Dynamika vegetácie horských smrekových lesov

F. Máliš

PRIMARY RESEARCH ARTICLE

WILEY Global Change Biology

Natural disturbances are spatially diverse but temporally synchronized across temperate forest landscapes in Europe

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Funding information
Deutscher Akademischer Austauschdienst, Grant/Award Number: 605728; Austrian Science Fund, Grant/Award Number: Y895-B25

Abstract
Natural disturbance regimes are cha
However, large-scale disturbance ch
poral variation within biomes. This va
ularly in the temperate forests
disturbance information is lacking. H
patterns of forest disturbances acro
remote sensing data and determine
two hypotheses: (1) Topography det
(2) climatic extremes synchronize na
novel Landsat-based maps of forest
landscape analysis to compare spati
forest landscapes with varying topo
annual estimates of disturbances for
extremes on temporal disturbance p
was substantial across temperate f
complexity, natural disturbance patc
dispersed, and affected a smaller p

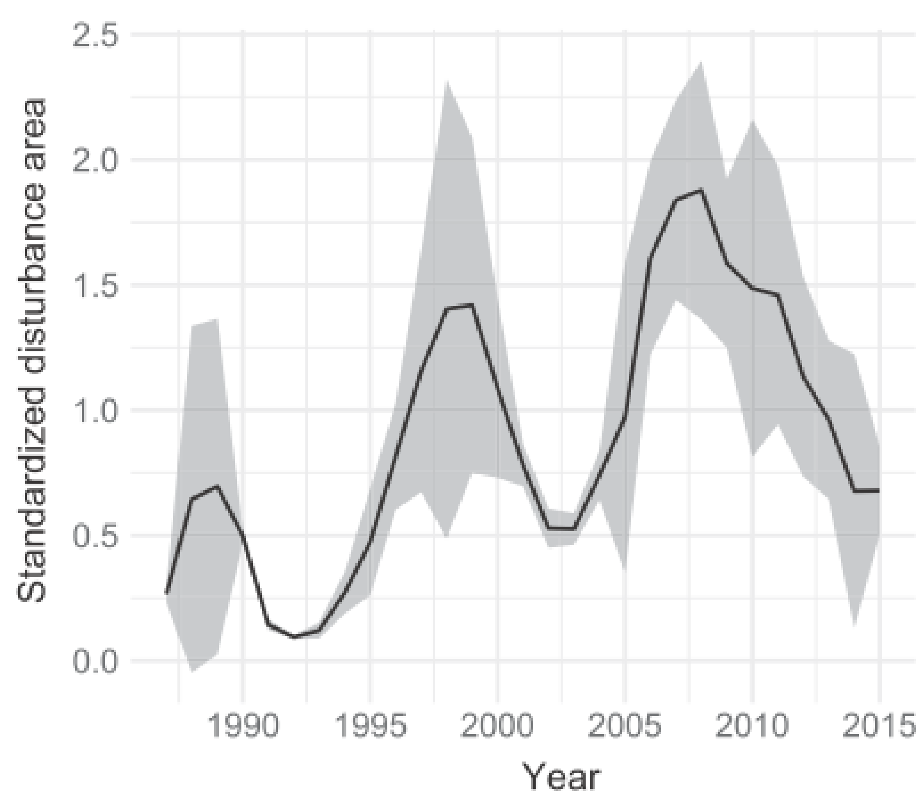

FIGURE 3 Synchrony in temporal disturbance dynamics across the temperate forest biome of Europe. The values shown are the mean and standard error over the standardized disturbance time series of the five different landscapes. The *y*-axis is given in units of standard deviation. If there would be no temporal synchrony between landscapes, the time series would be a flat line close to one. (see also Fig. S10)

Living with bark beetles: impacts, outlook and management options

Tomáš Hlásny, Paal Krokene, Andrew Liebhold, Claire Montagné-Huck,
Jörg Müller, Hua Qin, Kenneth Raffa, Mart-Jan Schelhaas,
Rupert Seidl, Miroslav Svoboda and Heli Viiri

Figure 13. One million cubic meters of spruce blown down by storm Gudrun in Sweden in 2005, stacked on an abandoned airfield in Southern Sweden. Photo: Thomas Adolfsén / Skogenbild.

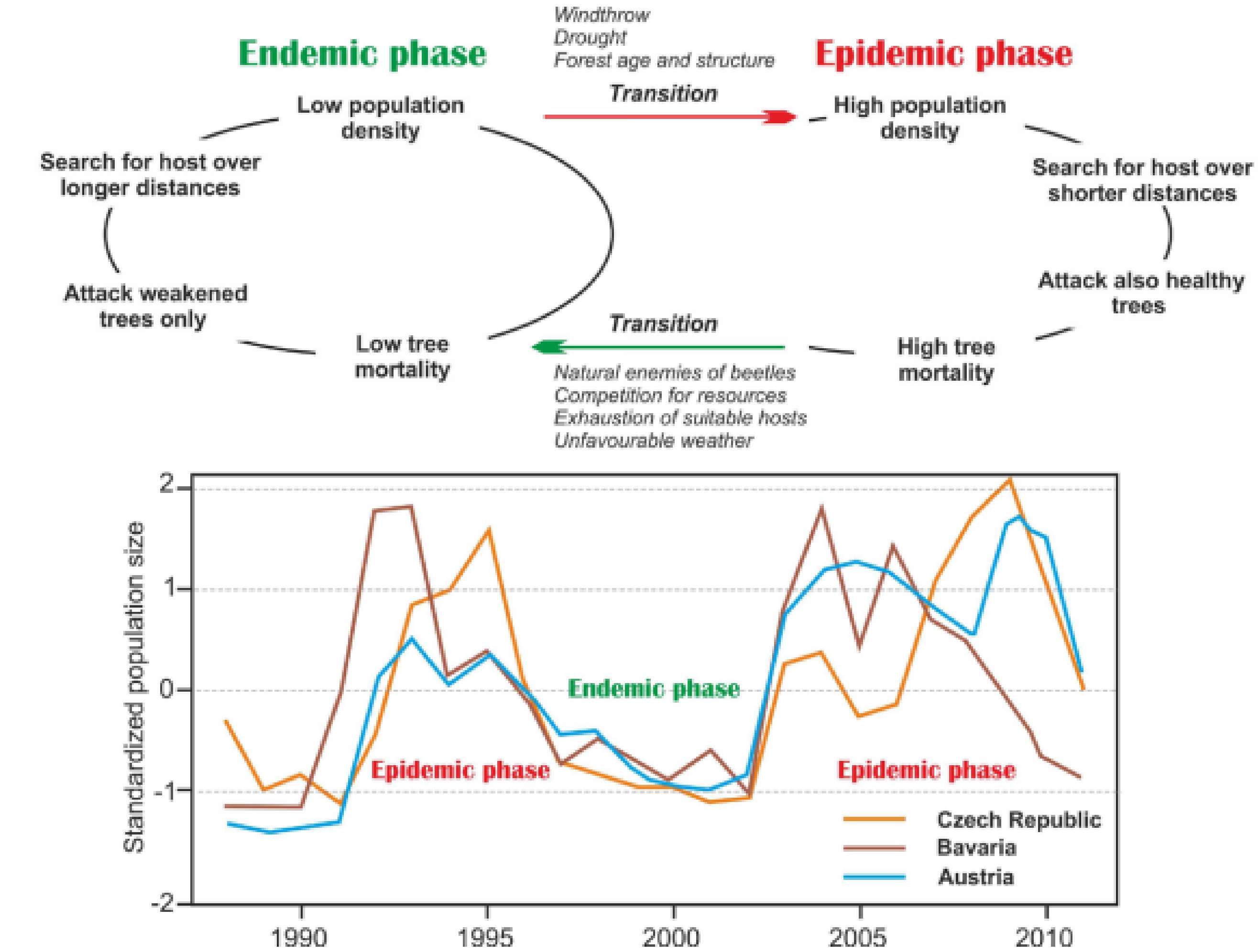

Figure 3. Scheme of bark beetle population dynamics. Low and stable bark beetle populations (endemic phase) can be periodically disrupted by external factors such as droughts and windthrows, which trigger a transition to the epidemic phase (upper panel, adopted from Kautz et al. 2014). For *Ips typographus*, the epidemic phase typically lasts several years. Population decrease and transition back to the endemic phase (outbreak collapse) is driven by factors such as natural enemies and competition for resources, but also by unfavourable weather or the exhaustion of suitable host trees. The bottom graph shows the transition between endemic and epidemic phases over time during synchronous *Ips typographus* outbreaks in the Czech Republic, Bavaria (Germany) and Austria. Population values have been standardized for comparison across regions (adopted from Seidl et al. 2014).

PRIMARY RESEARCH ARTICLE

WILEY Global Change Biology

Large-scale disturbance legacies and the climate sensitivity of primary *Picea abies* forests

