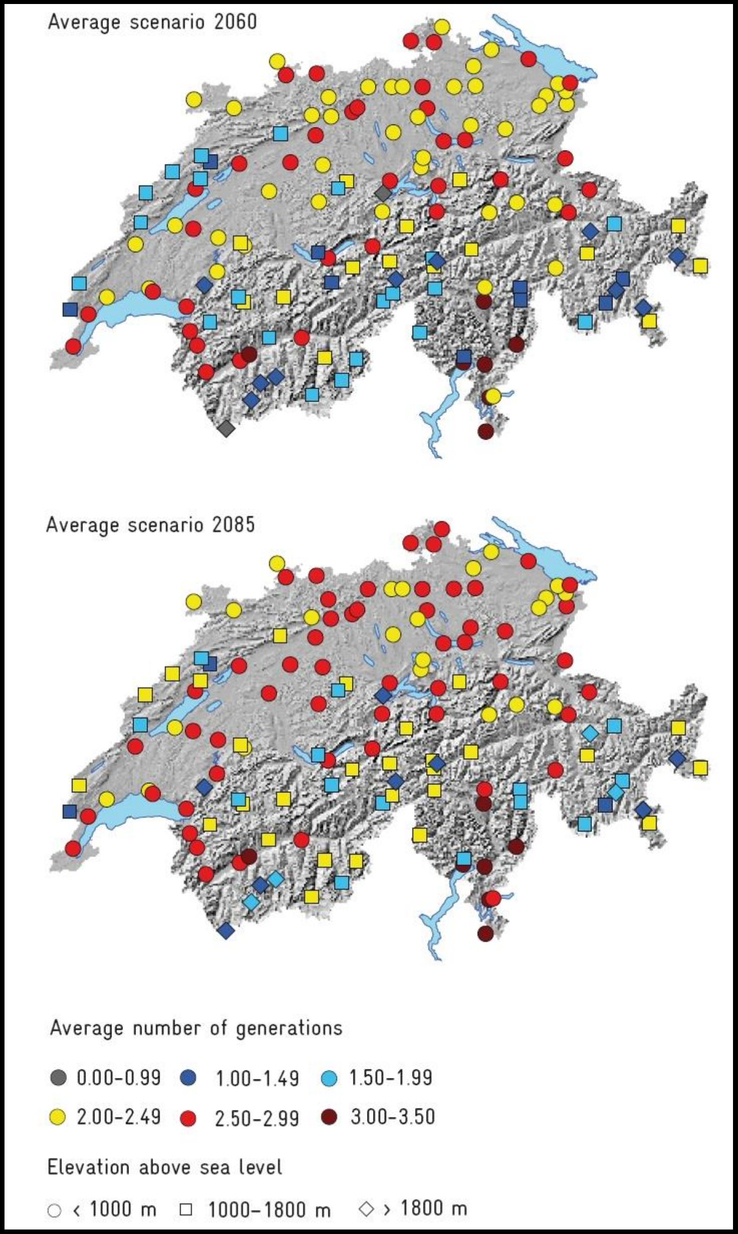


Figure 8.6: Average potential number of spruce bark beetle generations per year at 141 locations in Switzerland for the reference period 1980–2009 and under the A1B climate scenario for 2035, 2060, and 2085, respectively.



Bugmann et al. 2016

Effekte verstärken sich

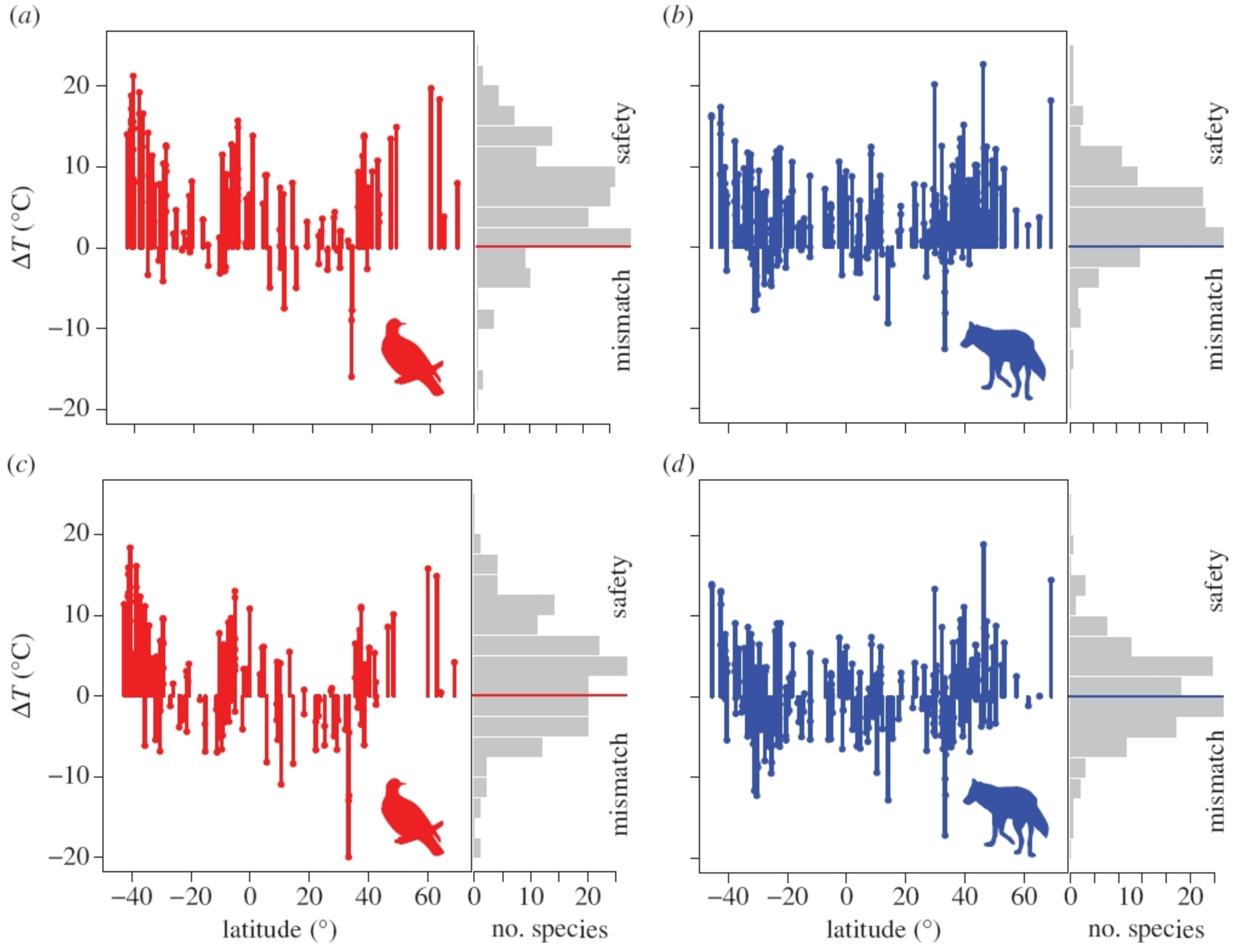


Figure 2. Latitudinal variation in differences between species' thermal tolerance and ambient temperature (ΔT) for birds and mammals. ΔT is calculated as the difference between upper TNZ limit (UCT) and maximum ambient temperature (T_a). Thermal safety is defined as UCT $> T_a$, thermal mismatch is defined as UCT $< T_a$. Histograms indicate the distribution of the numbers of species that experience thermal safety and mismatch. Latitudes and maximum T_a are estimated for the capture sites of the species' individuals used in the physiological experiments. (*a*) Birds ($n = 161$) and (*b*) mammals ($n = 297$) under current conditions; (*c*) birds and (*d*) mammals under projected future conditions (year 2080, MIROC-H global climate model, the A2 emission scenario; for other GCM × scenario combinations, see the electronic supplementary material, figure S4). (Online version in colour.)

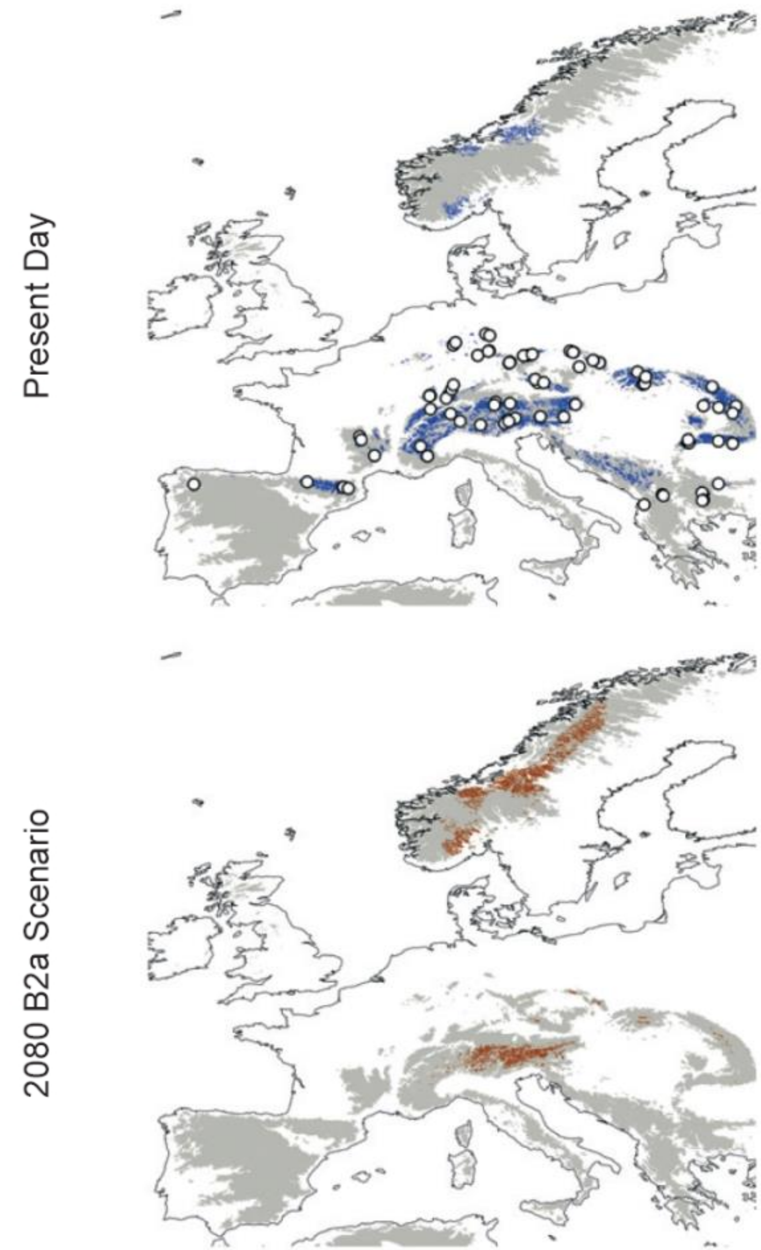
5
rspb.royalsocietypublishing.org *Proc. R. Soc. B* **281**: 20141097

Khalig et al. 2014

Areale der allermeisten Arten verschieben sich

Foto: A. Schmidt-Kloiber & W. Graf

Foto: André Karwath



Pauls et al. 2012

klimatische Nischen wandern schneller als Arten

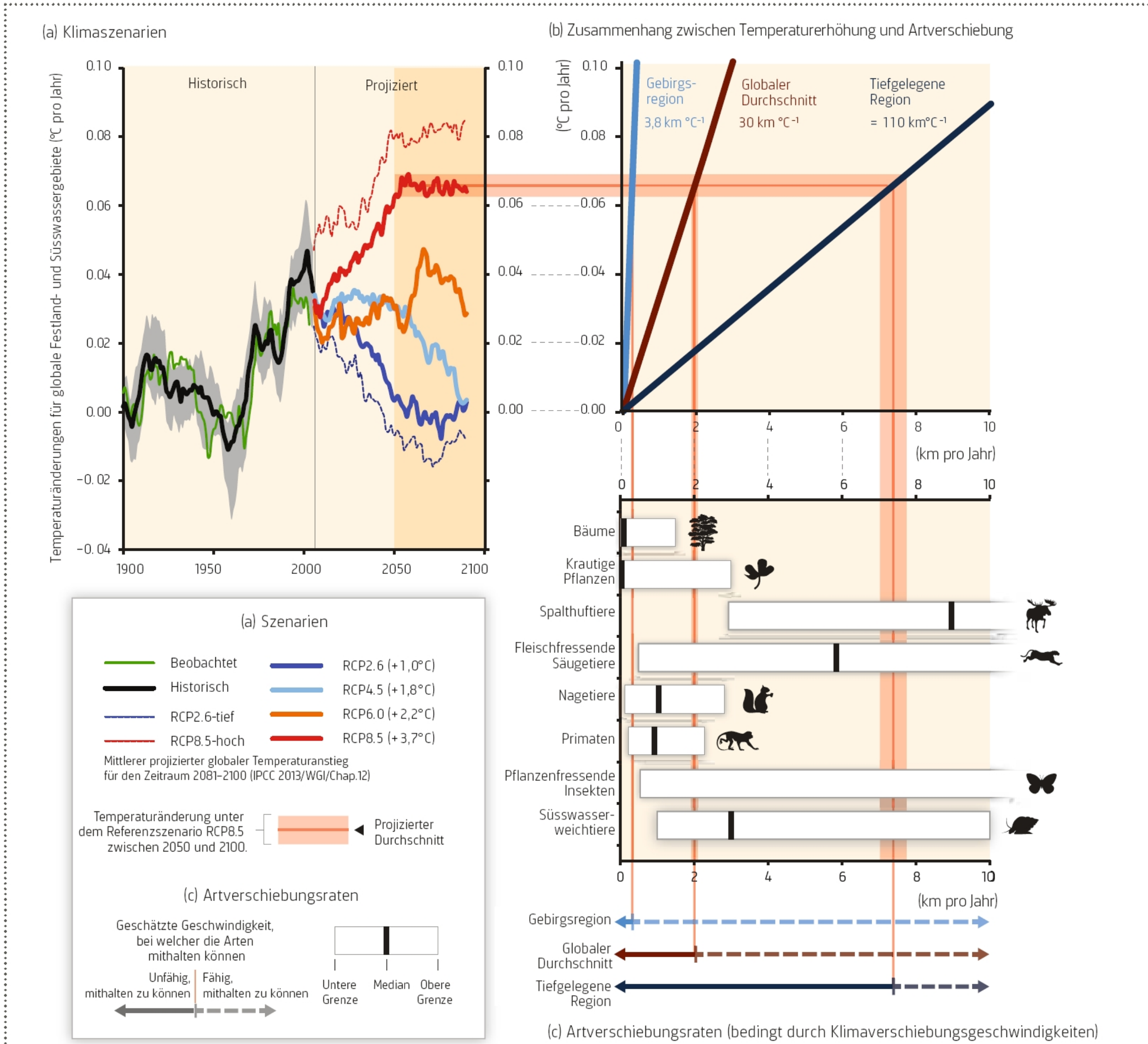
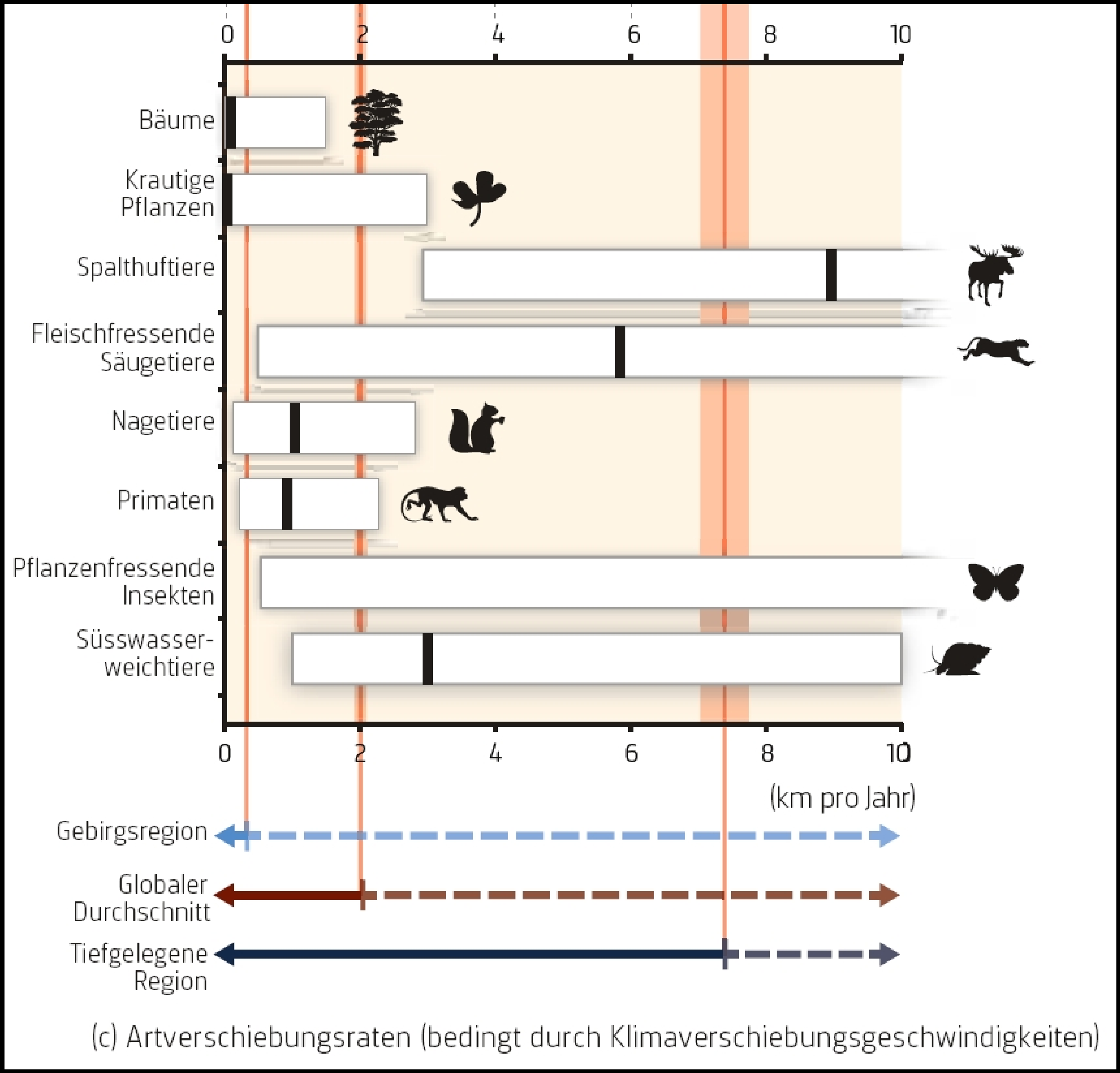


Abbildung 2.13: (a) Klimawandelszenarien, (b) dazugehörige Klimaverschiebungsgeschwindigkeiten und (c) Artverschiebungsraten verschiedener taxonomischer Gruppen. Artengruppen mit langsameren Verschiebungsraten sind wahrscheinlich ohne menschliches Zutun nicht fähig, dem Klimawandel zu folgen. (Quelle: IPCC 2014/WGII/Chap.4/Fig.4–05)

klimatische Nischen wandern schneller als Arten



warmadaptierte Arten breiten sich aus

Foto: CDC / James Gathany

warmadaptierte Arten breiten sich aus

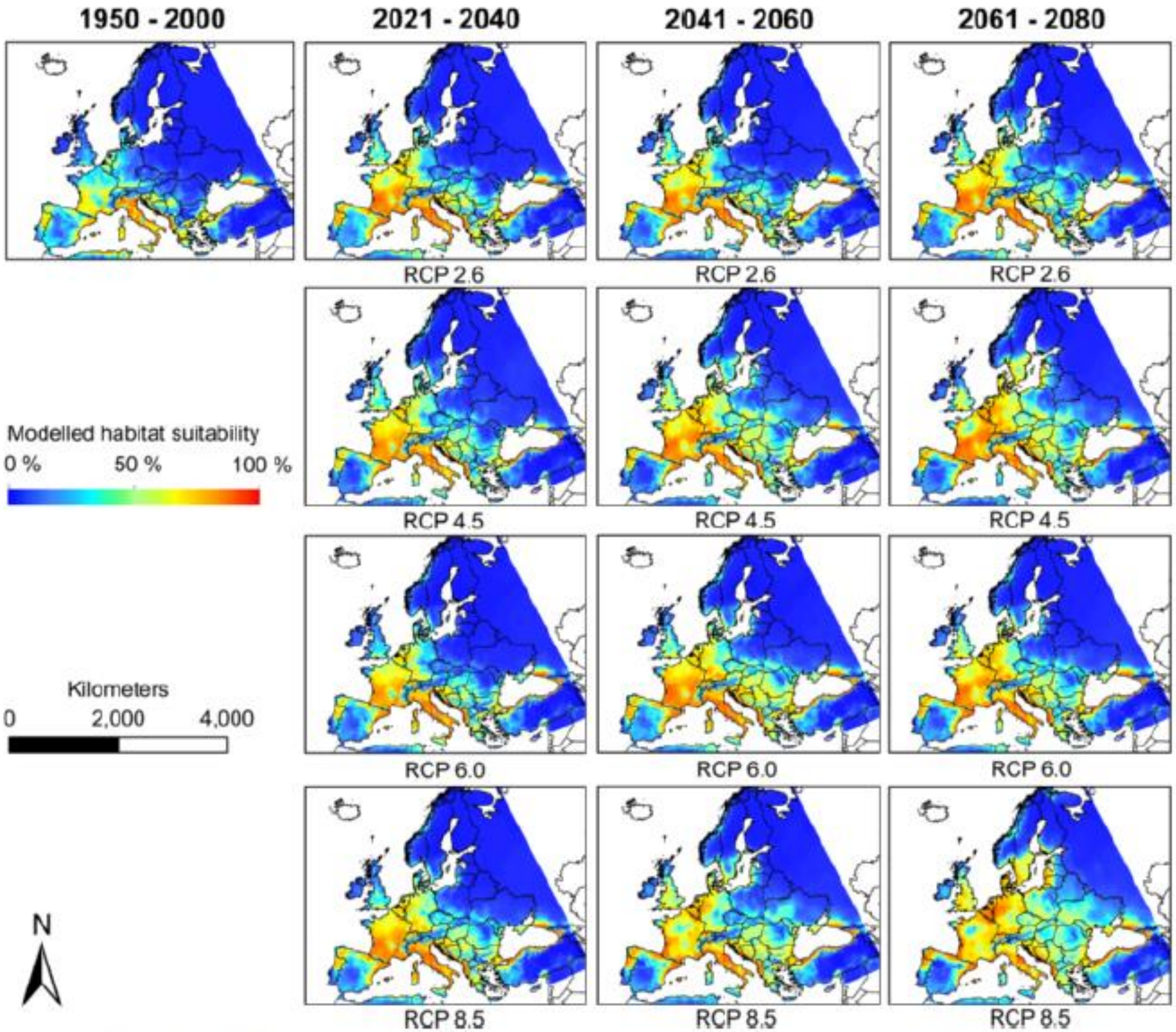
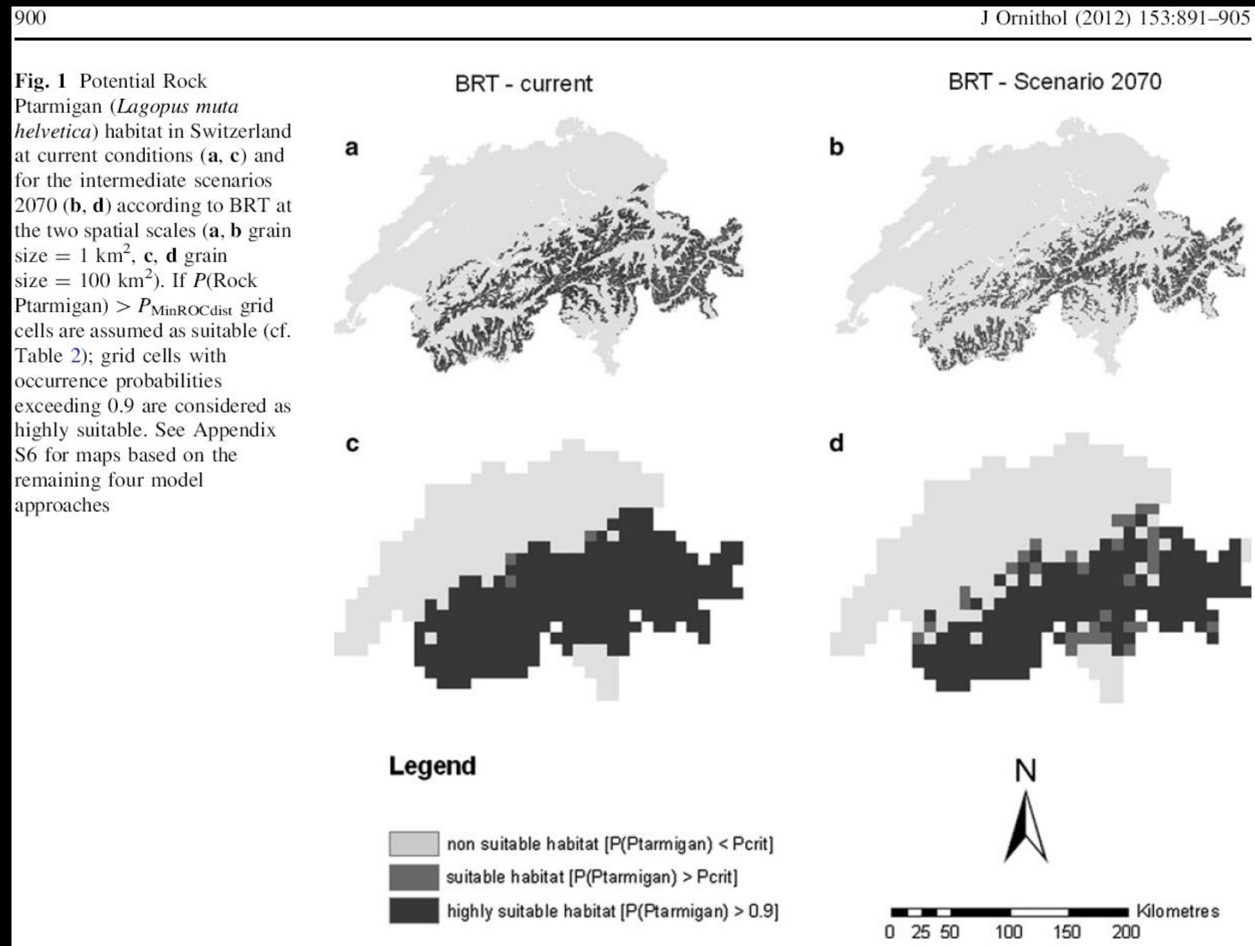


