Składy gatunkowe drzewostanów Europy w obliczu zmiany klimatu

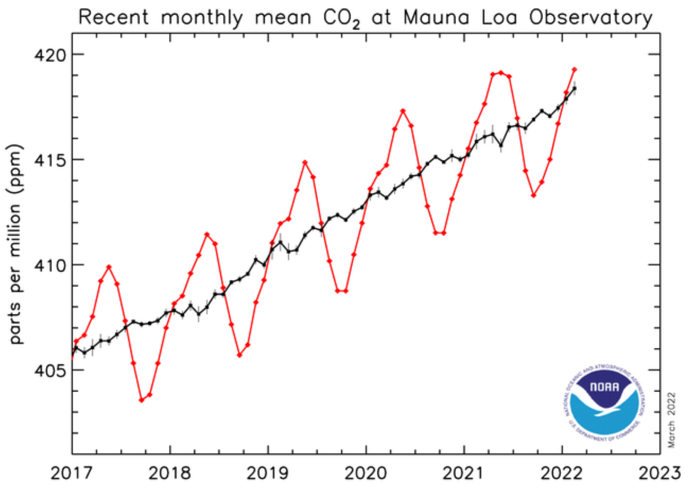
Andrzej M. Jagodziński
Instytut Dendrologii Polskiej Akademii Nauk

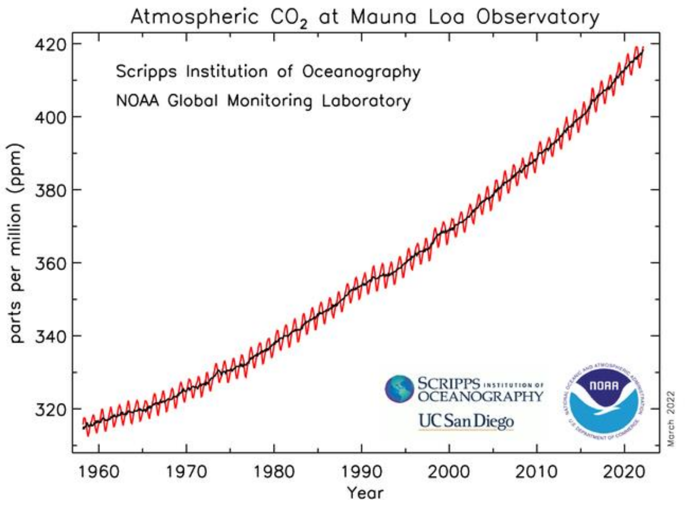
ul. Parkowa 5, 62-035 Kórnik
amj@man.poznan.pl

LIFE+ ForBioSensing

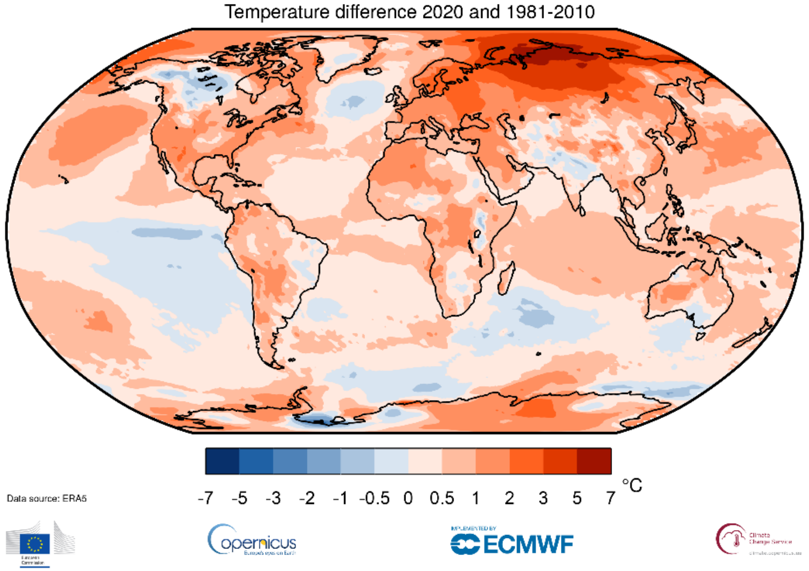
Konferencja podsumowująca projekt LIFE+ ForBioSensing, 29.03.2022 r.

Globalna zmiana klimatu

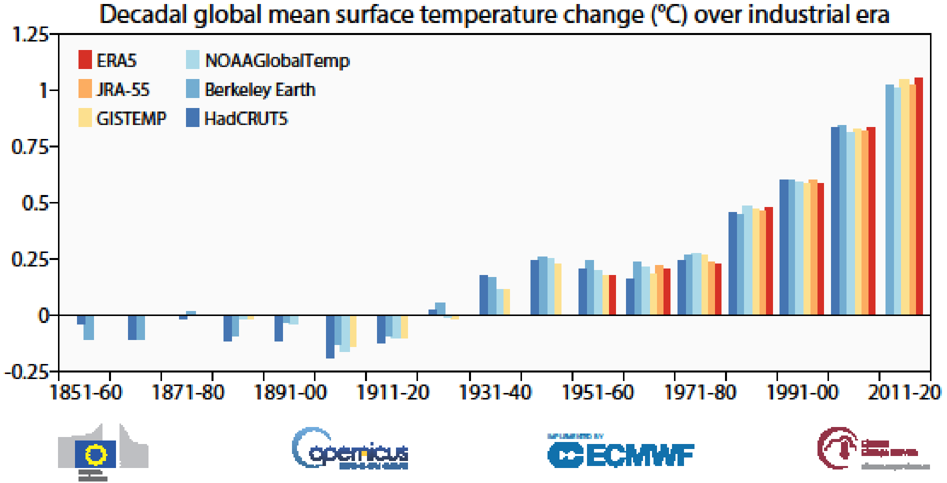




Global Monitoring Laboratory; Mauna Loa; https://gml.noaa.gov/ccgg/trends/



Temperatura powietrza na wys. 2 m dla roku 2020 w odniesieniu do średniej z lat 1981-2010. Źródło: ERA5. Credit: Copernicus Climate Change Service/ECMWF



Średnie dziesięcioletnie temperatury globalne powietrza na wys. 2 m w odniesieniu do ery preindustrialnej. Źródła danych: ERA5 (ECMWF Copernicus Climate Change Service, C3S); GISTEMPv4 (NASA); HadCRUT5 (Met Office Hadley Centre); NOAAGlobalTempv5 (NOAA), JRA-55 (JMA); Berkeley Earth. Credit: Copernicus Climate Change Service/ECMWF

Globalna zmiana klimatu

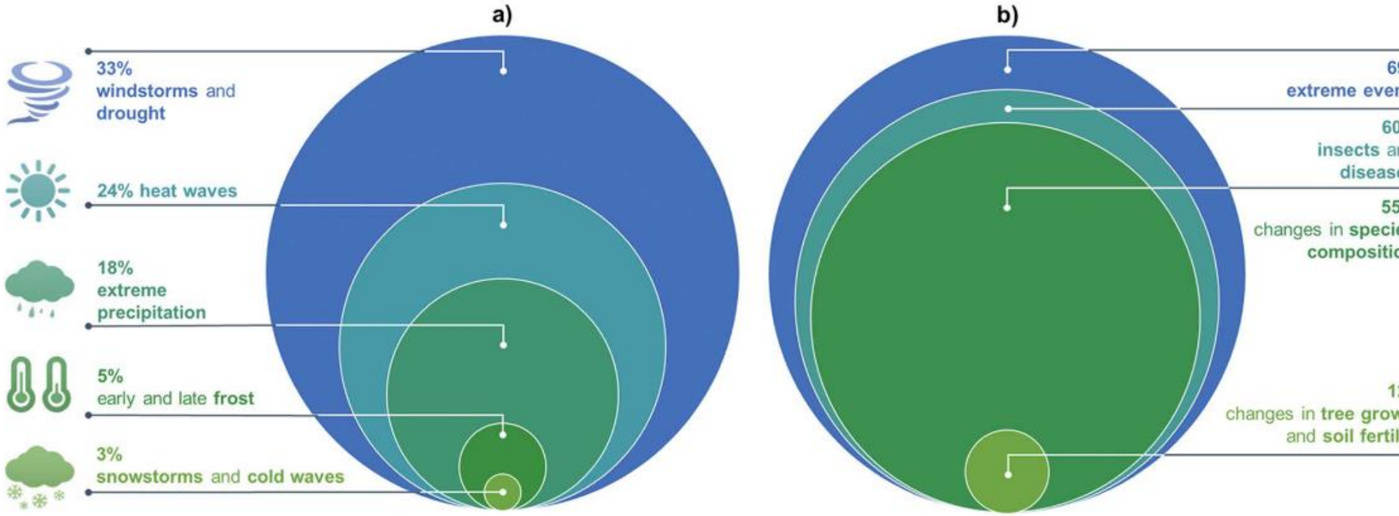


Fig. 1. Experienced extreme events perceived as climate change related (a), and expected future impacts on forests (b). Circle areas are proportional to the number of responses.

Forest Policy and Economics 90 (2018) 22–30

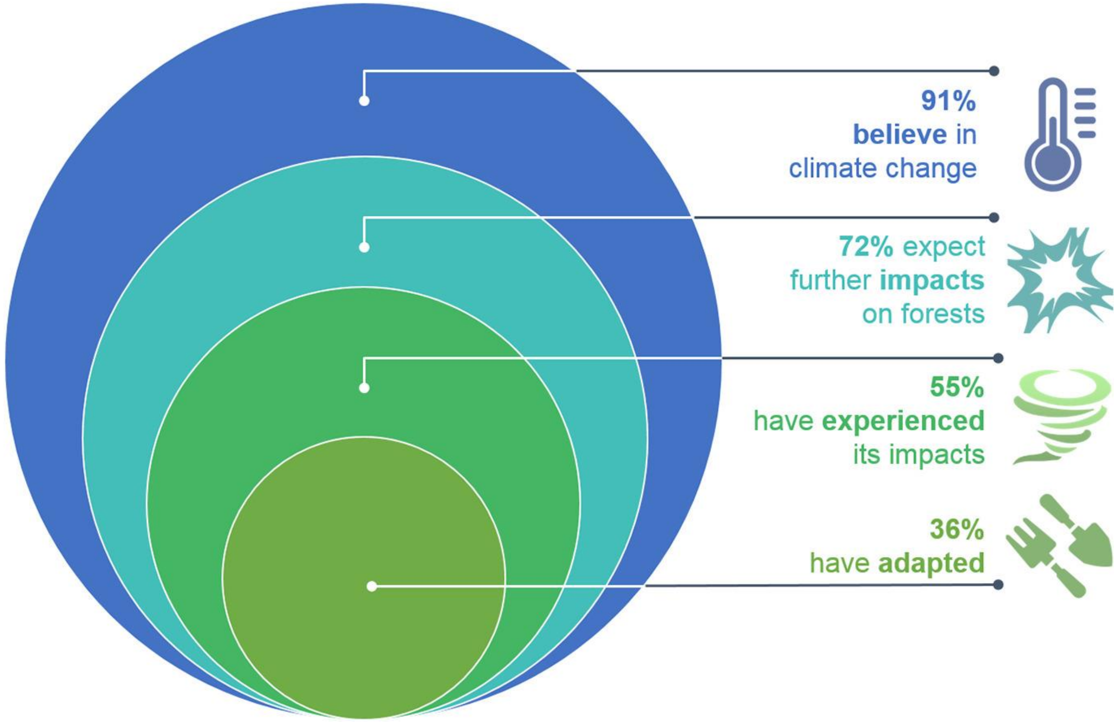
Contents lists available at ScienceDirect

Forest Policy and Economics

journal homepage: www.elsevier.com/locate/forpol

Adapting forest management to climate change in Europe: Linking perceptions to adaptive responses

Rita Sousa-Silva[a,*], Bruno Verbist[a], Ângela Lomba[b], Peter Valent[c], Monika Suškevičs[d], Olivier Picard[e], Marjanke A. Hoogstra-Klein[f], Vasile-Cosmin Cosofret[g], Laura Bouriaud[g], Quentin Ponette[h], Kris Verheyen[i], Bart Muys[a,j,*]



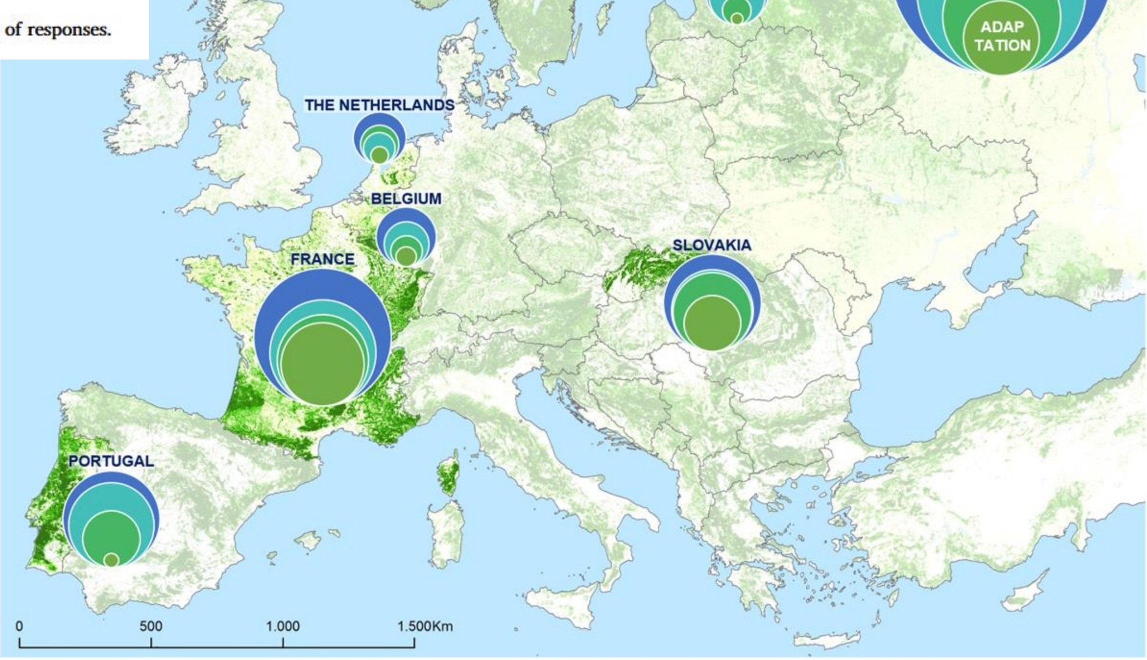
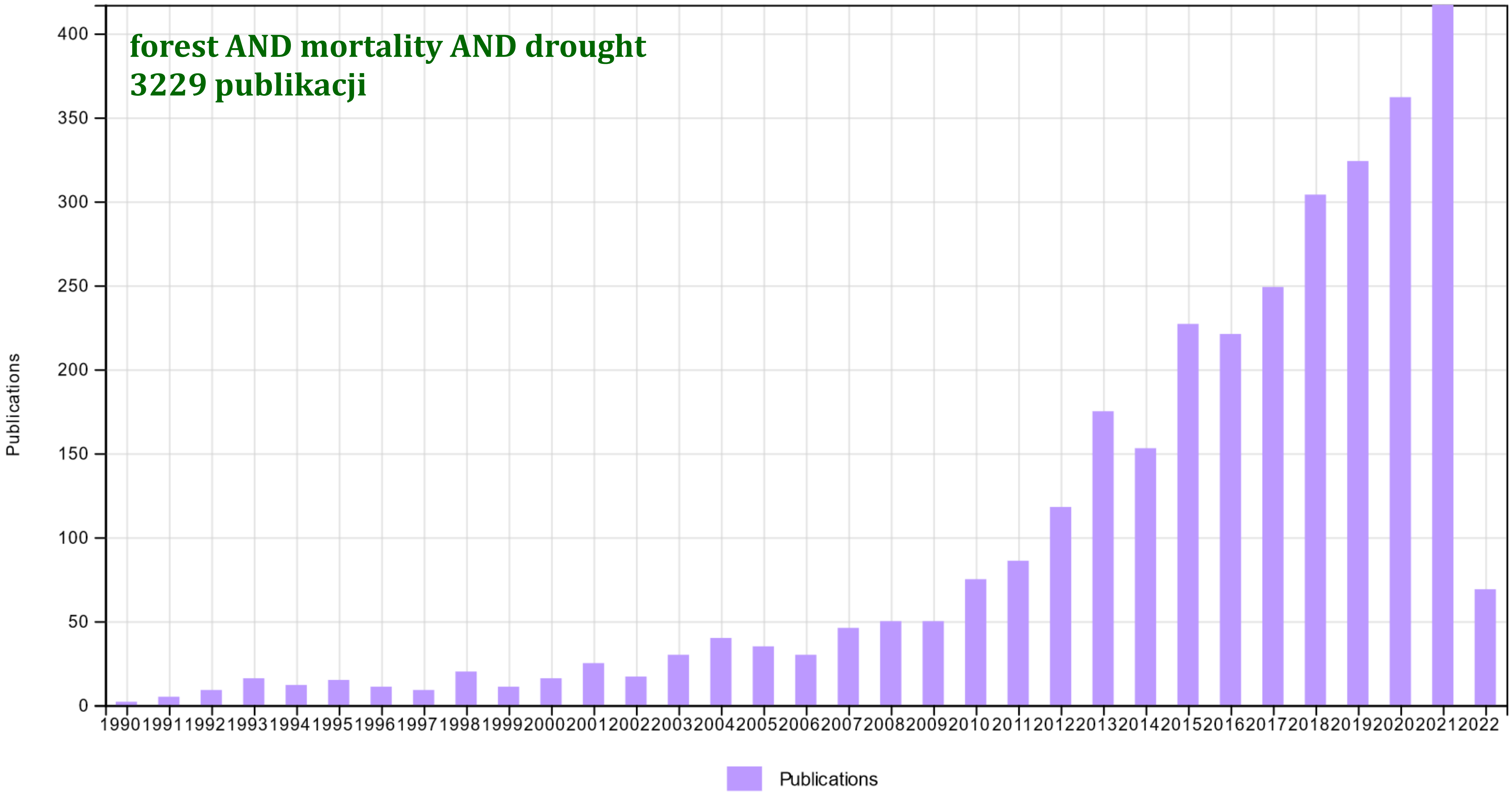