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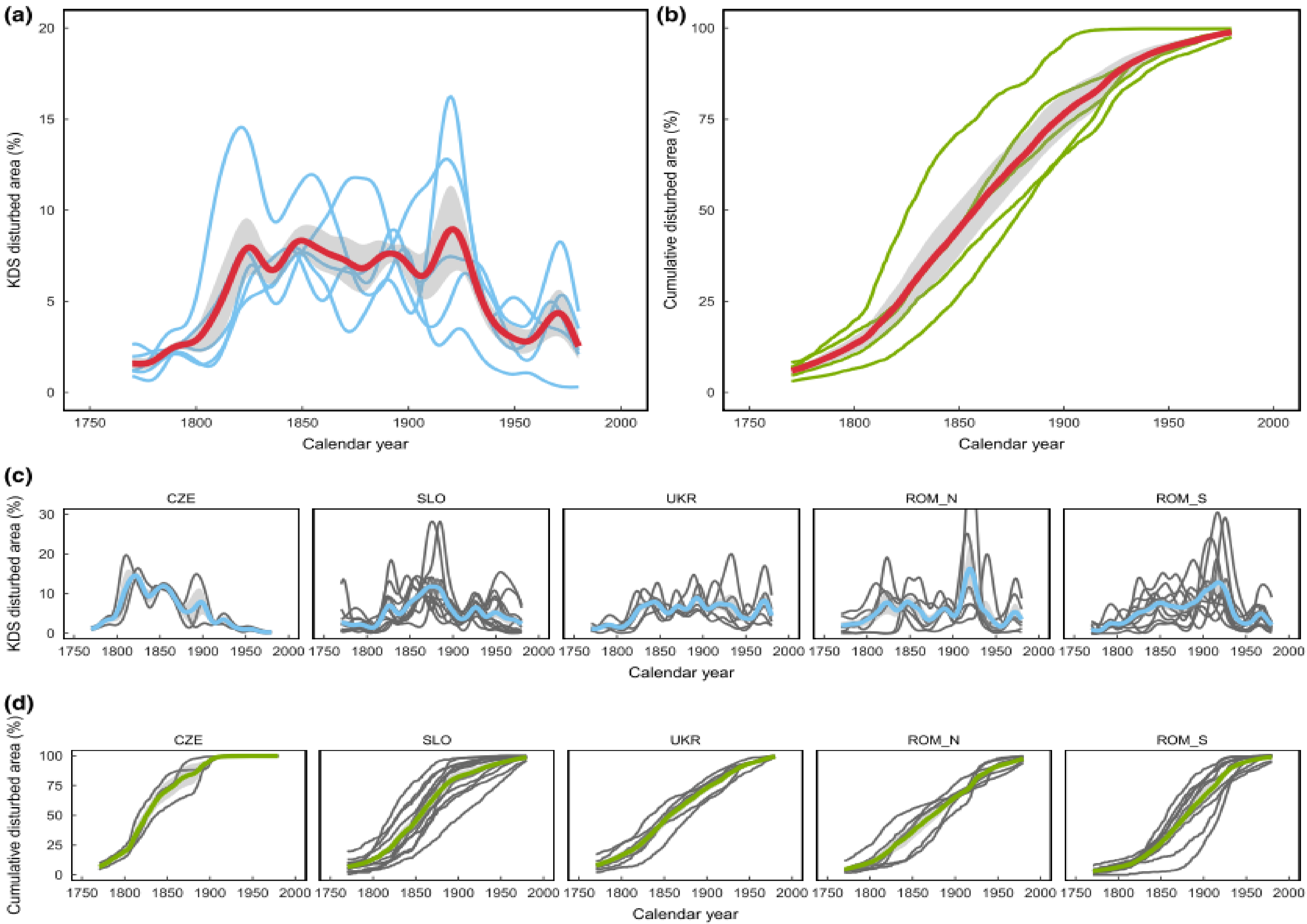
Abstract

Determining the drivers of shifting forest disturbance rates remains a pressing global change issue. Large-scale forest dynamics are commonly assumed to be climate driven, but appropriately scaled disturbance histories are rarely available to assess how disturbance legacies alter subsequent disturbance rates and the climate sensitivity of disturbance. We compiled multiple tree ring-based disturbance histories from primary *Picea abies* forest fragments distributed throughout five European landscapes spanning the Bohemian Forest and the Carpathian Mountains. The regional chronology includes 11,595 tree cores, with ring dates spanning the years 1750–2000, collected from 560 inventory plots in 37 stands distributed across a 1,000 km geographic gradient, amounting to the largest disturbance chronology yet constructed in Europe. Decadal disturbance rates varied significantly through time and declined after 1920, resulting in widespread increases in canopy tree age. Approximately 75% of current canopy area recruited prior to 1900. Long-term disturbance patterns were compared to an historical drought reconstruction, and further linked to spatial variation in stand structure and contemporary disturbance patterns derived from LANDSAT imagery. Histori-



(a)
KDS disturbed area (%)
Calendar year
(b)
Cumulative disturbed area (%)
Calendar year
(c)
CZE
SLO
UKR
ROM_N
ROM_S
KDS disturbed area (%)
Calendar year
(d)
CZE
SLO
UKR
ROM_N
ROM_S
Cumulative disturbed area (%)
Calendar year

Received: 16 January 2017 | Accepted: 18 May 2017
DOI: 10.1111/1365-2664.12945

REVIEW

Journal of Applied Ecology BRITISH ECOLOGICAL SOCIETY

Impacts of salvage logging on biodiversity: A meta-analysis

Simon Thorn[1] | Claus Bässler[2] | Roland Brandl[3] | Philip J. Burton[4] | Rebecca Cahall[5] | John L. Campbell[5] | Jorge Castro[6] | Chang-Yong Choi[7] | Tyler Cobb[8] | Daniel C. Donato[9] | Ewa Durska[10] | Joseph B. Fontaine[11] | Sylvie Gauthier[12] | Christian Hebert[12] | Torsten Hothorn[13] | Richard L. Hutto[14] | Eun-Jae Lee[15] | Alexandro B. Leverkus[16] | David B. Lindenmayer[17] | Martin K. Obrist[18] | Josep Rost[19,20] | Sebastian Seibold[2,21] | Rupert Seidl[22] | Dominik Thom[22] | Kaysandra Waldron[23] | Beat Wermelinger[24] | Maria-Barbara Winter[25] | Michal Zmihorski[26] | Jörg Müller[1,2]

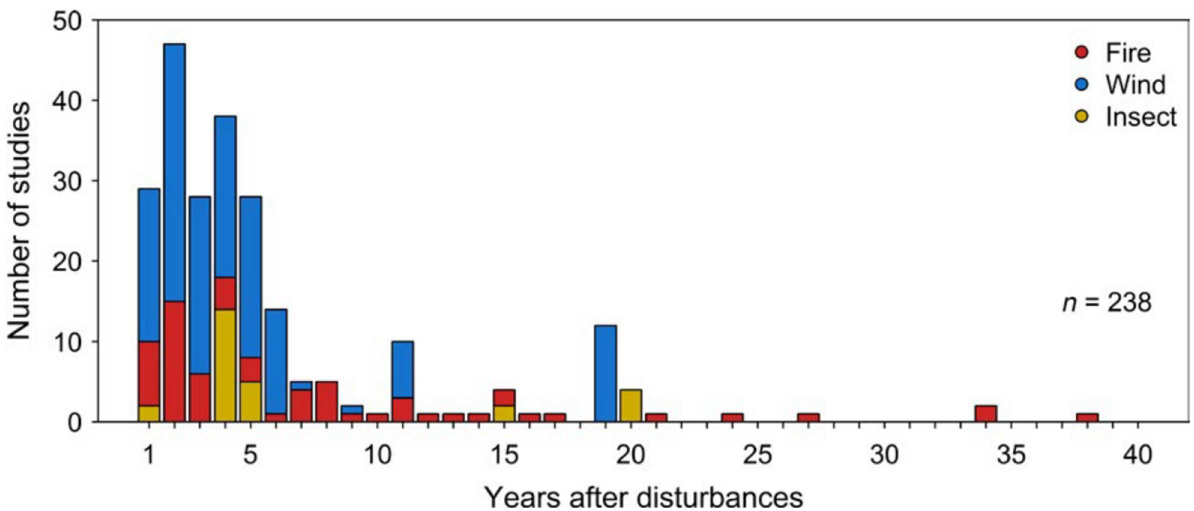


FIGURE 2 Distribution of studies investigating the effects of salvage logging on biodiversity after wildfire, windstorms and insect outbreaks according to the years after disturbance. [Colour figure can be viewed at wileyonlinelibrary.com]

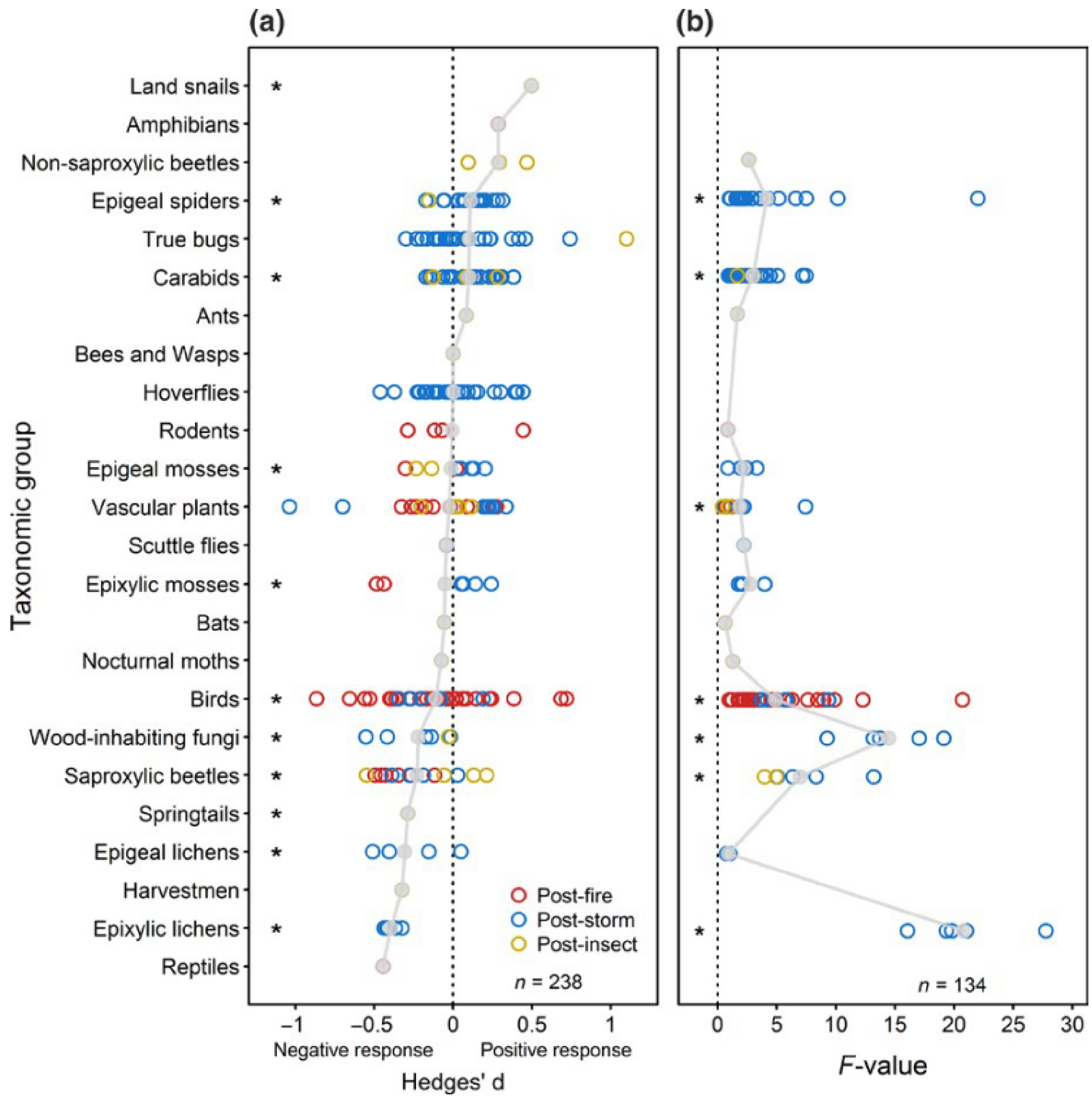


FIGURE 3 (a) Estimated response of Hedges' *d* based on 238 individual comparisons of species numbers in salvage logged and unsalvaged forests affected by natural disturbances. Higher species numbers in salvage logged areas correspond to positive Hedges' *d*, whereas negative values indicate lower species numbers in salvage logged areas. (b) Pseudo *F*-values of permutational multivariate analysis of variance based on 134 individual species abundance matrices. Larger pseudo *F*-values correspond to larger changes in community composition induced by salvage logging. Asterisks indicate significant responses (see Tables S1 and S2 for statistical details). For illustrative purposes, grey dots (and the grey line joining them for emphasis) represent the mean effect size in each taxonomic group. [Colour figure can be viewed at wileyonlinelibrary.com]