Fig. 3 Modelled habitat suitability (Ensemble forecasting) for *Aedes albopictus* under current and future climatic conditions

Cunze *et al. Parasites & Vectors* (2016) 9:573

kaltadaptierte Arten müssen steigen

Foto: Jan Frode



900 J Ornithol (2012) 153:891–905

Fig. 1 Potential Rock Ptarmigan (*Lagopus muta helvetica*) habitat in Switzerland at current conditions (**a**, **c**) and for the intermediate scenarios 2070 (**b**, **d**) according to BRT at the two spatial scales (**a**, **b** grain size = 1 km^2, **c**, **d** grain size = 100 km^2). If P(Rock Ptarmigan) > $P_{MinROCdist}$ grid cells are assumed as suitable (cf. Table 2); grid cells with occurrence probabilities exceeding 0.9 are considered as highly suitable. See Appendix S6 for maps based on the remaining four model approaches

Revermann et al. 2012

kaltadaptierte Arten müssen steigen

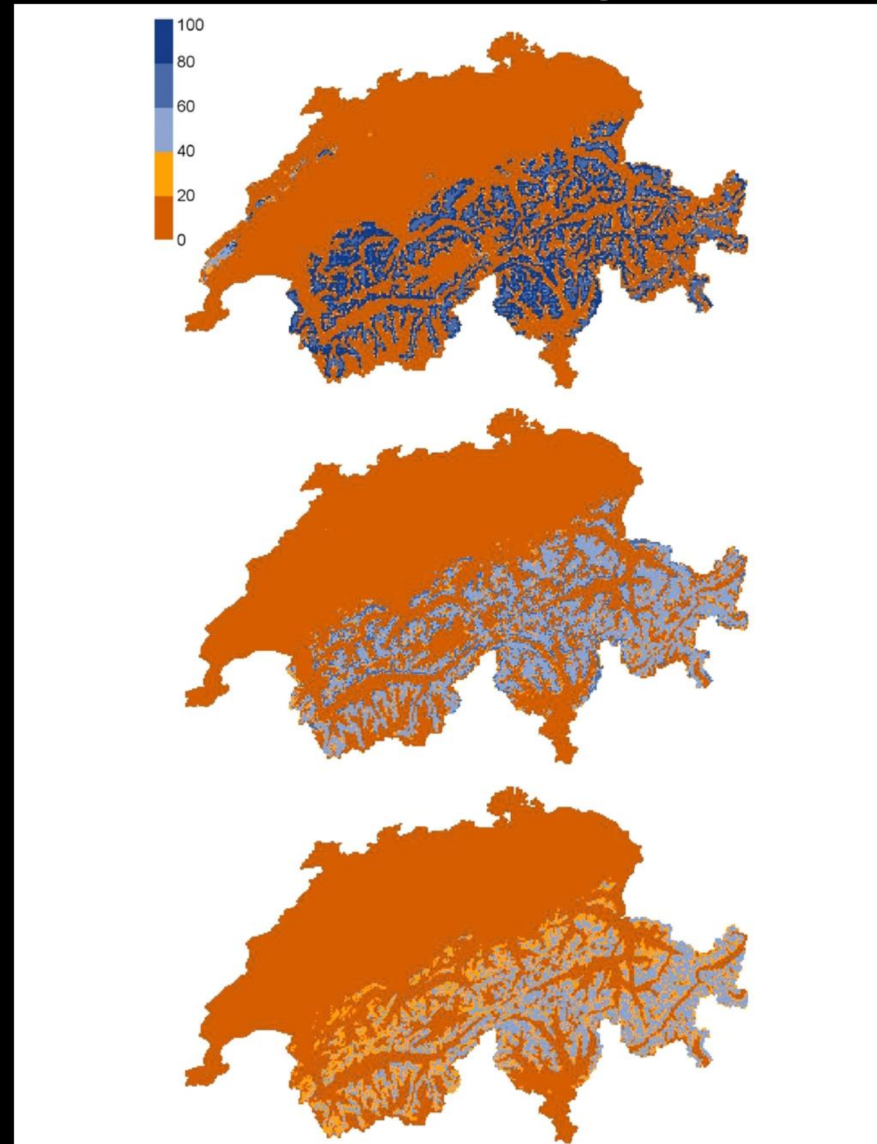


Figure 6. Consensus on black grouse presence for years 2001 (top), 2050 (centre) and 2100 (bottom); calculated as the fraction of all simulations (n = 1215) predicting black grouse to be present. (Note that zero percent consensus on presence equal 100 percent consensus on black grouse absence.)

Zurell et al. 2012

Berge: Refugien und Gipfelfallen

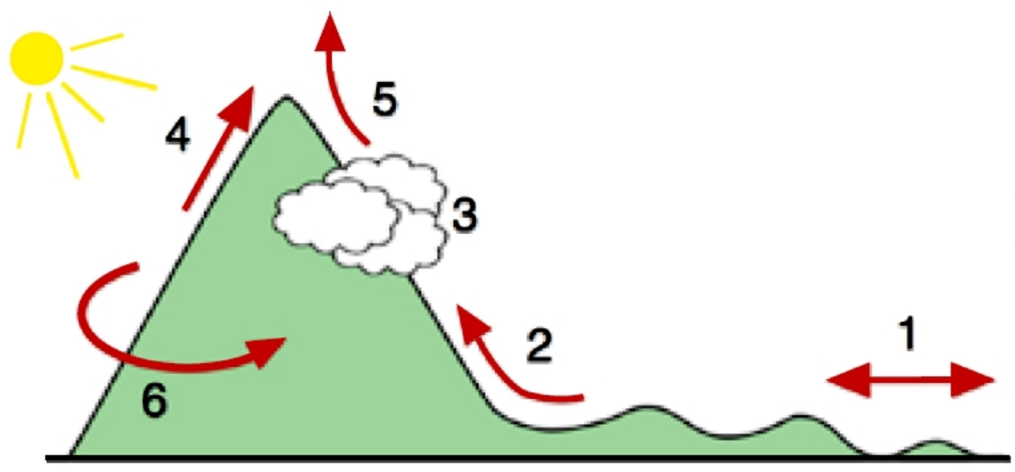


Abbildung 2.10: Wollen Arten der Niederung einer Klimaänderung ausweichen, müssen sie sehr grosse Distanzen überwinden (für sie gibt es kaum einen Ausweg (1). Berge können hingegen ein Fluchtort (Refugium) sein (2, 4) und waren das erdgeschichtlich auch immer. Berge können auch zur Falle werden, wie im Fall schrumpfender Nebelbänke in tropischen Bergnebelwälder oder wenn Organismen Berge besiedeln, die nicht hoch genug sind (3, 5). In aller Regel sind Berge aber eine Chance (6), weil es über sehr kurze Distanzen «Fluchtwege» gibt (6), als Folge des Mosaiks von Kleinklimabedingungen. (Quelle: Körner 2013)

Bestandsdichten nehmen hier zu, da ab

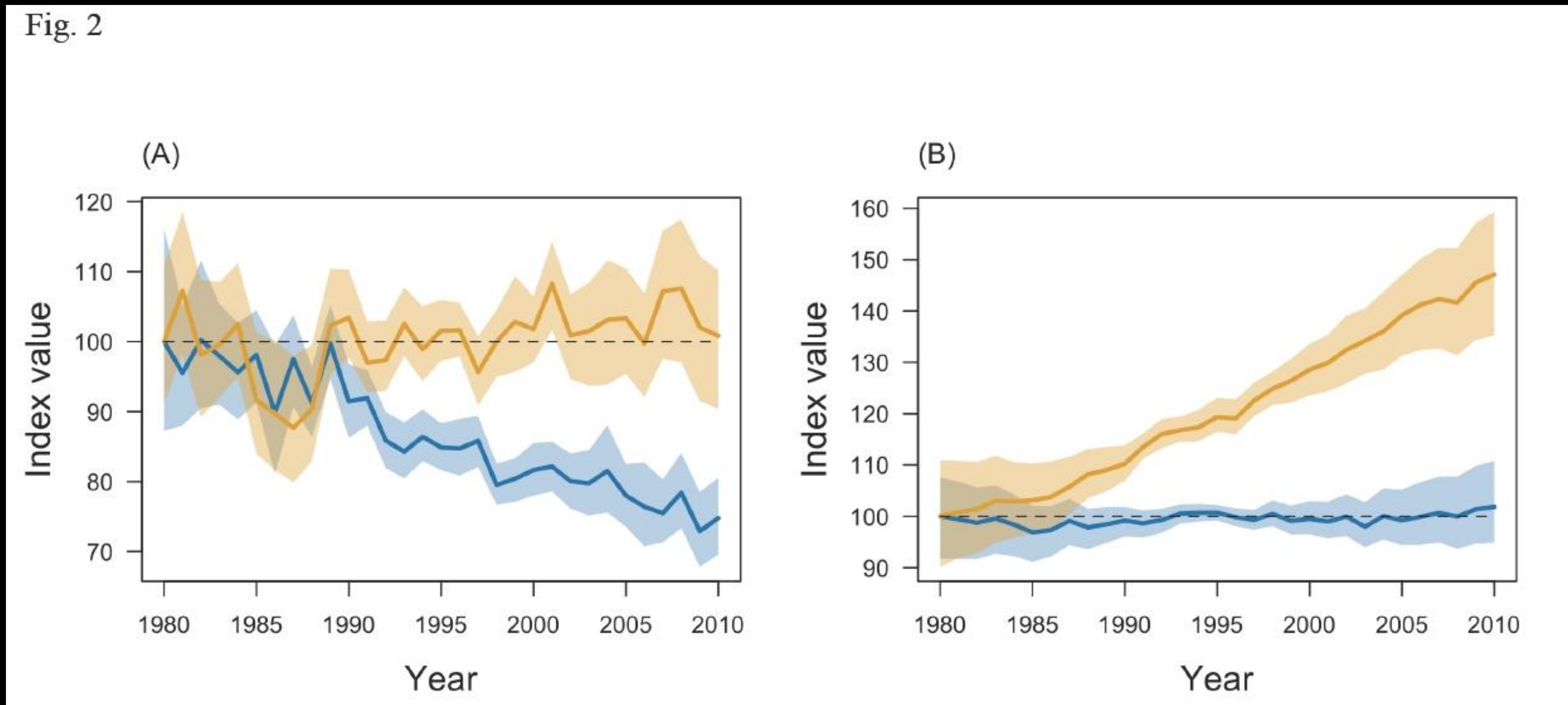


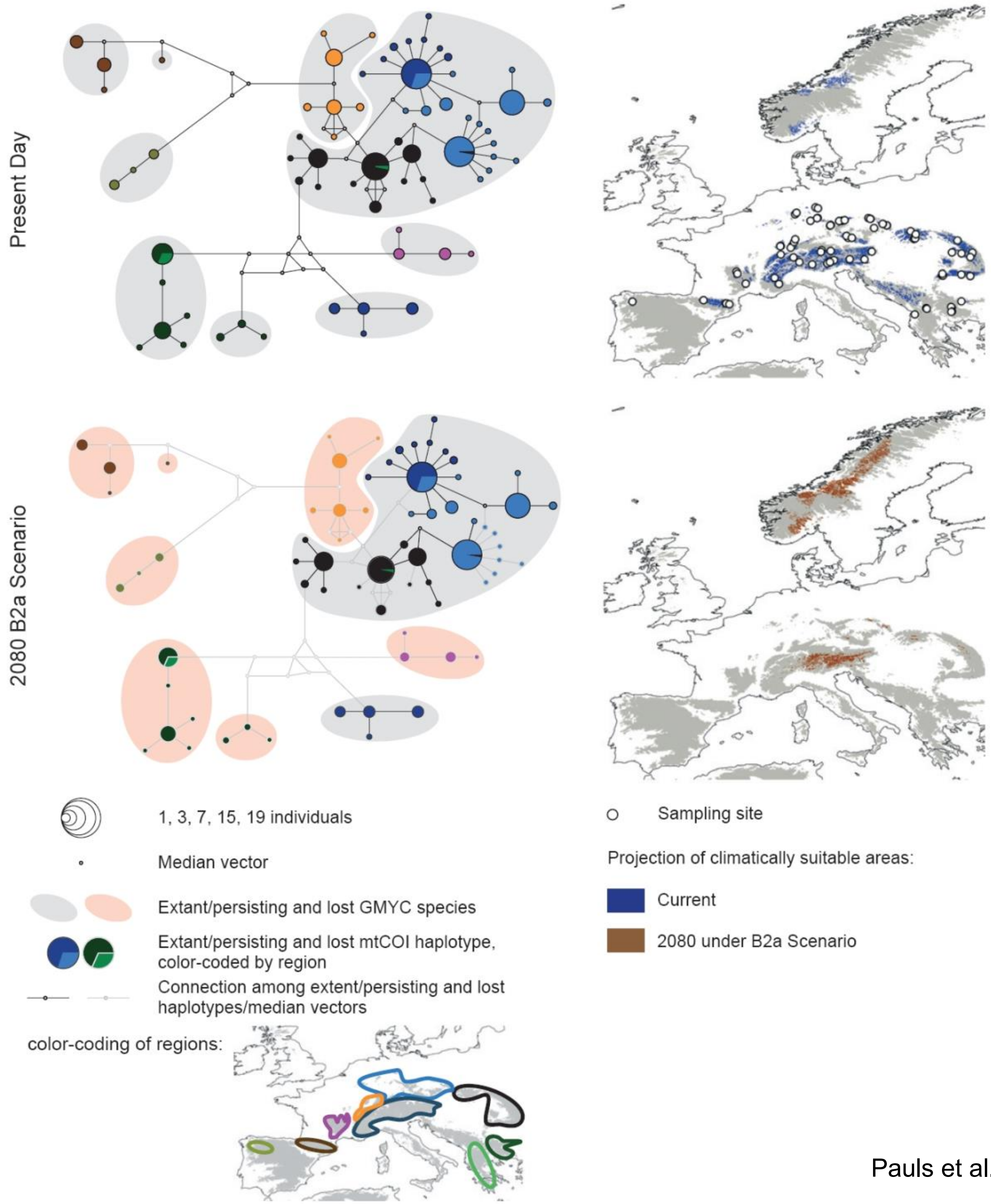
Fig. 2. Effect of climate on abundance trends of common birds. Multi-species population indices for CST+ ( ) and CST- ( ) groups combined across all eligible countries of Europe (A) and states of the USA (B). Shaded polygons in each case indicate 90% confidence intervals (produced from 2,000 bootstrap replicates) (*20*). Annual values of the ratio of the CST+ index to the CST- index, the CII, are shown for Europe (C) and USA (D). In all four panels the index is arbitrarily set to 100 in 1980. Horizontal broken lines at index values of 100 show the expectation if there is no trend; in panels (C) and (D), these indicate the expectation if climatic suitability played no role and, thus, there was no difference in the composite trends for CST+ and CST- groups.

Stephens et al. 2016

lokales Aussterben: weniger genetische Diversität

Foto: A. Schmidt-Kloiber & W. Graf

Foto: André Karwath



Pauls et al. 2012

vermehrte Aussterbeereignisse

Fotos: David Perez

Conservation & Climate Change

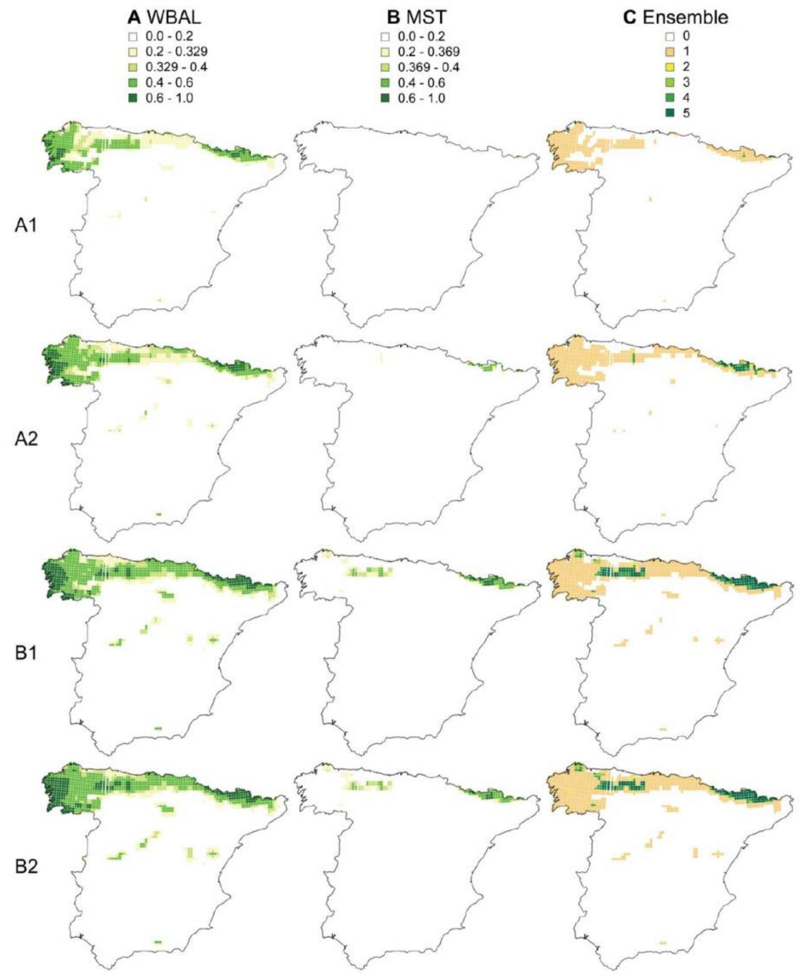
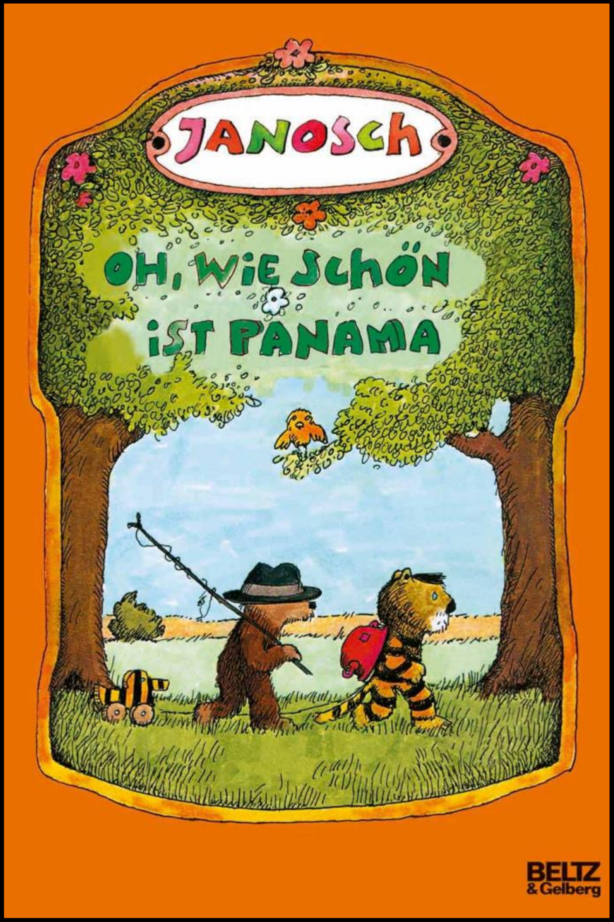


Figure 4. Future potential distribution of *Galemys pyrenaicus* in Spain. Projection of MAXENT distribution models for *Galemys pyrenaicus* in Spain onto four future climate scenarios for 2070–2099. (**A**) and (**B**) predicted probability of presence from projections of models based only on water balance (WBAL) or mean summer temperature (MST), respectively. The 10th percentile training presence threshold is indicated (0.329 and 0.369, respectively). (**C**) Ensemble intersection: overlap of predicted presence among the five best models. Colours indicate the number of models predicting presence (based on the 10th percentile training presence threshold) for each grid cell ranging from 0 to 5.
doi:10.1371/journal.pone.0010360.g004

Holme et al. 2010

Zur Sache: Species Distribution Modelling...


JANOSCH
OH, WIE SCHÖN IST PANAMA
BELTZ & Gelberg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Breite 8.702198° Länge -81.853418° Höhe -1553 m
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Sichthöhe 18985.32 km


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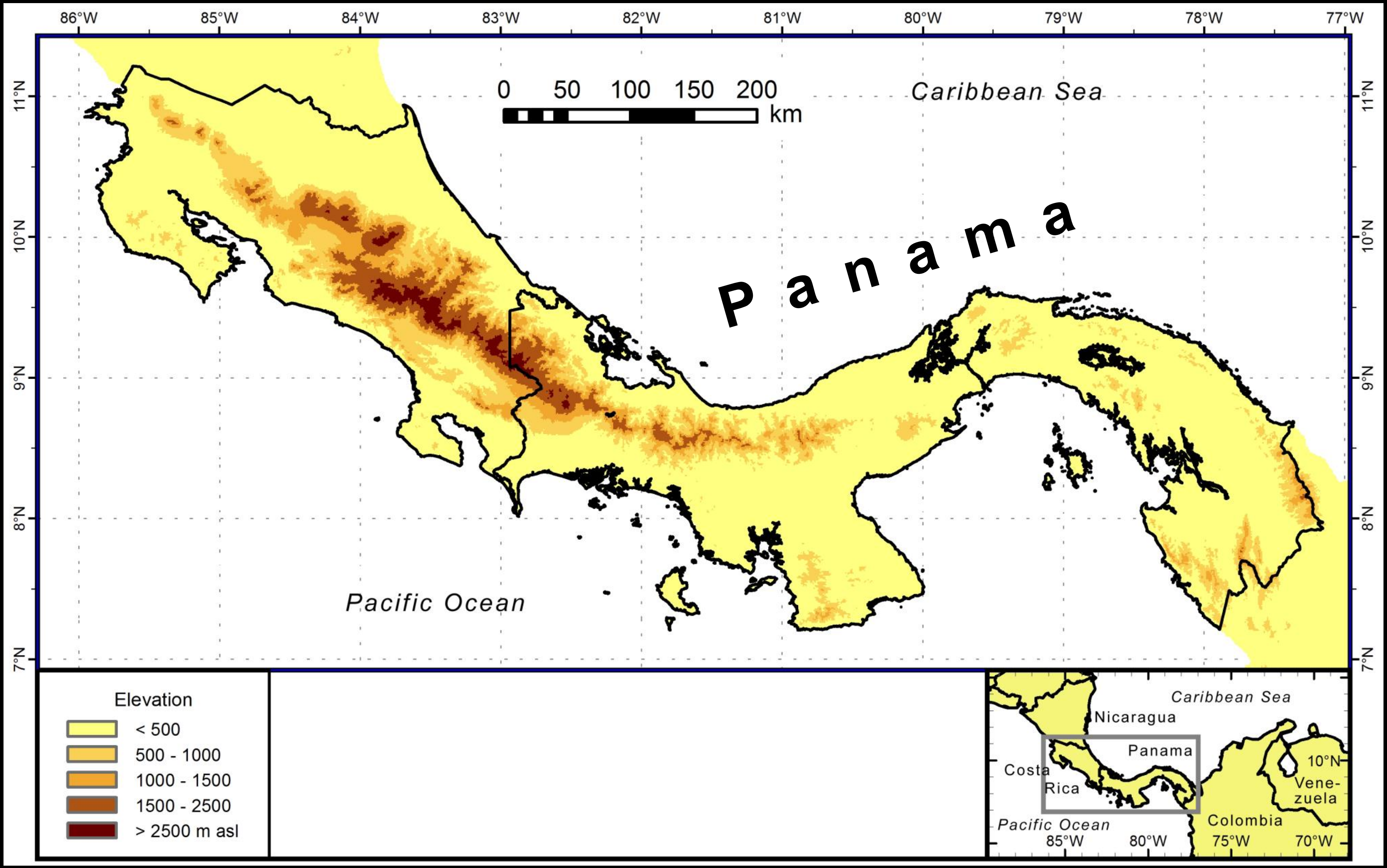
Sichthöhe 18985.32 km