Fig. 4. Beliefs and perceptions about climate change: general belief (blue), awareness of potential impacts (tile), personal experiences (sea green), and implementation of climate adaptation actions (apple green).

Wzrost śmiertelności drzew

Clarivate™



forest AND mortality AND drought
3229 publikacji

Wzrost śmiertelności drzew

Regional vegetation die-off in response to global-change-type drought

David D. Breshears[a,b], Neil S. Cobb[c], Paul M. Rich[d], Kevin P. Price[e,f], Craig D. Allen[g], Randy G. Balice[h], William H. Romme[i], Jude H. Kastens[f,j], M. Lisa Floyd[k], Jayne Belnap[l,m], Jesse J. Anderson[c], Orrin B. Myers[n], and Clifton W. Meyer[d]

[a]School of Natural Resources, Institute for the Study of Planet Earth, and Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, AZ 85721-0043; [c]Merriam Powell Center for Environmental Research and Department of Biological Sciences, Northern Arizona University, Flagstaff, AZ 86011; [d]Earth and Environmental Sciences Division, and [h]Environmental Stewardship Division, University of California–Los Alamos National Laboratory, Los Alamos, NM 87545; Departments of [e]Geography and [j]Mathematics, University of Kansas, Lawrence, KS 66045; [f]Kansas Applied Remote Sensing Program, 2101 Constant Avenue, Lawrence, KS 66047-3759; [g]Fort Collins Science Center, U.S. Geological Survey, Jemez Mountains Field Station, Los Alamos, NM 87544; [i]Forest, Rangeland, and Watershed Stewardship, Colorado State University, Fort Collins, CO 80523; [k]Environmental Studies Program,Prescott College, 220 Grove Avenue, Prescott, AZ 86301; [l]Southwest Biological Science Center, U.S. Geological Survey, Moab, UT 84532; [m]Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO 80523-1499; and [n]Division of Epidemiology and Biostatistics, University of New Mexico, Albuquerque, NM 87131

Edited by Harold A. Mooney, Stanford University, Stanford, CA, and approved September 7, 2005 (received for review July 8, 2005)

PNAS 2005; 102(42): 15144-15148

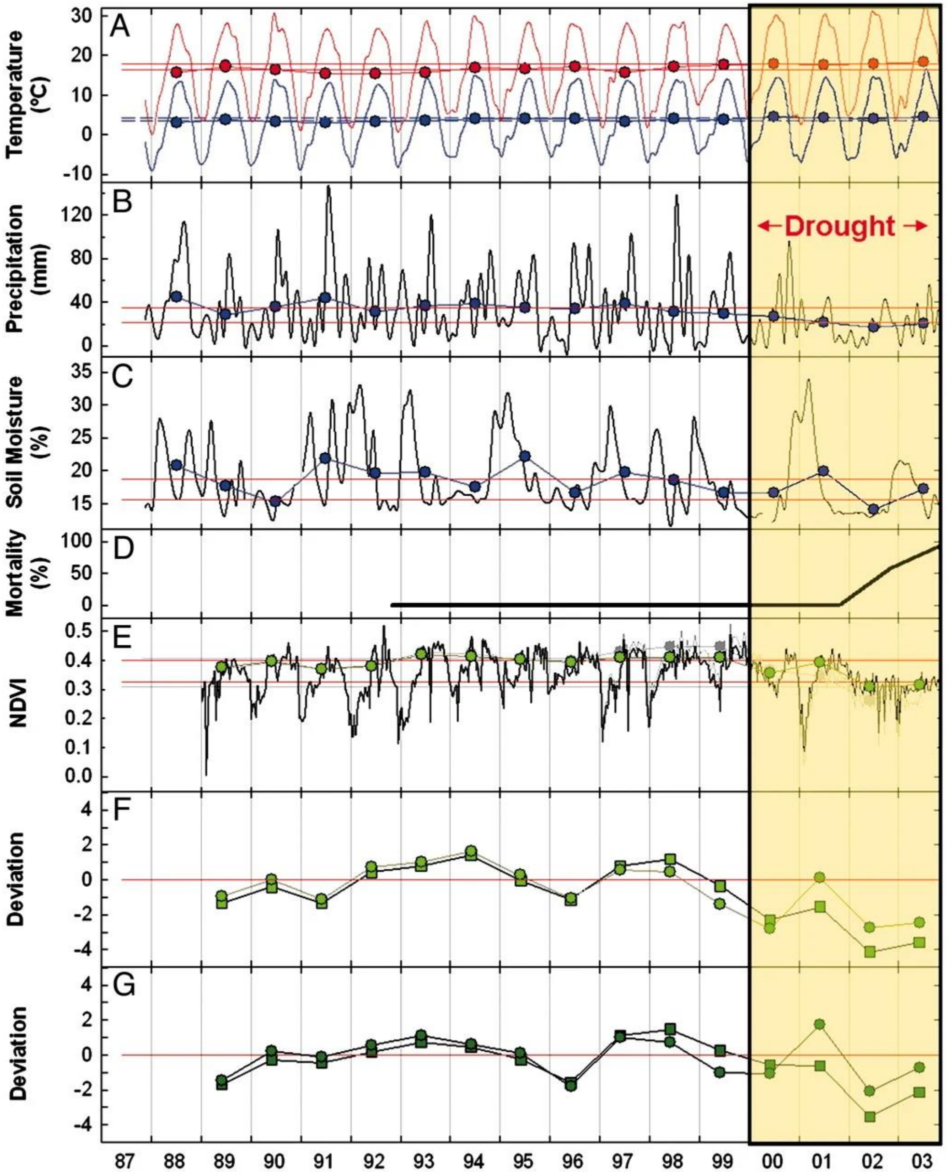


Fig. 2. Drought-induced mortality at Mesita del Buey, northern New Mexico. Shown for predrought and drought periods are: minimum (blue) and maximum (red) temperature (°C) (*A*), precipitation (mm) (*B*), volumetric soil water content at 20 cm (%) (*C*), *P. edulis* mortality (*D*), weekly NDVI at Mesita del Buey (*E*), and NDVI for late May-June for Mesita del Buey (*F*) and the region encompassing *P. edulis* (*G*).

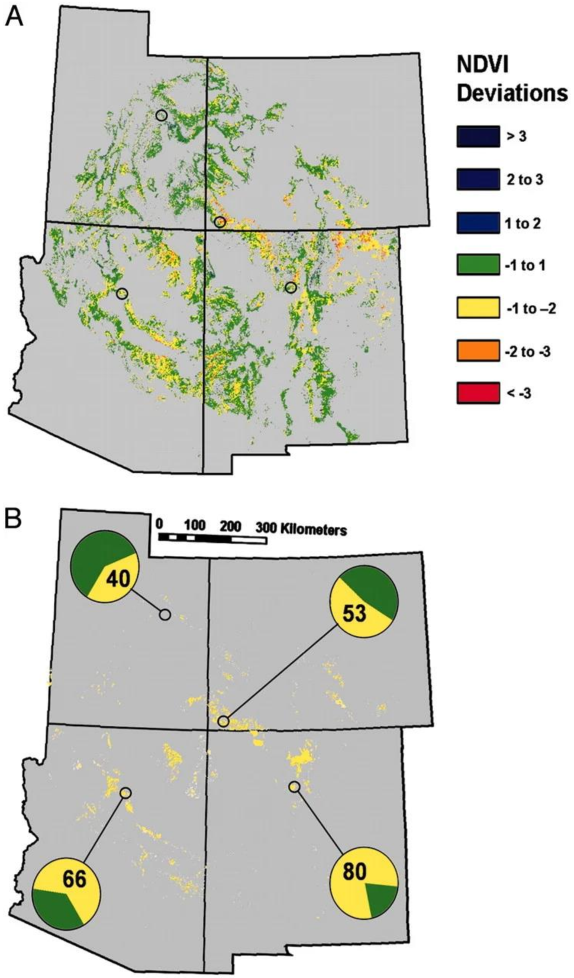


Fig. 3. Regional drought-induced vegetation changes. (*A*) Change map for NDVI for the region encompassing *P. edulis* distribution within Arizona, New Mexico, Colorado, and Utah, based on deviation from 2002-2003 relative to the predrought mean (1989-1999) during the period late-May to June. (*B*) Aerial survey map of piñon-juniper woodlands, delineating areas that experienced noticeable levels of tree mortality (including larger, older trees), conducted by the U.S. Forest Service (19) in four study areas throughout the region, corroborates the NDVI and aerial survey maps and documents standlevel estimates of mortality that range from 40% to 80% of nonseedling trees.

Wzrost śmiertelności drzew

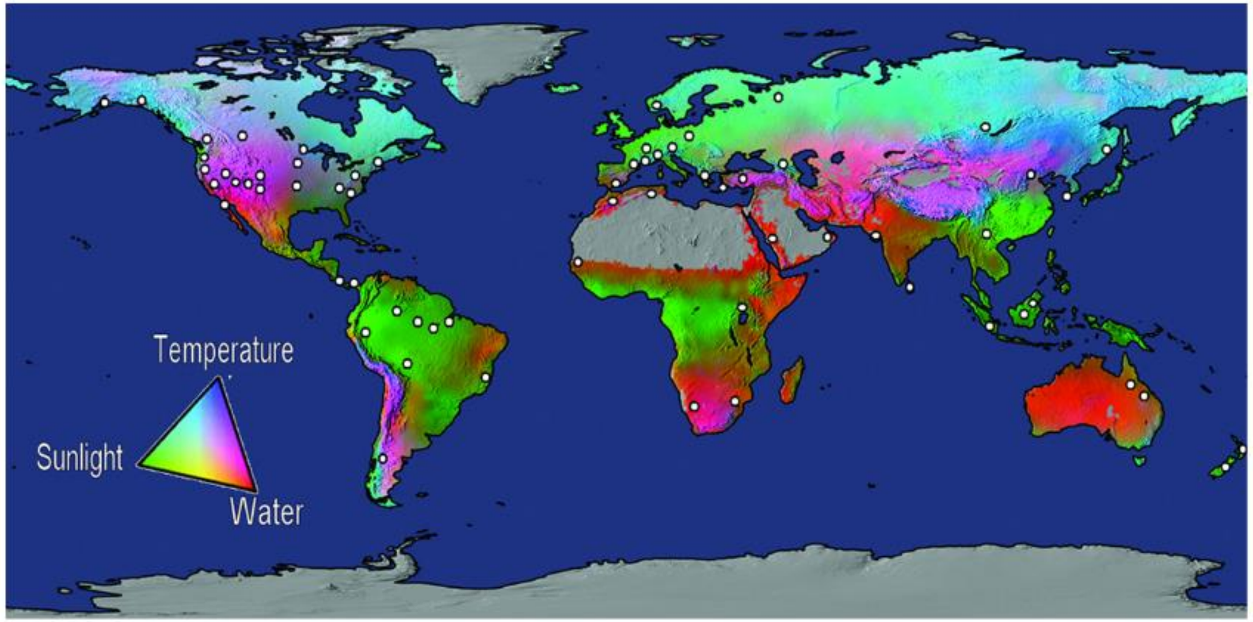


Fig. 1. White dots indicate documented localities with forest mortality related to climatic stress from drought and high temperatures. Background map shows potential environmental limits to vegetation net primary production (Boisvenue and Running, 2006). Only the general areas documented in the tables are shown—many additional localities are mapped more precisely on the continental-scale maps. Drought and heat-driven forest mortality often is documented in relatively dry regions (~red/orange/pink), but also occurs outside these regions.