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Agricultural and Forest Meteorology

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Post-disturbance recovery of forest carbon in a temperate forest landscape under climate change

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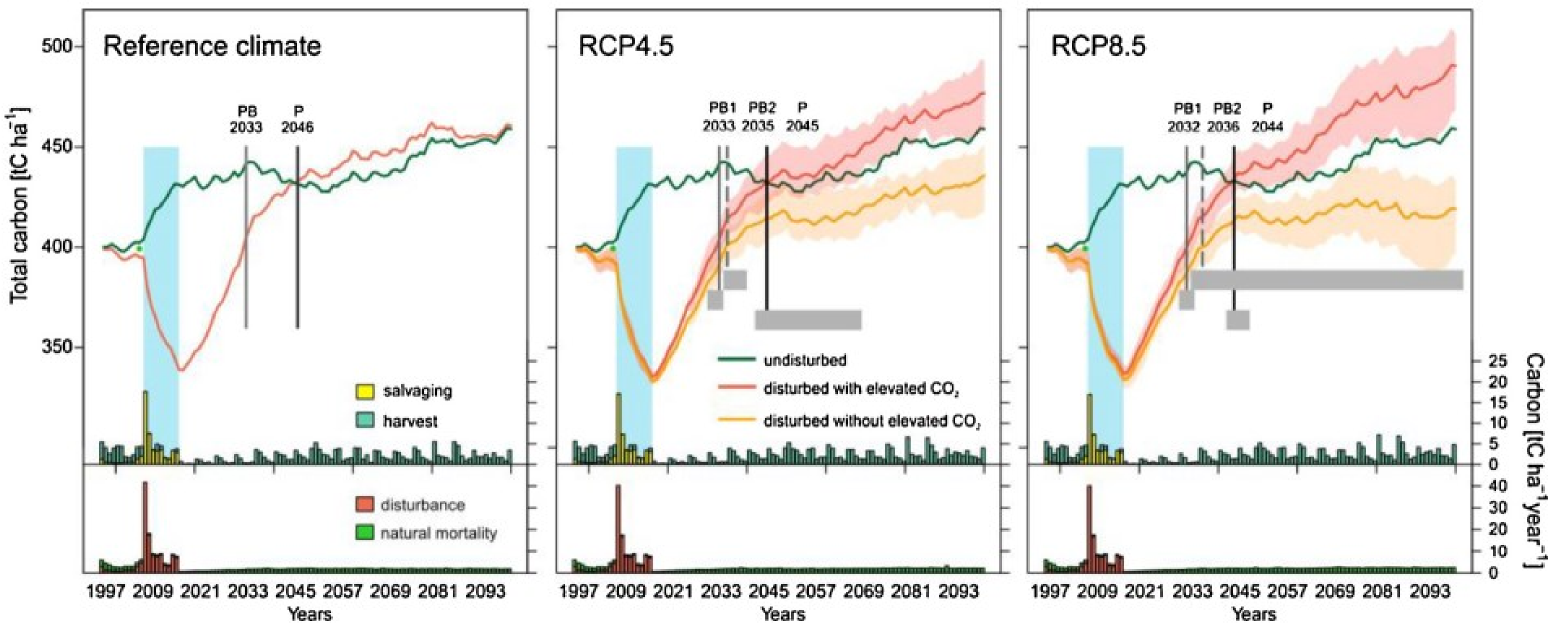

Fig. 3. Simulated total ecosystem carbon (C_{total}) and its post-disturbance recovery. The disturbed forest development is simulated under three different climate conditions, as well as with and without the fertilizing effect of CO_2. The reference undisturbed development was generated under reference climate corresponding to the period 1961-1990. Simulations under climate change are driven by seven climate models for each RCP scenario; solid lines indicate the average projection and shaded envelopes indicate the minimum–maximum range of the simulations. Grey rectangles indicate the inter-model range of payback time (PB1 with elevated CO_2; PB2 without elevated CO_2) and the C parity (P). Columns at the bottom indicate the annual C amount removed from the landscape by harvests and salvage cutting, and the annual C in dead trees. In case of RCP scenarios, columns show multi-model means under elevated CO_2 level. The blue vertical rectangle indicates the wind-bark beetle disturbance episode investigated here (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.).

BIOLOGICAL REVIEWS
Cambridge Philosophical Society
Biol. Rev. (2016), 91, pp. 760–781. 760
doi: 10.1111/brv.12193

Natural disturbance impacts on ecosystem services and biodiversity in temperate and boreal forests

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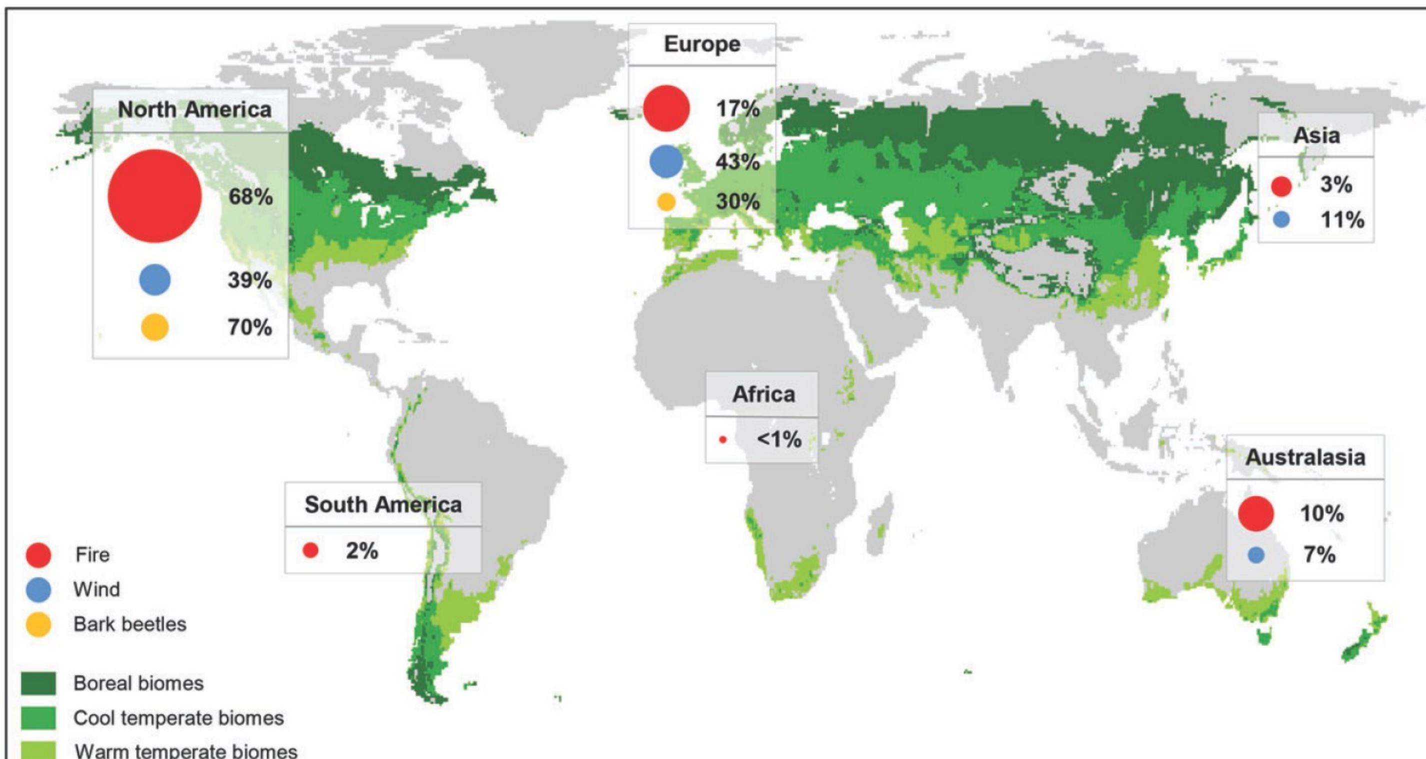

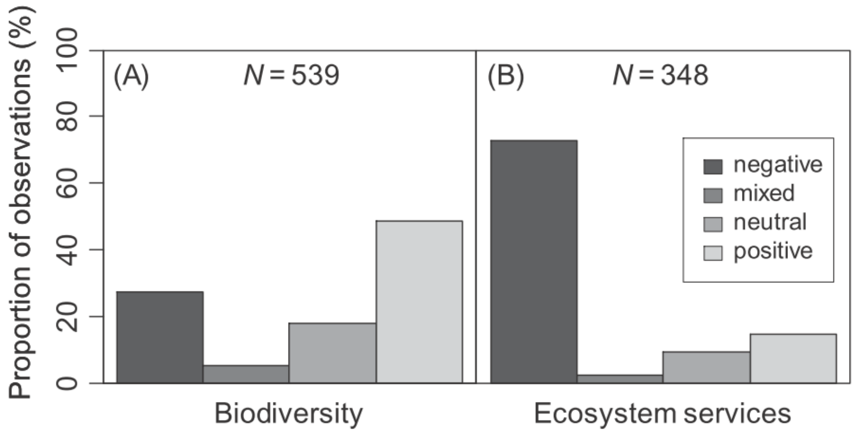

Fig. 2. Disturbance effects on (A) biodiversity and (B) ecosystem services. *N* indicates the number of observations in our database of disturbance effects synthesized from 478 peer-reviewed articles.