86°W
85°W
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80°W
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77°W
11°N
10°N
9°N
8°N
7°N
0 50 100 150 200
km
Caribbean Sea
Panama
Pacific Ocean
Elevation
< 500
500 - 1000
1000 - 1500
1500 - 2500
> 2500 m asl
Caribbean Sea
Nicaragua
Panama
Costa Rica
10°N
Vene-zuela
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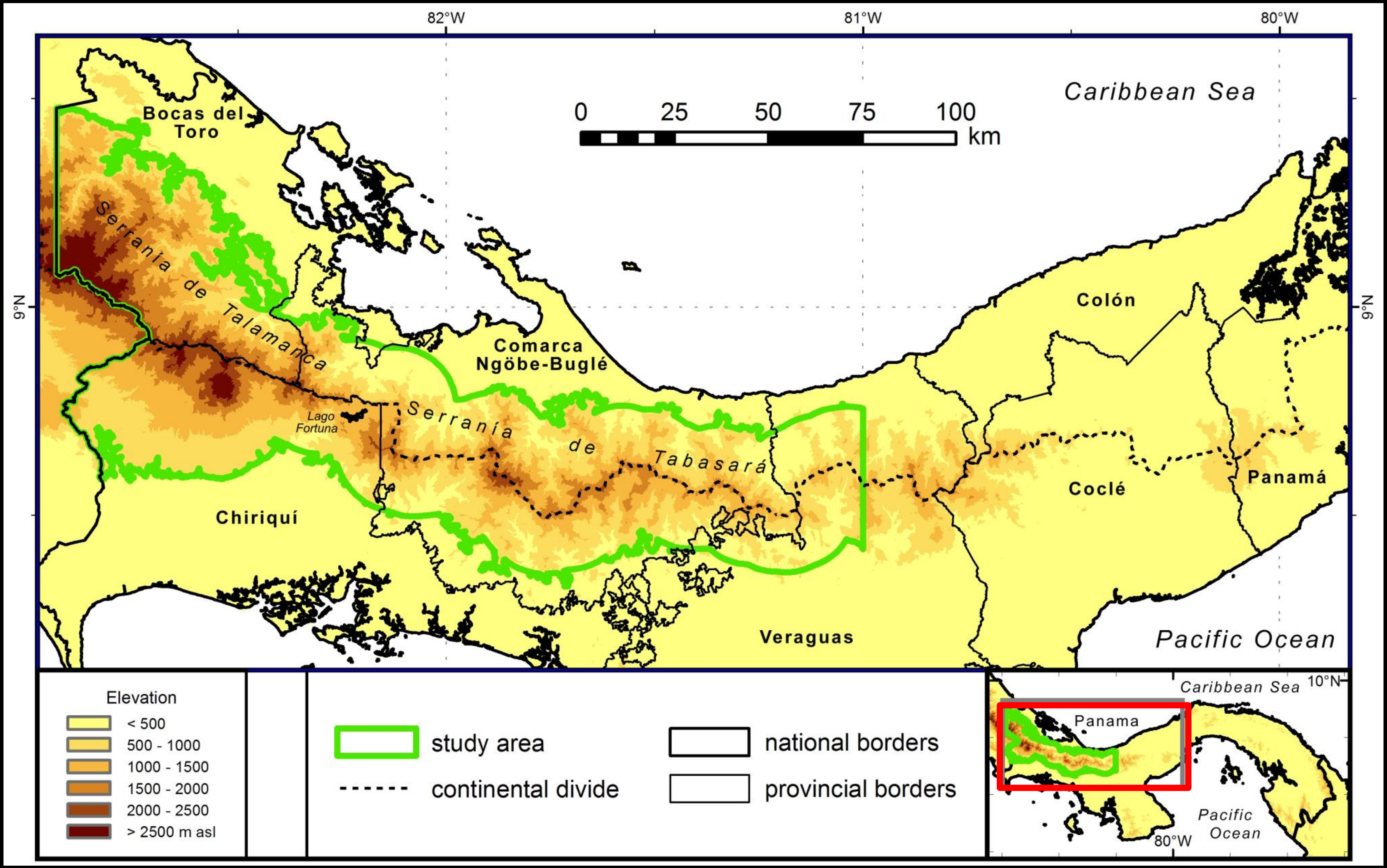
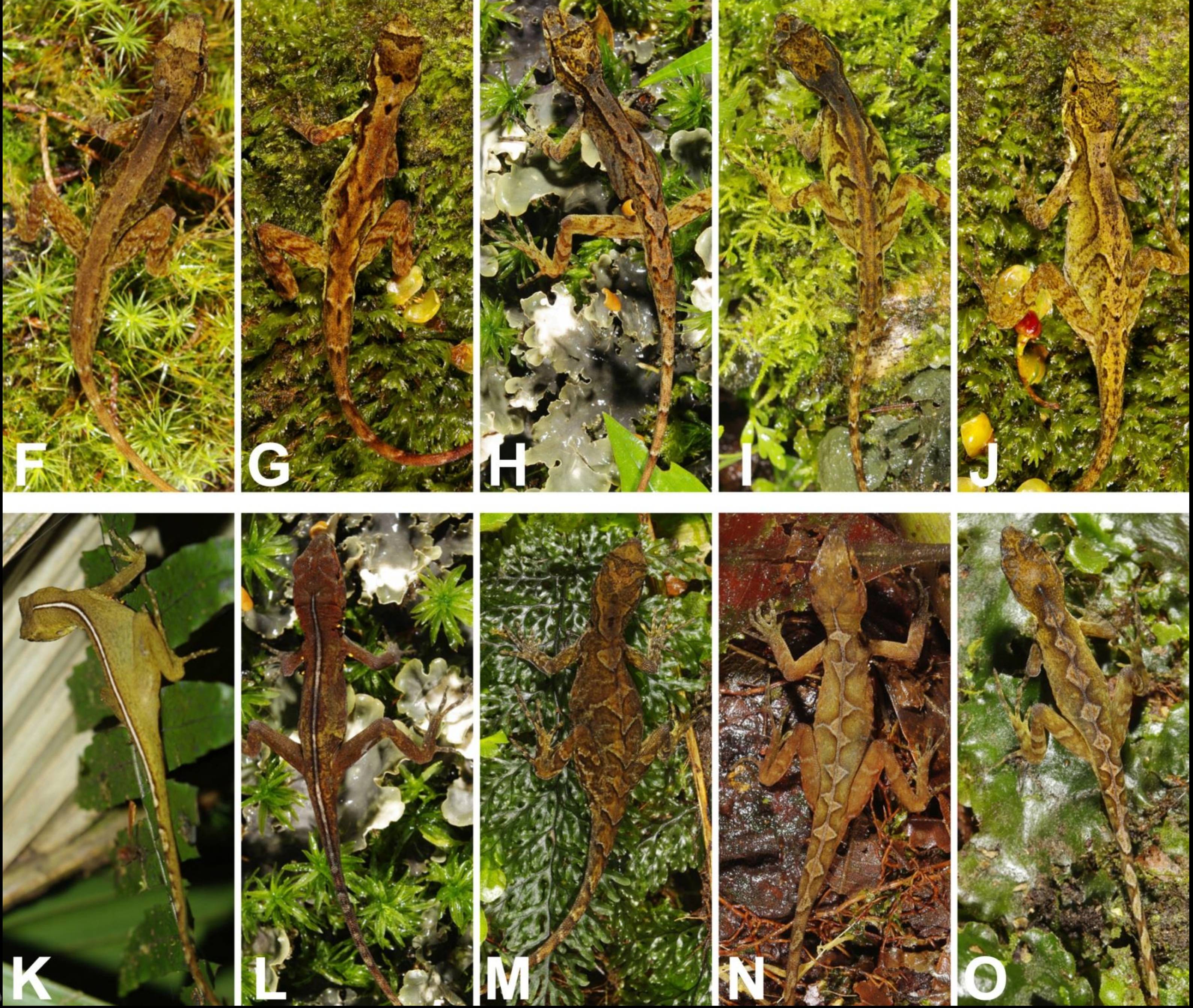
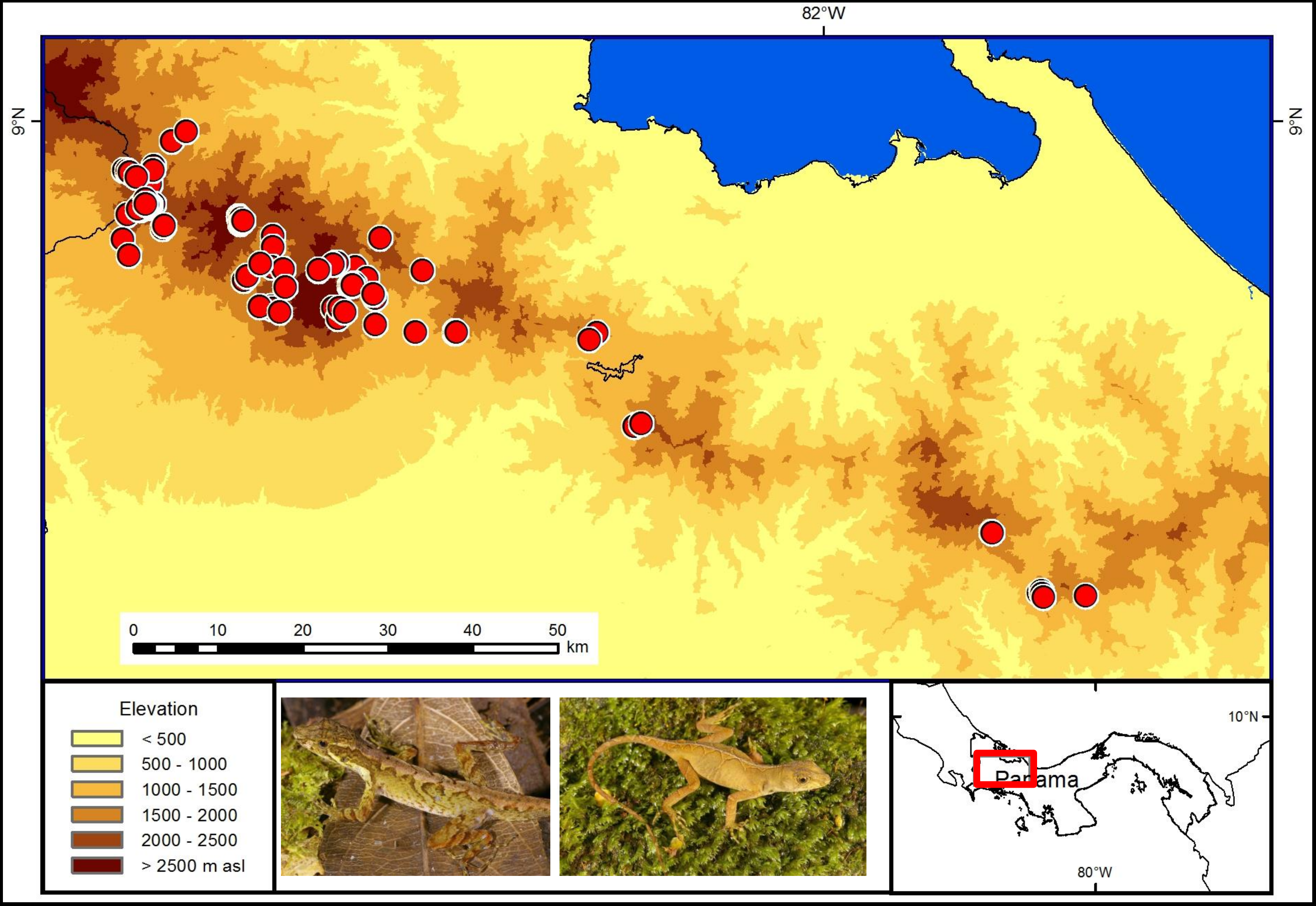
80°W
75°W
70°W


82°W
81°W
80°W
9°N
Caribbean Sea
0 25 50 75 100 km
Bocas del Toro
Serranía de Talamanca
Comarca Ngöbe-Buglé
Colón
Lago Fortuna
Serranía de Tabasará
Chiriquí
Coclé
Panamá
Veraguas
Pacific Ocean
Elevation
< 500
500 - 1000
1000 - 1500
1500 - 2000
2000 - 2500
> 2500 m asl
study area
continental divide
national borders
provincial borders
Caribbean Sea
10°N
Panama
Pacific Ocean
80°W

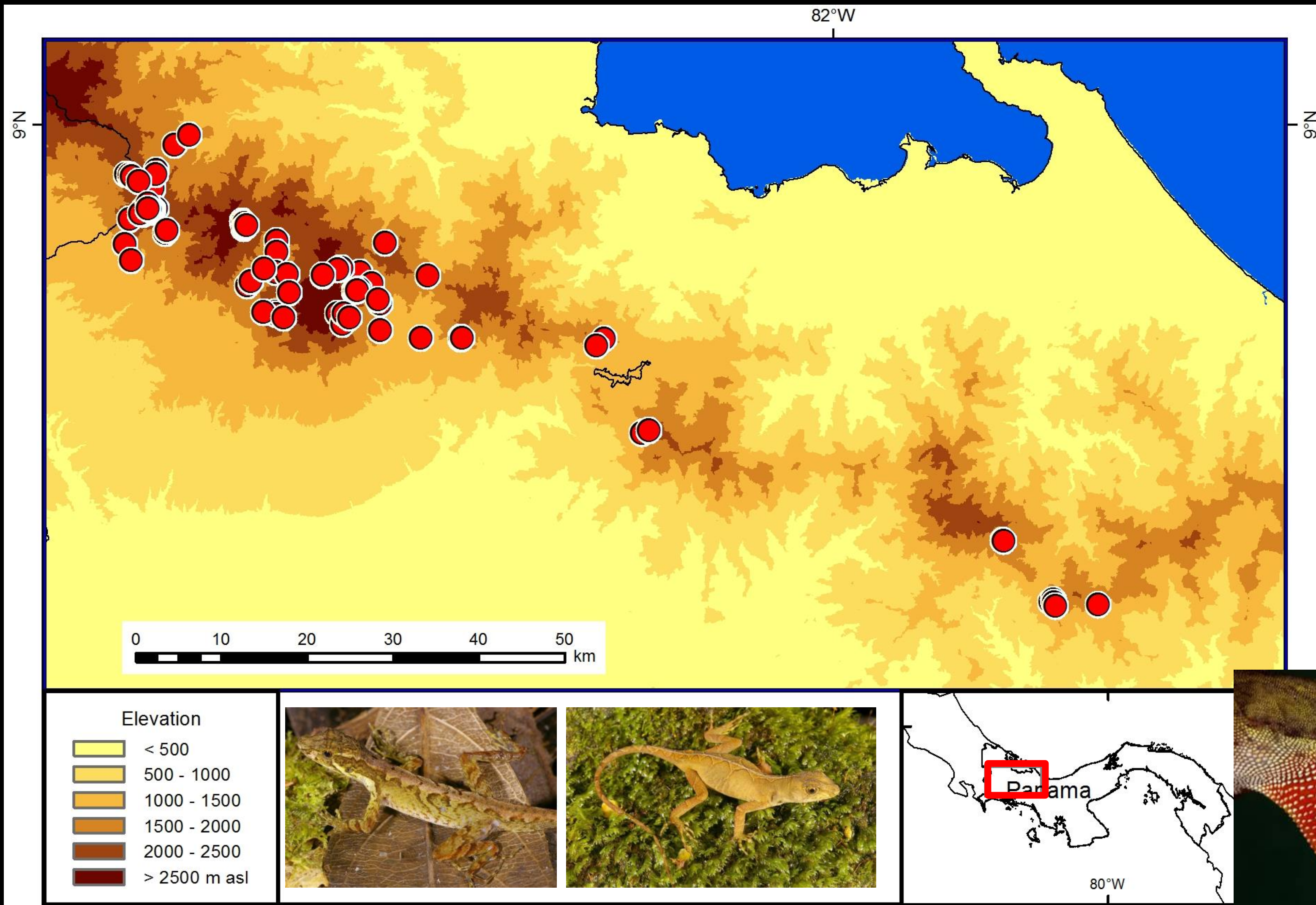


Lotzkat et al. 2011 — Zootaxa 3125: 1–21

Kryptische Diversität im *Anolis pachypus*-Komplex

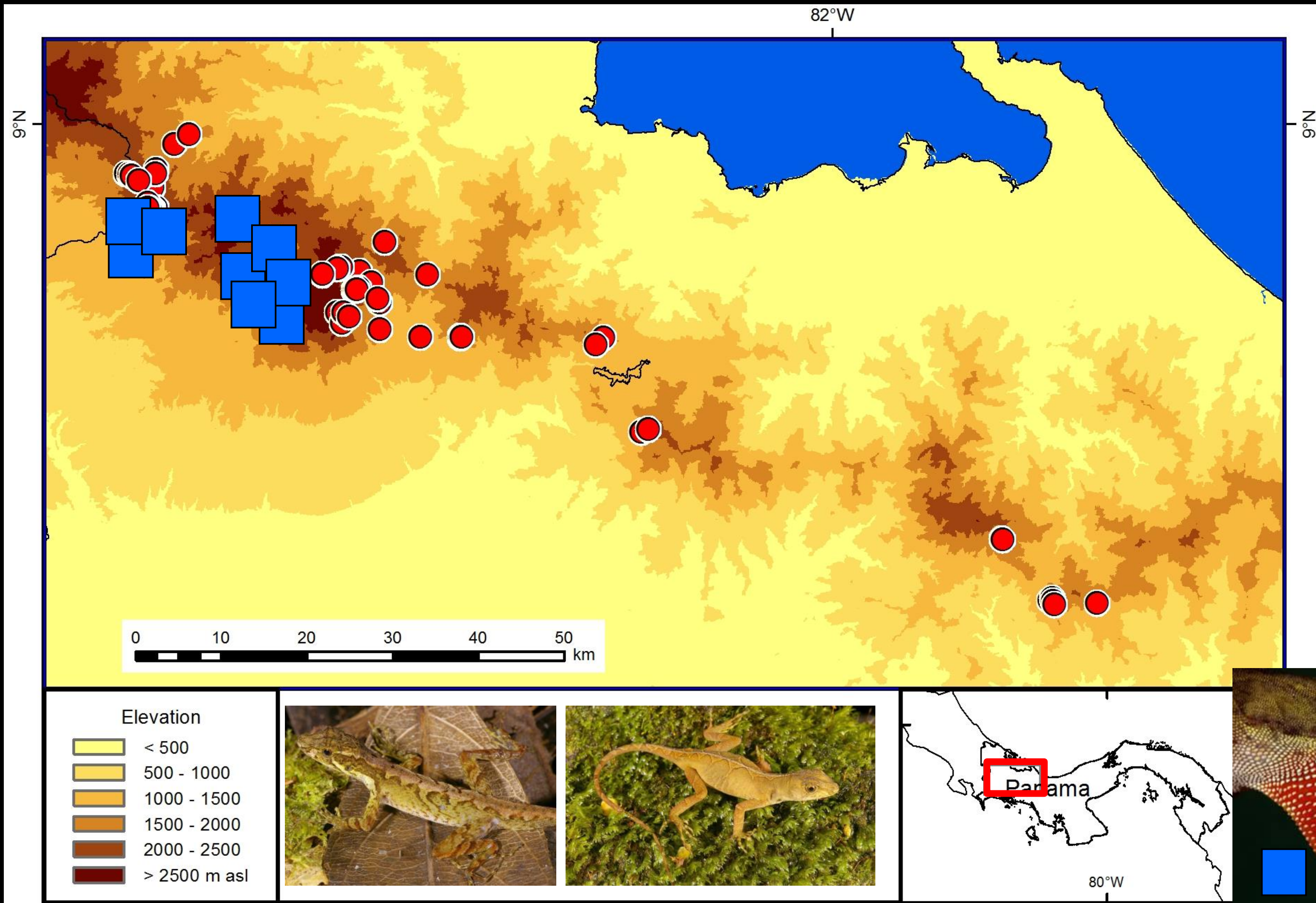


Kryptische Diversität im *Anolis pachypus*-Komplex



Anolis pachypus

Kryptische Diversität im *Anolis pachypus*-Komplex



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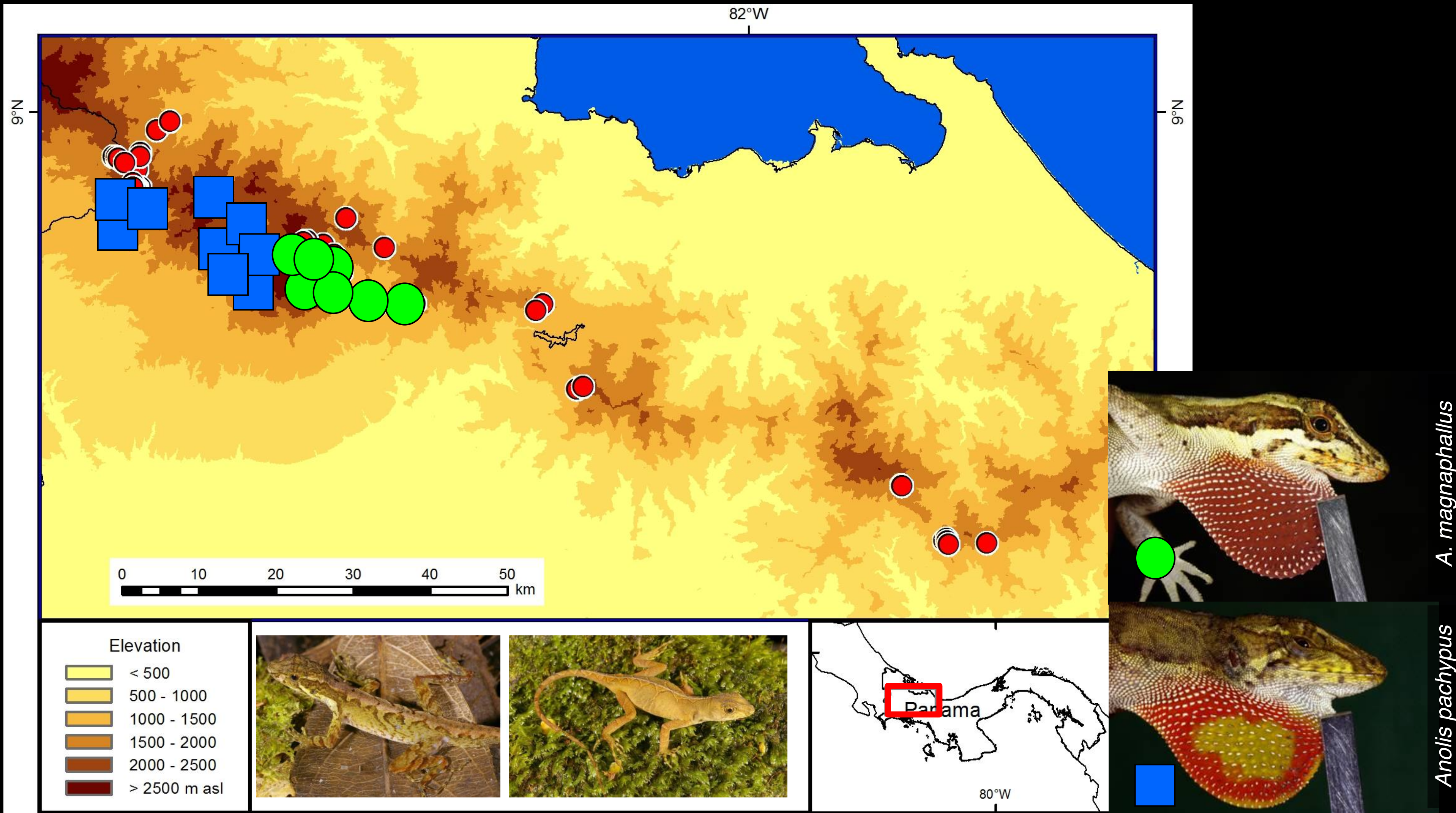

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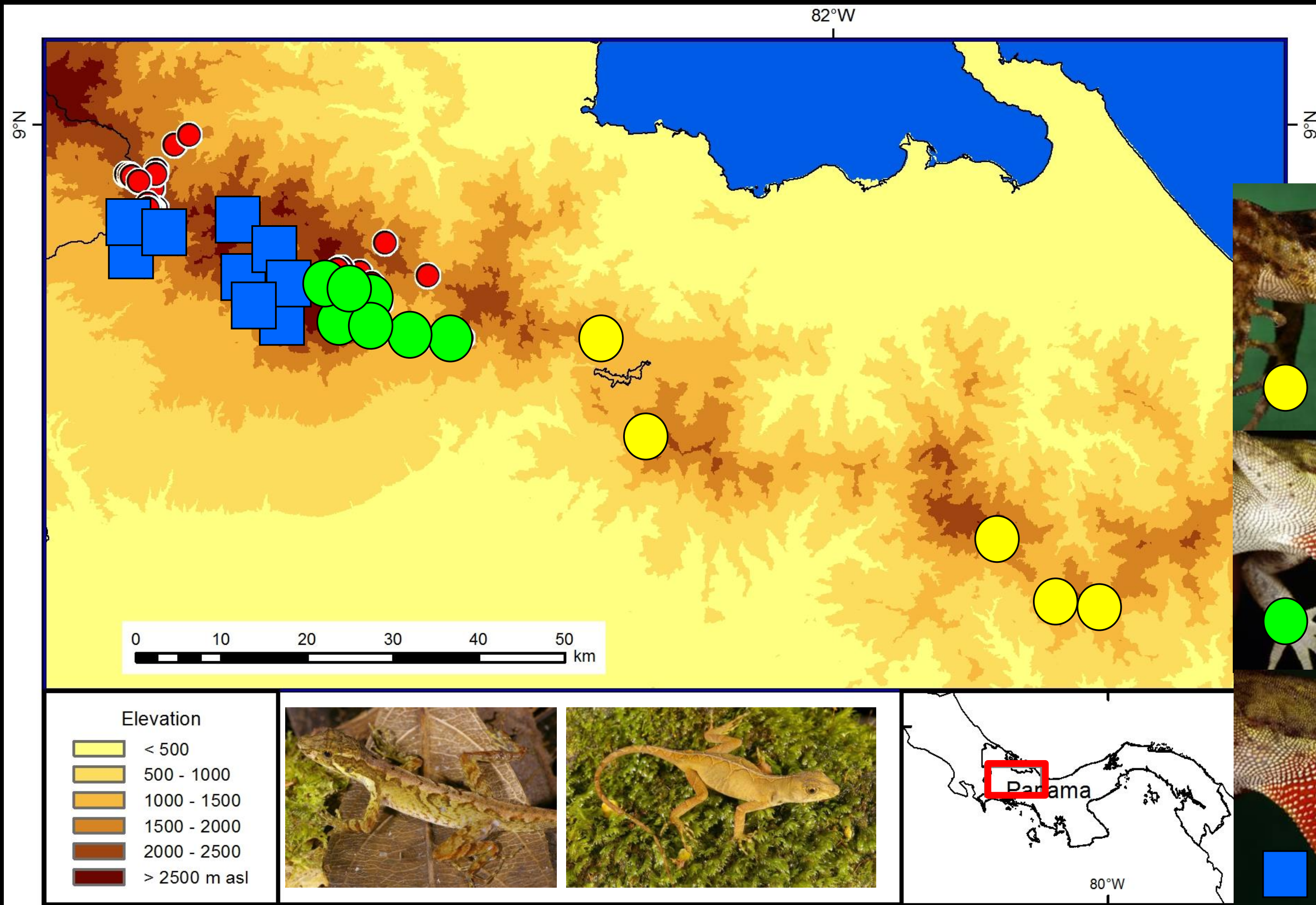