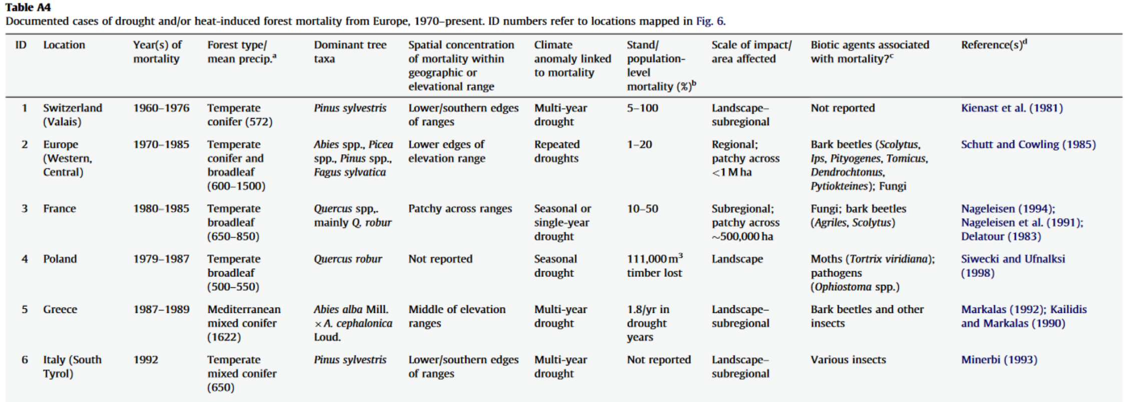
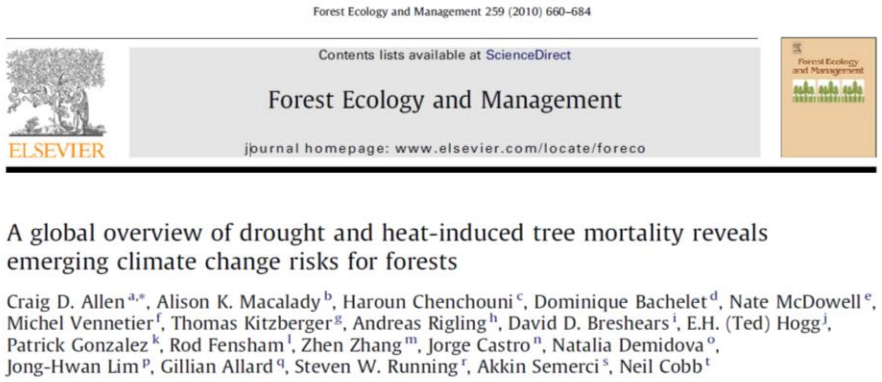


Table A4

Documented cases of drought and/or heat-induced forest mortality from Europe, 1970–present. ID numbers refer to locations mapped in Fig. 6.

ID	Location	Year(s) of mortality	Forest type/ mean precip.[a]	Dominant tree taxa	Spatial concentration of mortality within geographic or elevational range	Climate anomaly linked to mortality	Stand/ population-level mortality (%)[b]	Scale of impact/ area affected	Biotic agents associated with mortality?[c]	Reference(s)[d]
1	Switzerland (Valais)	1960–1976	Temperate conifer (572)	*Pinus sylvestris*	Lower/southern edges of ranges	Multi-year drought	5–100	Landscape–subregional	Not reported	Kienast et al. (1981)
2	Europe (Western, Central)	1970–1985	Temperate conifer and broadleaf (600–1500)	*Abies* spp., *Picea* spp., *Pinus* spp., *Fagus sylvatica*	Lower edges of elevation range	Repeated droughts	1–20	Regional; patchy across <1 M ha	Bark beetles (*Scolytus*, *Ips*, *Pityogenes*, *Tomicus*, *Dendrochtonus*, *Pytiokteines*); Fungi	Schutt and Cowling (1985)
3	France	1980–1985	Temperate broadleaf (650–850)	*Quercus* spp,. mainly *Q. robur*	Patchy across ranges	Seasonal or single-year drought	10–50	Subregional; patchy across ~500,000 ha	Fungi; bark beetles (*Agriles*, *Scolytus*)	Nageleisen (1994); Nageleisen et al. (1991); Delatour (1983)
4	Poland	1979–1987	Temperate broadleaf (500–550)	*Quercus robur*	Not reported	Seasonal drought	111,000 m³ timber lost	Landscape	Moths (*Tortrix viridiana*); pathogens (*Ophiostoma* spp.)	Siwecki and Ufnalksi (1998)
5	Greece	1987–1989	Mediterranean mixed conifer (1622)	*Abies alba* Mill. × *A. cephalonica* Loud.	Middle of elevation ranges	Multi-year drought	1.8/yr in drought years	Landscape–subregional	Bark beetles and other insects	Markalas (1992); Kailidis and Markalas (1990)
6	Italy (South Tyrol)	1992	Temperate mixed conifer (650)	*Pinus sylvestris*	Lower/southern edges of ranges	Multi-year drought	Not reported	Landscape–subregional	Various insects	Minerbi (1993)



Forest Ecology and Management 259 (2010) 660–684

Contents lists available at ScienceDirect

Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco

A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests

Craig D. Allen[a,*], Alison K. Macalady[b], Haroun Chenchouni[c], Dominique Bachelet[d], Nate McDowell[e], Michel Vennetier[f], Thomas Kitzberger[g], Andreas Rigling[h], David D. Breshears[i], E.H. (Ted) Hogg[j], Patrick Gonzalez[k], Rod Fensham[l], Zhen Zhang[m], Jorge Castro[n], Natalia Demidova[o], Jong-Hwan Lim[p], Gillian Allard[q], Steven W. Running[r], Akkin Semerci[s], Neil Cobb[t]

For Ecol Manage 2010; 259: 660-684

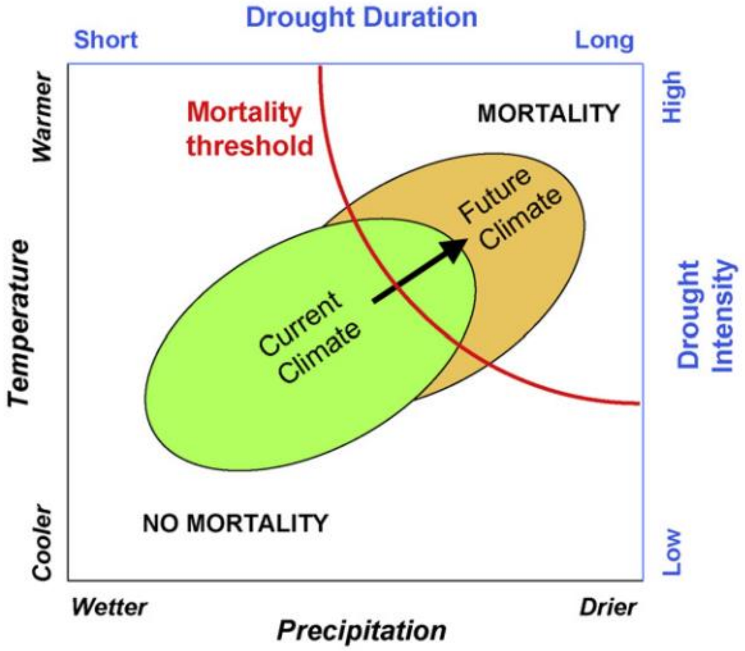


Fig. 12. Conceptual diagram, showing range of variability of "Current Climate" parameters for precipitation and temperature, or alternatively for drought duration and intensity, with only a small portion of the climate "space" currently exceeding a species-specific tree mortality threshold. "Future Climate" shows increases in extreme drought and temperature events associated with projected global climate change, indicating heightened risks of drought-induced die-off for current tree populations.

Wzrost śmiertelności drzew

Environ. Res. Lett. 13 (2018) 025001
https://doi.org/10.1088/1748-9326/aaa0b4

Environmental Research Letters

LETTER

Are Scots pine forest edges particularly prone to drought-induced mortality?

Allan Buras[1,6], Christian Schunk[1], Claudia Zeiträg[1], Corinna Herrmann[1], Laura Kaiser[1], Hannes Lemme[2], Christoph Straub[3], Steffen Taeger[4], Sebastian Gößwein[2], Hans-Joachim Klemmt[4] and Annette Menzel[1,5]

---

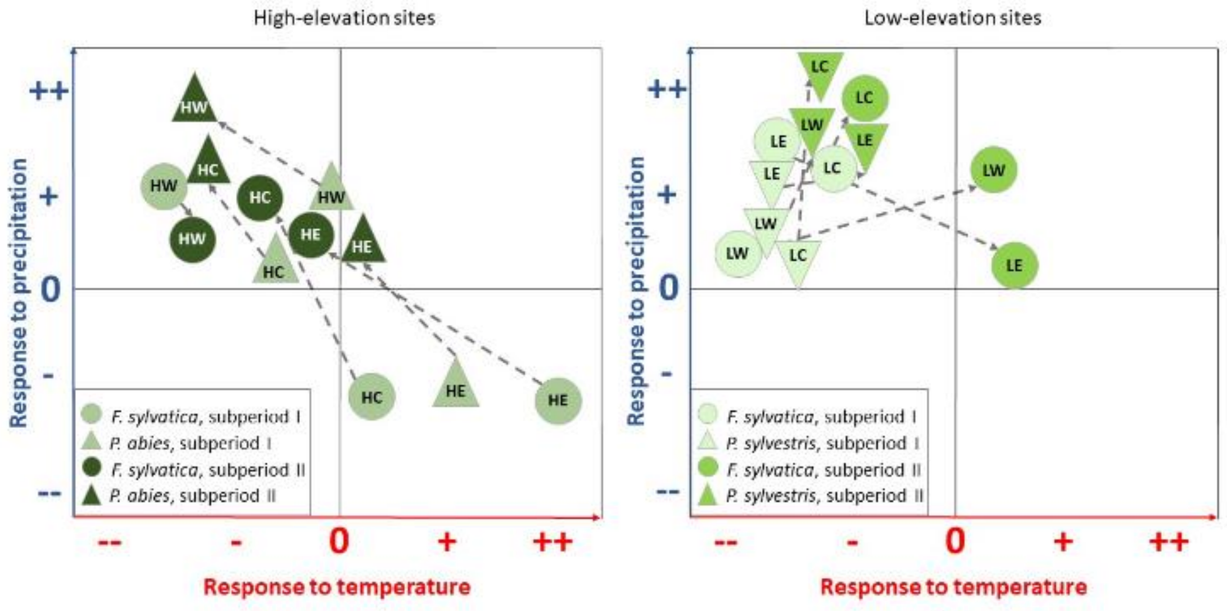
forests

Article

Climate Signals for Growth Variations of *F. sylvatica*, *P. abies*, and *P. sylvestris* in Southeast Germany over the Past 50 Years

Annette Debel *, Wolfgang Jens-Henrik Meier and Achim Bräuning

Forests 2021; 12: 1433



(a) (b)

Figure 9. Schematic illustration of the shift in climate–growth relationships between subperiod I (1970–1994) and subperiod II (1995–2019), with respect to precipitation and temperature. **(a)** Changes for *F. sylvatica* and *P. abies* at the high-elevation sites HW, HC, and HE. **(b)** Changes for *F. sylvatica* and *P. sylvestris* at the low-elevation sites LW, LC, and LE.

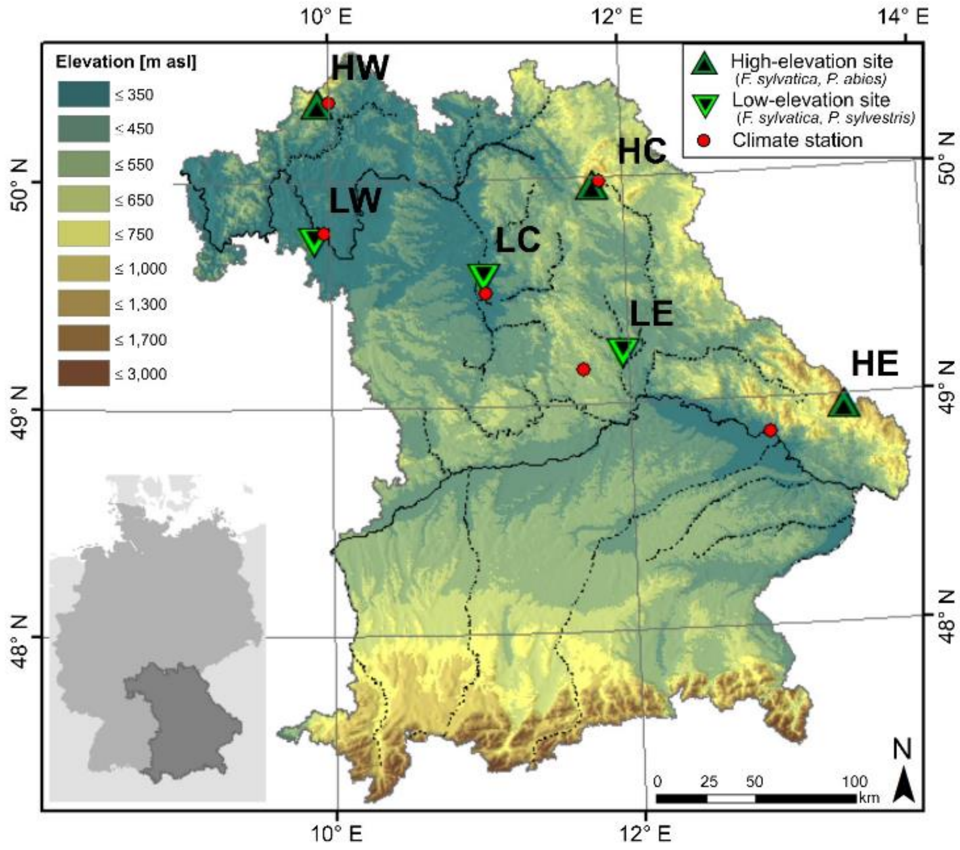
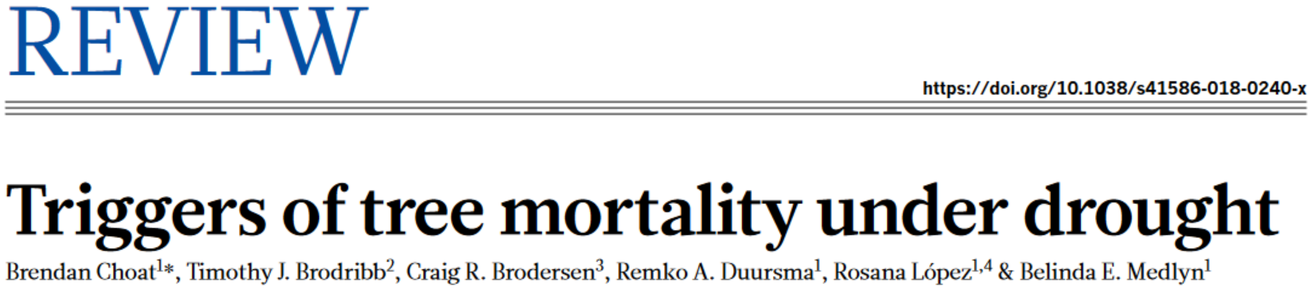


Figure 1. Location of the studied forests and climate stations at Bavaria, in southeast Germany. High-elevation sites from west to east: HW (Bad Brückenau), HC (Wunsiedel), and HE (Grafenau). Low-elevation sites from west to east: LW (Würzburg), LC (Tennenlohe), and LE (Burglengenfeld).