Disturbance paradox

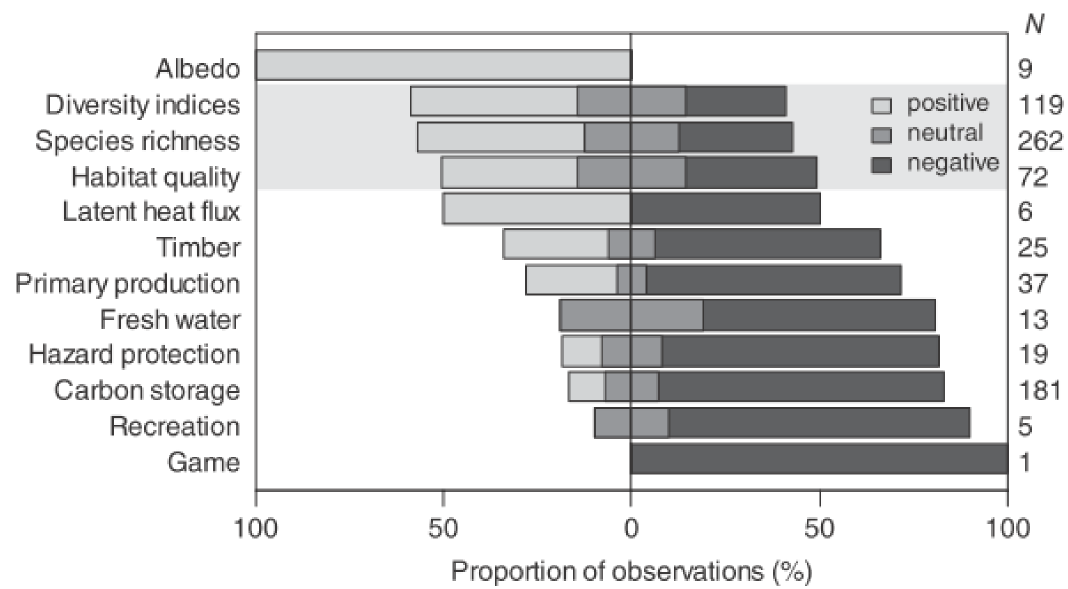

Fig. 3. Disturbance effects on indicators of ecosystem services and biodiversity (shaded). Bars show the distribution of positive, neutral and negative disturbance effects per indicator; *N* denotes the total number of observations. Note that neutral and mixed effects were subsumed under the neutral category here, and that findings based on expert opinions were excluded.

Advance View
https://doi.org/10.3354/cr01461

CLIMATE RESEARCH
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Available online:
June 28, 2017

Contribution to CR Special 34 'SENSFOR: Resilience in SENSitive mountain FORest ecosystems under environmental change'

Forest ecosystem services affected by natural disturbances, climate and land-use changes in the Tatra Mountains

Peter Fleischer[1,2], Viliam Pichler[1], Peter Fleischer Jr.[1], Ladislav Holko[3], František Máliš[1,4], Erika Gömöryová[1,*], Pavel Cudlín[5], Jan Holeksa[6], Zuzana Michalová[7], Zuzana Homolová[2], Jaroslav Škvarenina[1], Katarína Střelcová[1], Pavol Hlaváč[1]

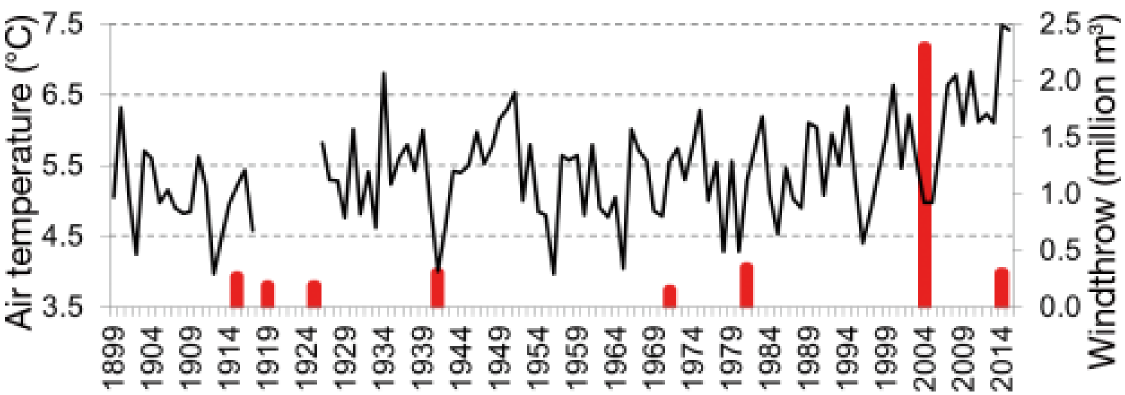


Fig. 2. Mean annual air temperature (Tatranská Lomnica, elevation 830 m a.s.l., period 1898–2015) and windstorm damage (million m^3 of fallen trees). Source: State Forests of TANAP and the Slovak Hydrometeorological Institute

CI$_{ij}$ FIR 10	NEX 5	NEX 10	IPS 5	IPS 10	Source
0.92	0.95	1.11	0.63	0.39	Fleischer (2016)
0.73	0.35	0.73	0.50	0.28	Fleischer (2016)
0.81	0.76	0.90	0.13	0.28	Kyselová & Homolová (2012), Pajtík et al. (2015), Fleischer (2016)
2.51	3.63	3.77	1.33	2.13	Jonášová et al. (2010), Šebeň et al. (2011b), Michalová (2015)
0.39	3.25	3.38	3.25	3.38	Šebeň et al. (2011a)
0.16	0.13	0.11	0.30	0.18	Kopecká & Nováček (2009), Havašová et al. (2017)
0.04	0.01	0.04	0.50	0.11	State Forests of TANAP, Tutka (2009)
1.00	1.00	0.40	0.75	0.75	Hloška et al. (2016)
0.33	0.50	0.50	0.50	0.25	State Forests of TANAP
1.00	0.86	0.75	0.50	0.40	Nikolov et al. (2014)
3.50	0.50	0.50	1.00	1.00	Šebeň et al. (2011b), Fleischer (2016)
0.54	0.63	1.00	1.12	1.31	Máliš et al. (2015)
0.97	0.98	0.88	0.73	0.78	Fleischer (2016)
0.25	0.45	0.49	0.06	0.04	Fleischer (2016)
1.00	1.00	1.00	1.00	1.00	Ziegler (2007), Frič & Škvarenina (2008)
1.29	1.16	1.10	1.00	1.05	Don et al. (2012), Hanajík & Šimonovičová (2015), Gömöryová et al. (2017)
0.96	1.00	0.98	1.00	0.97	Don et al. (2012), (2015)
0.90	0.55	0.94	0.84	0.82	Bischoff et al. (2008), Fleischer (2014)
1.00	1.13	1.08	1.00	1.00	Šimkovič et al. (2009), Gömöryová et al. (2017)
0.52	0.74	0.81	0.39	0.40	Gömöryová et al. (2017)
1.60	2.60	1.60	1.25	1.40	Kyselová & Homolová (2011), Z. Kyselová (pers. comm.)
0.75	1.29	1.29	1.00	1.00	www.lesytanap.sk
0.56	0.64	0.56	0.64	0.56	Holko et al. (2012), Holko & Škoda (2016)
0.35	0.46	0.35	0.46	0.46	Holko et al. (2012), Holko & Škoda (2016)
0.25	0.70	0.25	0.70	0.40	Holko et al. (2012), Holko & Škoda (2016)
0.36	0.52	0.66	0.53	0.36	Fleischer (2014)
0.58	0.40	0.58	0.40	0.58	Bičárová (2011), S. Bičárová (pers. comm.)
0.34	0.76	0.87	0.89	0.89	Sitko et al. (2011)
1.00	0.70	1.00	0.70	0.09	Sitko et al. (2011)
1.05	1.05	1.08	1.06	1.17	Bičárová et al. (2015)
1.34	1.13	1.35	1.12	1.35	Fleischer (2014)
0.89	0.92	0.88	0.93	0.88	Fleischer (2014), Fleischer (2016)
0.84	0.85	0.83	0.85	0.79	Matejka & Fleischer (2011), Fleischer (2014)
1.09	1.02	0.95	1.11	1.05	Fleischer (2016),
1.08	1.00	1.07	1.00	1.00	Bartík et al. (2014)
1.56	0.75	3.85	0.88	0.81	Fleischer et al. (2012), Fleischer (2014)
1.25	1.06	1.13	0.28	0.15	P. Fleischer (unpubl.)
0.33	0.10	0.25	0.14	0.11	www.lesytanap.sk
1.00	1.00	1.00	0.25	0.25	www.lesytanap.sk
1.00	0.50	0.50	0.14	0.11	Kajba et al. (2013), www.lesytanap.sk
1.17	0.88	1.17	0.88	1.17	www.lesytanap.sk
0.40	0.63	0.40	0.63	0.40	Božíková (2009), J. Božíková (pers. comm.)
0.55	0.50	0.55	0.50	0.50	Vyskot et al. (2007), Čekovská (2013)
0.25	0.66	0.33	0.50	0.50	Turčeková et al. (2014), Homolová et al. (2015)

Table 1. List of ecosystem state indicators categorised according to the ecosystem services (PES, provisioning; RES, regulating; CES, cultural) and their relative normalized change index (CI), when compared with the reference (REF) value (pre-disturbance state recorded at the REF site in 2004 [REF0] or alternatively, a site-specific value if recorded at the distinct research site before the disturbance) according to land-use types (EXT: salvage-logged windthrow; FIR: windthrow burnt by incidental fire; NEX: no timber extraction; IPS: no timer extraction but disturbed by bark beetle occurrence including treeline) and the time of assessment (5 and 10 yr after the disturbance). +/− indicates the interpretation of increasing ecosystem state indicator value on ecosystem functioning and ES provision based on the authors' evaluation. See Section 2.2 for further details. Key indicators are in **bold**