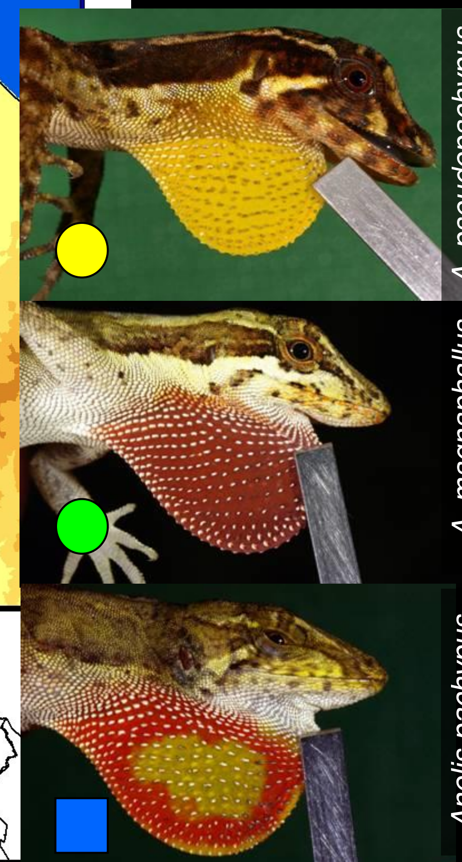

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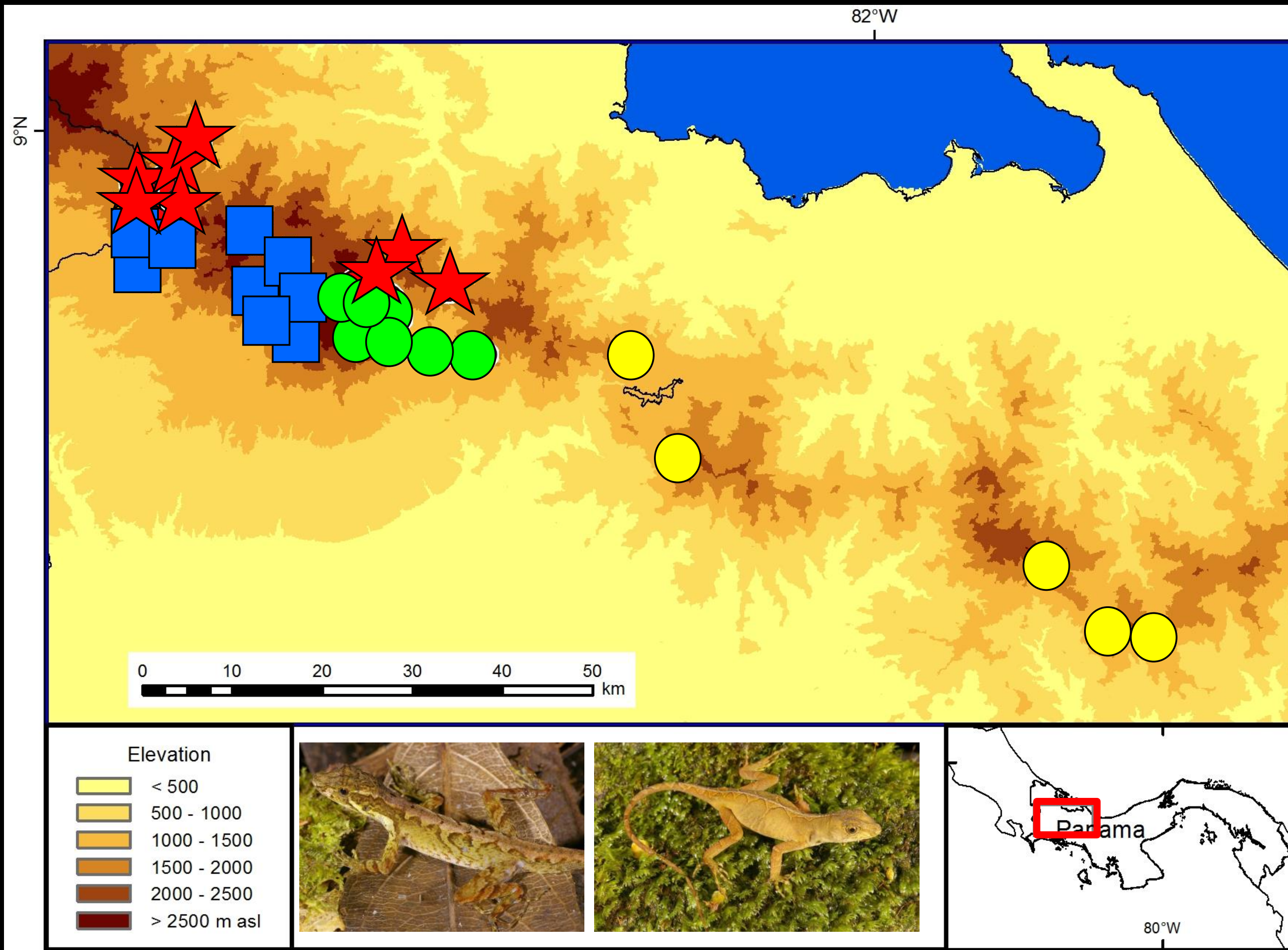
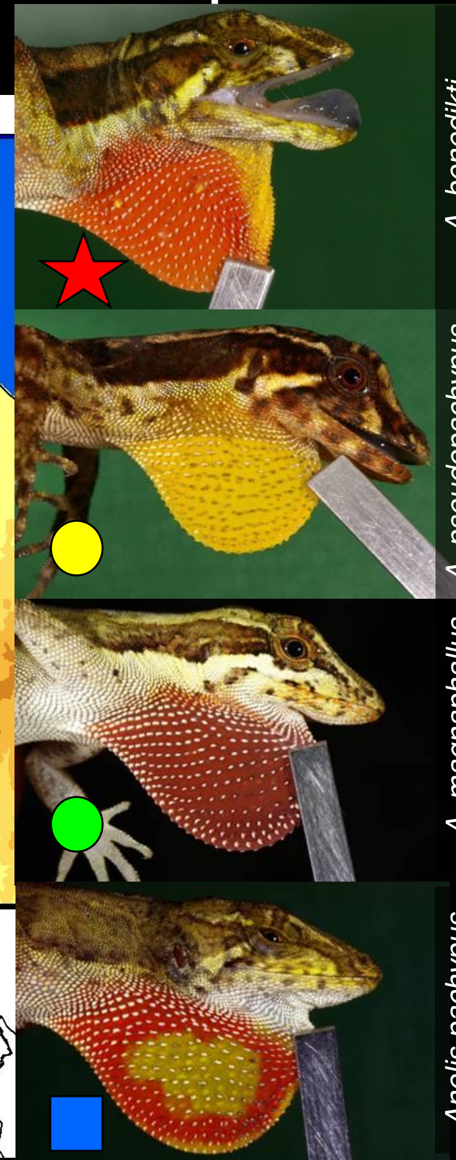
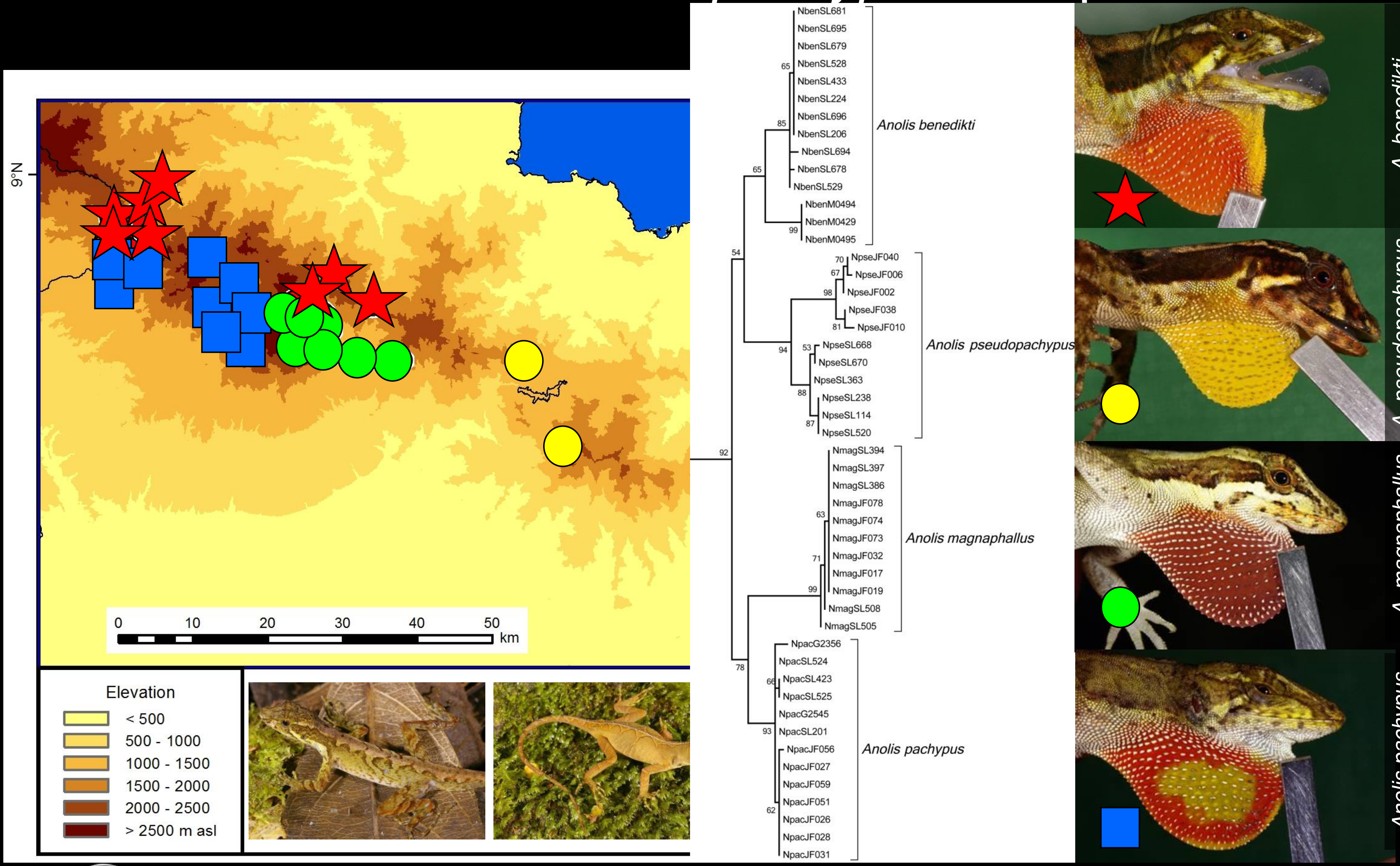
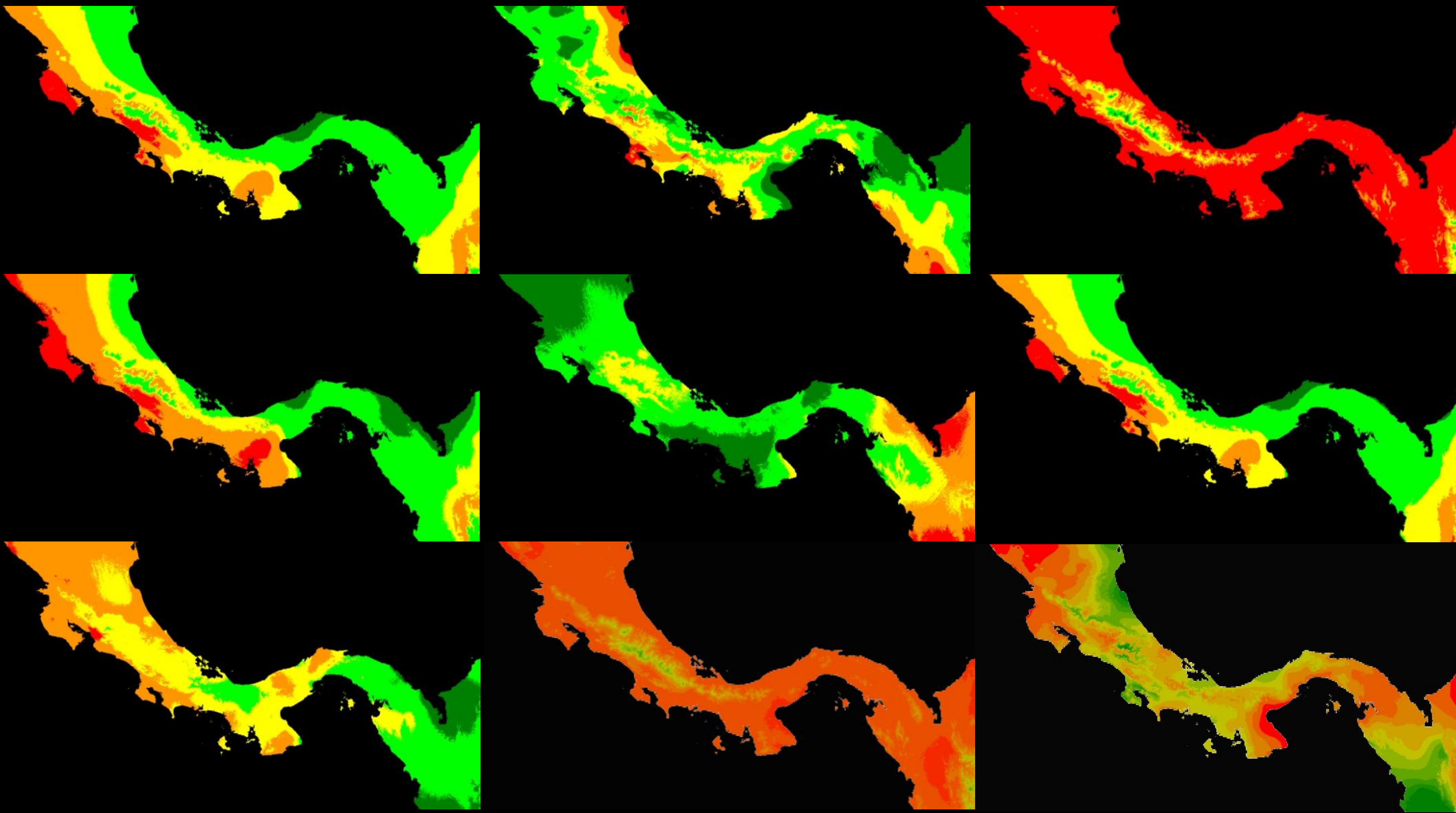




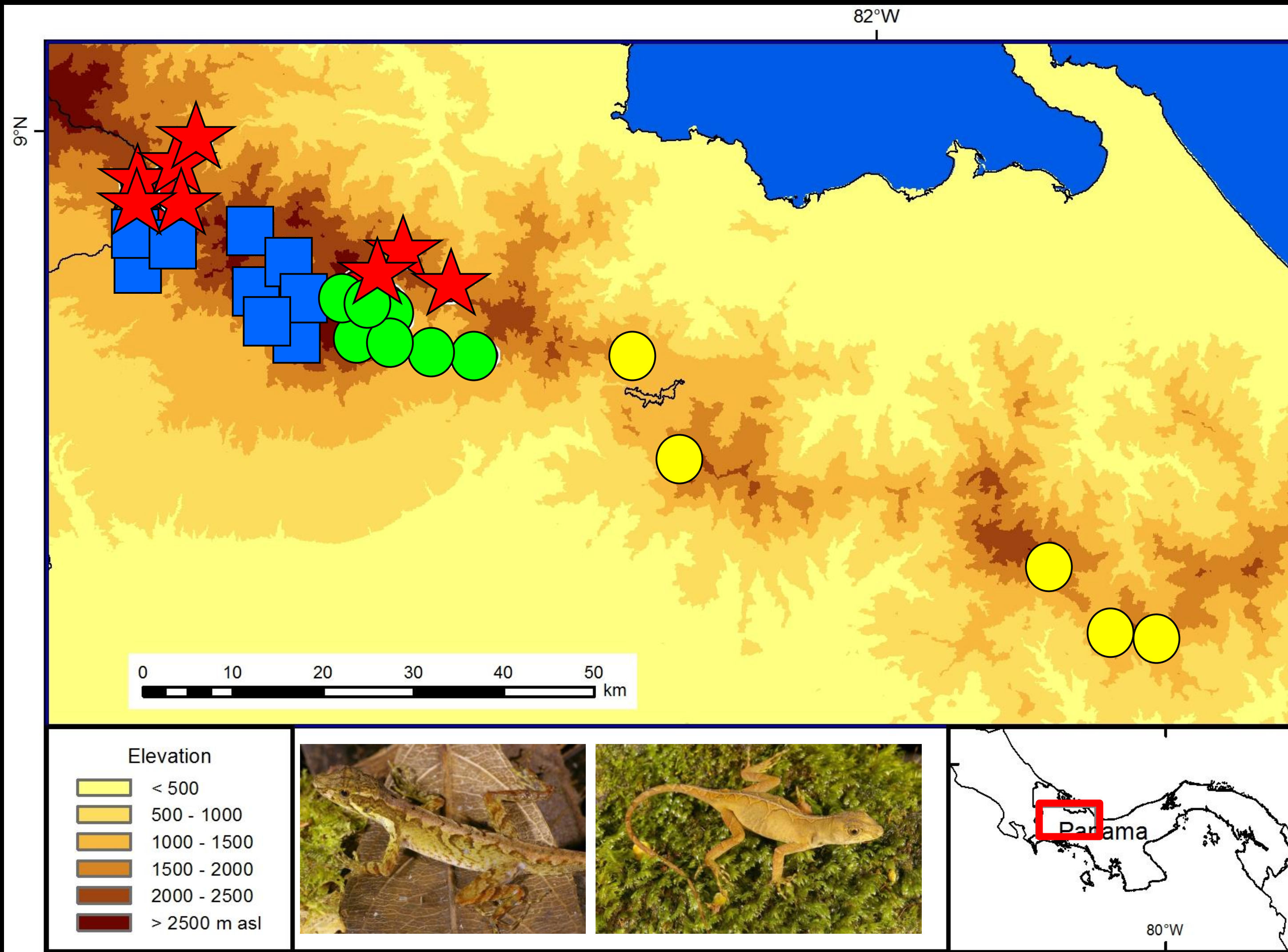
Evolution im *Anolis pachypus*-Komplex

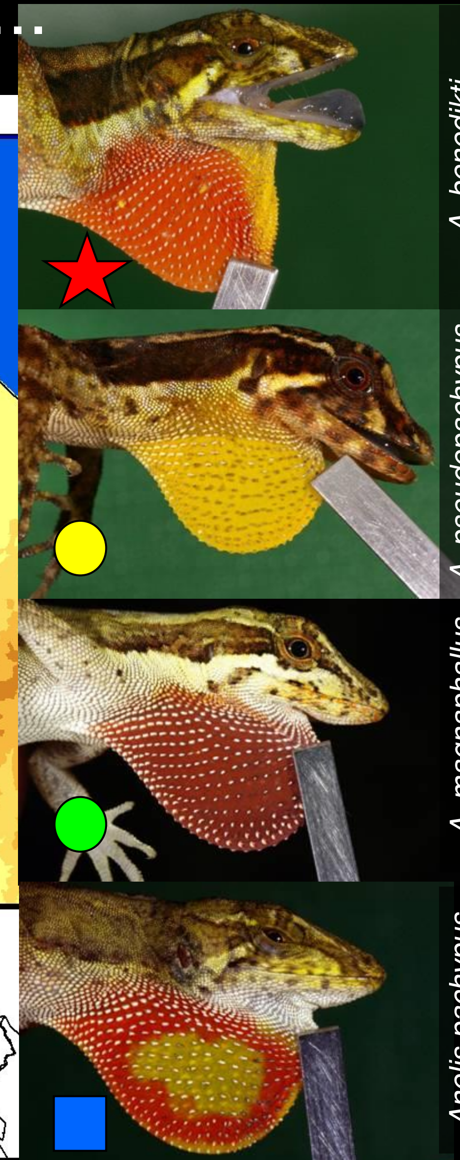


Klima-Abhängigkeit im *Anolis pachypus*-Komplex: Species Distribution Modelling...

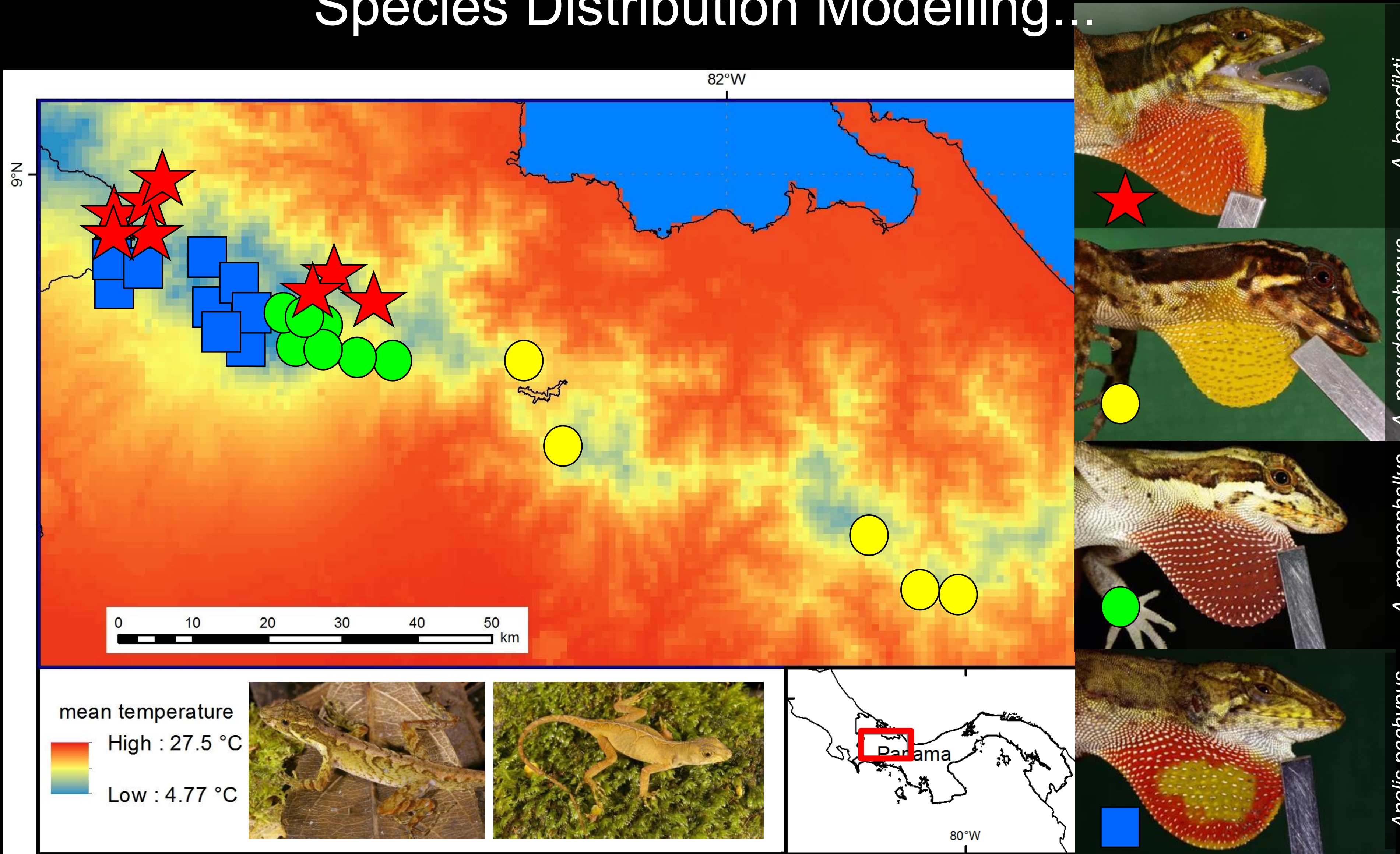


Klima-Abhängigkeit im *Anolis pachypus*-Komplex: Species Distribution Modelling...

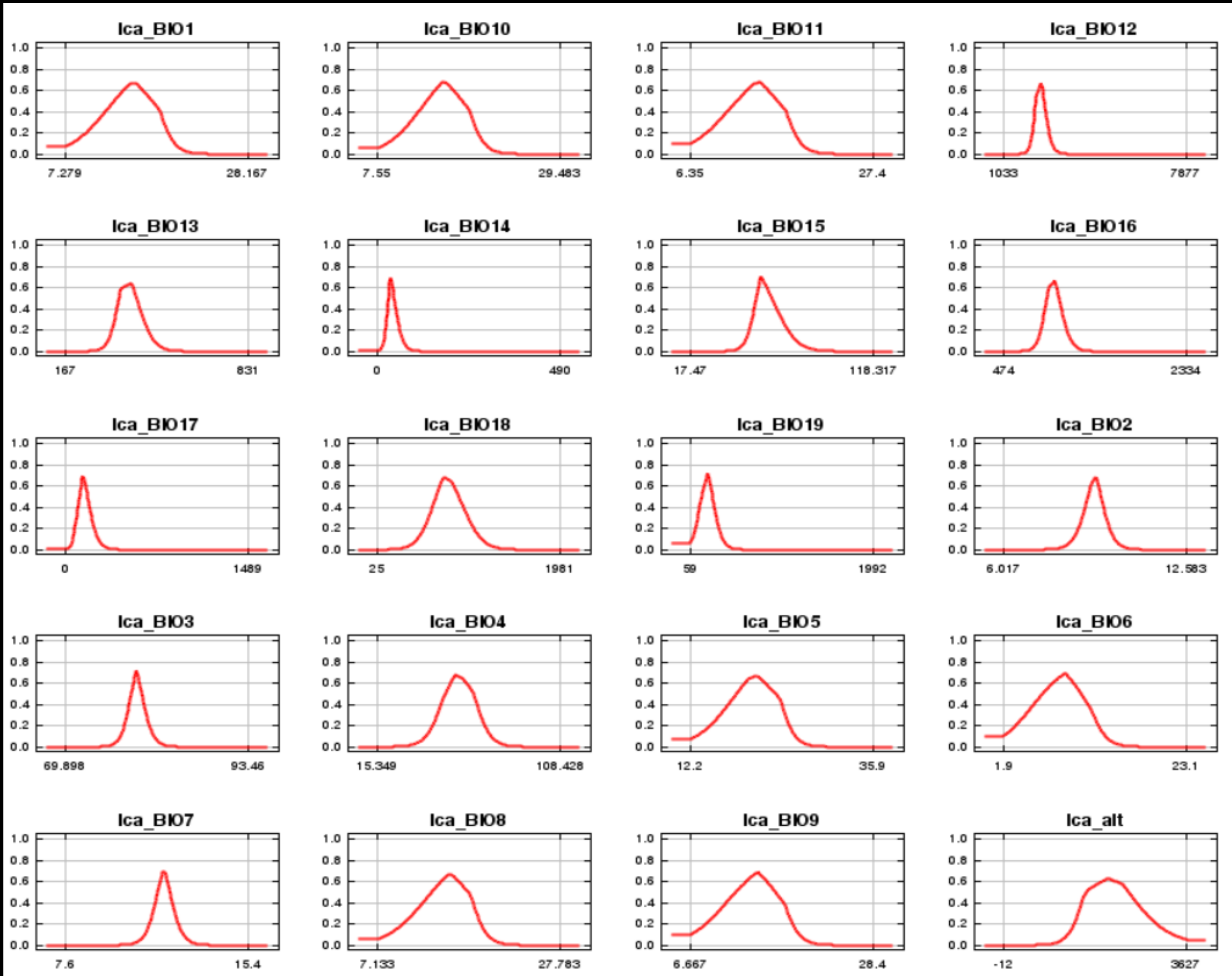


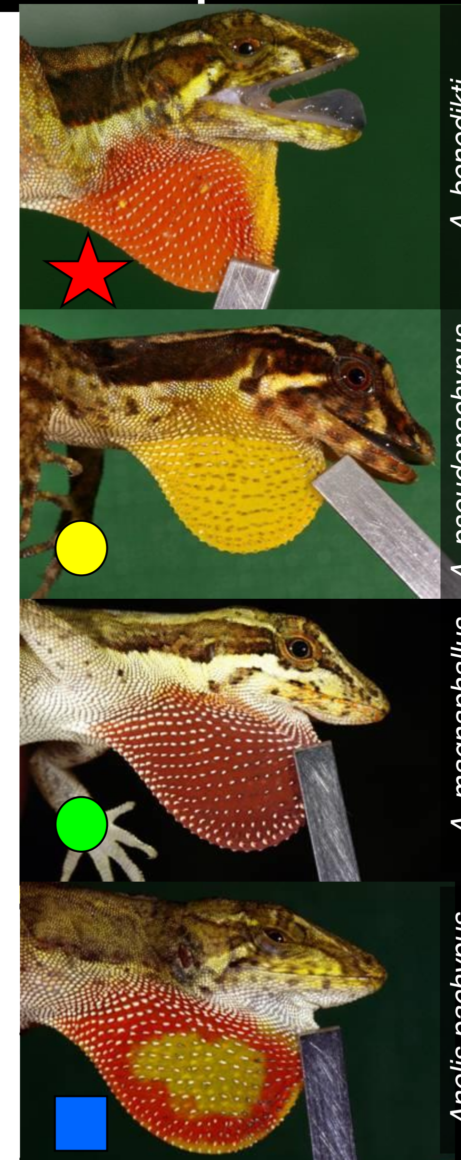


Klima-Abhängigkeit im *Anolis pachypus*-Komplex: Species Distribution Modelling...