Wzrost śmiertelności drzew



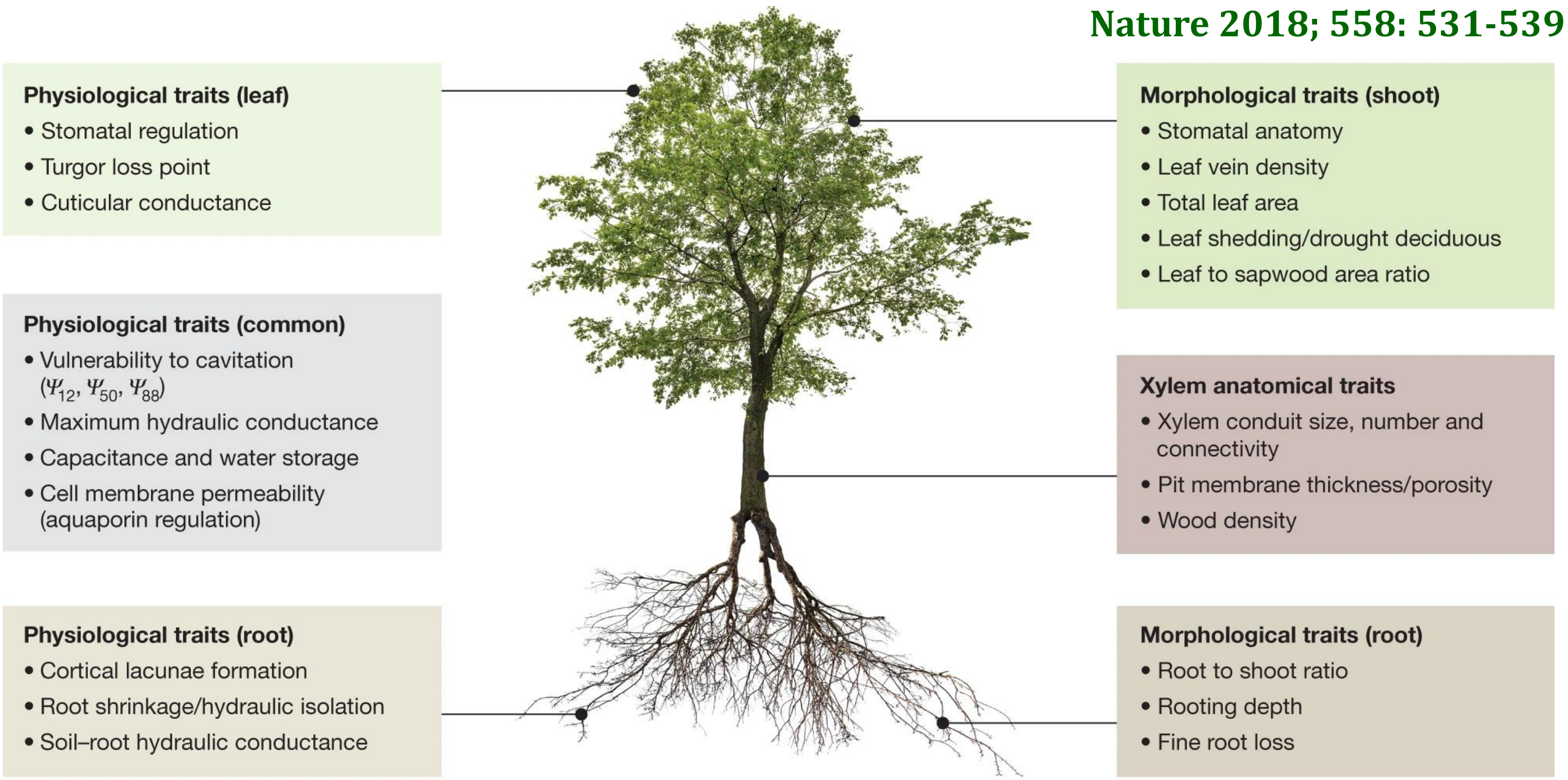
REVIEW

https://doi.org/10.1038/s41586-018-0240-x

Triggers of tree mortality under drought

Brendan Choat[1]*, Timothy J. Brodribb[2], Craig R. Brodersen[3], Remko A. Duursma[1], Rosana López[1,4] & Belinda E. Medlyn[1]

Nature 2018; 558: 531-539



Physiological traits (leaf)
- Stomatal regulation
- Turgor loss point
- Cuticular conductance

Physiological traits (common)
- Vulnerability to cavitation $(\Psi_{12}, \Psi_{50}, \Psi_{88})$
- Maximum hydraulic conductance
- Capacitance and water storage
- Cell membrane permeability (aquaporin regulation)

Physiological traits (root)
- Cortical lacunae formation
- Root shrinkage/hydraulic isolation
- Soil–root hydraulic conductance

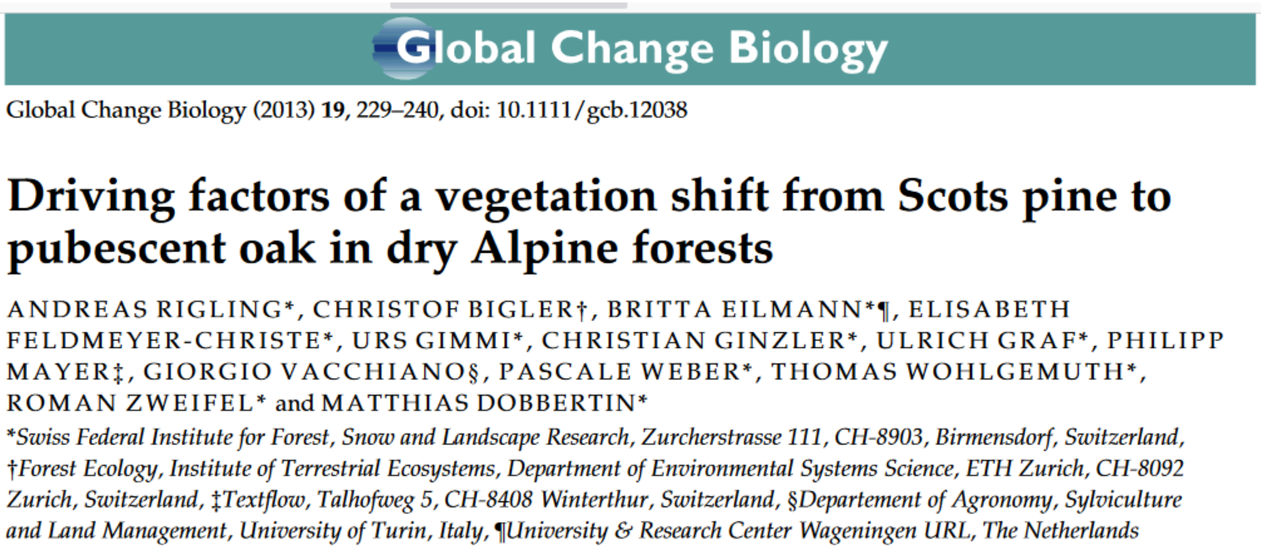
Morphological traits (shoot)
- Stomatal anatomy
- Leaf vein density
- Total leaf area
- Leaf shedding/drought deciduous
- Leaf to sapwood area ratio

Xylem anatomical traits
- Xylem conduit size, number and connectivity
- Pit membrane thickness/porosity
- Wood density

Morphological traits (root)
- Root to shoot ratio
- Rooting depth
- Fine root loss

Fig. 3. Trees use a variety of interdependent and coordinated morphological, anatomical and physiological traits to mitigate water loss and the development of increasingly negative xylem sap pressures during drought. This includes tissue-specific traits that function in the unique microenvironment of roots, stems and leaves, as well as traits that are common among most tissue types in trees. Many structure–function relationships exist between traits, for example, variation in xylem anatomical traits (pit membrane porosity, conduit size and connectivity) determine species and population-level vulnerability to cavitation. Note that this figure does not represent an exhaustive list of hydraulic traits relevant to the response of trees to drought and drought-induced mortality.

Zmiany zasięgów geograficznych



Global Change Biology

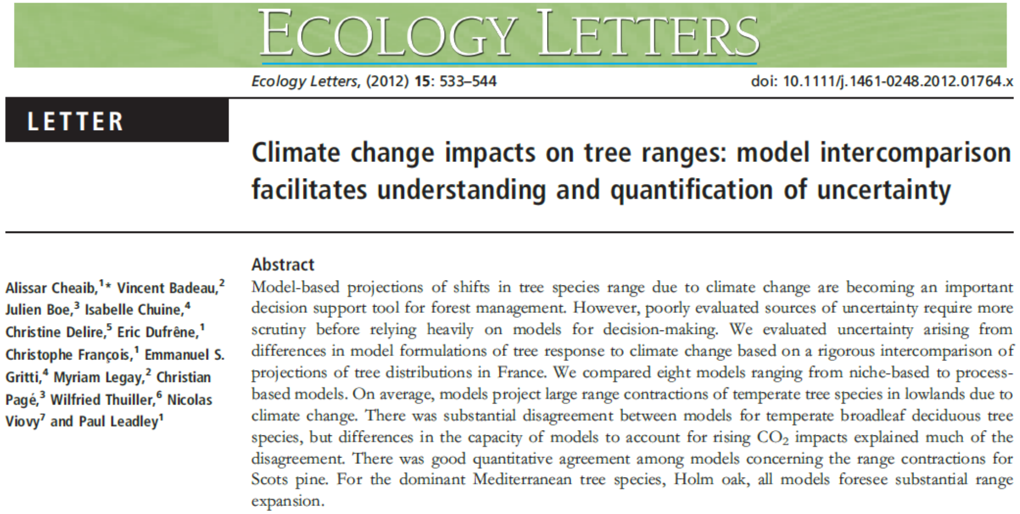
Global Change Biology (2013) **19**, 229–240, doi: 10.1111/gcb.12038

Driving factors of a vegetation shift from Scots pine to pubescent oak in dry Alpine forests

ANDREAS RIGLING*, CHRISTOF BIGLER†, BRITTA EILMANN*¶, ELISABETH FELDMEYER-CHRISTE*, URS GIMMI*, CHRISTIAN GINZLER*, ULRICH GRAF*, PHILIPP MAYER‡, GIORGIO VACCHIANO§, PASCALE WEBER*, THOMAS WOHLGEMUTH*, ROMAN ZWEIFEL* and MATTHIAS DOBBERTIN*

Swiss Federal Institute for Forest, Snow and Landscape Research, Zurcherstrasse 111, CH-8903, Birmensdorf, Switzerland, †Forest Ecology, Institute of Terrestrial Ecosystems, Department of Environmental Systems Science, ETH Zurich, CH-8092 Zurich, Switzerland, ‡Textflow, Talhofweg 5, CH-8408 Winterthur, Switzerland, §Departement of Agronomy, Sylviculture and Land Management, University of Turin, Italy, ¶University & Research Center Wageningen URL, The Netherlands

---



ECOLOGY LETTERS

Ecology Letters, (2012) **15**: 533–544 doi: 10.1111/j.1461-0248.2012.01764.x

LETTER

Climate change impacts on tree ranges: model intercomparison facilitates understanding and quantification of uncertainty

Alissar Cheaib,[1]* Vincent Badeau,[2] Julien Boe,[3] Isabelle Chuine,[4] Christine Delire,[5] Eric Dufrêne,[1] Christophe François,[1] Emmanuel S. Gritti,[4] Myriam Legay,[2] Christian Pagé,[3] Wilfried Thuiller,[6] Nicolas Viovy[7] and Paul Leadley[1]

Abstract

Model-based projections of shifts in tree species range due to climate change are becoming an important decision support tool for forest management. However, poorly evaluated sources of uncertainty require more scrutiny before relying heavily on models for decision-making. We evaluated uncertainty arising from differences in model formulations of tree response to climate change based on a rigorous intercomparison of projections of tree distributions in France. We compared eight models ranging from niche-based to process-based models. On average, models project large range contractions of temperate tree species in lowlands due to climate change. There was substantial disagreement between models for temperate broadleaf deciduous tree species, but differences in the capacity of models to account for rising CO_2 impacts explained much of the disagreement. There was good quantitative agreement among models concerning the range contractions for Scots pine. For the dominant Mediterranean tree species, Holm oak, all models foresee substantial range expansion.

DOI: 10.1111/ddi.12548

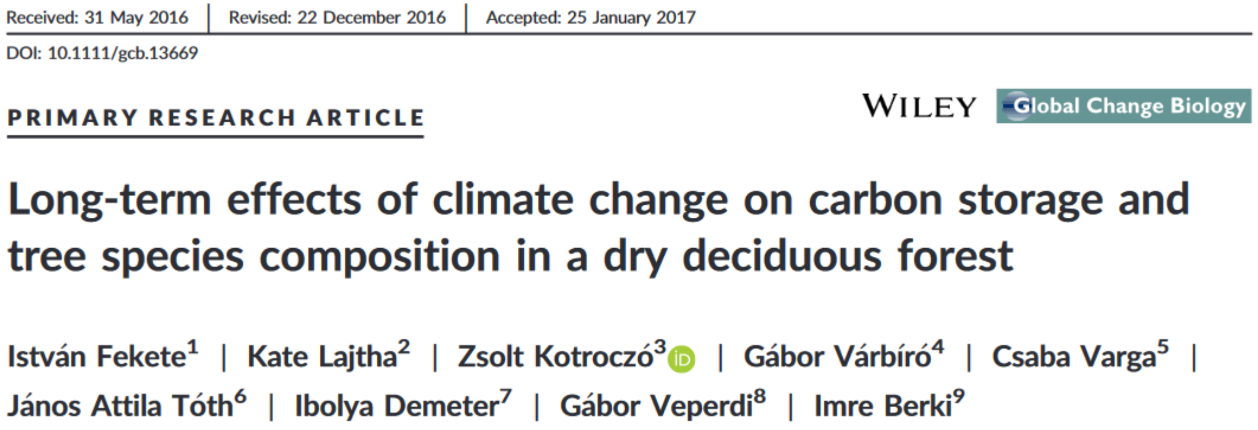
BIODIVERSITY RESEARCH

WILEY Diversity and Distributions

Assessing and predicting shifts in mountain forest composition across 25 years of climate change

Daniel Scherrer[1] | Stéphanie Massy[1] | Sylvain Meier[2] | Pascal Vittoz[3]† | Antoine Guisan[1,3]†

Diversity and Distributions 2017; 23: 517-528



Received: 31 May 2016 | Revised: 22 December 2016 | Accepted: 25 January 2017

DOI: 10.1111/gcb.13669

PRIMARY RESEARCH ARTICLE

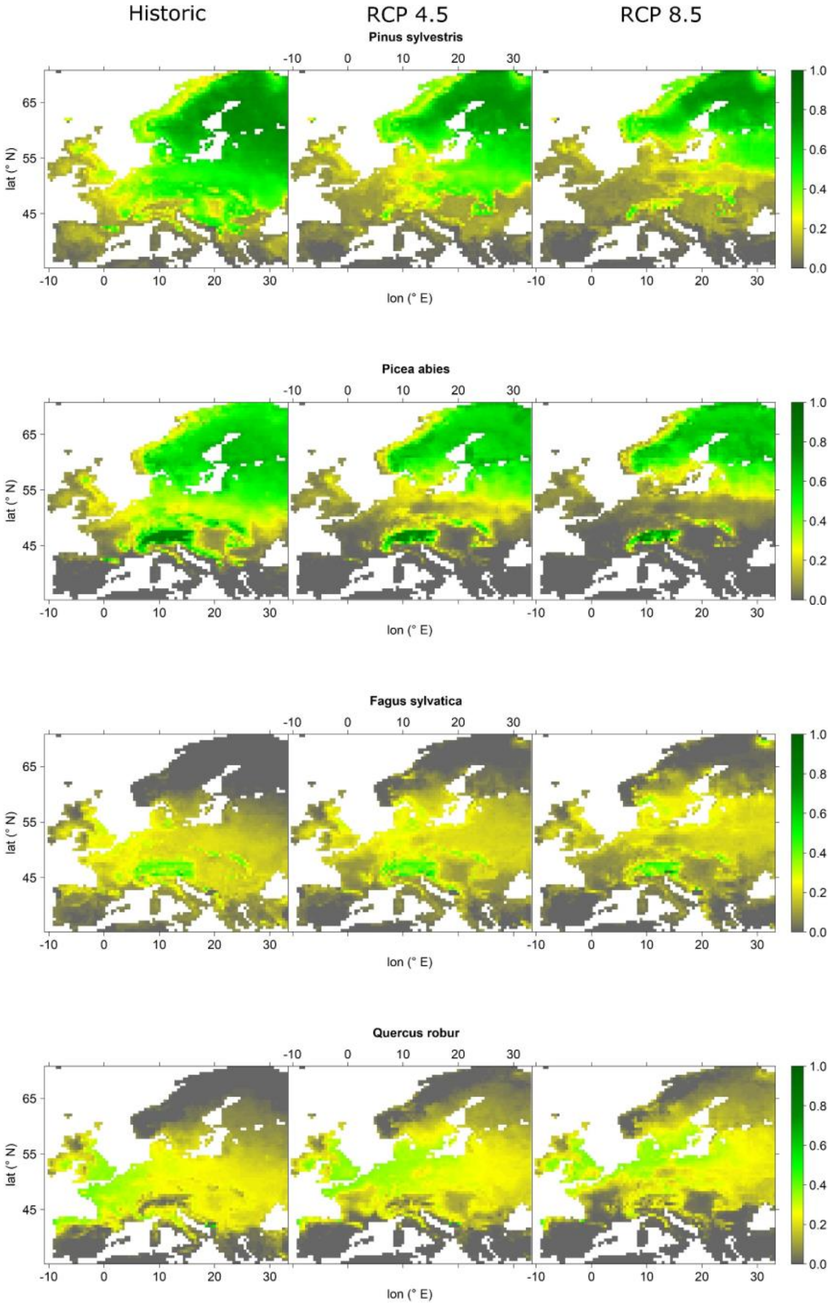
WILEY Global Change Biology

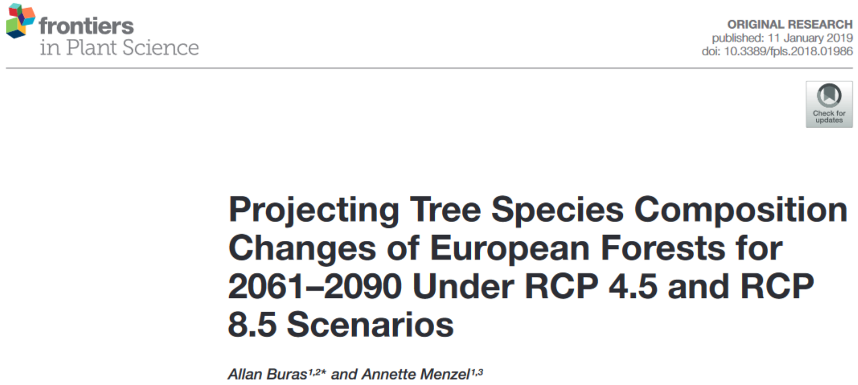
Long-term effects of climate change on carbon storage and tree species composition in a dry deciduous forest