Ecosystem service category	Indicator (unit)	ES trend (+/−)	REF REF0 or site value	CI_{ij} REF 5	REF 10	EXT 5	EXT 10	FIR 5
PES	**Gross primary production (g C m^{-2})**	+	1282	0.92	0.85	0.43	0.93	0.96
	Leaf area index (m^2 m^{-2})	+	6	0.92	0.67	0.2	0.63	0.33
	Net primary production (g C m^{-2})	+	460–505	0.81	0.18	0.63	0.62	0.83
	Natural regeneration (ind. ha^{-1})	+	2200	1.09	1.18	2.04	1.63	2.00
	Dead wood (m^3 ha^{-1})	+	77	1.09	1.17	1.43	1.43	0.39
	Fragmentation (%)	−	15	0.88	0.75	0.16	0.16	0.16
	Yield (m^3 ha^{-1})	+	280	1.04	0.25	0.00	0.04	0.00
	Soil fauna diversity (n)	+	5	1.00	0.60	2.80	1.00	3.20
	Game (n ha^{-1})	−	0.5	1.00	1.00	0.50	0.33	0.50
	Bark beetle population (% trees infested)	−	30	0.75	0.60	1.00	1.00	1.00
	Tree species (n)	+	2	1.00	1.00	2.00	2.50	2.50
	Plant species (n)	+	22	1.09	1.05	0.36	0.77	0.32
RES	**Respiration (g C m^{-2})**	−	1235	1.07	1.16	1.15	0.93	0.96
	C balance (g C m^{-2})	+	47	0.74	0.40	0.16	0.21	0.22
	Total organic C (mg l^{-1})	−	375	0.99	0.99	0.99	0.99	1.00
	C/N	−	22	0,.6	0.96	1.00	1.05	1.31
	C stock (Mg C ha^{-1})	+	92	1.09	1.12	1.02	0.94	0.94
	Leaching (index)	−	4.6	1.00	0.92	0.58	0.92	0.55
	Soil pH	+	3.9–4.8	1.00	1.00	0.98	0.98	0.98
	Microbial diversity	+	226	0.39	0.51	0.33	0.56	0.30
	Cellulose decomposition (%)	+	25	1.00	1.00	1.60	1.60	2.40
	Naturalness (% of natural stands)	+	20–90	1.00	1.00	0.25	0.40	0.25
	High flow pulses (n)	−	90	0.75	0.69	0.82	0.69	0.64
	Flow reversals (n)	−	7	1.00	1.00	1.00	1.00	0.46
	Flow minimum (index)	−	0.15–0.4	0.33	0.33	0.87	1.00	0.60
	Interception (% of rain retained by canopy)	+	42	0.90	0.67	0.24	0.24	0.12
	Ground water level (m)	−	2.5	0.40	0.58	0.40	0.58	0.40
	Surface runoff (%)	−	0.61–1.57	0.87	0.76	0.32	0.41	0.27
	Erosion (kg ha^{-1} yr^{-1})	−	0.007	0.43	0.43	0.70	1.00	0.70
	O_3 (ppb)	−	39–48	1.08	1.05	1.08	1.05	1.08
	Precipitation pH	+	4.0–4.1	1.07	1.36	1.20	1.38	1.05
	Soil temperature (°C)	−	7.4–9.0	0.98	0.78	0.72	0.82	0.80
	Air temperature (°C)	−	11.0–11.5	0.94	0.92	0.85	0.84	0.86
	Soil moisture (%)	+	33–38	1.00	1.08	0.86	0.70	1.06
	Snow accumulation (cm)	+	150–250	1.00	1.10	1.00	1.08	1.00
	Sensible heat (% in energy balance)	−	45.9	0.96	0.92	0.83	0.84	0.79
	Wind velocity (m s^{-1})	−	0.2	0.67	0.50	1.06	1.2	1.11
	Fire risk (index)	−	1	1.00	0.50	0.14	0.25	0.33
	Rockfall risk (index)	−	1	1.00	1.00	1.00	1.00	1.00
	Treefall risk (index)	−	1	0.50	0.33	1.00	1.00	1.00
CES	**Visitors (n)**	+	18 000	0.88	1.17	0.88	1.17	0.88
	Patients (n in climatic spa)	+	3000	0.63	0.40	0.63	0.40	0.63
	Attractiveness (index)	+	1	1.00	0.80	0.50	0.55	0.50
	Allergen, disease (index)	−	1	0.66	0.50	0.28	0.25	0.67

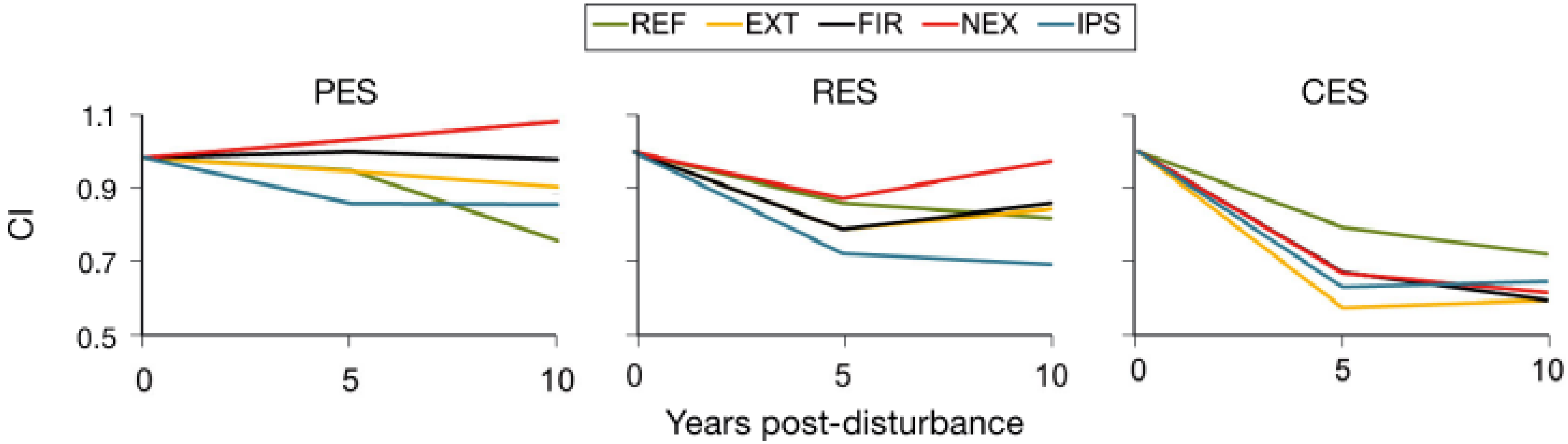


Fig. 3. Trajectories of provisioning (PES), regulating (RES) and cultural (CES) ecosystem services before the disturbance (0) and 5 and 10 yr after the disturbance at sites with different disturbance and land-use practices: REF: reference; EXT:extracted windthrow; FIR: burnt extracted windthrow; NEX: non-extracted windthrow; IPS: non-extracted site disturbed by bark beetle. Temporal values represent the average normalised change index (CI) of ecosystem service provision indicators (n = 12 for PES, n = 28 for RES and n = 4 for CES)