Klima-Abhängigkeit im *Anolis pachypus*-Komplex





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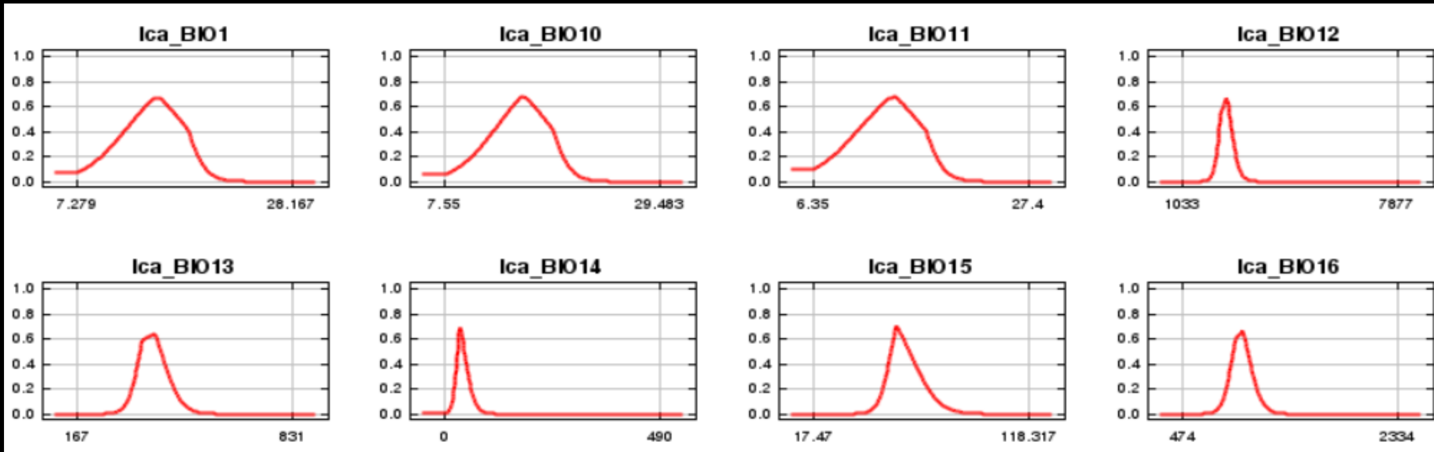
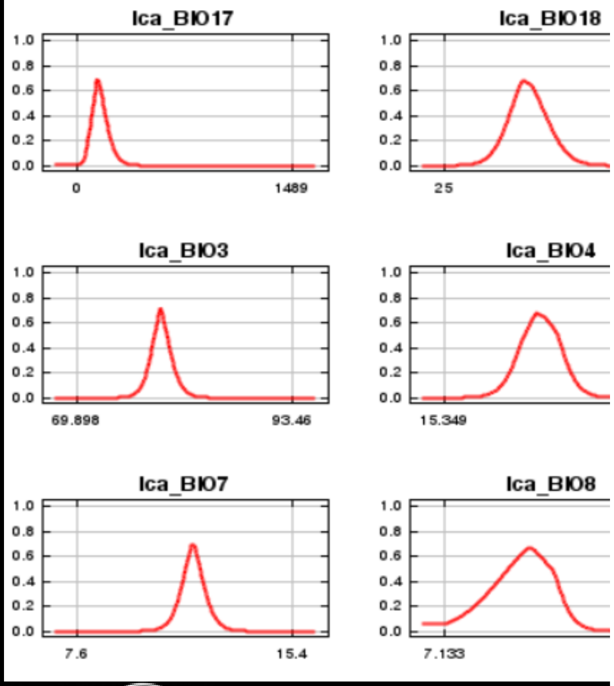
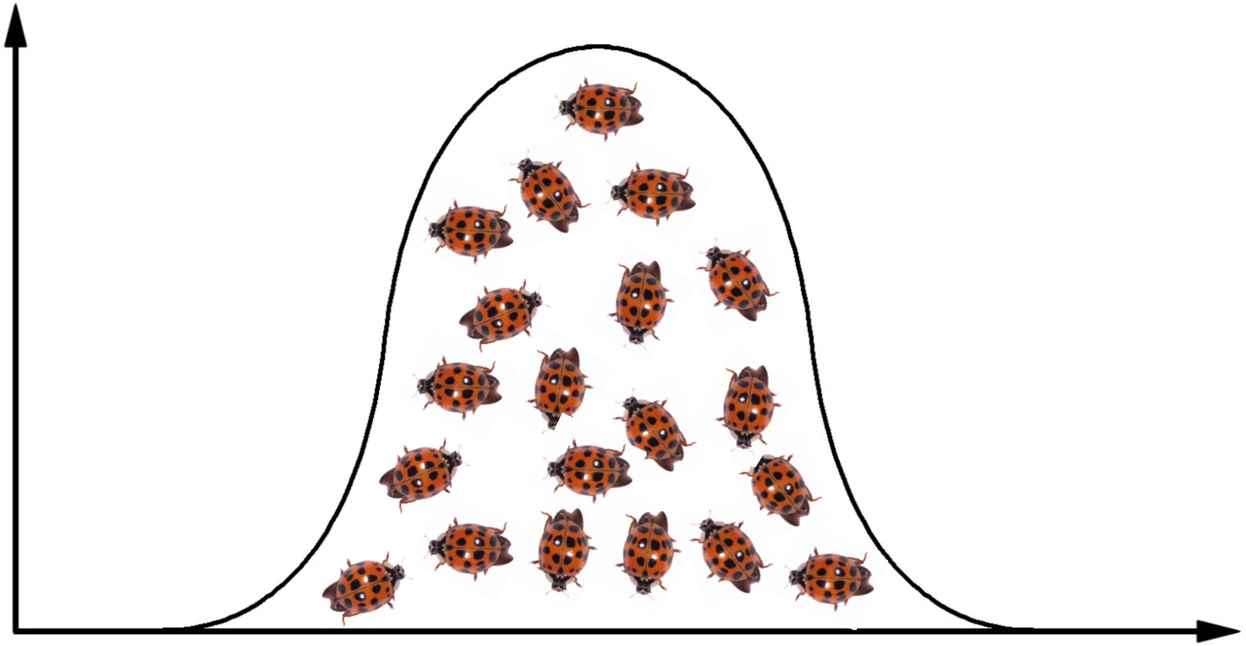
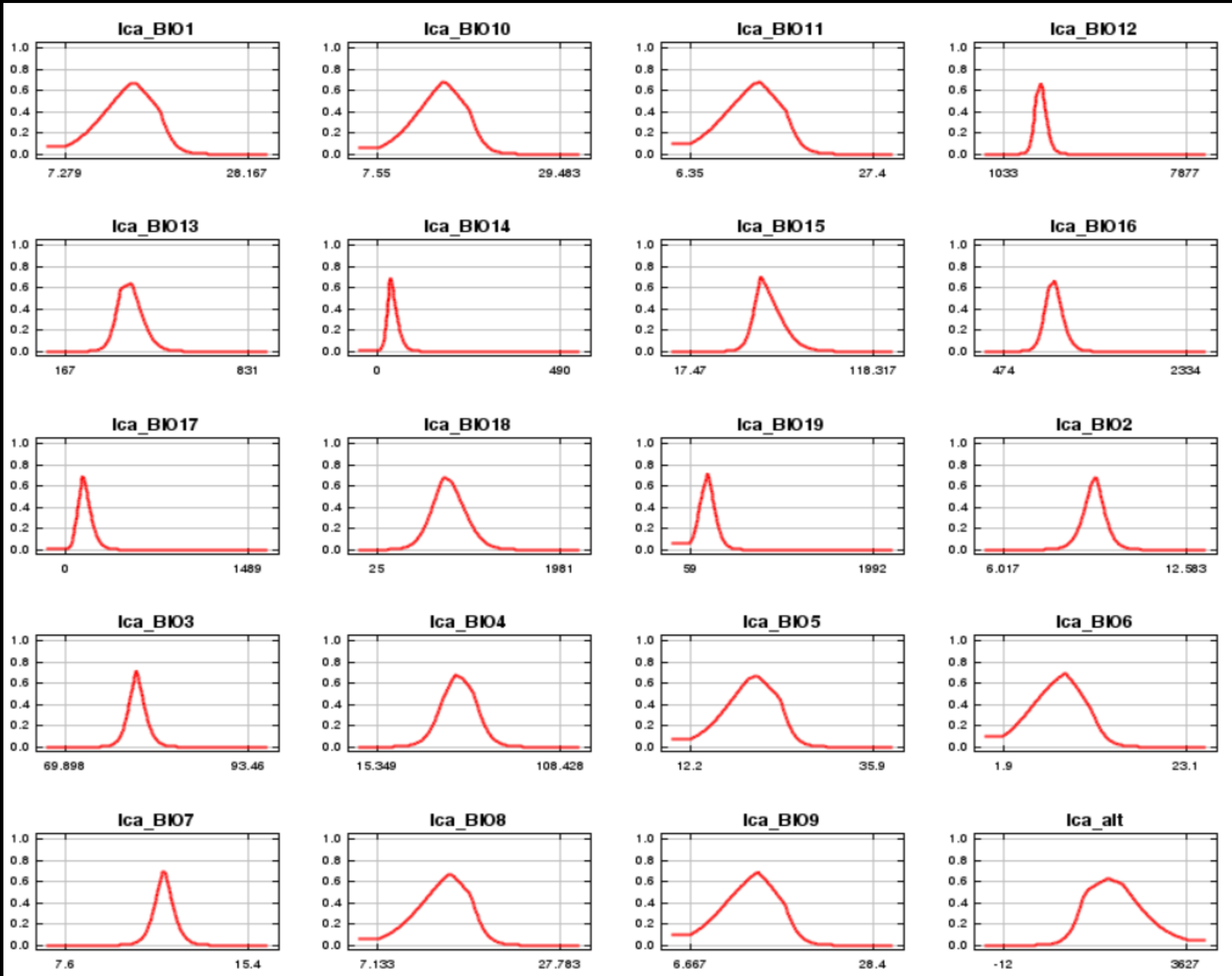


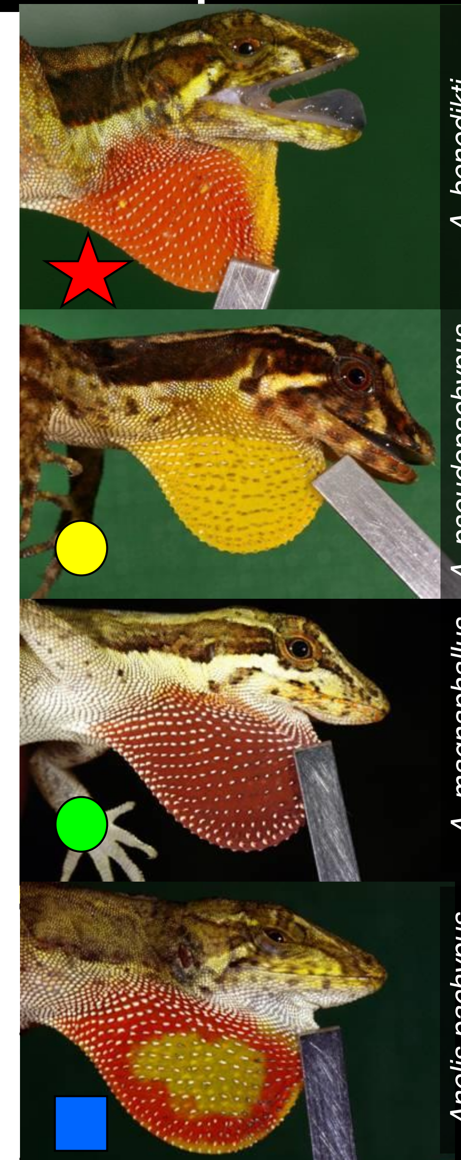




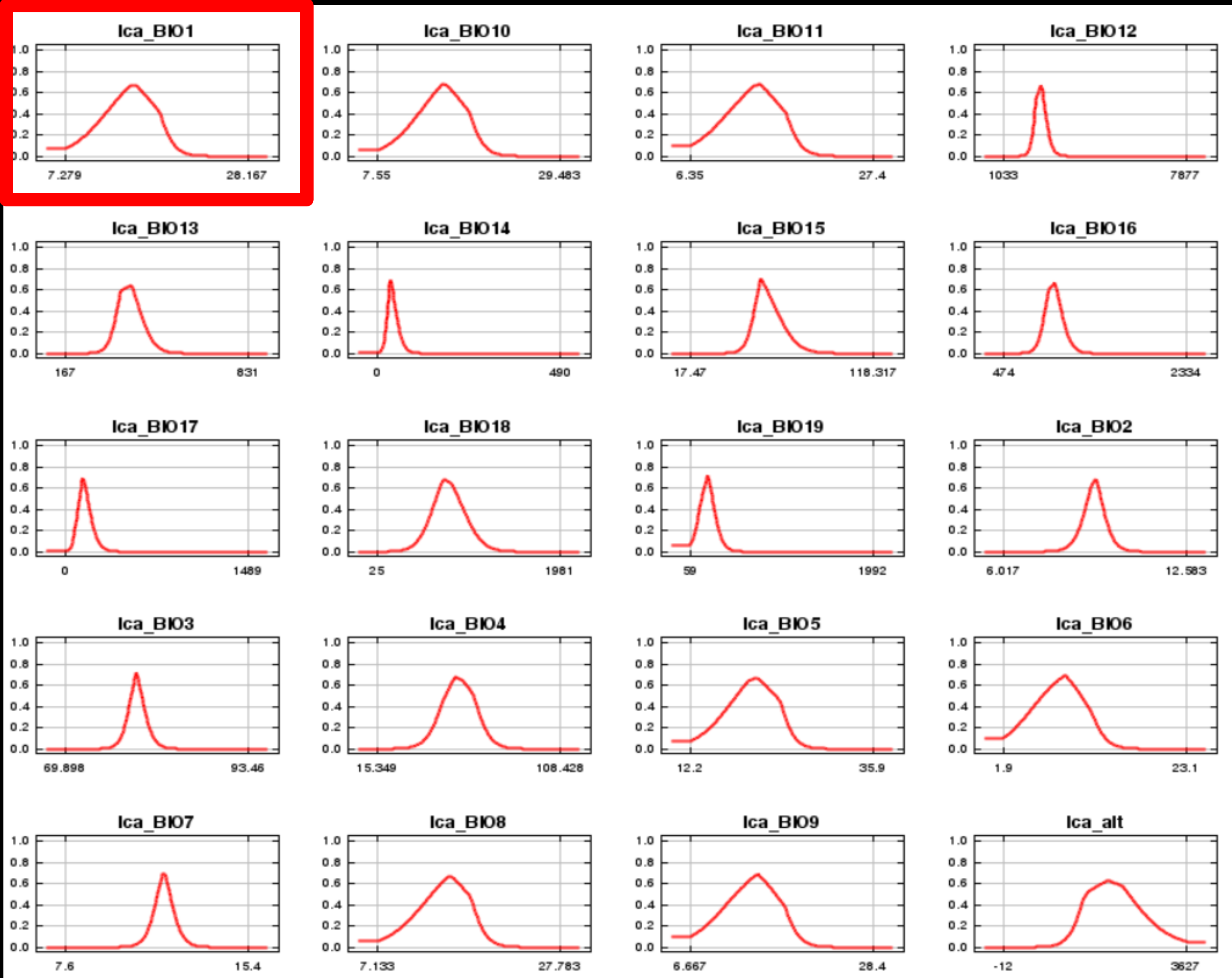
Sebastian Lotzkat: T

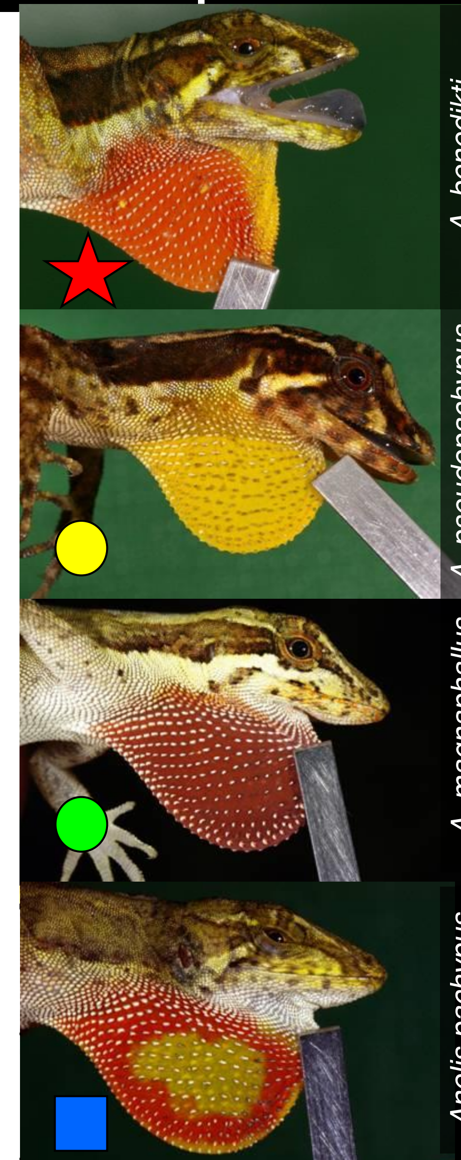
Klima-Abhängigkeit im *Anolis pachypus*-Komplex



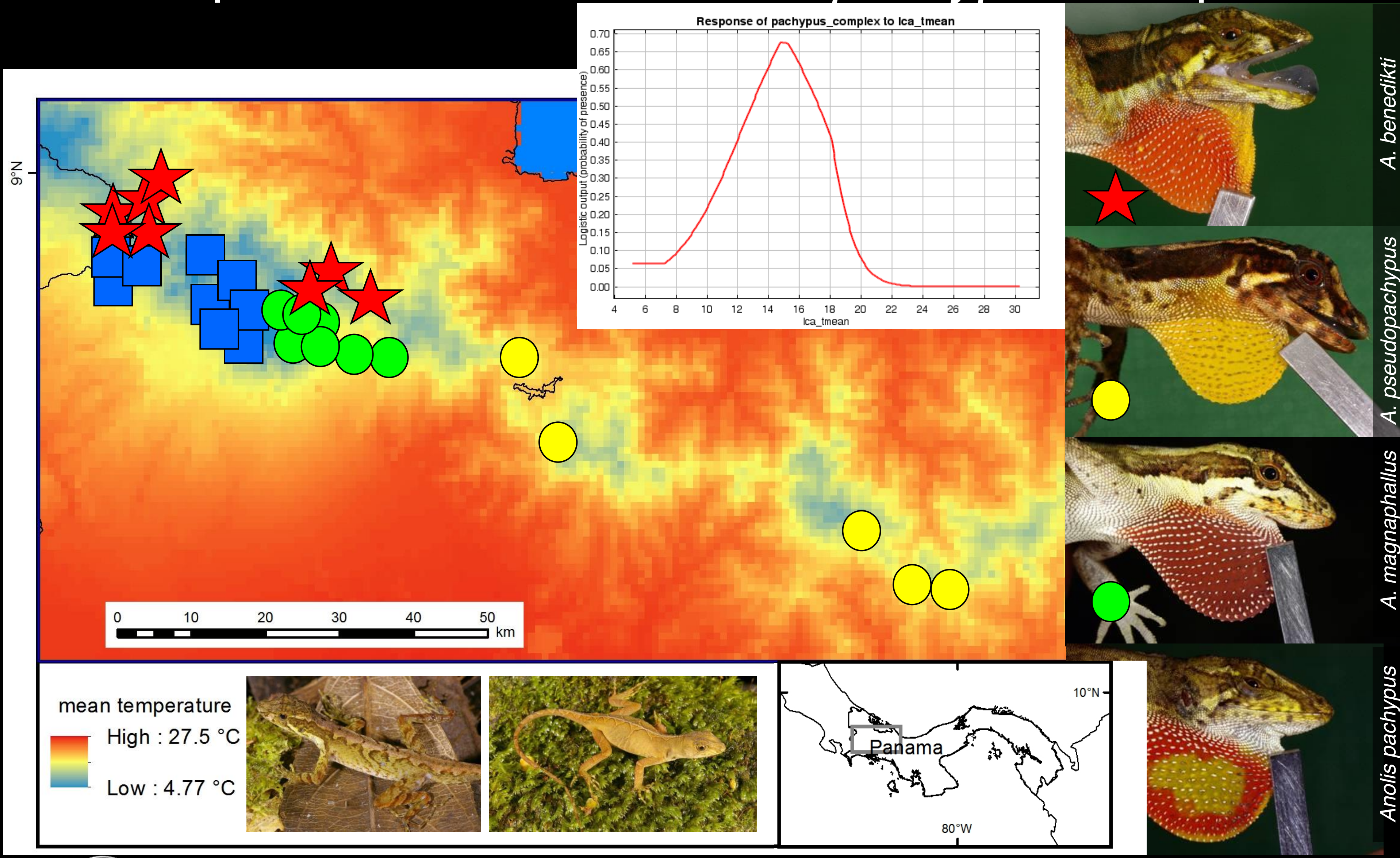


Klima-Abhängigkeit im *Anolis pachypus*-Komplex

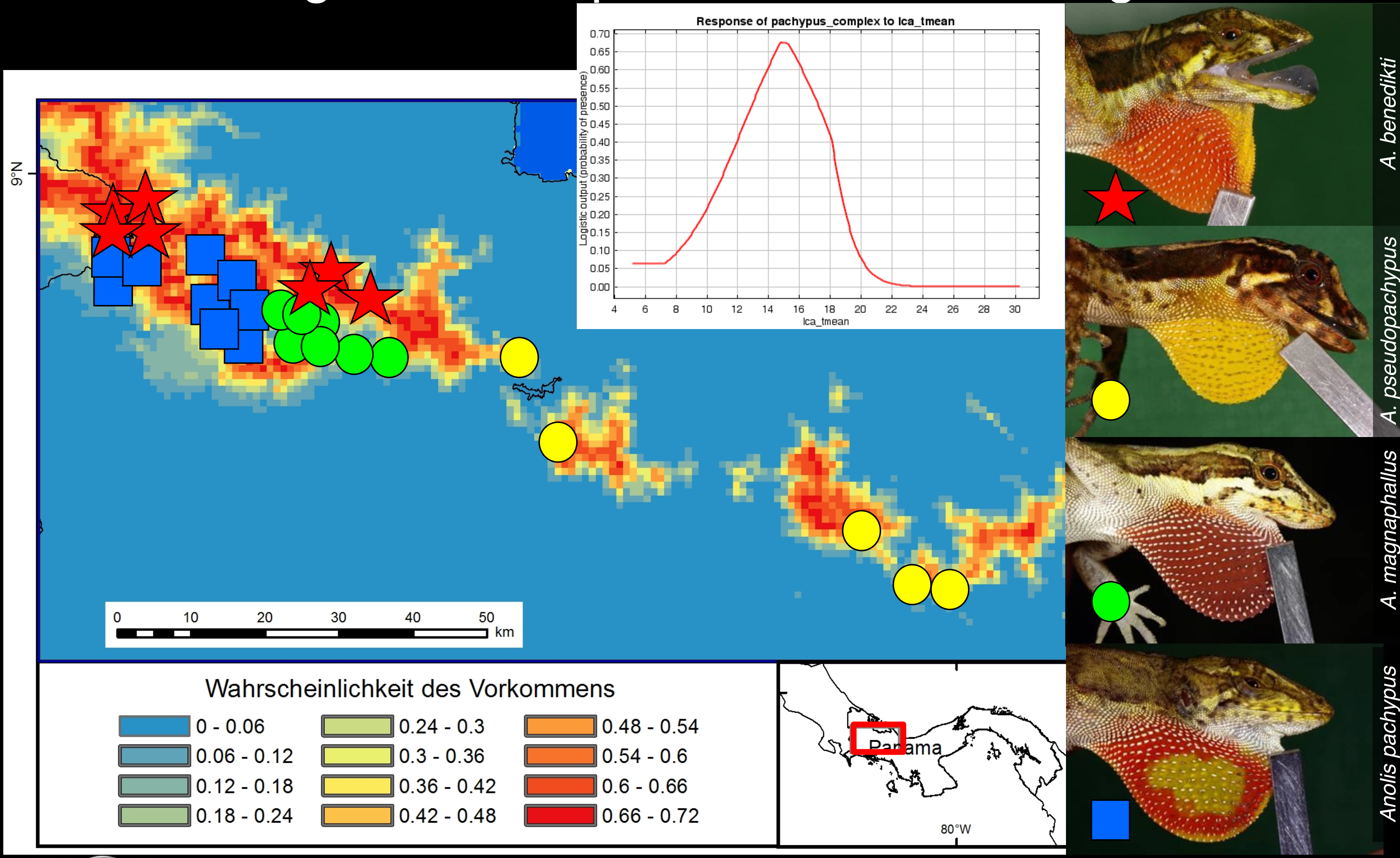




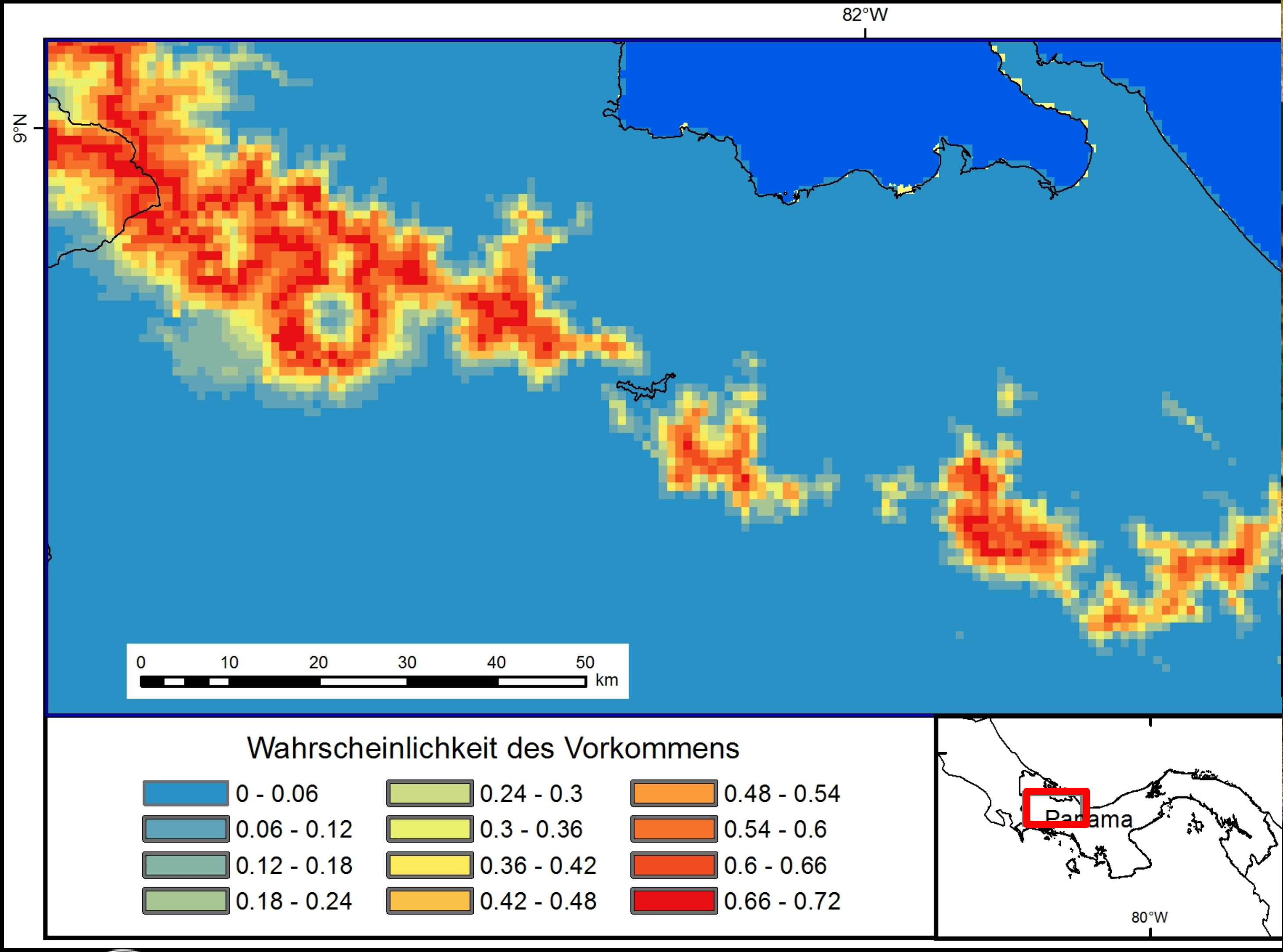
Temperaturtoleranz im *Anolis pachypus*-Komplex