István Fekete[1] | Kate Lajtha[2] | Zsolt Kotroczó[3] | Gábor Várbíró[4] | Csaba Varga[5] | János Attila Tóth[6] | Ibolya Demeter[7] | Gábor Veperdi[8] | Imre Berki[9]

Global Change Biology 2017; 23: 3154-3168

Zmiany zasięgów geograficznych





frontiers
in Plant Science

ORIGINAL RESEARCH
published: 11 January 2019
doi: 10.3389/fpls.2018.01986

Projecting Tree Species Composition Changes of European Forests for 2061–2090 Under RCP 4.5 and RCP 8.5 Scenarios

Allan Buras[1,2]* and Annette Menzel[1,3]

Frontiers in Plant Science 2019; 9: 1986

Figure 3. Mean relative abundance probabilities under current (blue) and projected future (orange = RCP 4.5, red = RCP 8.5) climate conditions. Species abbreviations: Pin.syl, *Pinus sylvestris*; Pic.abi, *Picea abies*; Fag.syl, *Fagus sylvatica*; Que.rob, *Quercus robur*; Bet.pub, *Betula pubescens*; Que.ile, *Quercus ilex*; Bet.pen, *Betula pendula*; Fra.exc, *Fraxinus excelsior*; Que.pet, *Quercus petraea*; Pin.pin, *Pinus pinaster*; Car.bet, *Carpinus betulus*; Pin.hal, *Pinus halepensis*; Ace.pse, *Acer pseudoplatanus*; Sor.auc, *Sorbus aucuparia*; Pin.nig, *Pinus nigra*; Pop.tre, *Populus tremula*; Aln.glu, *Alnus glutinosa*; Abi.alb, *Abies alba*; Pic.sit, *Picea sitchensis*; Cas.sat, *Castanea sativa*; Que.pub, *Quercus pubescens*; Lar.dec, *Larix decidua*; Sal.cap, *Salix caprea*; Aln.inc, *Alnus incana*; Que.sub, *Quercus suber*; Que.pyr, *Quercus pyrenaica*.

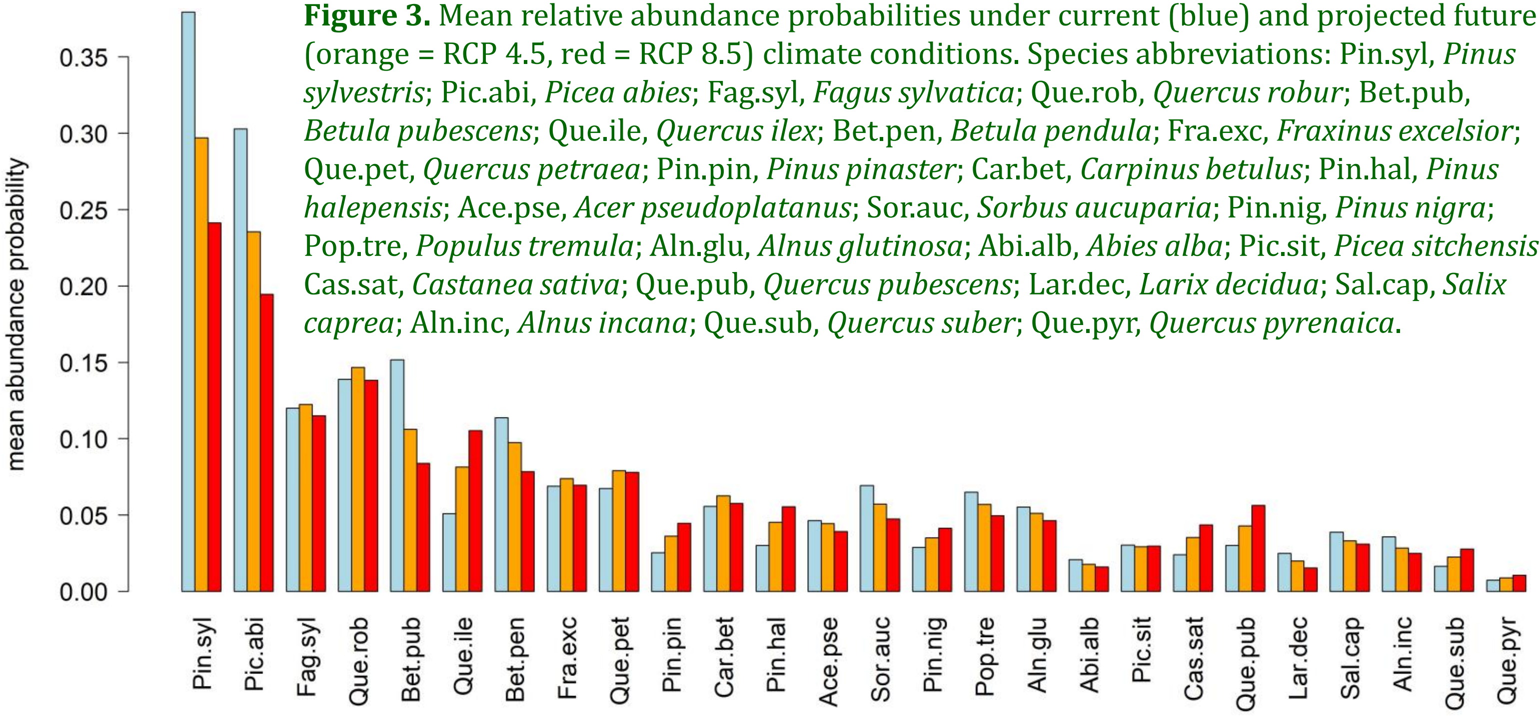


Figure 2. Projected relative abundance probabilities for the four most abundant tree species *Pinus sylvestris*, *Picea abies*, *Fagus sylvatica*, and *Quercus robur* for current analogs (left panels), RCP 4.5 analogs (mid panels), and RCP 8.5 analog (right panels). Relative abundance probability increases from gray over yellow to green colors.

Zmiany zasięgów geograficznych

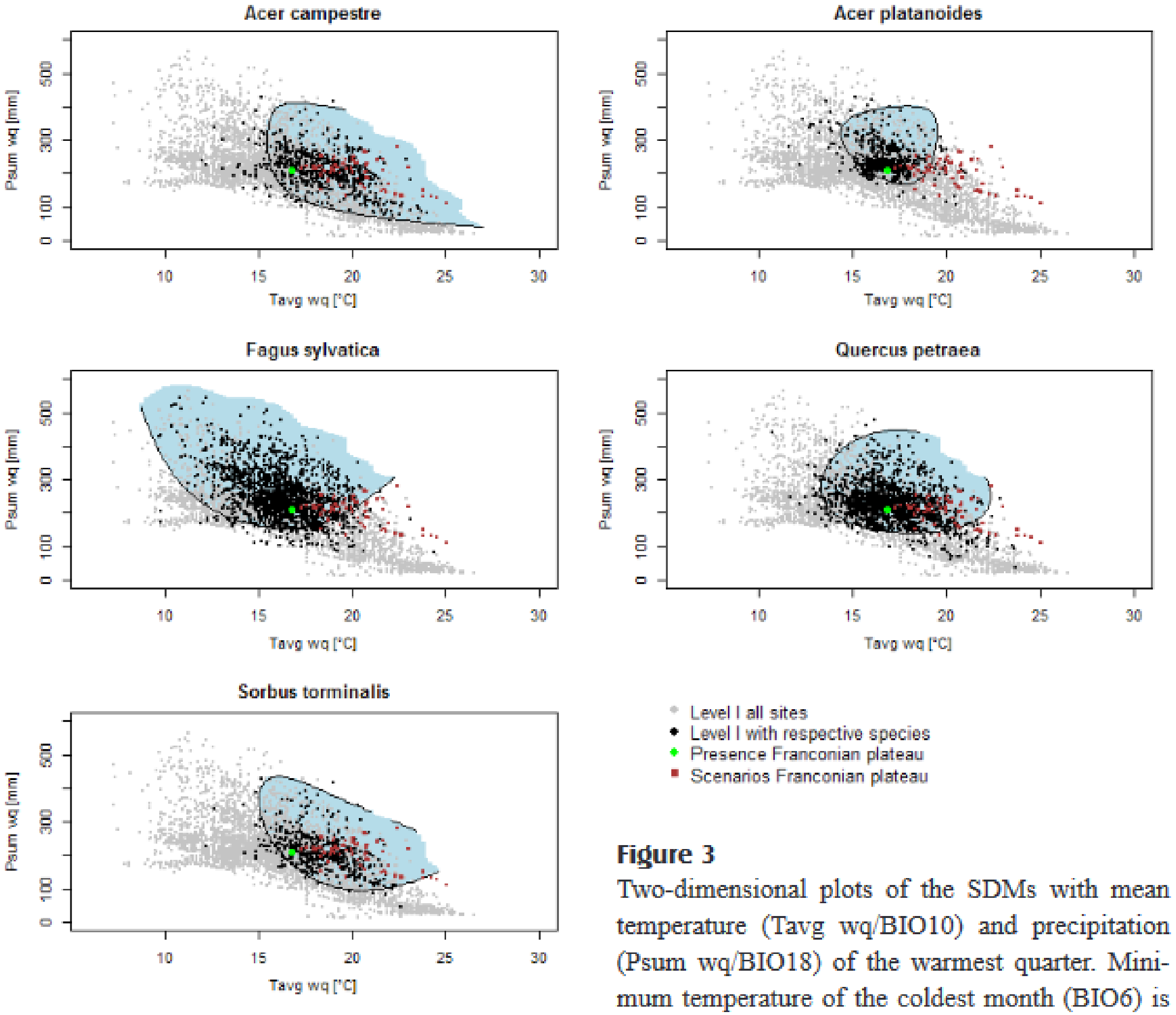


Figure 3
Two-dimensional plots of the SDMs with mean temperature (Tavg wq/BIO10) and precipitation (Psum wq/BIO18) of the warmest quarter. Minimum temperature of the coldest month (BIO6) is set to mean value 1951-2000 of the species presences in the European data used for SDMs. Colored area is suitable for the species, threshold 0.5. Extrapolation area is masked. Grey dots show complete Level I data, black dots the presences of the species. The green dot is the mean value of Franconian Plateau (1951-2000), brown squares are the mean values for 63 WorldClim scenarios 2061-2080.

Ann. For. Res. 60(1): 101-126, 2017
DOI: 10.15287/afr.2016.789

ANNALS OF FOREST RESEARCH
www.afrjournal.org

Assessing future suitability of tree species under climate change by multiple methods: a case study in southern Germany

H. Walentowski, W. Falk, T. Mette, J. Kunz, A. Bräuning, C. Meinardus, Ch. Zang, L. Sutcliffe, Ch. Leuschner

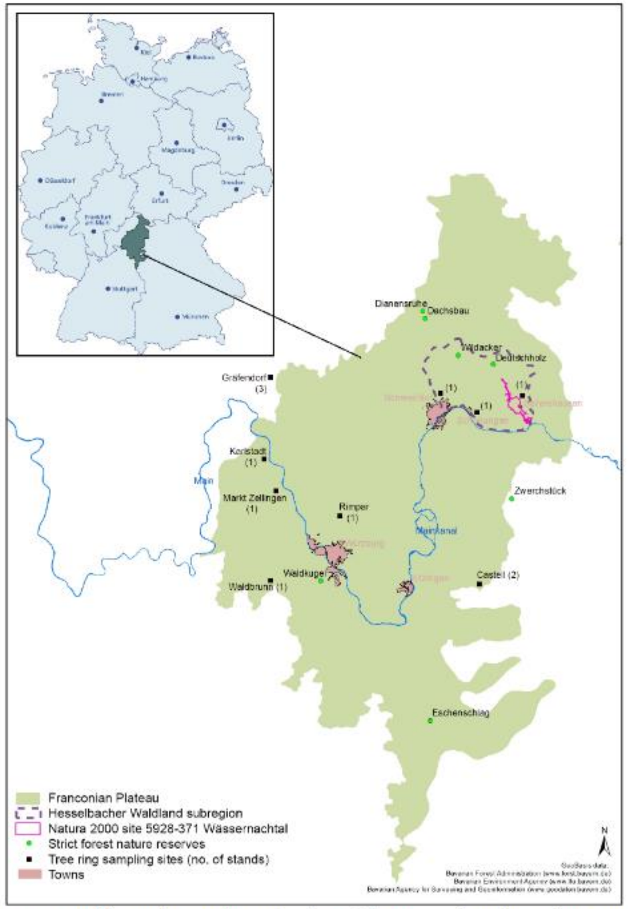


Figure 1 Map of the study area (inset: location of the Franconian Plateau in Germany)

Zmiany zasięgów geograficznych


Received: 20 July 2017 | Accepted: 30 August 2017
DOI: 10.1111/gcb.13925

PRIMARY RESEARCH ARTICLE

WILEY Global Change Biology

How much does climate change threaten European forest tree species distributions?