Michalová et al. 2017

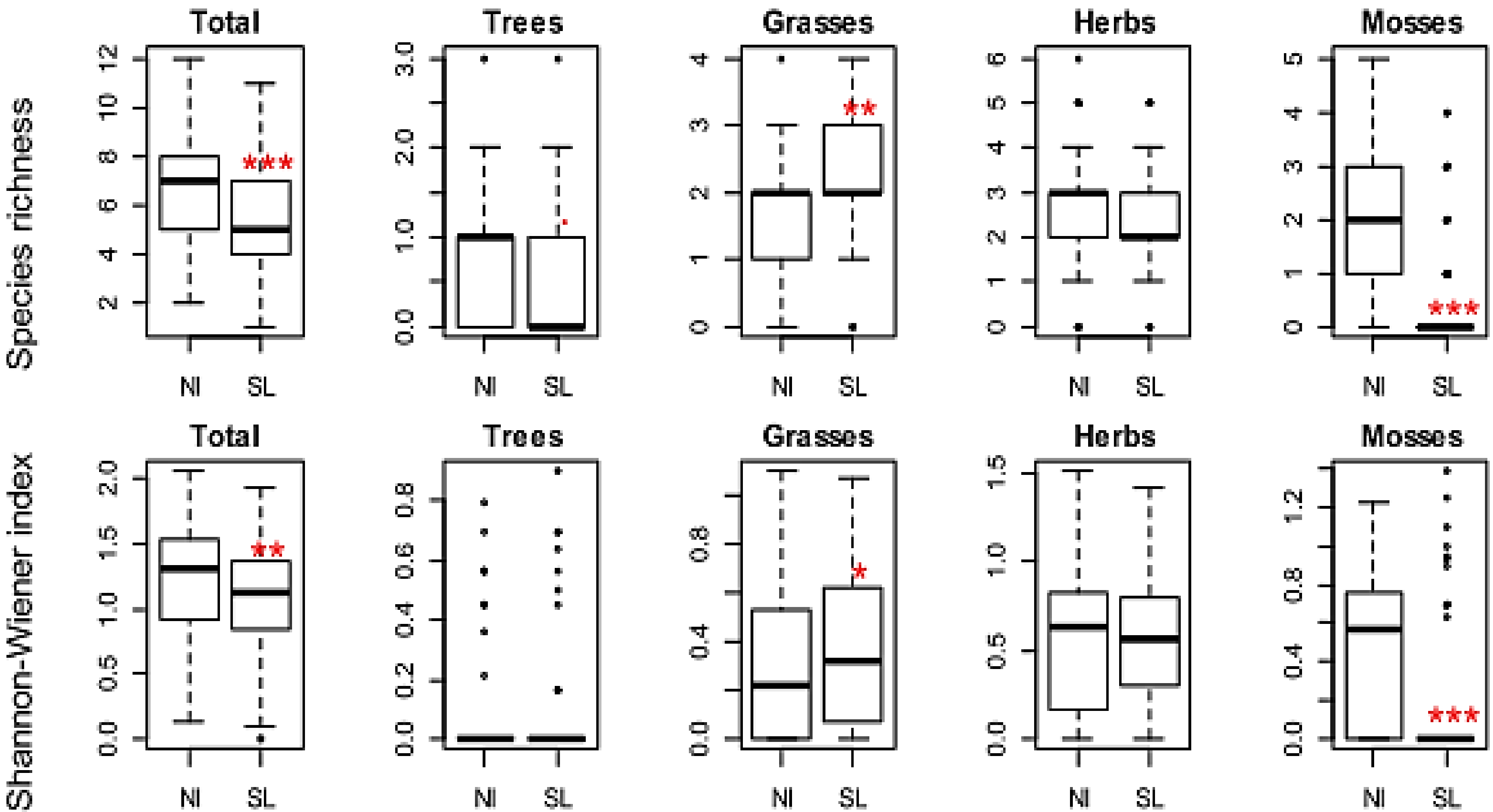
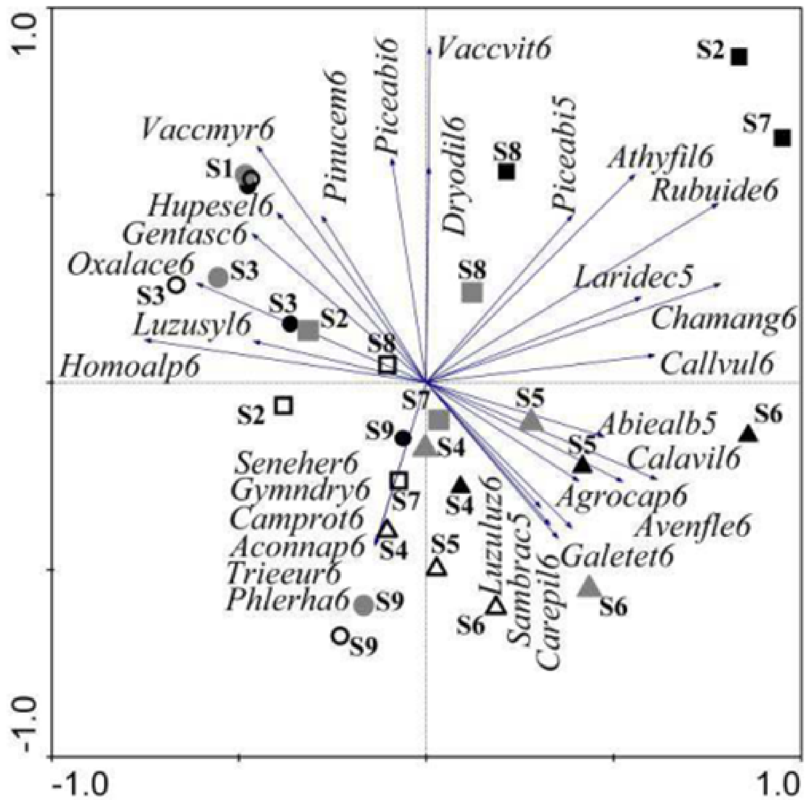
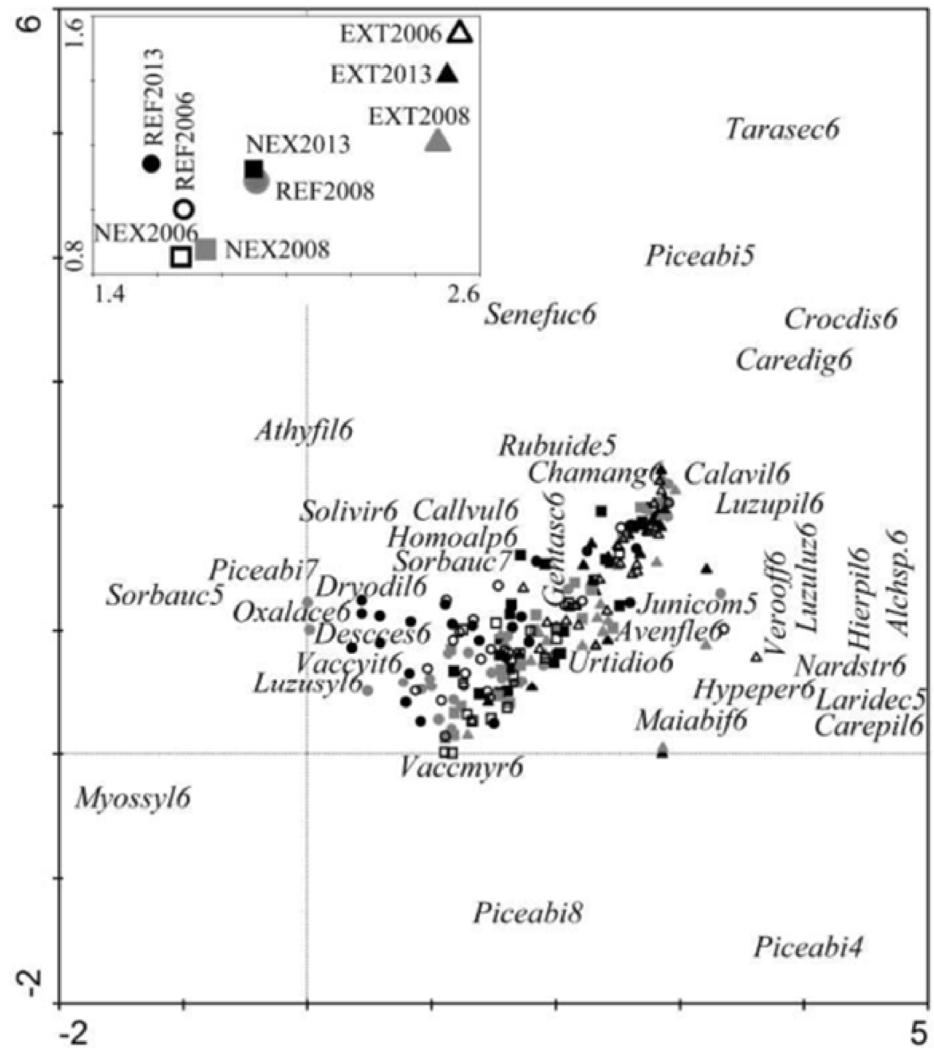


Figure 3. Boxplots presenting comparisons of species richness (**top** row) and Shannon-Wiener index (**bottom** row) for all species pooled together (i.e., Total), for tree species, and for individual plant functional groups for both NI and SL sites (statistical significance: "***" $p < 0.001$, "**" $p < 0.01$, "*" $p < 0.05$, "." $p < 0.1$).

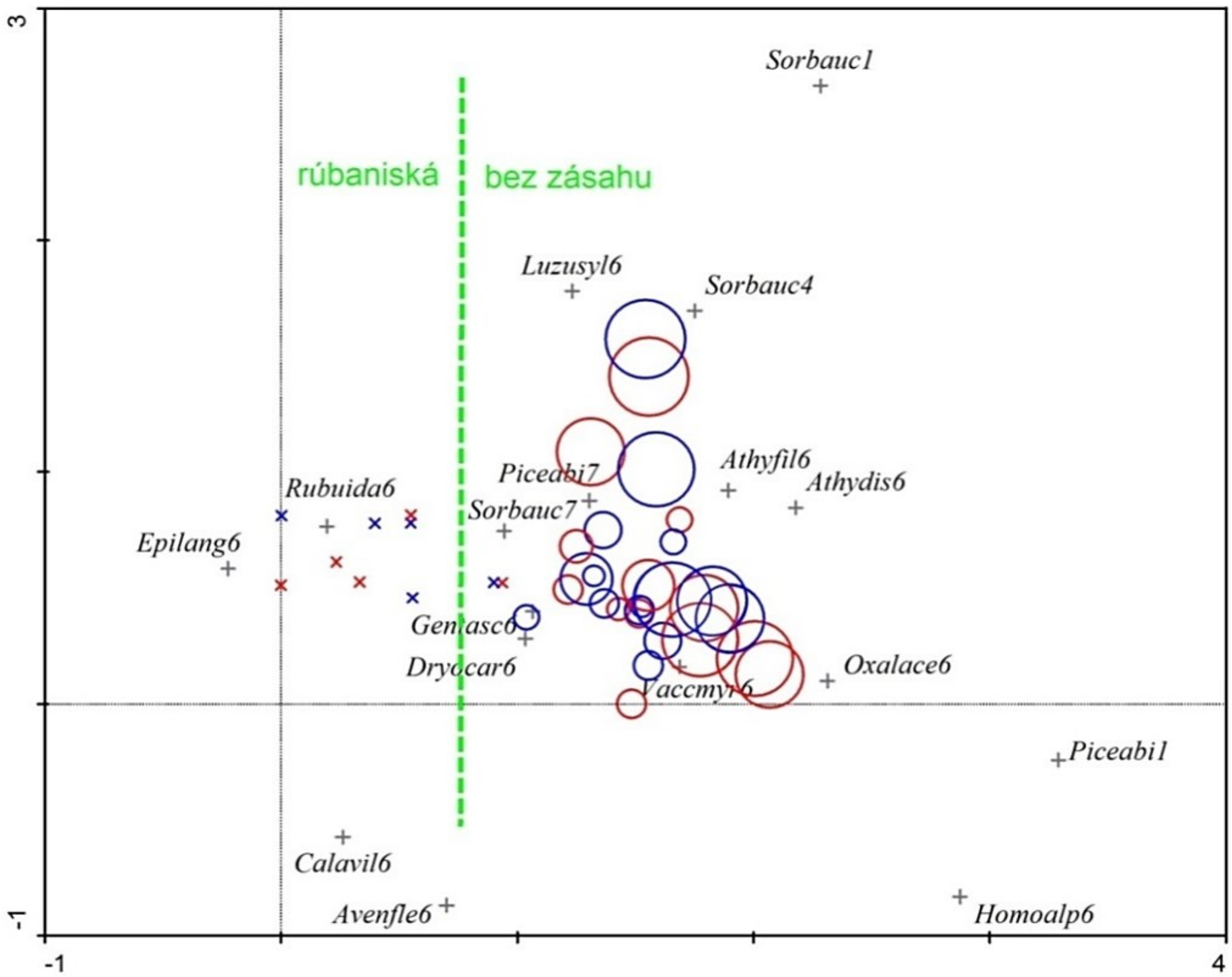
Máliš et al. 2015 – vývoj vegetácie v nespracovanej vetrovej a lykožrútovej kalamite je podobný a líši sa od rúbanísk po spracovanej vetrovej kalamite; podobne Križová et al. 2010



Obrázok 1 Analýza PCA zobrazujúca variabilitu a vývoj vegetácie na plochách. Trojuholník – EXT, štvorec – NEX, kruh – REF; prázdny znak – rok 2006, sivý – 2008, čierny – 2013.



Obrázok 2 Analýza DCA zobrazujúca variabilitu a vývoj vegetácie na subplochách. Vnorený je graf identickej analýzy so zobrazením centroidov subplôch.