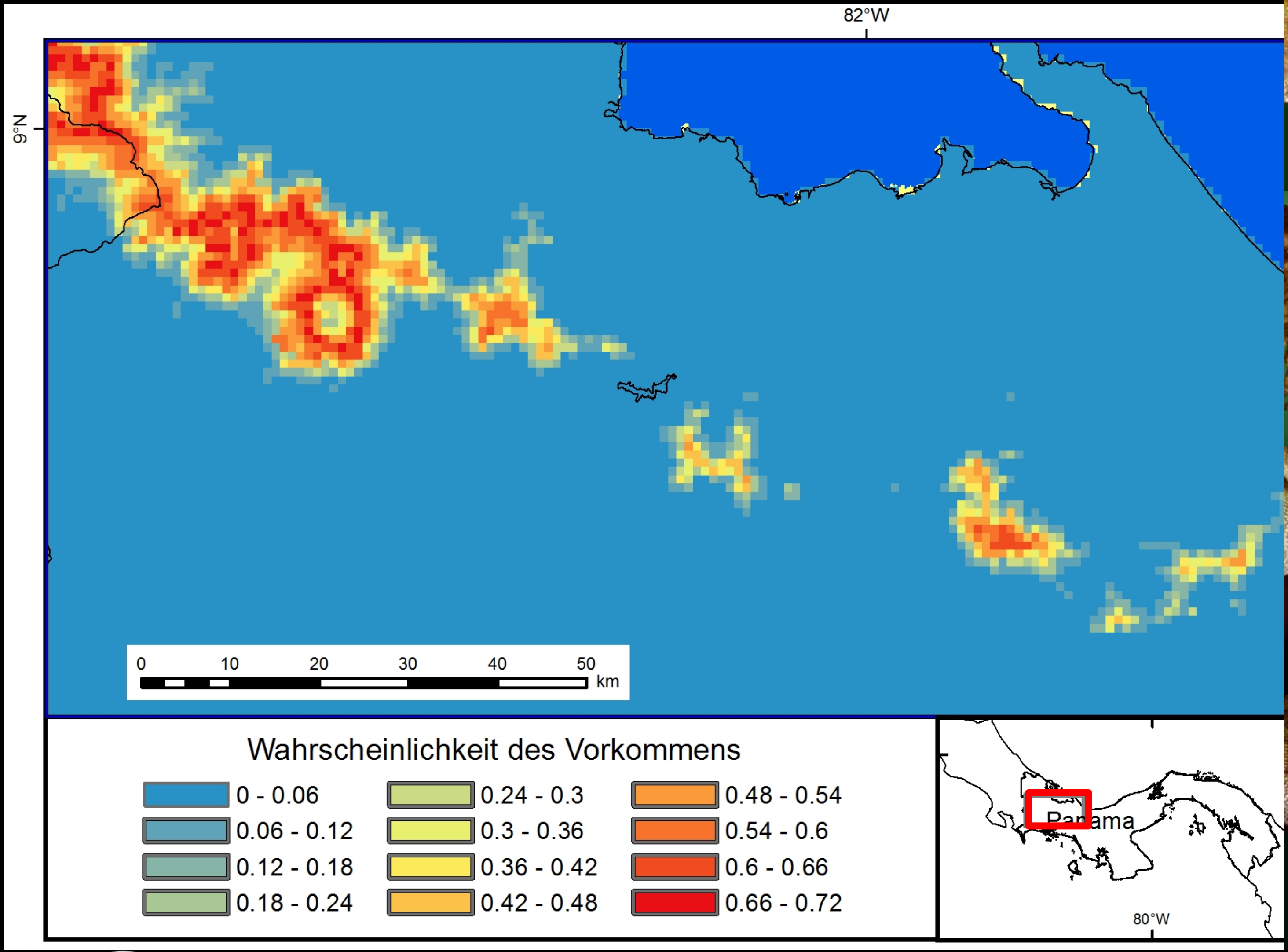
Verbreitung nach Temperaturtoleranz: heutiges Klima

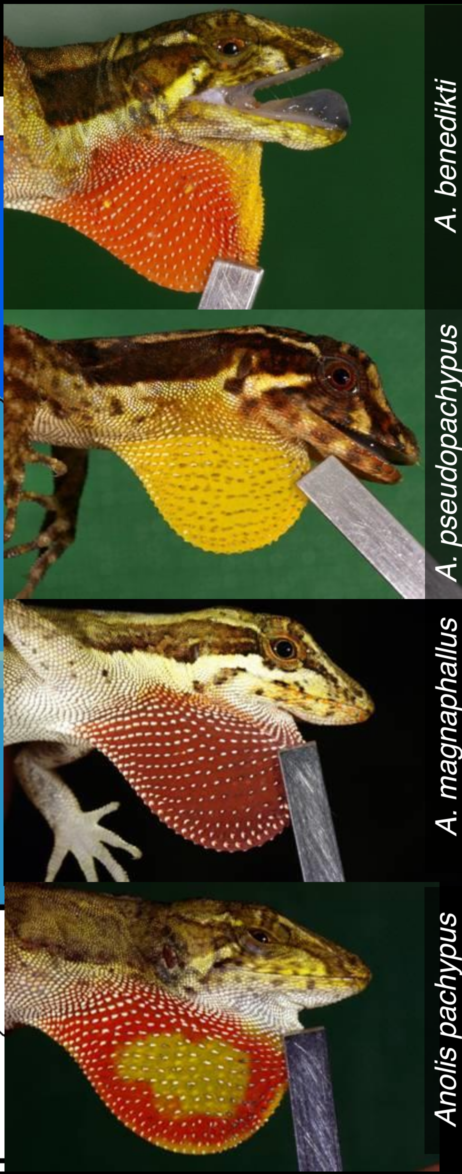


Verbreitung nach Temperaturtoleranz: heutiges Klima



Verbreitung nach Temperaturtoleranz: 2°C wärmer





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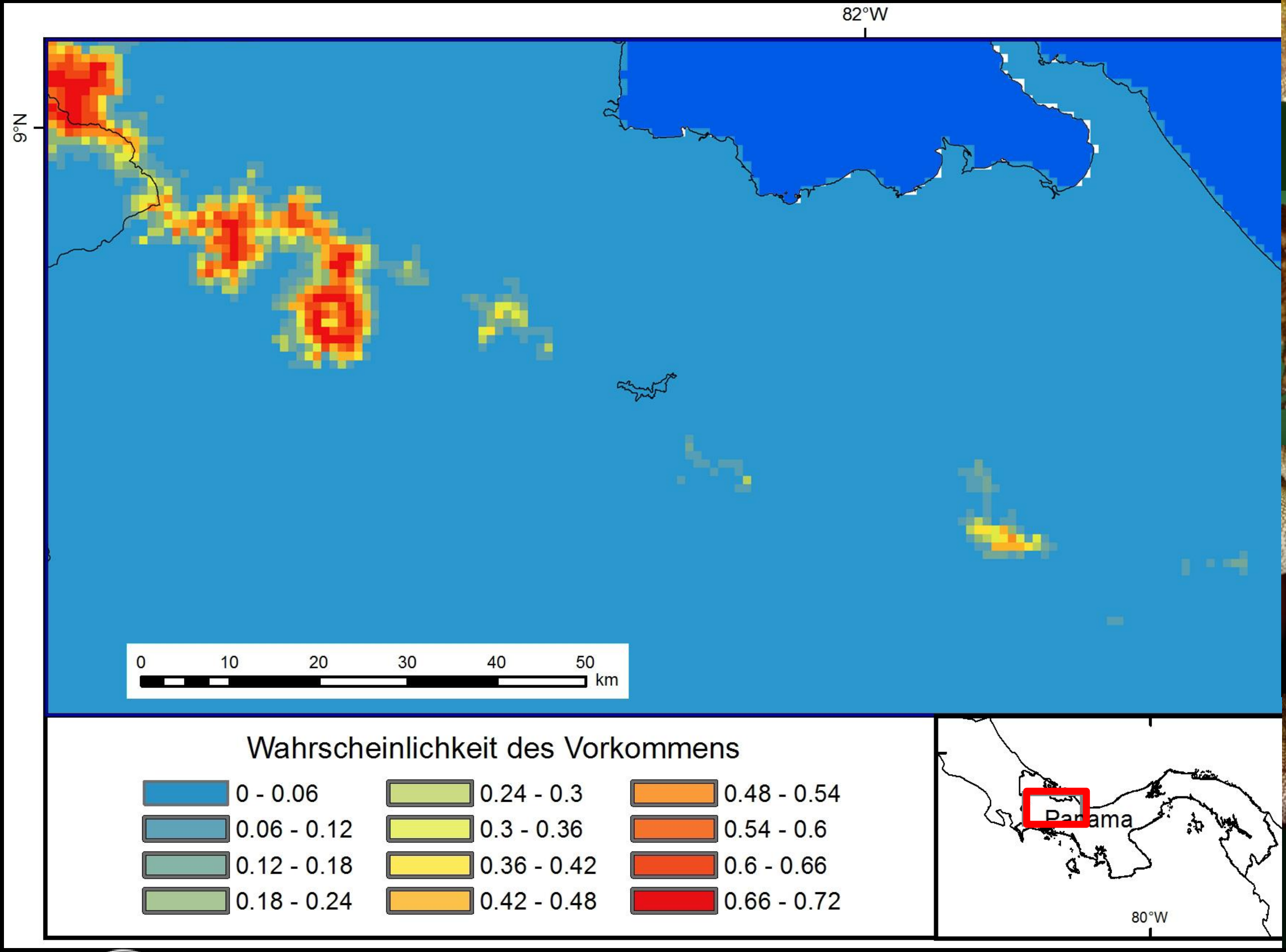
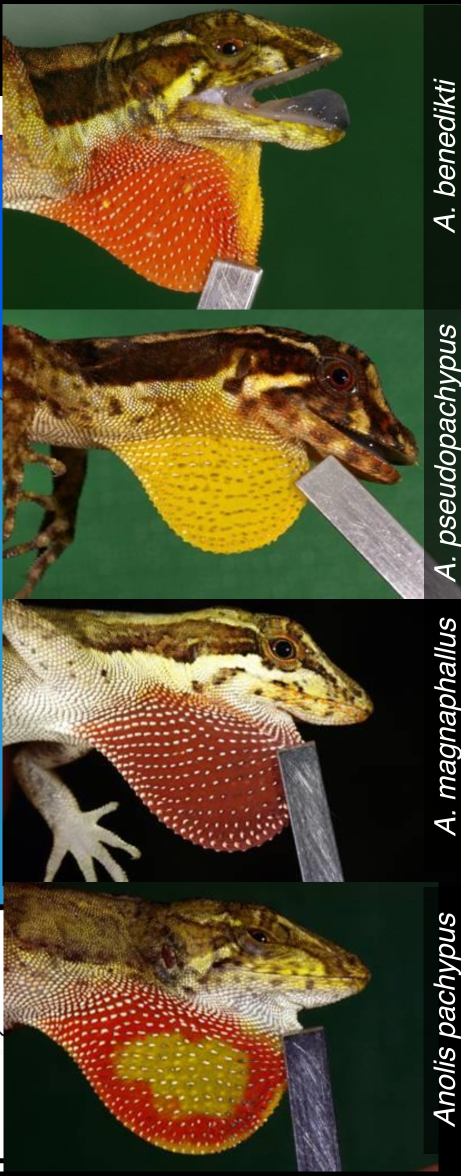


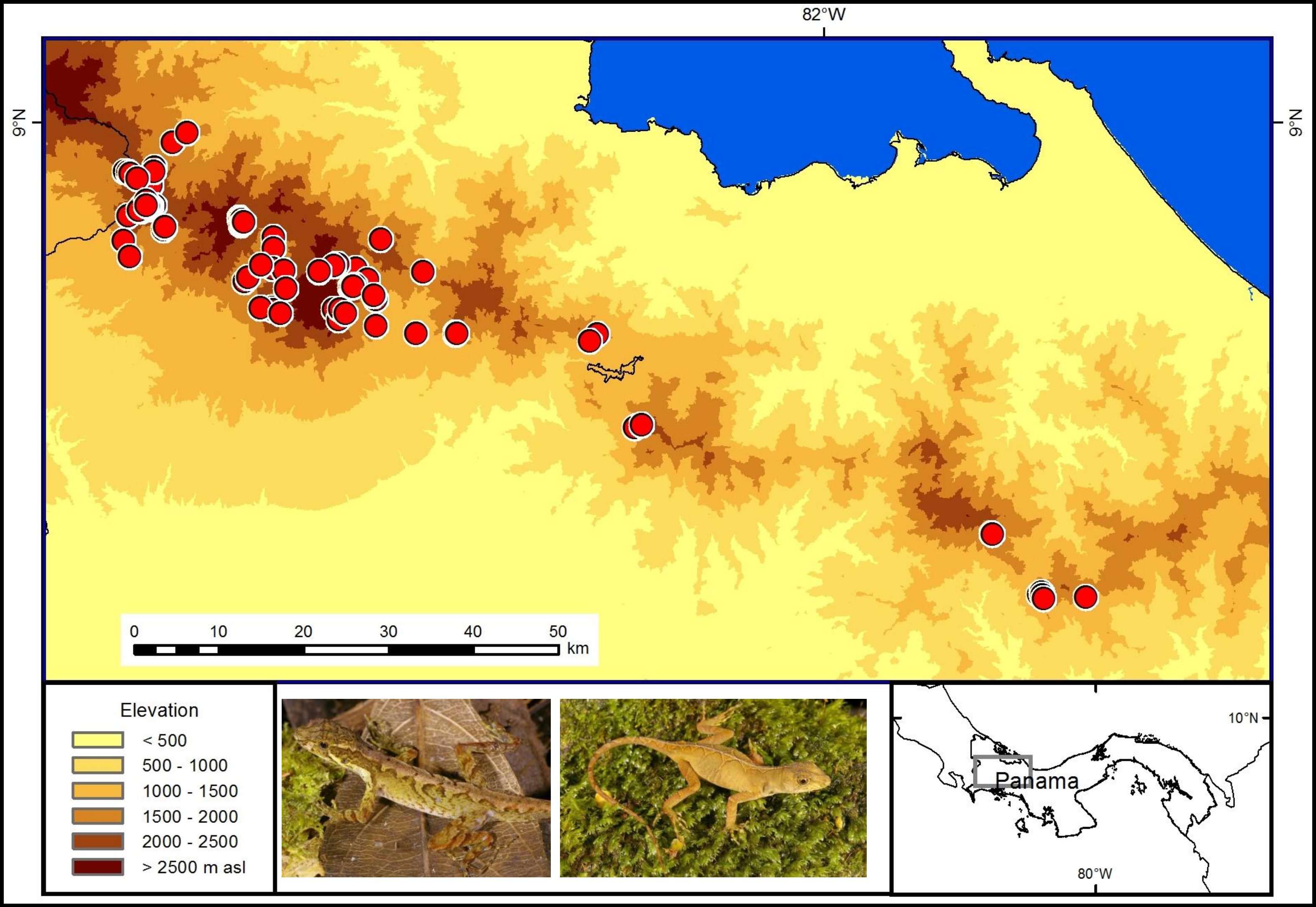


Wirklich?

4. Grenzen der Vorhersehbarkeit:

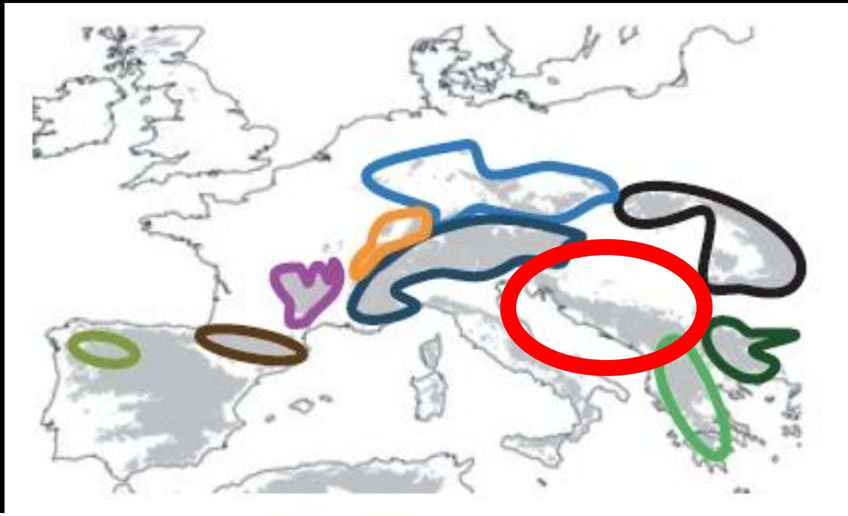
was nicht wissen (können)

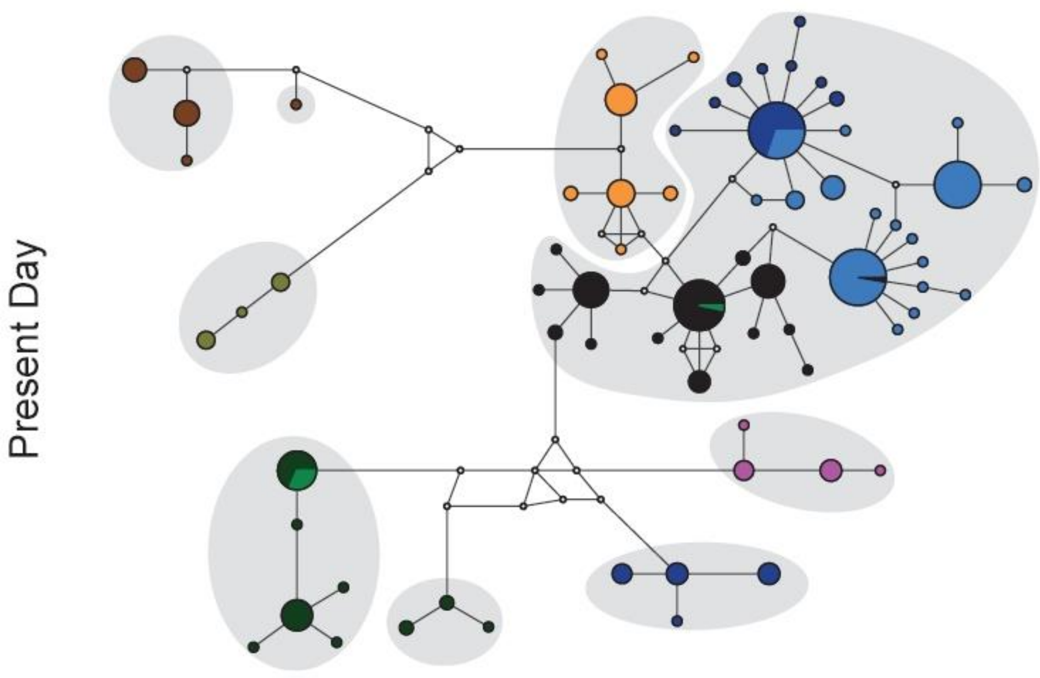
Wie gut ist die Datengrundlage?

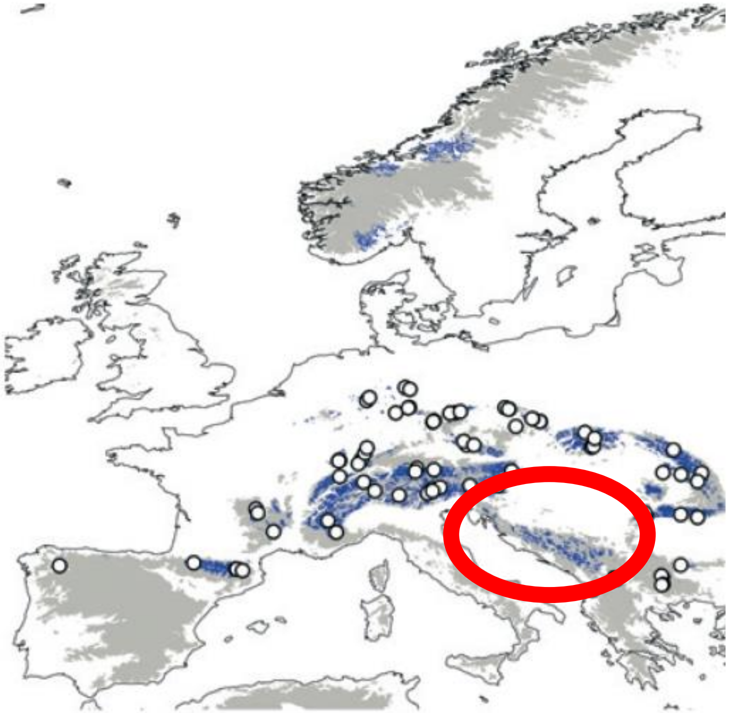


Wie gut ist die Datengrundlage?

Foto: A. Schmidt-Kloiber & W. Graf







Pauls et al. 2012

Wie gut ist die Datengrundlage?

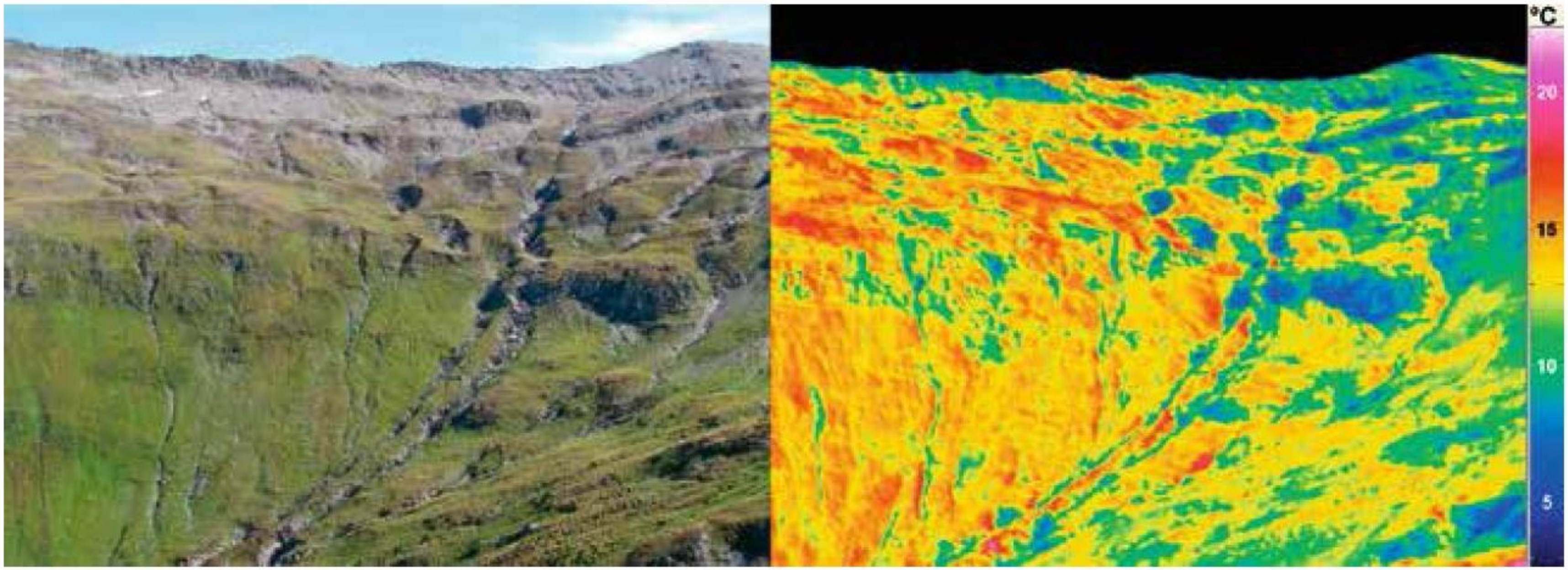


Abbildung 2.9: Geländestruktur, Hangneigung und Exposition schaffen in der baumlosen Hochgebirgslandschaft ein Mosaik an Kleinlebensräumen mit sehr unterschiedlichen Temperaturen. Deshalb sind alpine Organismen weniger gefährdet durch eine allgemeine Erwärmung als Arten in tieferen Lagen. Die Wege zu geeigneteren Lebensräumen sind sehr kurz. Ein Wärmebild zeigt das Wärmemosaik in 2500 Metern Höhe, hier am Beispiel der Furkapass-Region. Während einer Saison unterscheiden sich die Mitteltemperaturen der verschiedenen Kleinlebensräume am Hang um mehr als zehn Grad Celsius. Die Daten wurden mit vielen automatischen Temperatursensoren verteilt über den ganzen Hang ganzjährig erhärtet. (Quelle: Angepasst von Scherrer & Körner 2010)

Swiss Academies Reports, Vol. 11, Nº 5, 2016

Wie gut sind die Modelle?