Marcin K. Dyderski[1,2] | Sonia Paź[3] | Lee E. Frelich[4] | Andrzej M. Jagodziński[1,2]

Global Change Biology 2018; 24: 1150-1163

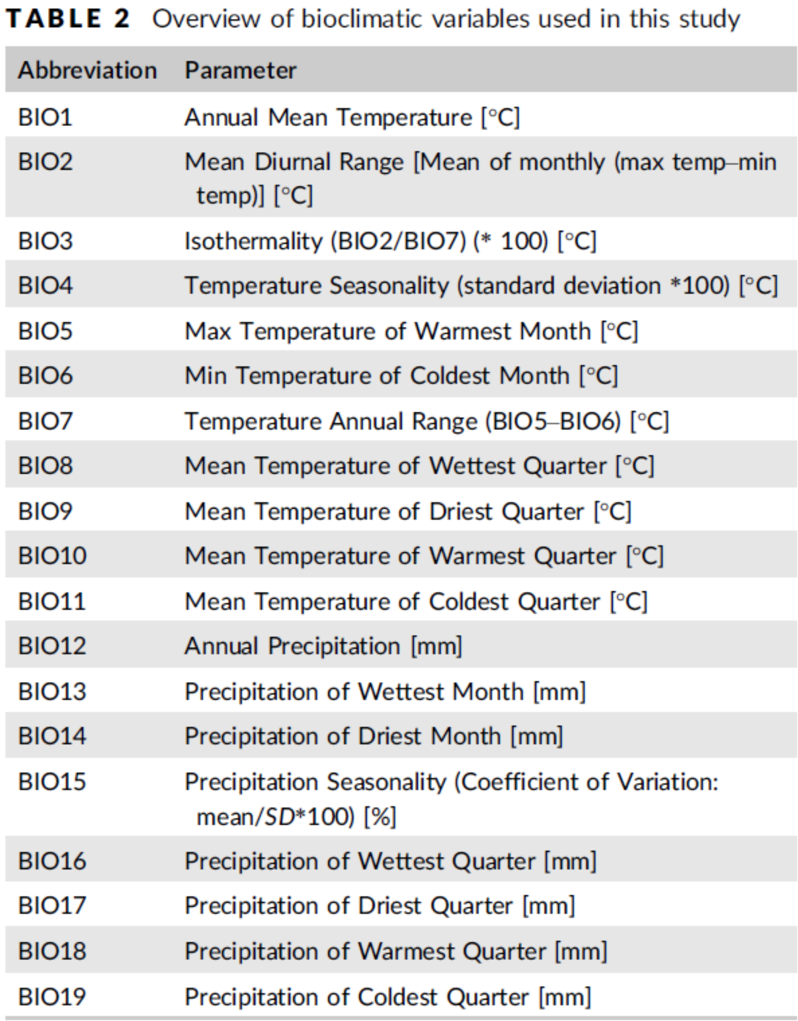


TABLE 2 Overview of bioclimatic variables used in this study

Abbreviation	Parameter
BIO1	Annual Mean Temperature [°C]
BIO2	Mean Diurnal Range [Mean of monthly (max temp–min temp)] [°C]
BIO3	Isothermality (BIO2/BIO7) (* 100) [°C]
BIO4	Temperature Seasonality (standard deviation *100) [°C]
BIO5	Max Temperature of Warmest Month [°C]
BIO6	Min Temperature of Coldest Month [°C]
BIO7	Temperature Annual Range (BIO5–BIO6) [°C]
BIO8	Mean Temperature of Wettest Quarter [°C]
BIO9	Mean Temperature of Driest Quarter [°C]
BIO10	Mean Temperature of Warmest Quarter [°C]
BIO11	Mean Temperature of Coldest Quarter [°C]
BIO12	Annual Precipitation [mm]
BIO13	Precipitation of Wettest Month [mm]
BIO14	Precipitation of Driest Month [mm]
BIO15	Precipitation Seasonality (Coefficient of Variation: mean/*SD**100) [%]
BIO16	Precipitation of Wettest Quarter [mm]
BIO17	Precipitation of Driest Quarter [mm]
BIO18	Precipitation of Warmest Quarter [mm]
BIO19	Precipitation of Coldest Quarter [mm]

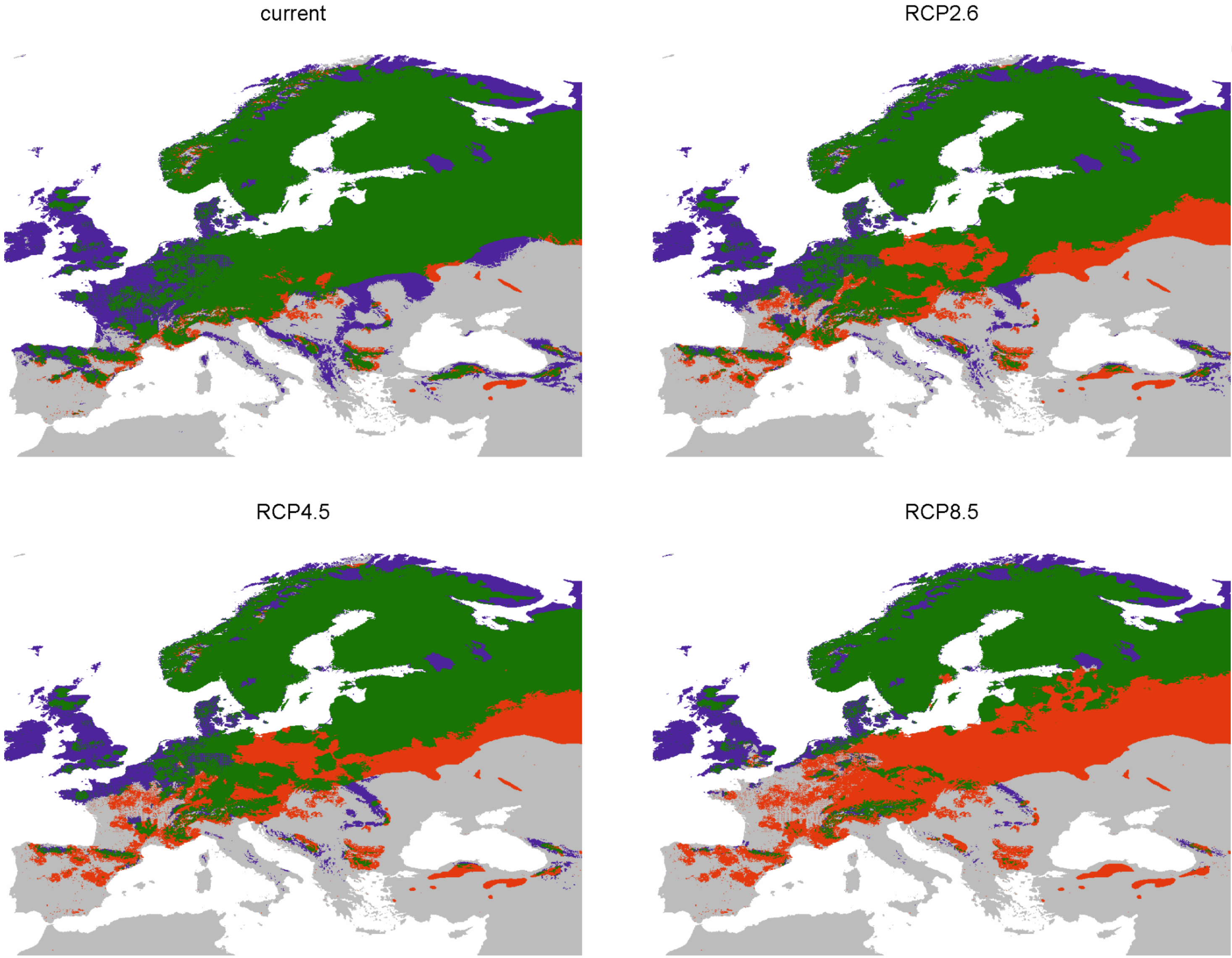

WorldClim - Global Climate Data

Free climate data for ecological modeling and GIS

Scenariusze zmian (2100):

- **optymistyczny (RCP2.6)**
  CO_2 – 450 ppm
  wzrost temp. 0,2-1,8 °C
- **pośredni (RCP4.5)**
  CO_2 – 650 ppm
  wzrost temp. 1,0-2,6 °C
- **pesymistyczny (RCP8.5)**
  CO_2 – 1350 ppm
  wzrost temp. 2,6-4,8 °C

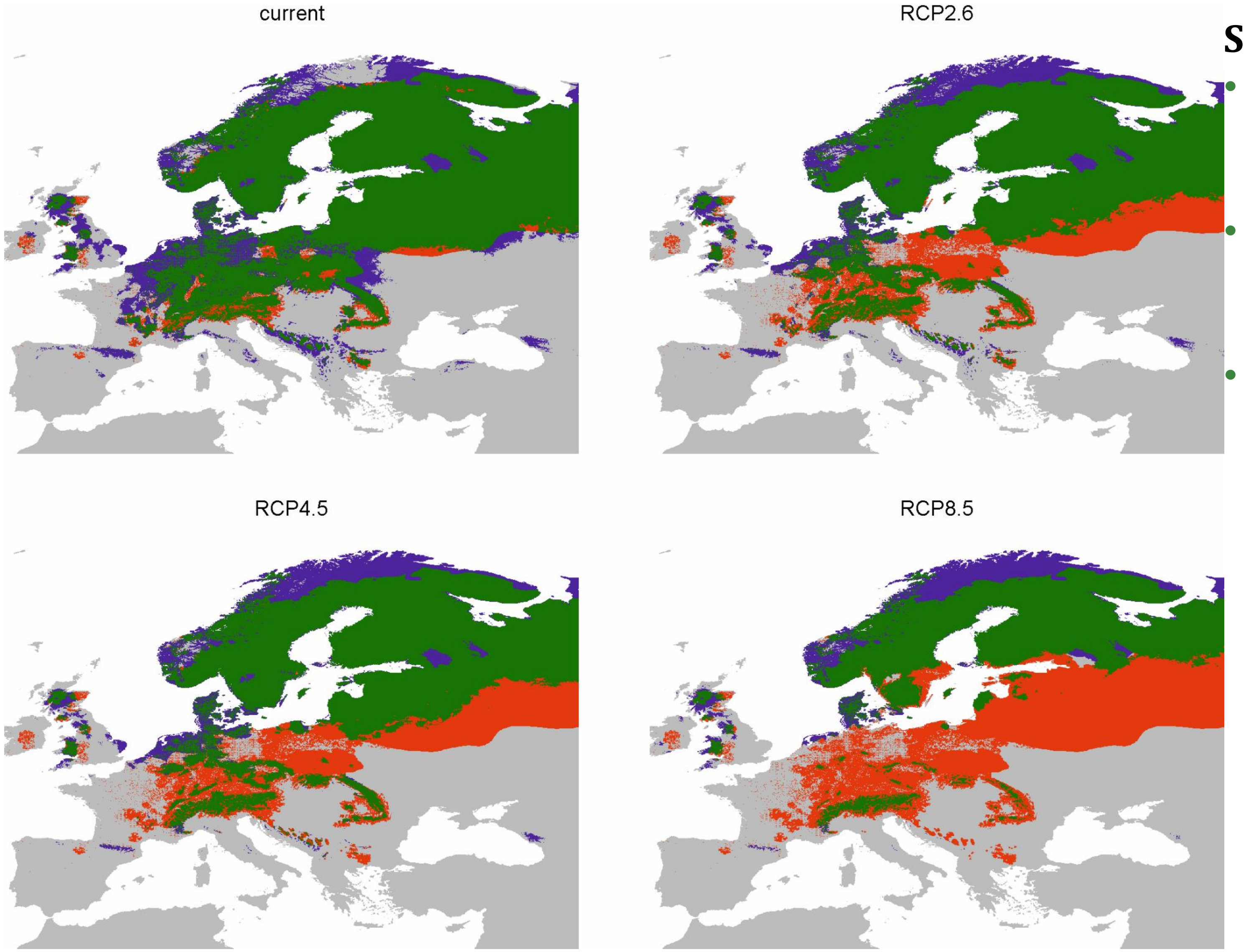
Zasięgi geograficzne drzew – sosna zwyczajna



Scenariusze zmian (2100):

- **optymistyczny (RCP2.6)**
  CO_2 – 450 ppm
  wzrost temp. 0,2-1,8 °C
- **pośredni (RCP4.5)**
  CO_2 – 650 ppm
  wzrost temp. 1,0-2,6 °C
- **pesymistyczny (RCP8.5)**
  CO_2 – 1350 ppm
  wzrost temp. 2,6-4,8 °C

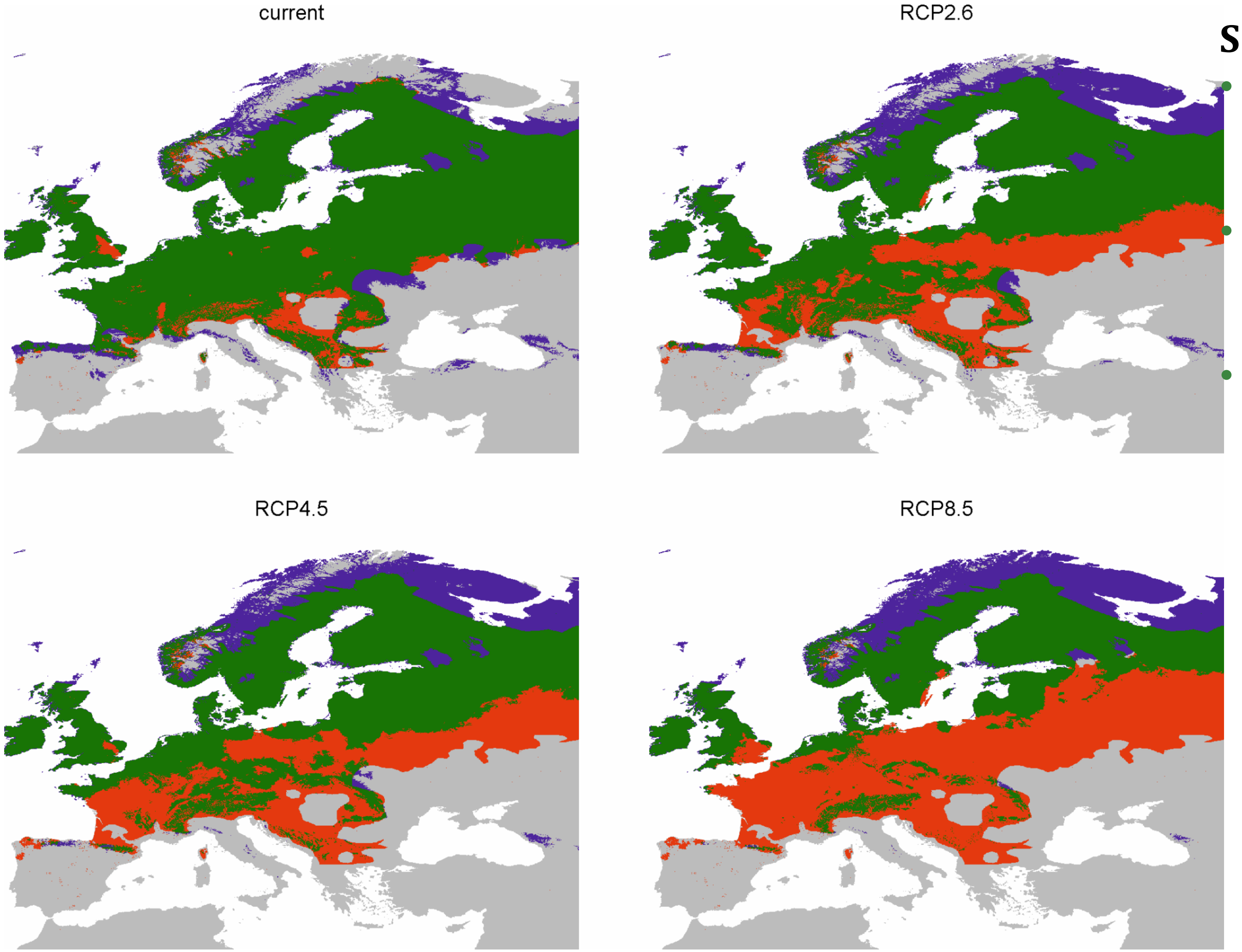
Zasięgi geograficzne drzew – świerk pospolity