Rok 2013 = červená; 2015 = modrá
Veľkosť krúžku = pokryvnosť stromovej etáže E3
Nulová pokryvnosť E3 = x.

Ordinačný graf DCA analýzy na základe logaritmovaných percentických hodnôt pokryvnosti.

Regenerácia

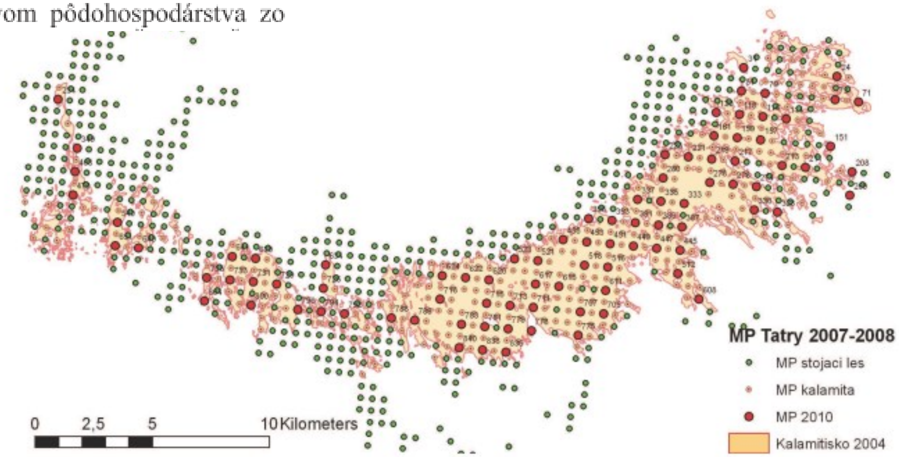

Vysoké Tatry 2008

Zmeny v obnove lesa na kalamitisku zistené v monitorovacej sieti procesu revitalizácie (2007-2010)

VLADIMÍR ŠEBEŇ, MICHAL BOŠEĽA

Úvod

Po vzniku tatranskej kalamity v novembri 2004 vyplynula požiadavka úspešne obnoviť alebo rekonštruovať poškodené územie. Pracovná komisia zriadená Ministerstvom pôdohospodárstva zo



Obr. 1: Rozmiestnenie MP procesu revitalizácie z rokov 2007-2008 a 2010

odstraňovanie (najčastejšie vyžínanie 1-2 krát počas vegetačnej sezóny). Monitoring zaznamenal v roku 2010 vyžínanie iba na 1/5 zaburinených plôch, zatiaľ čo 4/5 ostali bez takéhoto zásahu. Väčšina kalamitiska sa teda vyvíja skôr samovoľne, ako riadeným ošetrovaním. Zaujímavé je však porovnanie priemerného počtu jedincov. Kým na vyžatých plochách sa zistilo v priemere okolo 5 tisíc kusov jedincov obnovy na hektár, na nevyžatých to bolo takmer 2x toľko, 8-10 tisíc. Môže to poukazovať na fakt, že sa vyžínajú práve lokality s najnepriaznivejším stavom obnovy (kde je obnovy dostatok aj napriek burine, naliehavosť nie je vysoká). Ale rovnako to môže znamenať, že pri vyžínaní husto zaburinených plôch vzniká väčšie riziko neúmyselného odstránenia jedincov prirodzenej obnovy a tieto sa skutočne spolu s burinou aj redukujú. Zistenia monitoringu by poukazovali na šetrnejšie a opatrnejšie uplatňovanie mechanického odstraňovania buriny.

2013 – 5 rokov po odumretí E3

2018 – desať rokov po odumretí stromov

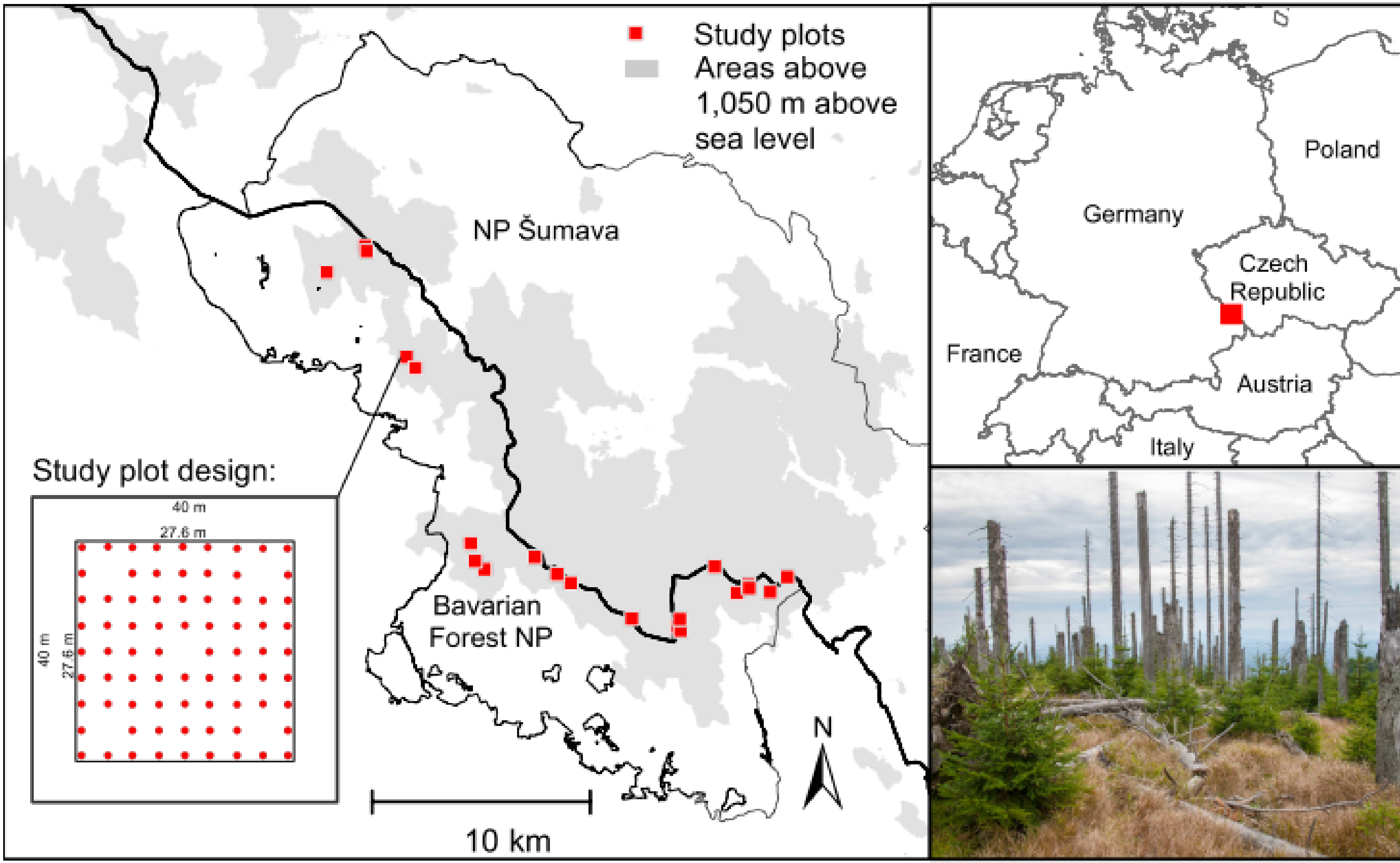


Fig. 1. Study site location and plot arrangement: plots are subdivided into a grid of 76 circular sub-plots, 0.5 m^2 each, spaced 3.35 m apart. All seedlings and saplings present on these sub-plots were permanently labelled and repeatedly measured during the first 12 years after stand-replacing disturbance by a massive bark-beetle outbreak. Inset photograph shows the stand 12 years after the outbreak (during fieldwork in 2010).

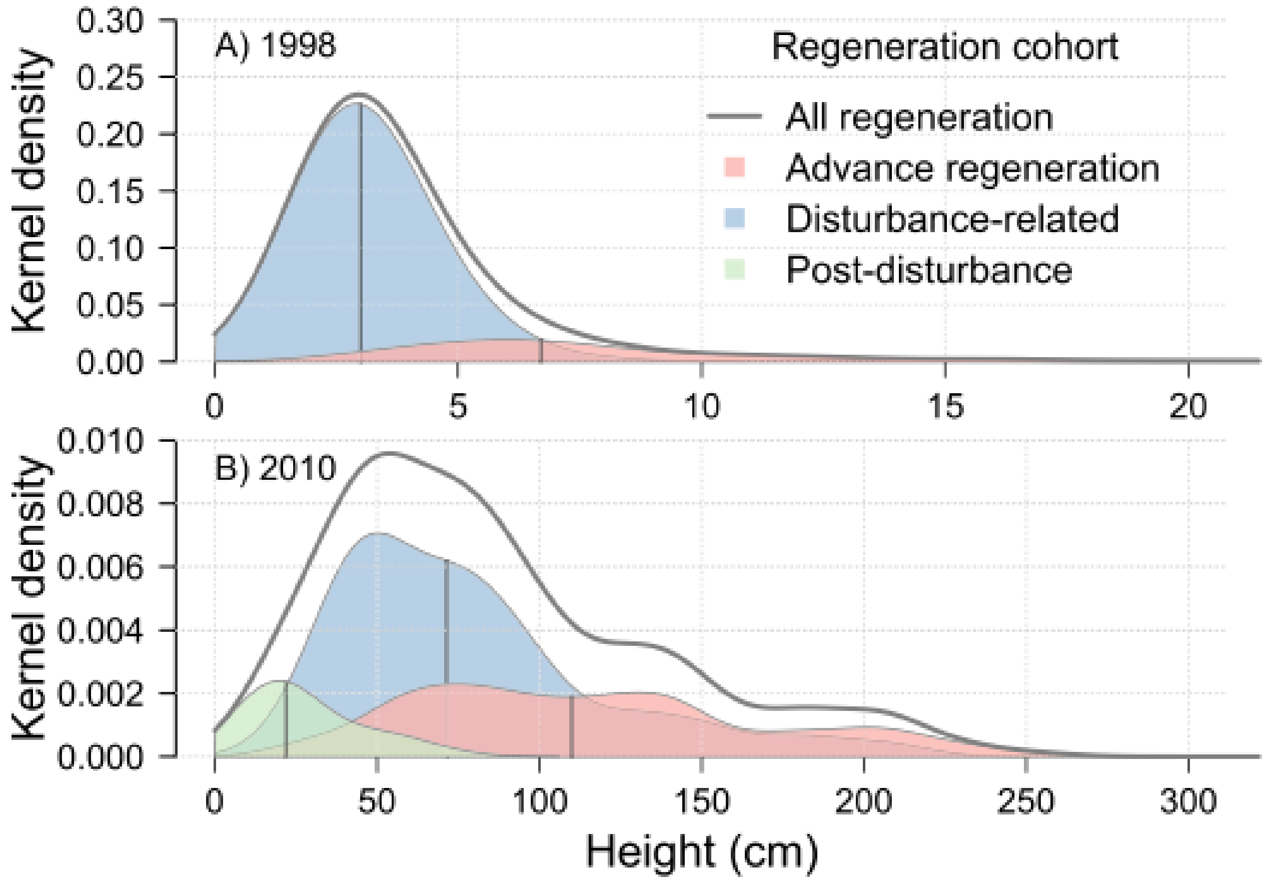


FIG. 3. Height distribution of seedlings and saplings (A) in 1998 and (B) in 2010. Solid gray line shows height distribution of all regeneration, and colored areas show height distributions of separate regeneration cohorts. Vertical lines denote median heights for each cohort separately. Note different scales used. (A) Regeneration during bark-beetle outbreak comprised mostly 1–2-yr-old seedlings of height <5 cm established during the outbreak itself. (B) Twelve years later, the dominance of this disturbance-related cohort was still apparent, but the relative proportion of advance regeneration increased. Only a small fraction of seedlings got established after the canopy dieback.