Foto: Jan Frode

J Ornithol (2012) 153:891–905

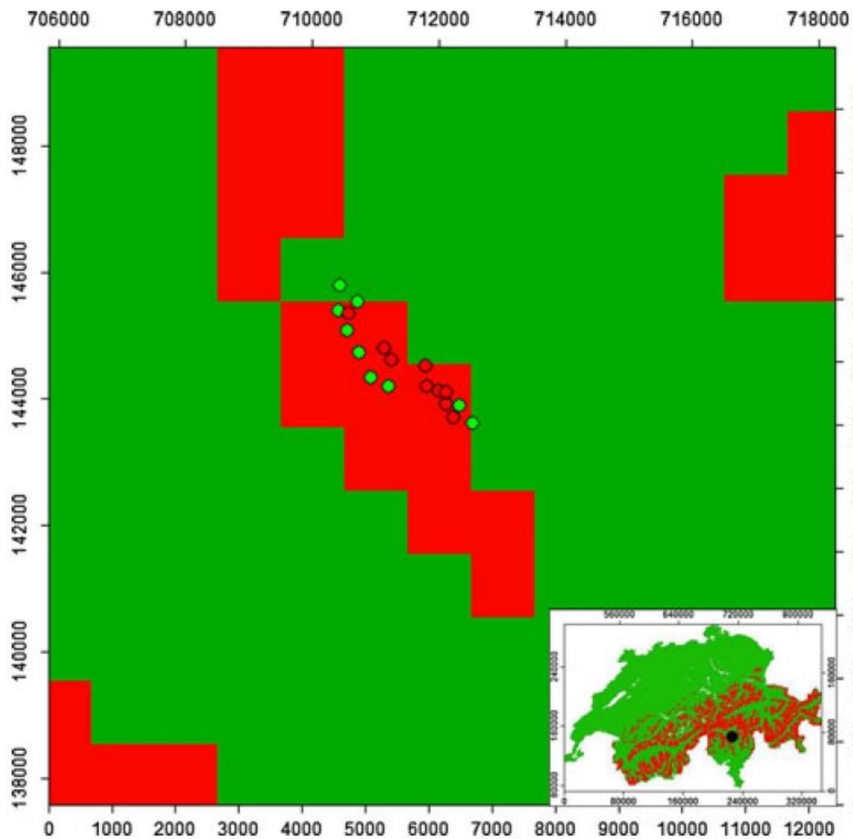
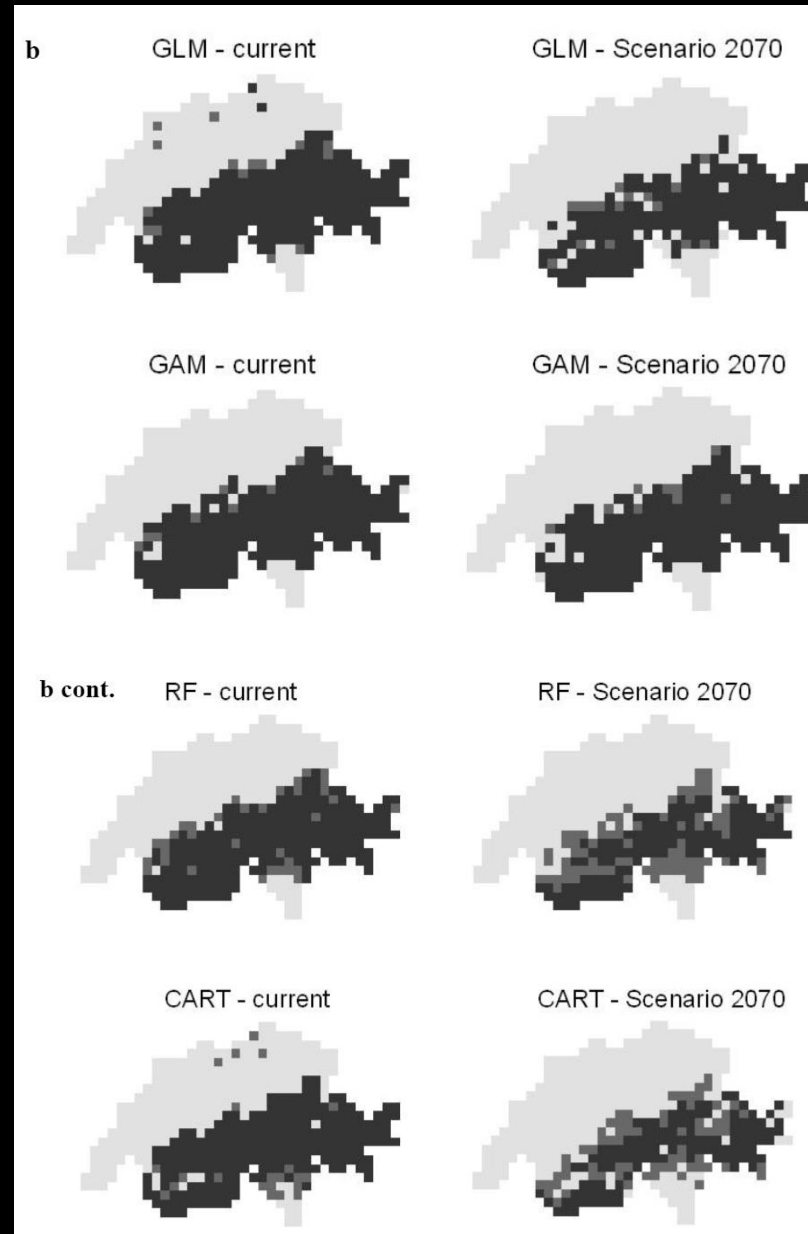


Fig. 2 Example for subgrid variability from Pizo Era ranges in southern Switzerland in the Canton Ticino. Predicted Rock Ptarmigan habitat by the meso-scale model (BRT, 1 × 1 km^2 grid cells) and the predictions of the territory model (BRT, *dots*). *Red* denotes suitable habitat whereas *green* displays unsuitable habitat. *Inset* shows location of Pizo Era ranges in Switzerland

Revermann et al. 2012

Wie gut sind die Modelle?

Foto: Jan Frode



Revermann et al. 2012

Wie gut sind die Modelle?

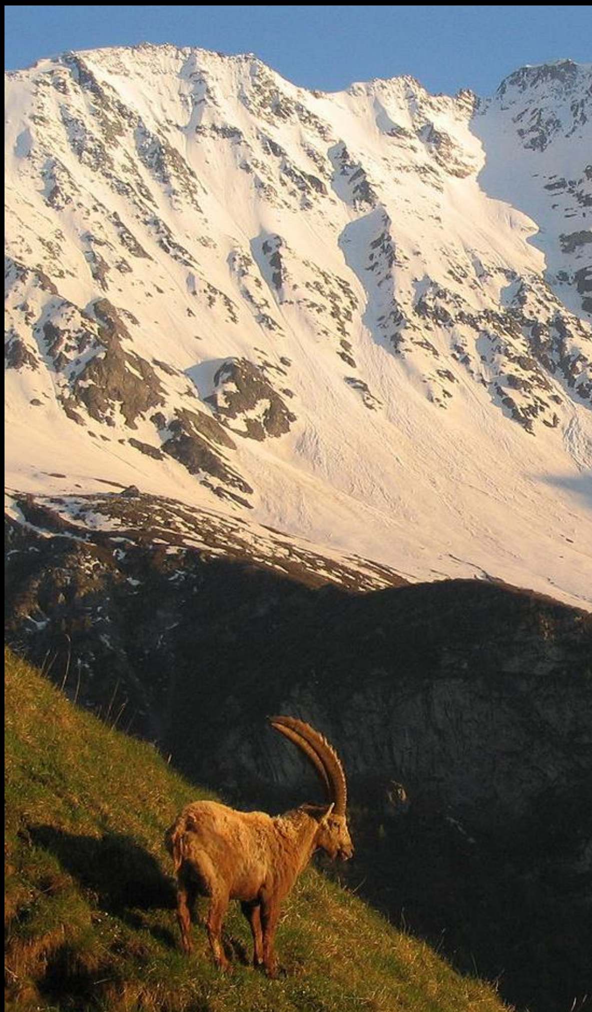


Foto: Eltouristo

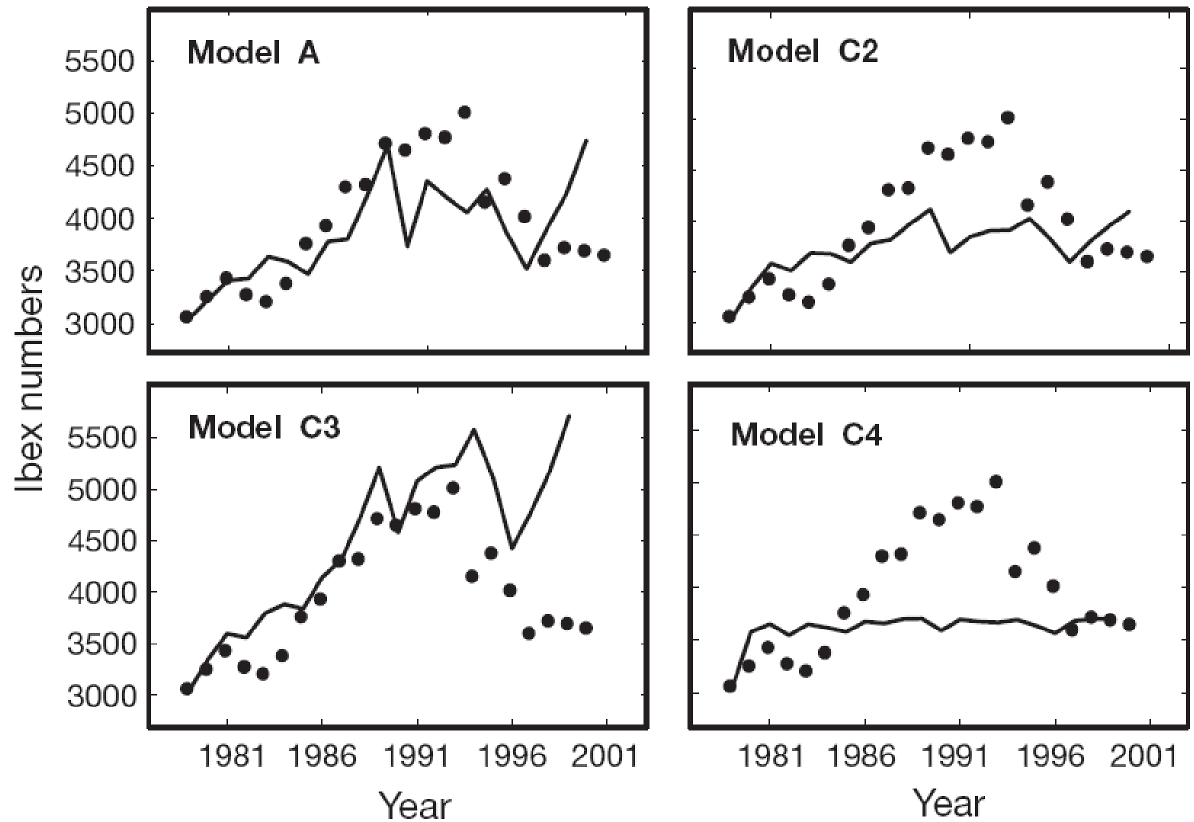


Fig. 3. *Capra Ibex*. Comparison of observed Alpine ibex counts (points) with deterministic predictions (lines) for parameterized models (Table 1). Models fit to data from 1961–1980. Runs began with an initial population size of 3412 ind., the number counted in 1981

Lima & Berryman 2006

Wie gut sind die Modelle?

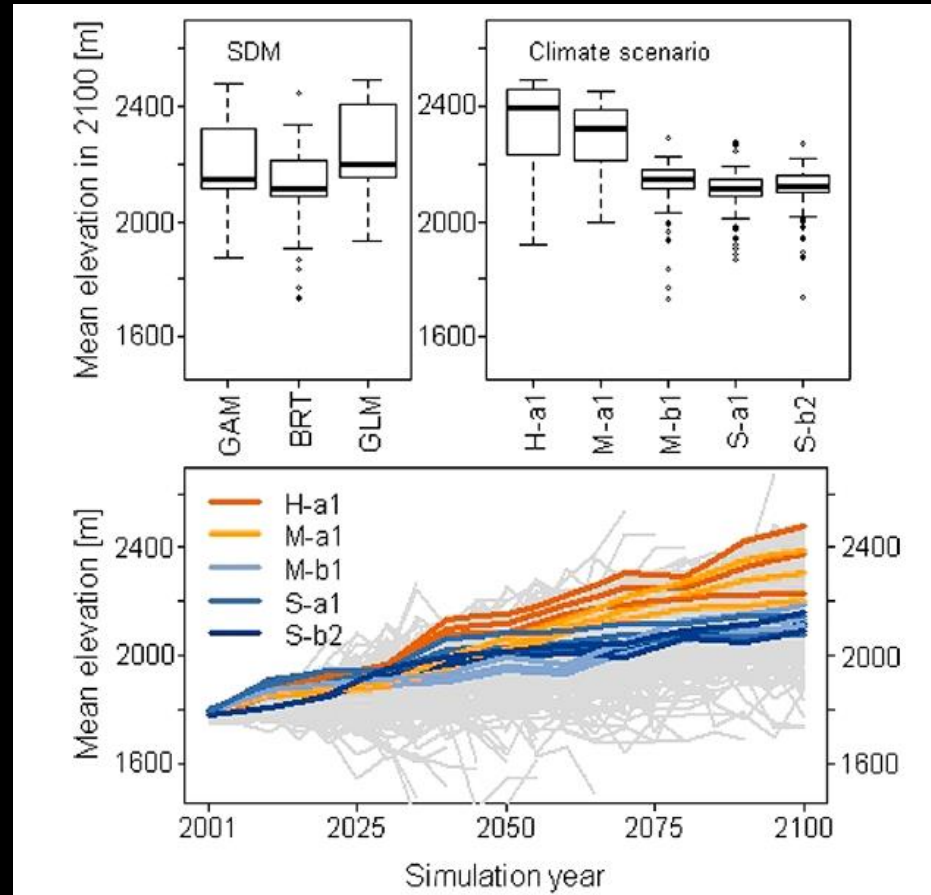
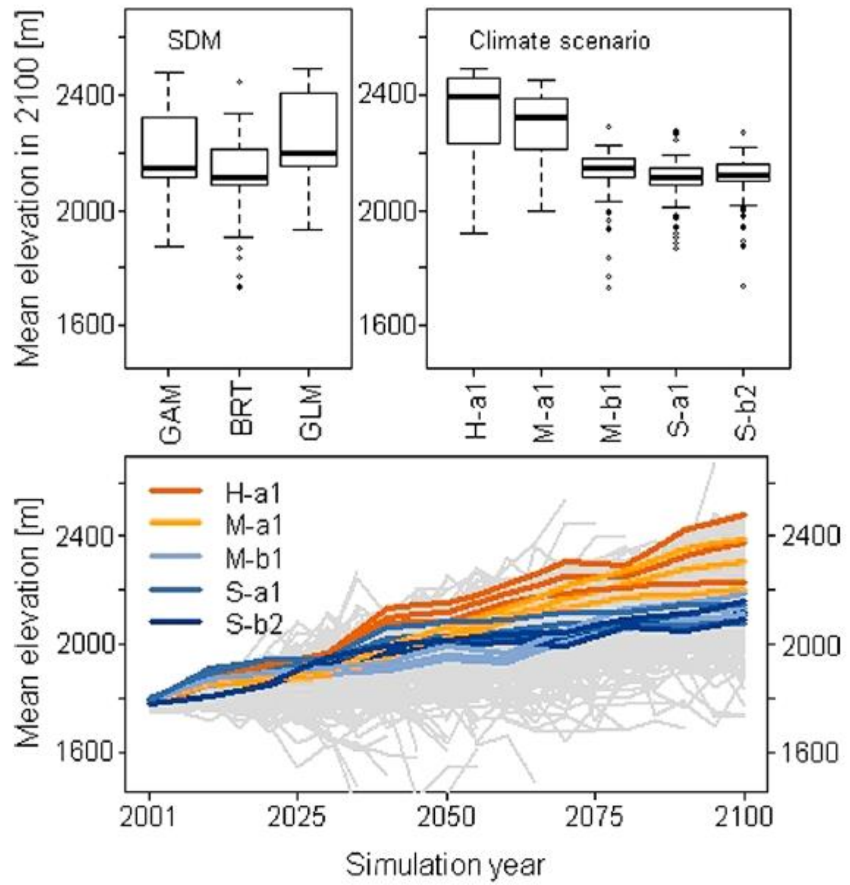


Figure 2. Mean elevation occupied by black grouse for scenarios of climate change. Bottom: grey lines show mean elevations across all simulations, coloured lines those for default IBM parameterisation (cf. Table 2) across different SDMs and climate scenarios. Top: box-plots depict variation of mean elevations predicted for the end of 21st century (2100) and for different SDMs and climate scenarios.

Zurell et al. 2012

Wie verläuft der Klimawandel tatsächlich?



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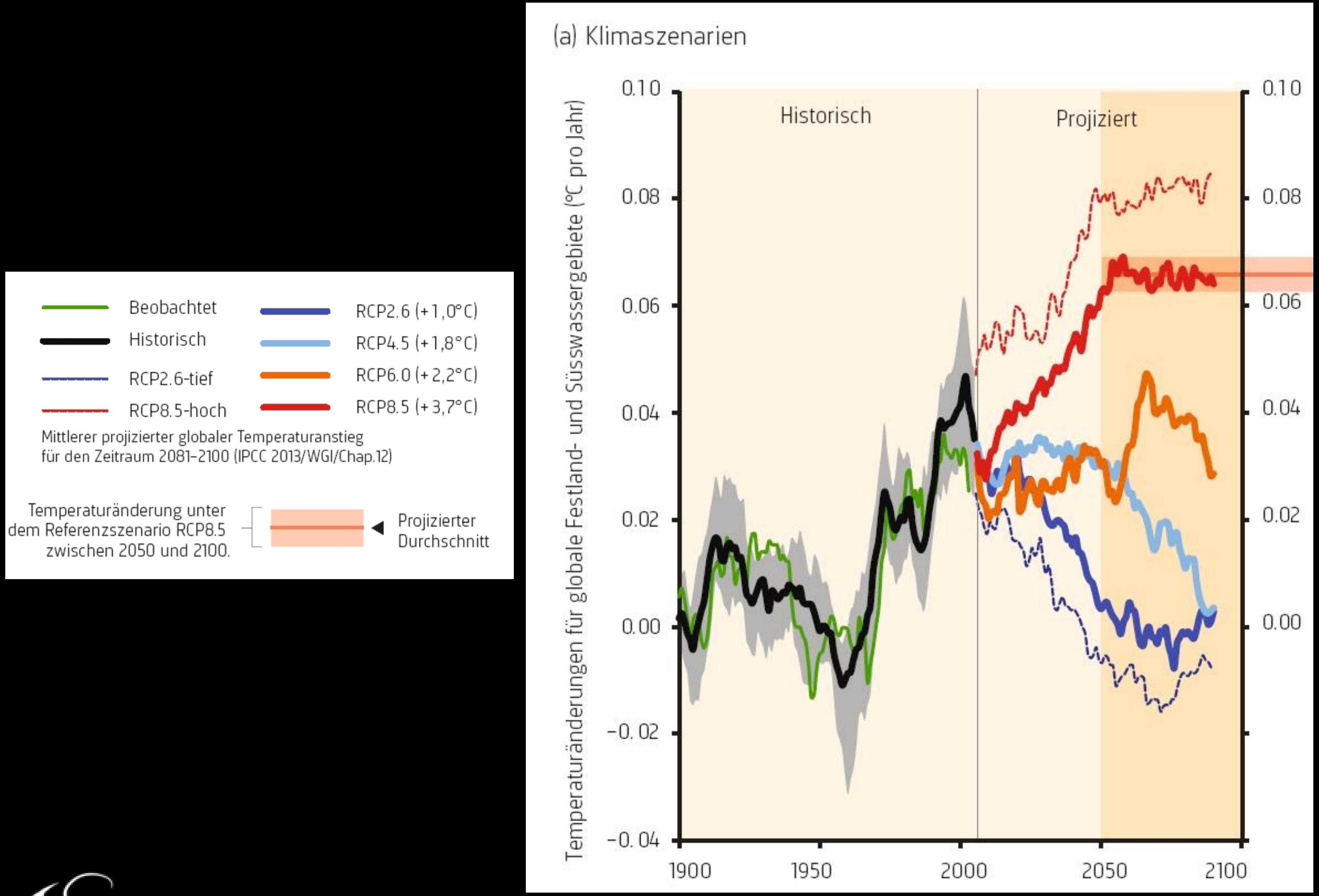
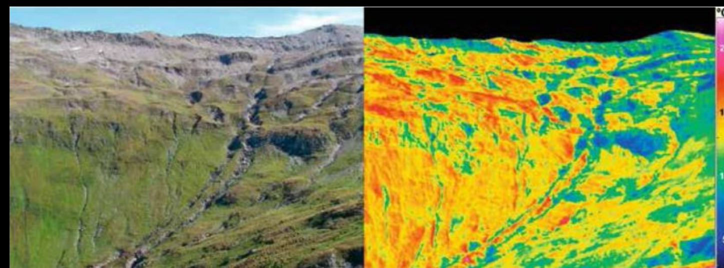


IPCC 2014

Klimawandel ist nicht alles...

Welche anderen Faktoren wirken wie stark?

- abiotisch



- biotisch




- anthropogen!
  - Landnutzung
  - Xenobiotika
  - selbst Klimaschutz...




Wirkmechanismen sämtlicher Faktoren?

?

Klimawandel ist nicht alles...

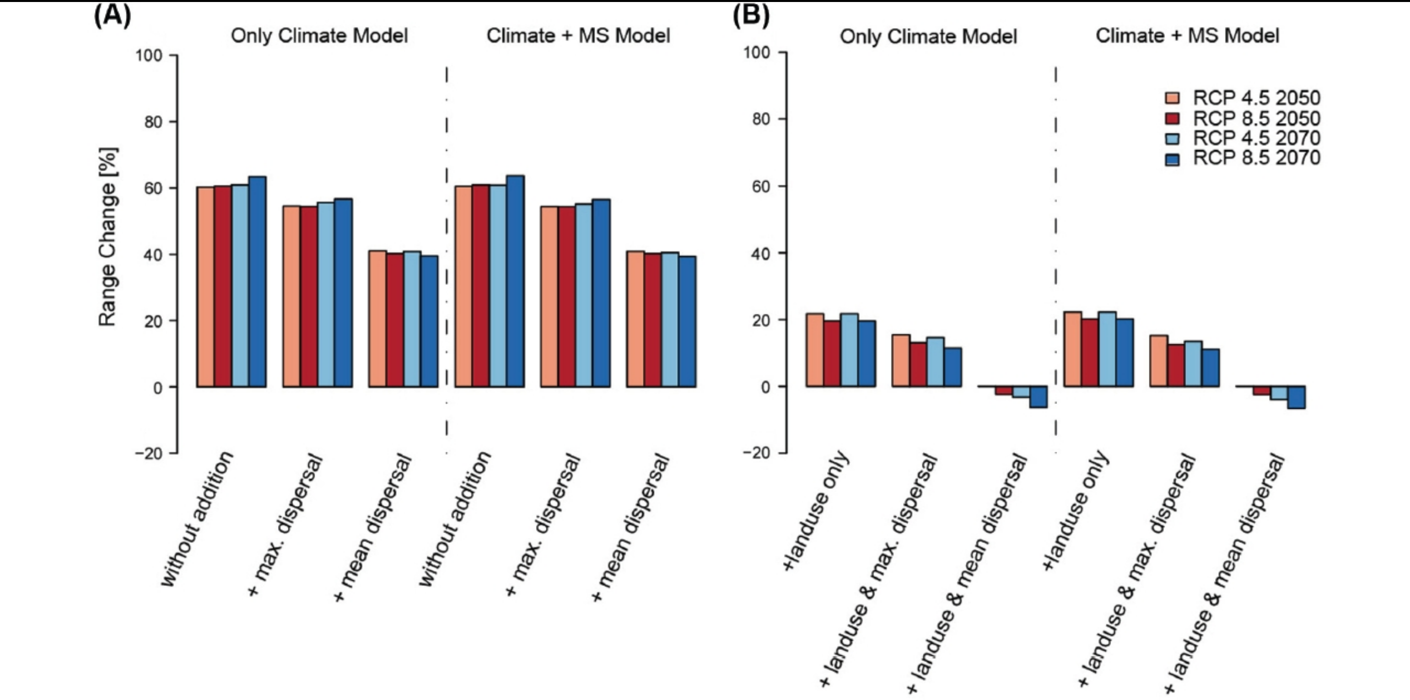


Figure 6. Projected change in range size *E. hortulana* for 2050 and 2070 and two representative concentration pathways (RCP 4.5 and RCP 8.5). Results are shown for both final BRT models: Model-Tmin (climate only) and Model-MS (climate and metabolic suitability; see text). Additionally, results were divided into two groups: range change without accounting for land-use change (A) and with accounting for land-use change (B). In the latter case the range change was calculated based on the distributions which were refined by land-use data both under current and projected future conditions. The percentage change in range size is given for six different scenarios: climate-only or climate and physiology, assuming unlimited dispersal and no land-use change ("Without Addition"); adding mean or maximum natal dispersal distance and no land-use change ("Max./Mean Dispersal"); accounting for land-use change but assuming unlimited dispersal ("Land-Use Only"); adding mean or maximum dispersal while accounting for land-use change ("Land-Use + Max. Dispersal"/"Land-Use + Mean Dispersal").

Methorst et al. 2017

Wie schnell / gut kann sich die Art tatsächlich...

...anpassen?

- ethologisch
- phänotypisch
- genotypisch

Wie schnell / gut kann sich die Art tatsächlich...

...ausbreiten?