Scenariusze zmian (2100):

- optymistyczny (RCP2.6)
  CO$_2$ – 450 ppm
  wzrost temp. 0,2-1,8 °C
- pośredni (RCP4.5)
  CO$_2$ – 650 ppm
  wzrost temp. 1,0-2,6 °C
- pesymistyczny (RCP8.5)
  CO$_2$ – 1350 ppm
  wzrost temp. 2,6-4,8 °C

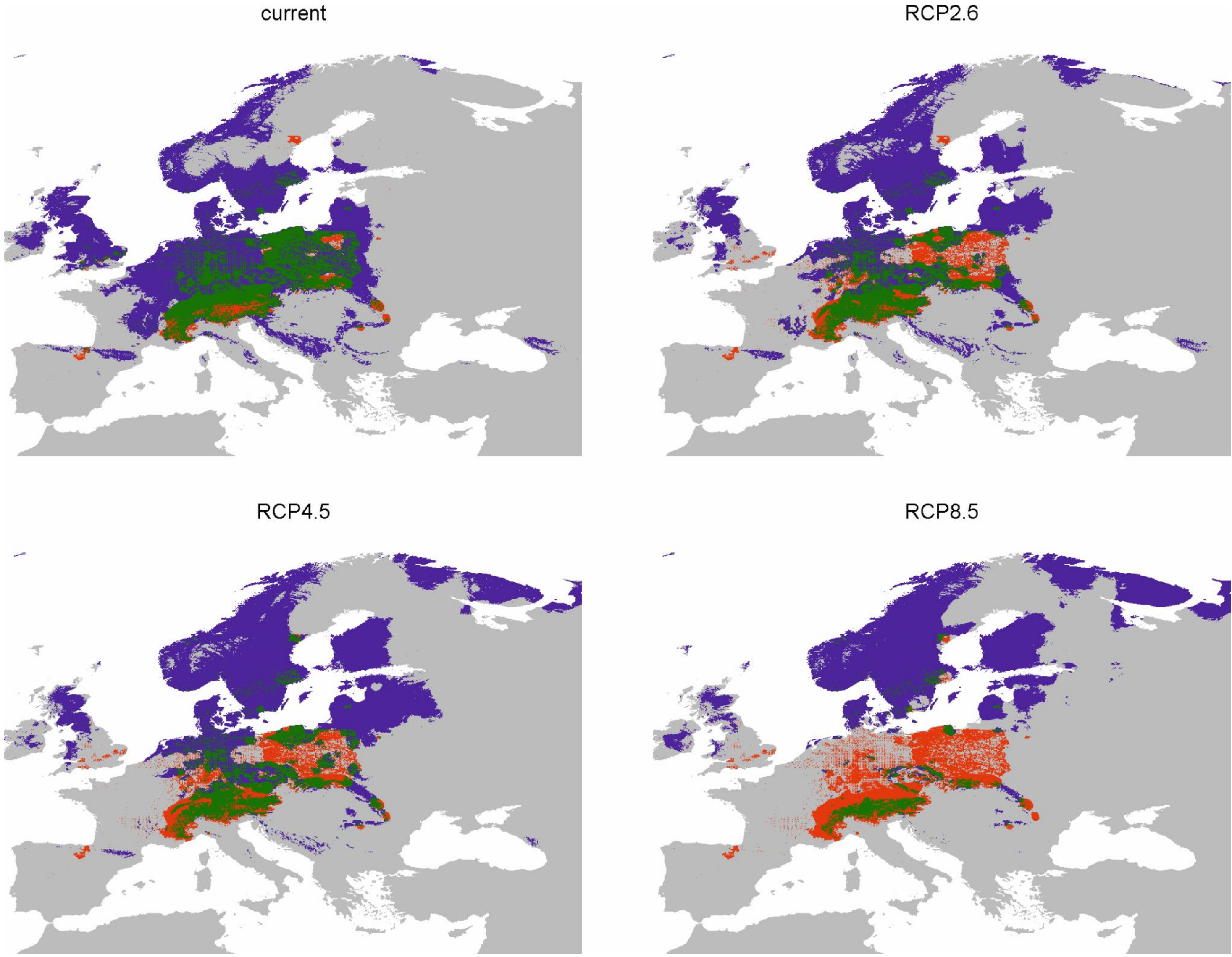
Zasięgi geograficzne drzew – brzoza brodawkowata



Scenariusze zmian (2100):

- **optymistyczny (RCP2.6)**
  CO_2 – 450 ppm
  wzrost temp. 0,2-1,8 °C
- **pośredni (RCP4.5)**
  CO_2 – 650 ppm
  wzrost temp. 1,0-2,6 °C
- **pesymistyczny (RCP8.5)**
  CO_2 – 1350 ppm
  wzrost temp. 2,6-4,8 °C

Zasięgi geograficzne drzew – modrzew europejski



Scenariusze zmian (2100):

- **optymistyczny (RCP2.6)**
  CO_2 – 450 ppm
  wzrost temp. 0,2-1,8 °C
- **pośredni (RCP4.5)**
  CO_2 – 650 ppm
  wzrost temp. 1,0-2,6 °C
- **pesymistyczny (RCP8.5)**
  CO_2 – 1350 ppm
  wzrost temp. 2,6-4,8 °C

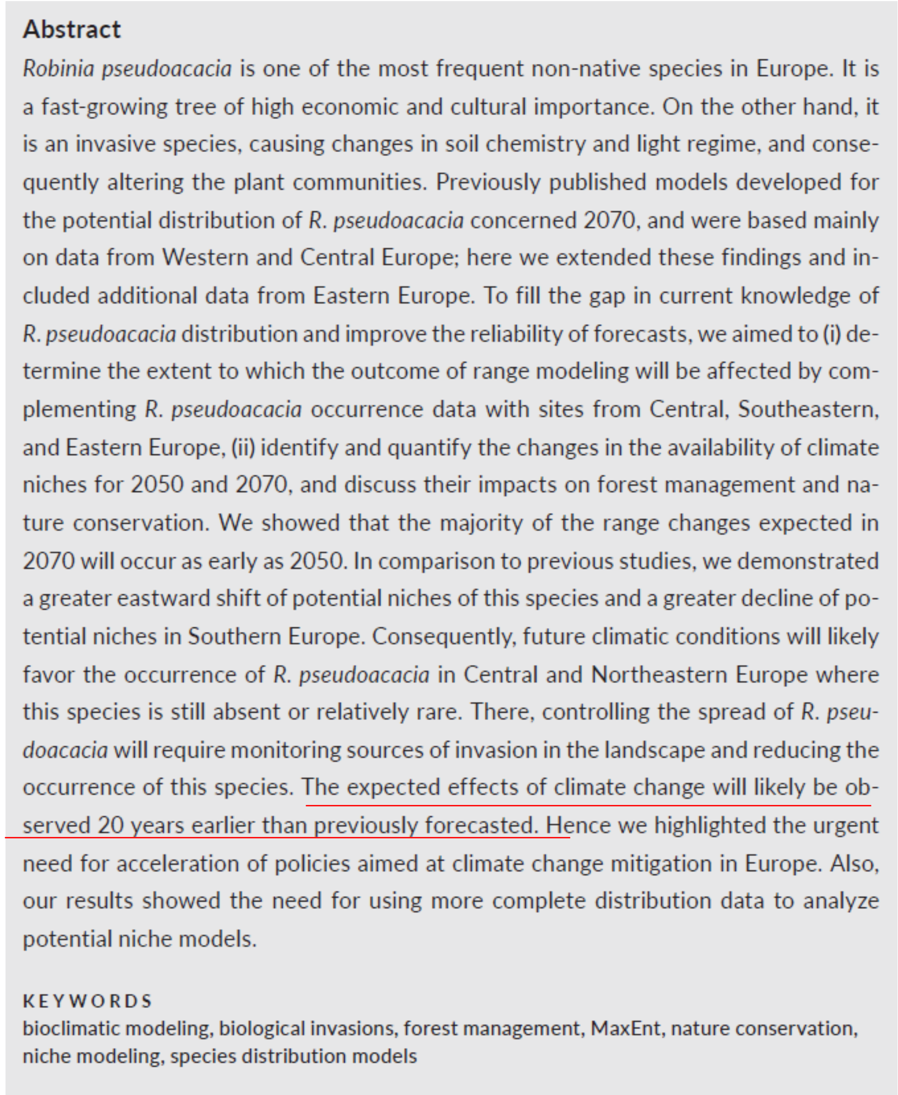
Zasięgi geograficzne drzew – zmiany

ODPOWIEDŹ NA ZMIANY KLIMATYCZNE:

- **ZWYCIĘZCY**
    - *Abies alba, Fagus sylvatica, Fraxinus excelsior, Quercus robur, Quercus petraea*
- **PRZEGRANI**
    - *Betula pendula, Larix decidua, Picea abies, Pinus sylvestris, Pseudotsuga menziesii, Quercus rubra, Robinia pseudoacacia*
- **BRAK ZMIAN**

PRZESUNIĘCIE RZECZYWISTEGO ZASIĘGU GEOGRAFICZNEGO W KIERUNKU PÓŁNOCNYM,
A TAKŻE UTRATA ZASIĘGU RZECZYWISTEGO NA POŁUDNIU

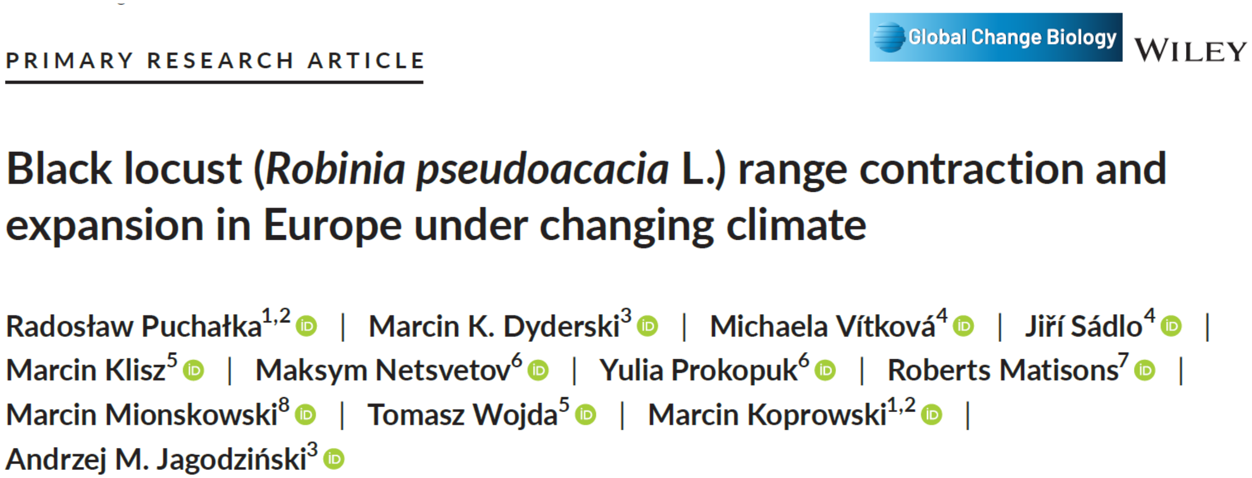
Zasięgi geograficzne drzew – robinia akacjowa



Abstract

Robinia pseudoacacia is one of the most frequent non-native species in Europe. It is a fast-growing tree of high economic and cultural importance. On the other hand, it is an invasive species, causing changes in soil chemistry and light regime, and consequently altering the plant communities. Previously published models developed for the potential distribution of *R. pseudoacacia* concerned 2070, and were based mainly on data from Western and Central Europe; here we extended these findings and included additional data from Eastern Europe. To fill the gap in current knowledge of *R. pseudoacacia* distribution and improve the reliability of forecasts, we aimed to (i) determine the extent to which the outcome of range modeling will be affected by complementing *R. pseudoacacia* occurrence data with sites from Central, Southeastern, and Eastern Europe, (ii) identify and quantify the changes in the availability of climate niches for 2050 and 2070, and discuss their impacts on forest management and nature conservation. We showed that the majority of the range changes expected in 2070 will occur as early as 2050. In comparison to previous studies, we demonstrated a greater eastward shift of potential niches of this species and a greater decline of potential niches in Southern Europe. Consequently, future climatic conditions will likely favor the occurrence of *R. pseudoacacia* in Central and Northeastern Europe where this species is still absent or relatively rare. There, controlling the spread of *R. pseudoacacia* will require monitoring sources of invasion in the landscape and reducing the occurrence of this species. The expected effects of climate change will likely be observed 20 years earlier than previously forecasted. Hence we highlighted the urgent need for acceleration of policies aimed at climate change mitigation in Europe. Also, our results showed the need for using more complete distribution data to analyze potential niche models.

KEYWORDS
bioclimatic modeling, biological invasions, forest management, MaxEnt, nature conservation, niche modeling, species distribution models



PRIMARY RESEARCH ARTICLE

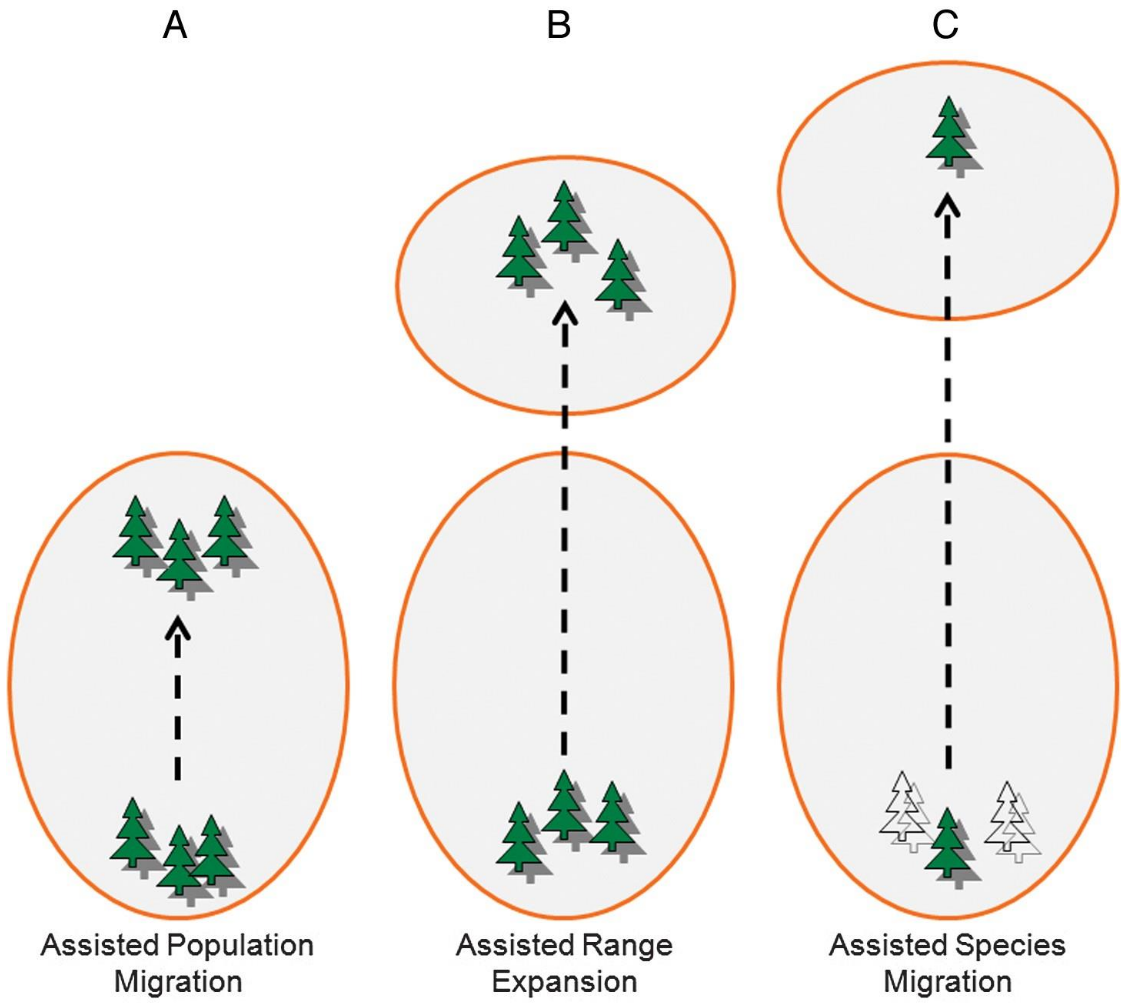
Global Change Biology WILEY

Black locust (*Robinia pseudoacacia* L.) range contraction and expansion in Europe under changing climate