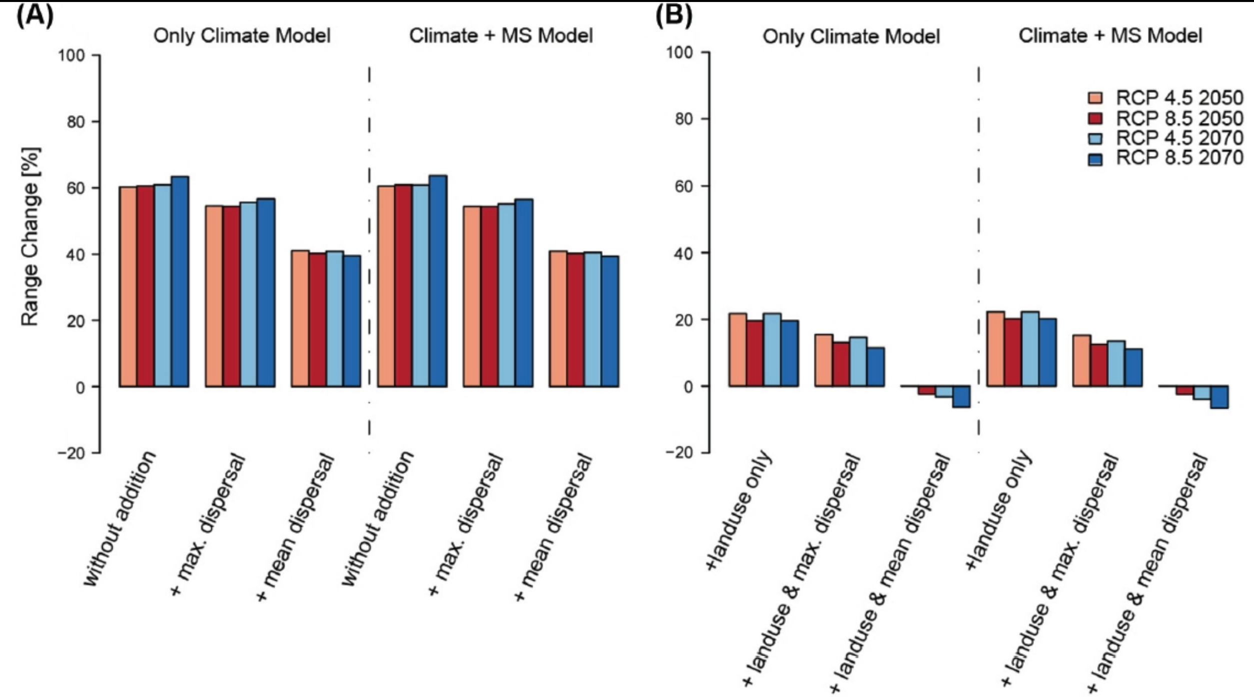
- Labor vs. Realität im Freiland
- natürliche Barrieren
- anthropogene Barrieren
- ...

Wie schnell / gut kann sich die Art tatsächlich...

...anderswo etablieren?

- in anderen Habitatstrukturen
- mit anderen "Mitbewohnern"
- trotz uns
- ...

Wir geloben Besserung!



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Methorst et al. 2017

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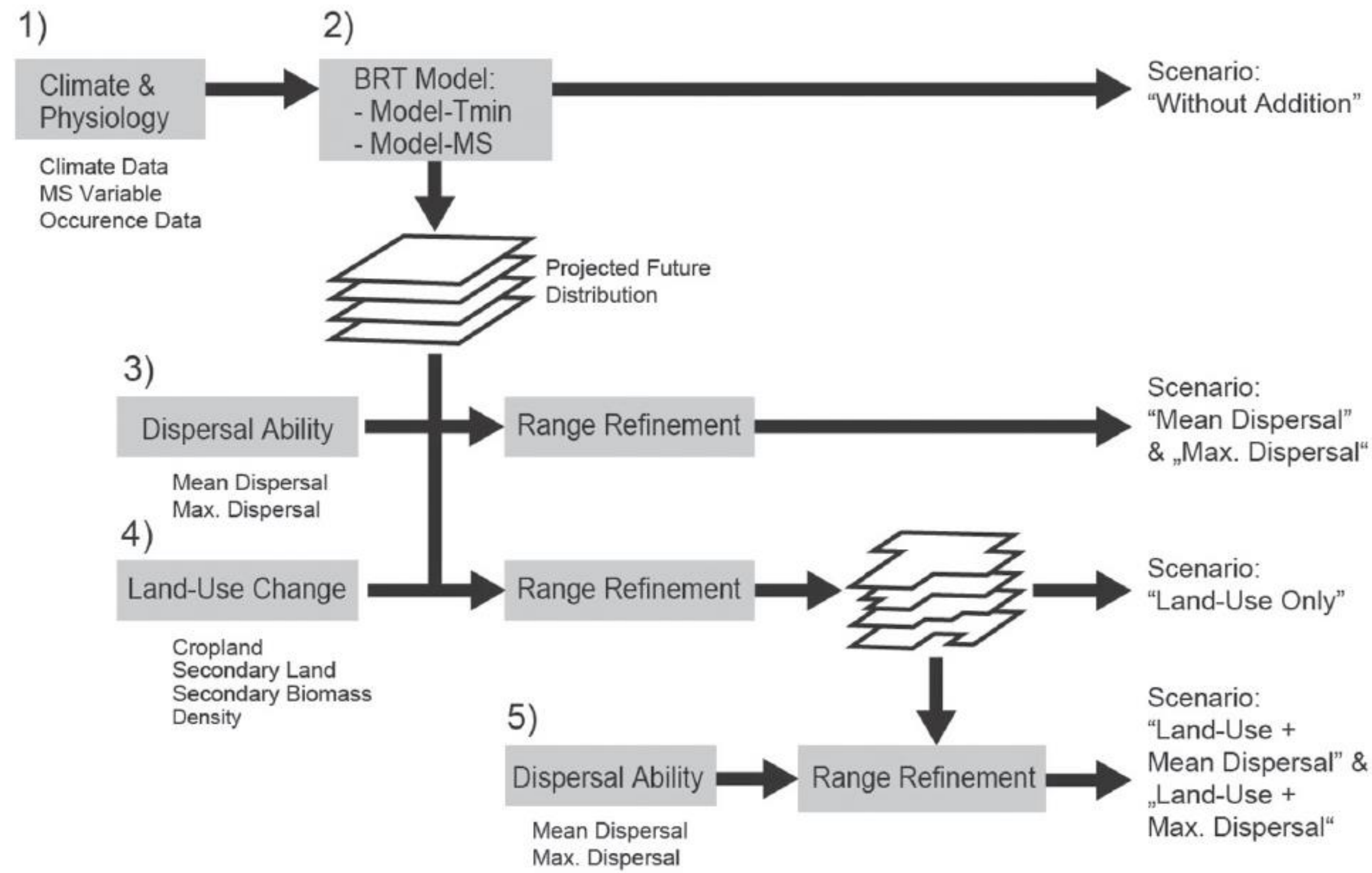
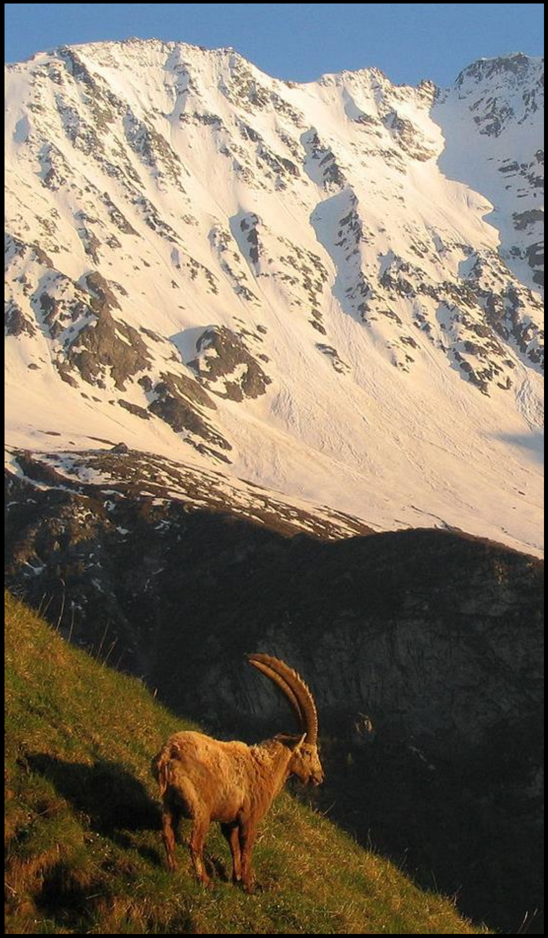


Figure 3. Schematic overview of the methodological steps of our analyses. In the first step 1) we prepare occurrence data, climatic data and the metabolic suitability variable (MS) in order to conduct the BRT models 2). Based on these BRT models, we create four different projections of *E. hortulana's* future distribution for each time period (2050 and 2070) and RCP (RCP 4.5 and RCP 8.5). In the subsequent steps (3 to 5), we refine the projected future distribution with future land-use data and observed natal dispersal distances. The final output of this procedure are six different scenarios per BRT model: climate-only or climate and physiology, assuming unlimited dispersal and no land-use change ("Without Addition"); adding mean or maximum natal dispersal distance and no land-use change ("Max./Mean Dispersal"); accounting for land-use change but assuming unlimited dispersal ("Land-Use Only"); adding mean or maximum dispersal while accounting for land-use change ("Land-Use + Max. Dispersal"/"Land-Use + Mean Dispersal").

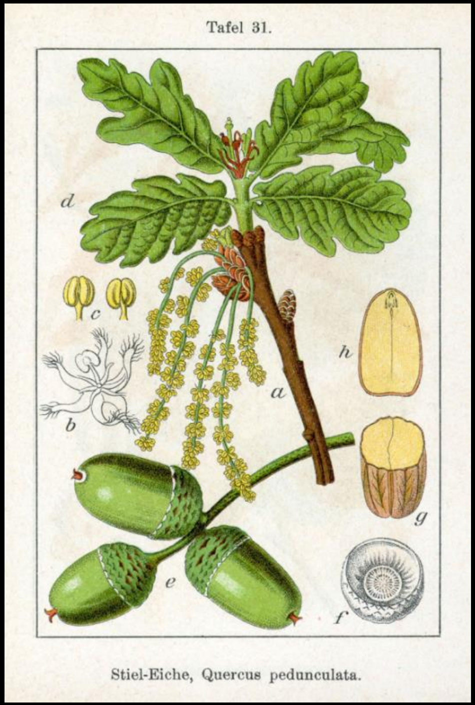
Methorst et al. 2017

5. Folgerungen

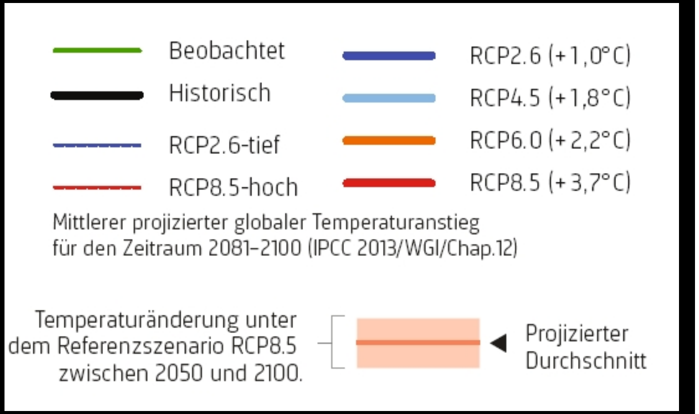
Ganz klar: Klimawandel beeinflusst Tiere

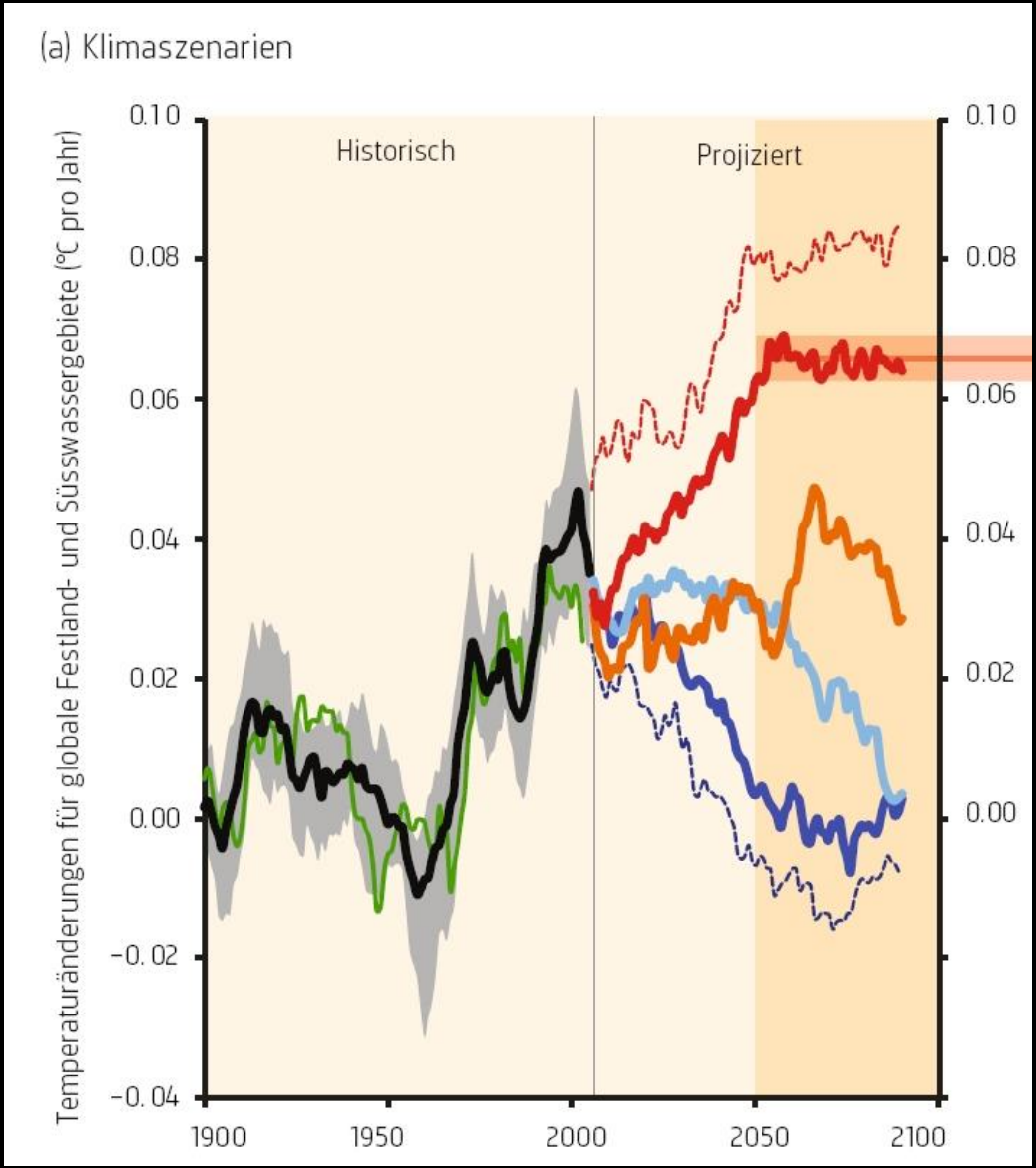


Klimawandel wirkt artspezifisch und komplex



Was wir bisher beobachten ist nur der Anfang...





IPCC 2014

Entscheidend für das längerfristige Überleben:

Anpassungsfähigkeit

Ausbreitungsfähigkeit

Etablierungsfähigkeit

Klimagewinner & Klimaverlierer

Klimagewinner sind oft ...

- euryöke Generalisten
- wärmeliebend
- Flachlandarten
- Offenlandarten

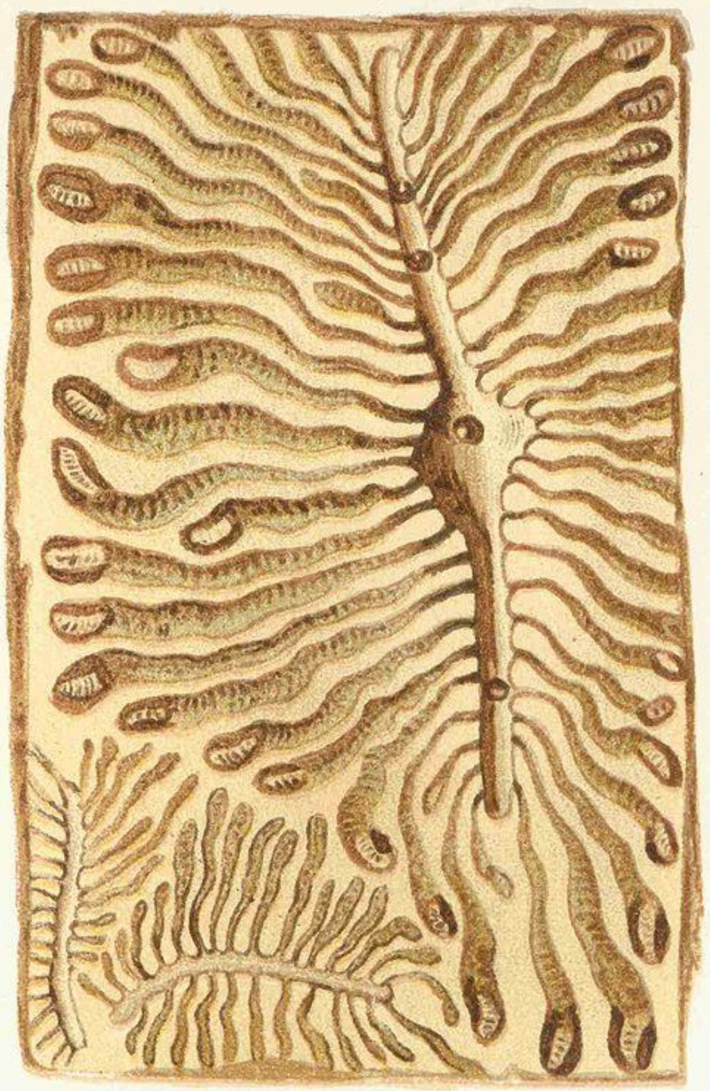
Klimaverlierer sind oft ...

- stenöke Spezialisten
- mesisch bzw. kaltadaptiert
- Gebirgsarten
- Waldarten

Problematische Gewinner...

Problematische Gewinner...

Problematische Gewinner...



Brutkolonie des Fichtenborkenkäfers.

Problematische Gewinner...

Problematische Gewinner...

Foto: CDC / James Gathany

Neue Maßnahmen sind gefragt!

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"Neue" Maßnahmen sind gefragt!

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"Neue" Maßnahmen sind gefragt!


Update
TRENDS in Ecology and Evolution Vol.xxx No.x
Research Focus
Top predators provide insurance against climate change
Enric Sala
Center for Marine Biodiversity and Conservation, Scripps Institution of Oceanography, La Jolla, CA 92093-0202, USA

Sala 2006

"Neue" Maßnahmen sind gefragt!

Kommen, gehen, bleiben?   Dreimal ja!

➔ Artengemeinschaften werden sich allerorten verändern

➔ dadurch ändern sich auch
Ökosystemfunktionen & -dienstleistungen...

...und wer, wie, was genau?

- Wirkmechanismen & Zusammenhänge großteils unbekannt
- Prognosen mit großen Unsicherheiten behaftet...

➔ am charmantesten hat es noch Doris Day gesagt:

Forschungsbedarf!

- Zusammenhänge...
  - Biodiversität & Ökosystemfunktionen / -dienstleistungen
  - Biodiversität & Landnutzung
  - Klimawandel & genetische Diversität
- Schnelle (Mikro-) Evolution

  ➔ mögliche Reaktion auf schnellen Klimawandel?
- biotische Interaktionen

  ➔ Wer hängt wie und worüber von wem ab?
- Umweltbeobachtung & Daten, Daten, Daten!

  ➔ je feinskaliger und umfassender, desto besser!

Handlungsbedarf!

- verstärktes Monitoring
    - sensible Systeme, Indikatoren
    - Gefahrenpotentiale

- geeignete Ausweichkorridore
    ➔ Biotopverbundsysteme über bestehende Schutzgebiete hinaus

- Dialog & Zusammenarbeit aller Beteiligten
    - Forst, Jagd, Landwirtschaft, Naturschutz, Wissenschaft
    - Politik, Wirtschaft & Gesellschaft

➔ **Besser jetzt als gleich!**

Epilog

*"Wir müssen keine Arten schützen,
Aussterben ist ein Teil der Evolution.*

*Die einzige Art, die wir retten müssen,
sind wir selbst"*

R. Alexander Pyron

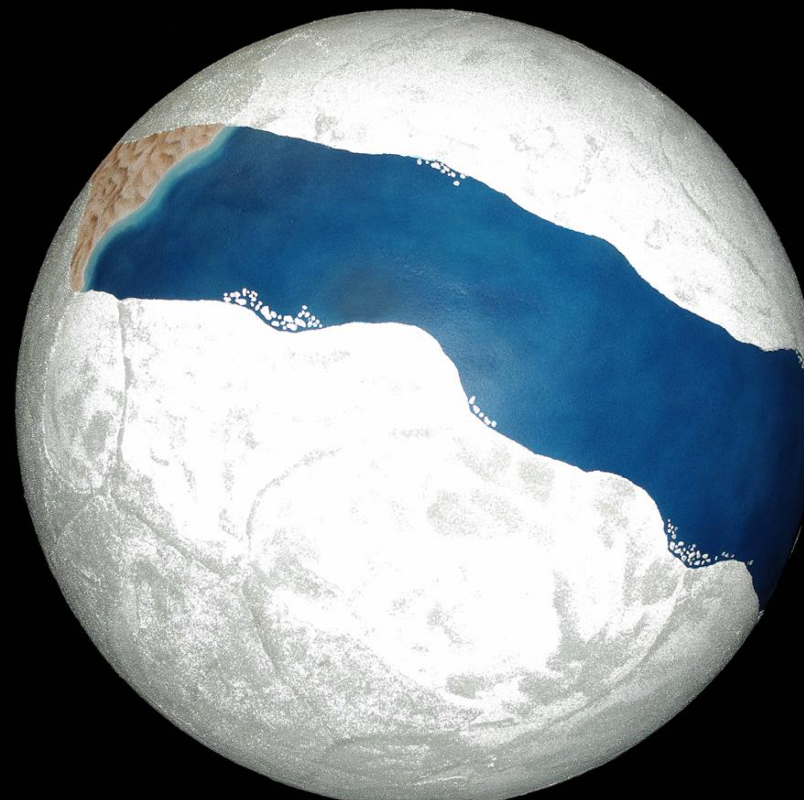
Organismen beeinflussen Klima

Wir entfernen das böse Treibhausgas CO_2 !!!

Organismen beeinflussen Klima

Wir entfernen das böse Treibhausgas CO_2 !!!

Schneeball Erde



Tiere beeinflussen Klima

Mir entweichen
so um die 700 kg
Methan pro Jahr...

Planet Lino

mobil 10.2012

Dinos pupsten Klima warm

Seit Langem ist bekannt, dass Kühe und andere Wiederkäuer vor allem beim Rülpsen das Gas **METHAN** ausstoßen und damit zur Klimaerwärmung beitragen. Ein Forscherteam hat nun herausgefunden, dass es dieses Phänomen auch schon in der Urzeit gab: Laut David Wilkinson und seinen Kollegen von der John-Moores-Universität im englischen Liverpool hatten viele pflanzenfressende Dinosaurier nicht nur gigantische Körper, sondern auch gigantische **BLÄHUNGEN**. »Ähnlich wie bei Kühen halfen etwa Bakterien den Dinosauriern, die Nahrung zu verdauen«, erklärt Wilkinson. Dabei entstand so viel Methan, dass die Dinopupse und -rülpser die urzeitliche Erde spürbar erwärmten!

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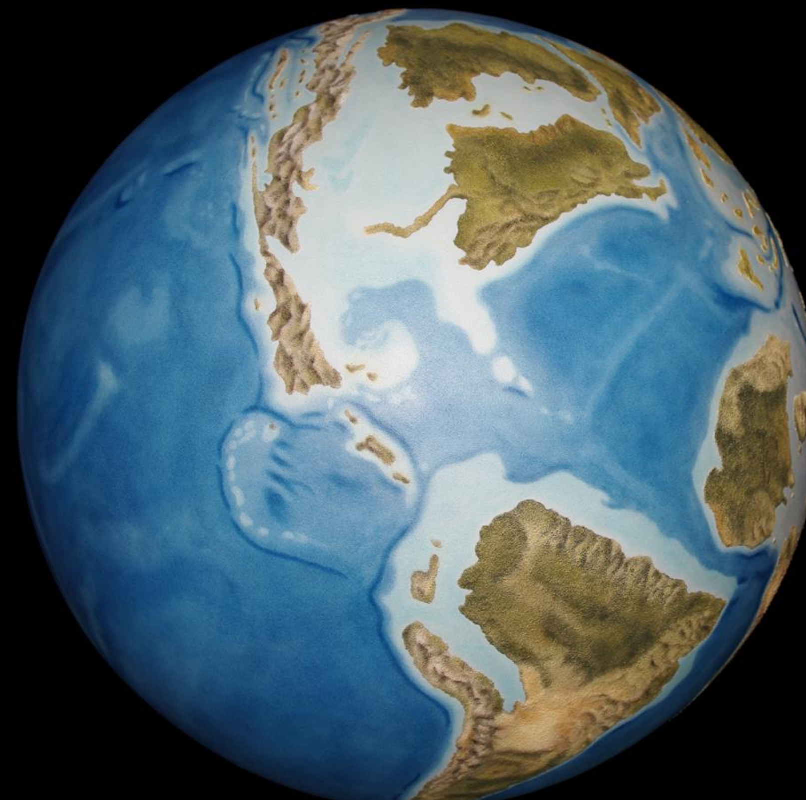
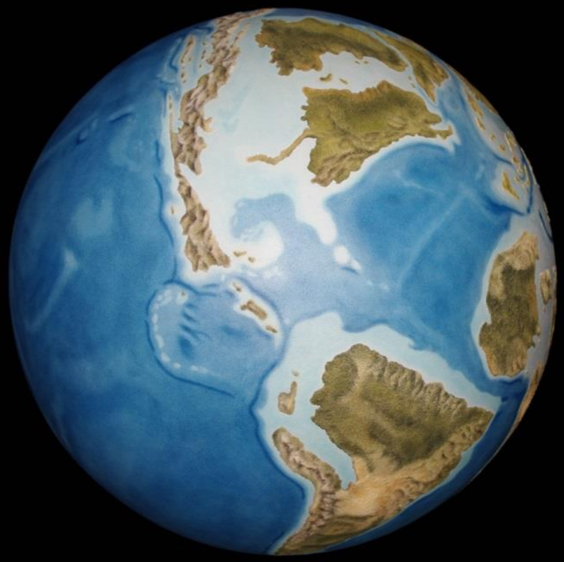
Treibhaus Erde



(prinzipiell zu Intelligenz befähigte)

Tiere beeinflussen Klima

Auf welcher hätten unsere Kinder das bessere Leben?



Vielen Dank!