Radosław Puchałka[1,2] | Marcin K. Dyderski[3] | Michaela Vítková[4] | Jiří Sádlo[4] | Marcin Klisz[5] | Maksym Netsvetov[6] | Yulia Prokopuk[6] | Roberts Matisons[7] | Marcin Mionskowski[8] | Tomasz Wojda[5] | Marcin Koprowski[1,2] | Andrzej M. Jagodziński[3]

Global Change Biology 2021; 27: 1587-1600

Zasięgi geograficzne drzew



REVIEW ARTICLE

J. For. 111(4):287–297
http://dx.doi.org/10.5849/jof.13-016

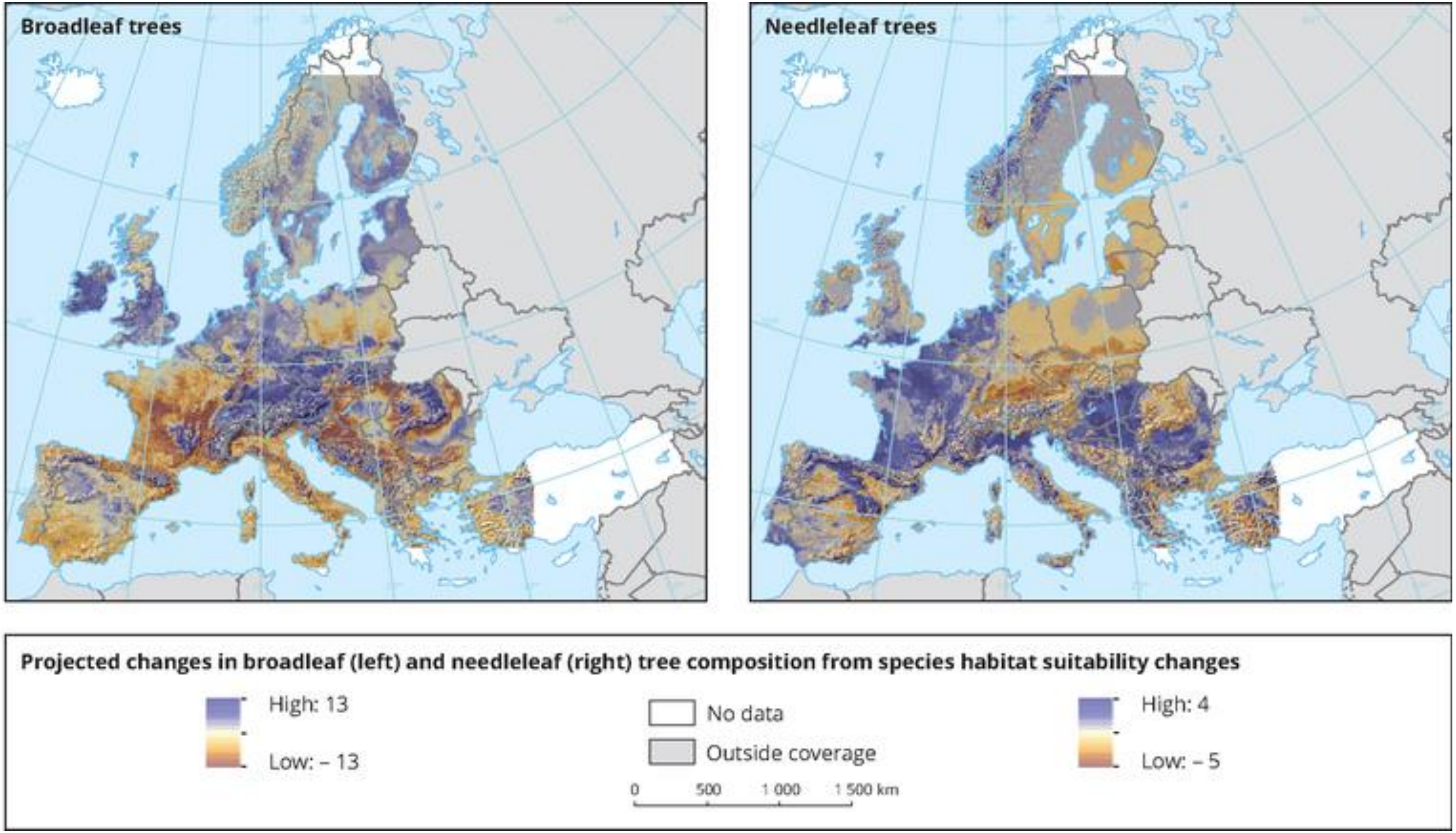
forest ecology

Journal of Forestry 2013; 111(4): 287-297

Preparing for Climate Change: Forestry and Assisted Migration

Mary I. Williams and R. Kasten Dumroese

Wspomagana migracja może przybierać różne formy i służyć realizacji różnych celów. Aby uniknąć strat ekonomicznych w przemyśle drzewnym, źródła nasion i populacje (np. genotypy) drzew użytkowych mogą być przemieszczane w obrębie ich obecnego zasięgu (A) lub z obecnego zasięgu na odpowiednie obszary położone tuż poza nim (B), aby dotrzymać kroku zmieniającym się warunkom (np. cieplejszemu klimatowi). Przeniesienie na tereny znacznie wykraczające poza obecny zasięg jest rozwiązaniem pozwalającym zapobiec wyginięciu gatunku (C). Ryzyko może być bardzo różne dla różnych form wspomaganej migracji, ale prawdopodobnie wzrasta wraz z odległością migracji. Na przykład wspomagana migracja do obszarów położonych daleko poza obecnym zasięgiem (np. C) wiązałaby się z większymi zobowiązaniami finansowymi i ryzykiem ekologicznym.



The two panels indicate to what degree broadleaf (left panel) and needleleaf (right panel) tree species are expected to increase (blue) or decrease (brown) in numbers. The results represent species distribution modelling, using climate projections from six regional climate models using the A1B scenario of future emissions.
Data source: Adapting to climate change in European forests – results of the MOTIVE project (dataset URL is not available) provided by **European Forest Institute (EFI)**

https://www.eea.europa.eu/data-and-maps/figures/projected-change-in-climatic-suitability

Plastyczność

Global Change Biology

Global Change Biology (2017), doi: 10.1111/gcb.13576

Adaptive and plastic responses of *Quercus petraea* populations to climate across Europe

CUAUHTÉMOC SÁENZ-ROMERO[1,2*], JEAN-BAPTISTE LAMY[3*], ALEXIS DUCOUSSO[1], BRIGITTE MUSCH[4], FRANÇOIS EHRENMANN[1], SYLVAIN DELZON[1], STEPHEN CAVERS[5], WŁADYSŁAW CHAŁUPKA[6], SAID DAĞDAŞ[7], JON KEHLET HANSEN[8], STEVE J. LEE[9], MIRKO LIESEBACH[10], HANS-MARTIN RAU[11], ACHILLEAS PSOMAS[12], VOLKER SCHNECK[13], WILFRIED STEINER[11], NIKLAUS E. ZIMMERMANN[12] and ANTOINE KREMER[1‡]

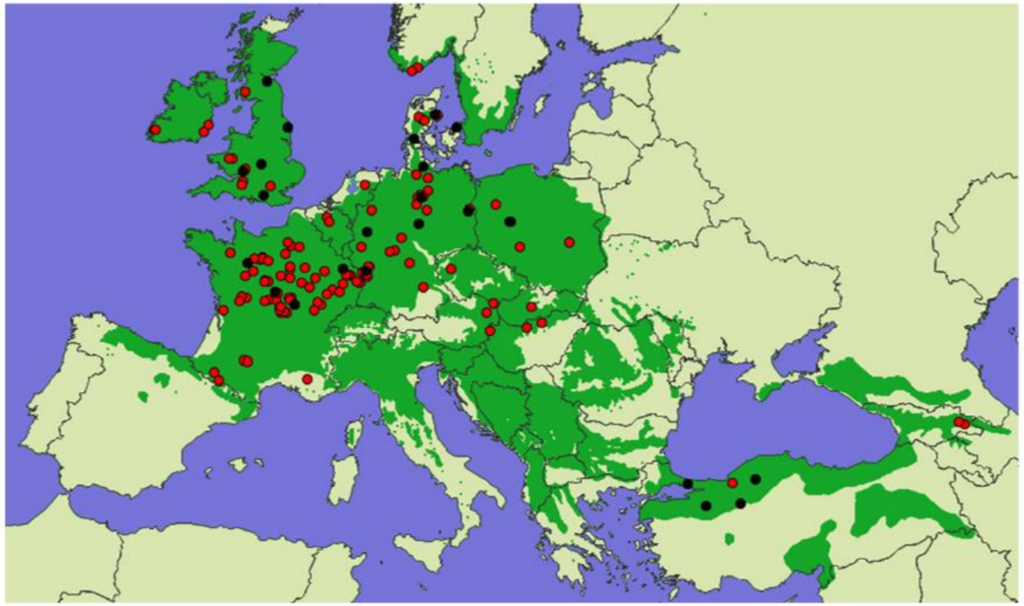


Fig. 1 Location of source populations and test sites. Red symbols indicate the locations of the 116 *Quercus petraea* populations from which seeds were collected for field tests. Black symbols indicate the 23 field test sites. The contemporary distribution of natural and naturalized stands is shown in dark green (EUFORGEN, 2009).

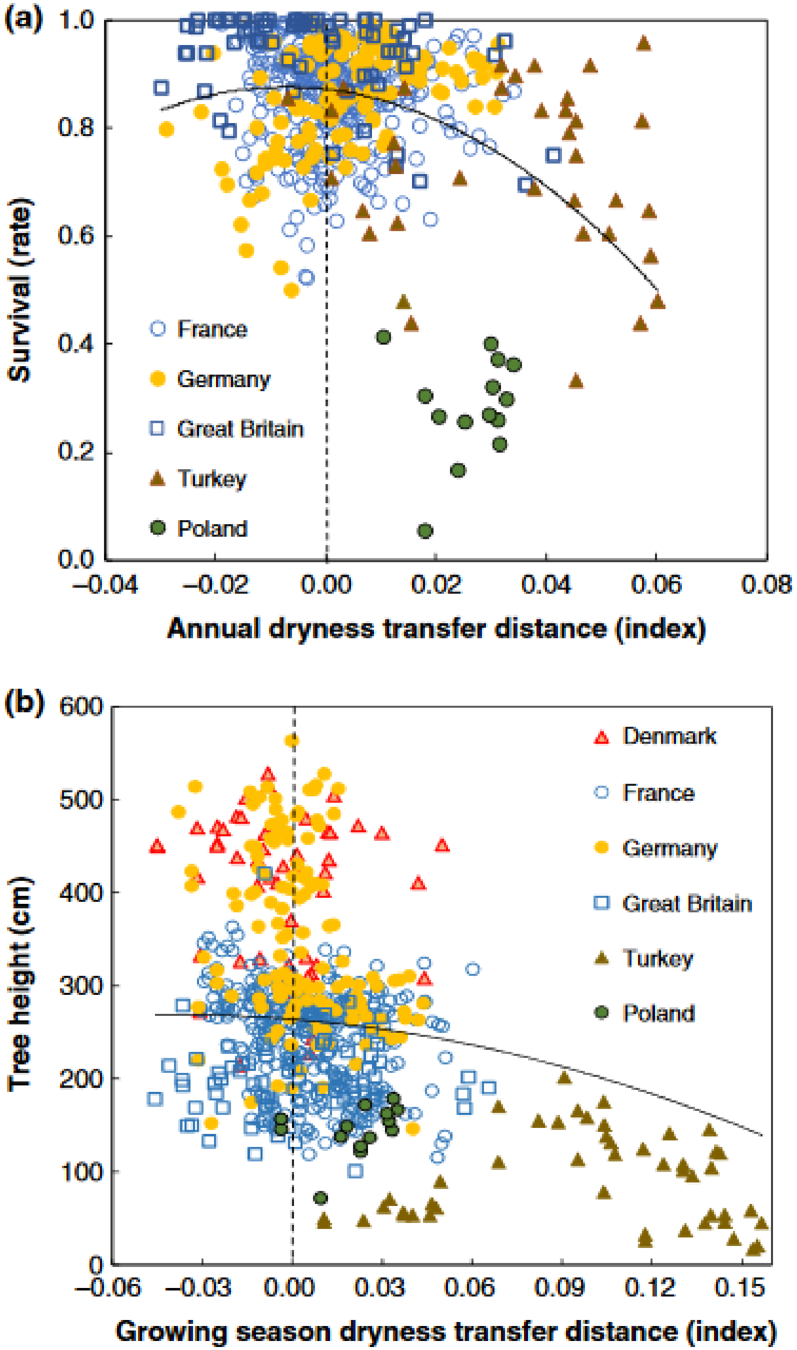


Fig. 2 Observed response of survival (a) and tree height (b) to climatic transfer distance. Scatter plots, at 10 years old, of population values by test site for (a) survival rates against annual dryness index (ADI) transfer distance and (b) tree height against growing season dryness index (GSDI) transfer distance. Symbols indicate the country of the test site, not that of the seed source. Larger positive values on the *x*-axis indicate transfer to drier sites; negative values indicate transfer to wetter sites; a value of zero (vertical dashed line) indicates transfer to a test site with a climate similar to that of the site of provenance. Predicted values were estimated from the fixed terms of the best full model selected (as in Table 1; for survival, model uses ADI as a climatic variable for both transfer distance and seed source (C term); for tree height, model uses mean temperature of the coldest month (MTCM) as a climatic variable for seed source). Note that model fit was made either with the rate of survival per plot or with individual tree height, not with the means per population per test site as this figure shows for clarity (see Material and methods and Appendices S1 and S2).

Składy gatunkowe drzewostanów Europy w obliczu zmiany klimatu

Andrzej M. Jagodziński
Instytut Dendrologii Polskiej Akademii Nauk

ul. Parkowa 5, 62-035 Kórnik
amj@man.poznan.pl

LIFE+ ForBioSensing

Konferencja podsumowująca projekt LIFE+ ForBioSensing, 29.03.2022 r.