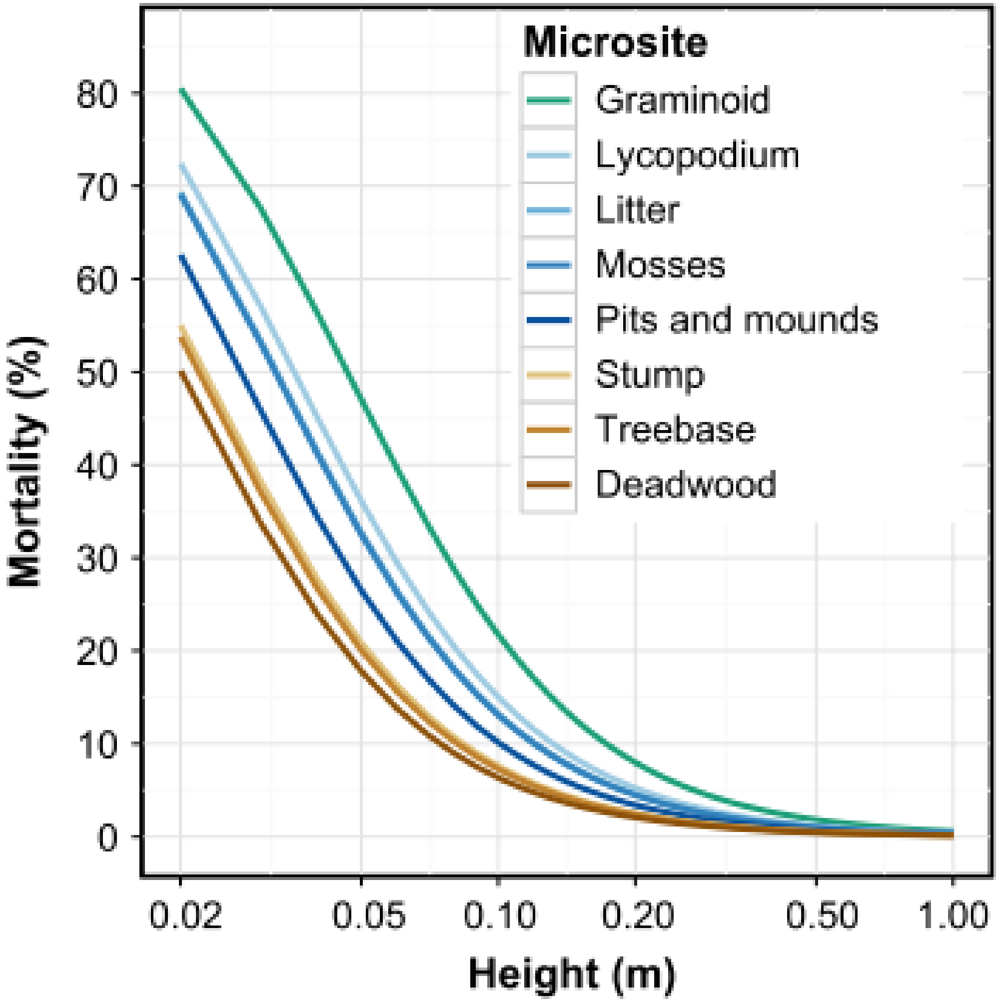


FIG. 5. Annual mortality steeply decreases with height and differs for particular microsites. Overall, the highest mortality was for seedlings growing in graminoid vegetation, whereas seedlings rooting in deadwood had the lowest mortality. Lines show marginal predictions of mortality model.

Journal of Vegetation Science **25** (2014) 1327–1340

Spatial patterns with memory: tree regeneration after stand-replacing disturbance in *Picea abies* mountain forests

Jan Wild, Martin Kopecký, Miroslav Svoboda, Jitka Zenáhlíková, Magda Edwards-Jonášová
Tomáš Herben

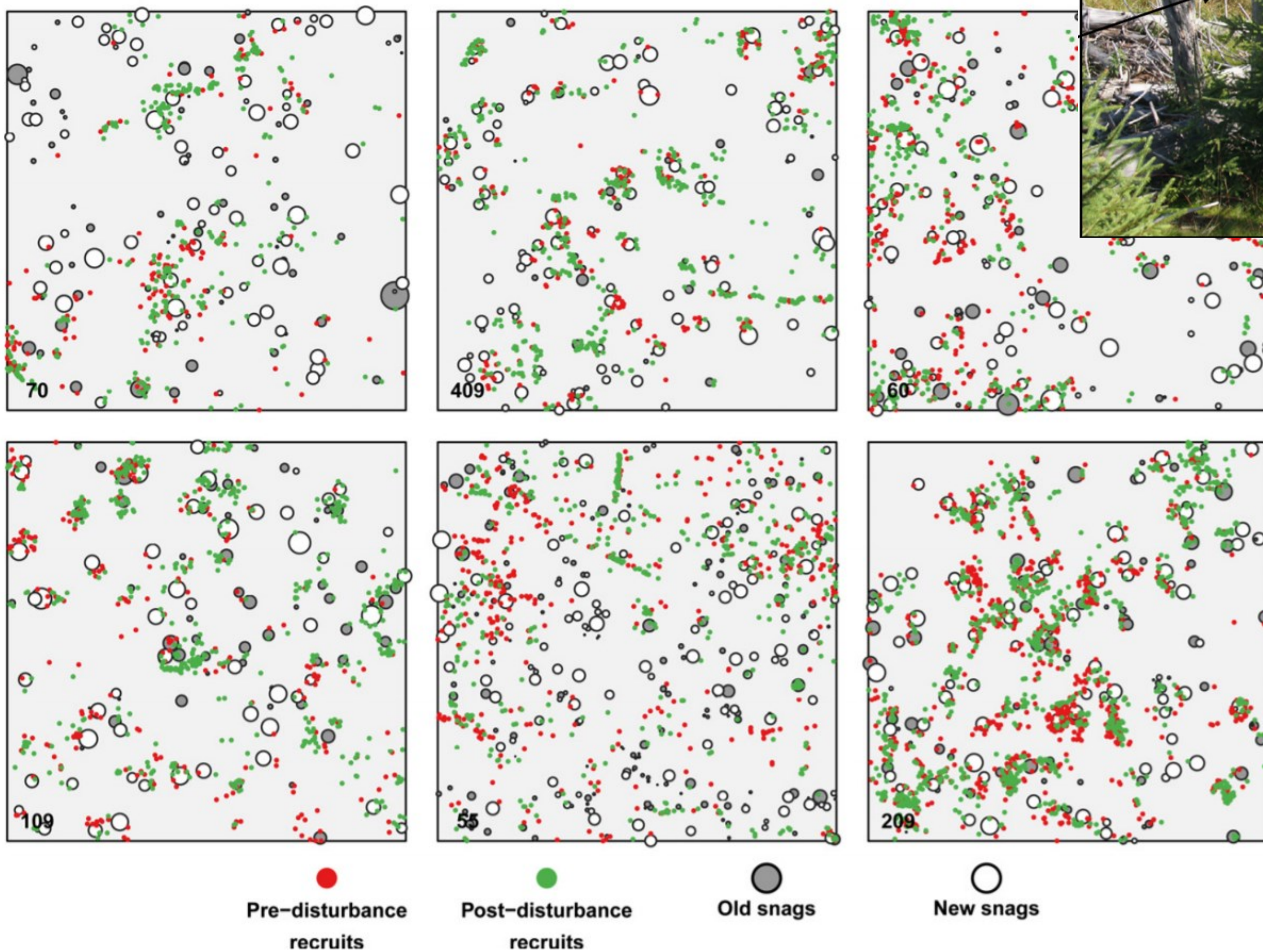


Fig. 2. Spatial patterns of pre- (red dots) and post- (green dots) disturbance recruits, and new (white) and old (grey) snags (circles with sizes proportional to stem diameter) in nine 40 × 40 m plots established in the core area of Šumava National Park, Czech Republic. Plots are ordered from low to high recruit density. Recruits formed clusters in all plots, while snags were distributed randomly.

Výlet do USA – IAVS meeting

UNITED STATES OF AMERICA
0 km 175 350 525 km
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Federal Capital (590.000 in 2007)
over 7.000.000
over 2.000.000
over 1.000.000
over 300.000
other main city
other city
State Capital
4000 m
3000 m
2000 m
1000 m
500 m
200 m
0 m
below sea level
C A N A D A
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO
MEXICO
CUBA
THE BAHAMAS
Havana
Mérida
Monterrey
Ciudad Juárez
Tijuana
Vancouver
Calgary
Regina
Winnipeg
Québec
Montréal
Ottawa
Toronto
Halifax
Lake Superior
Lake Michigan
Lake Huron
Lake Erie
Lake Ontario
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
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MAINE
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El Paso
Dallas
Fort Worth
Houston
San Antonio
Austin
Oklahoma City
Tulsa
Kansas City
Omaha
Minneapolis
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Detroit
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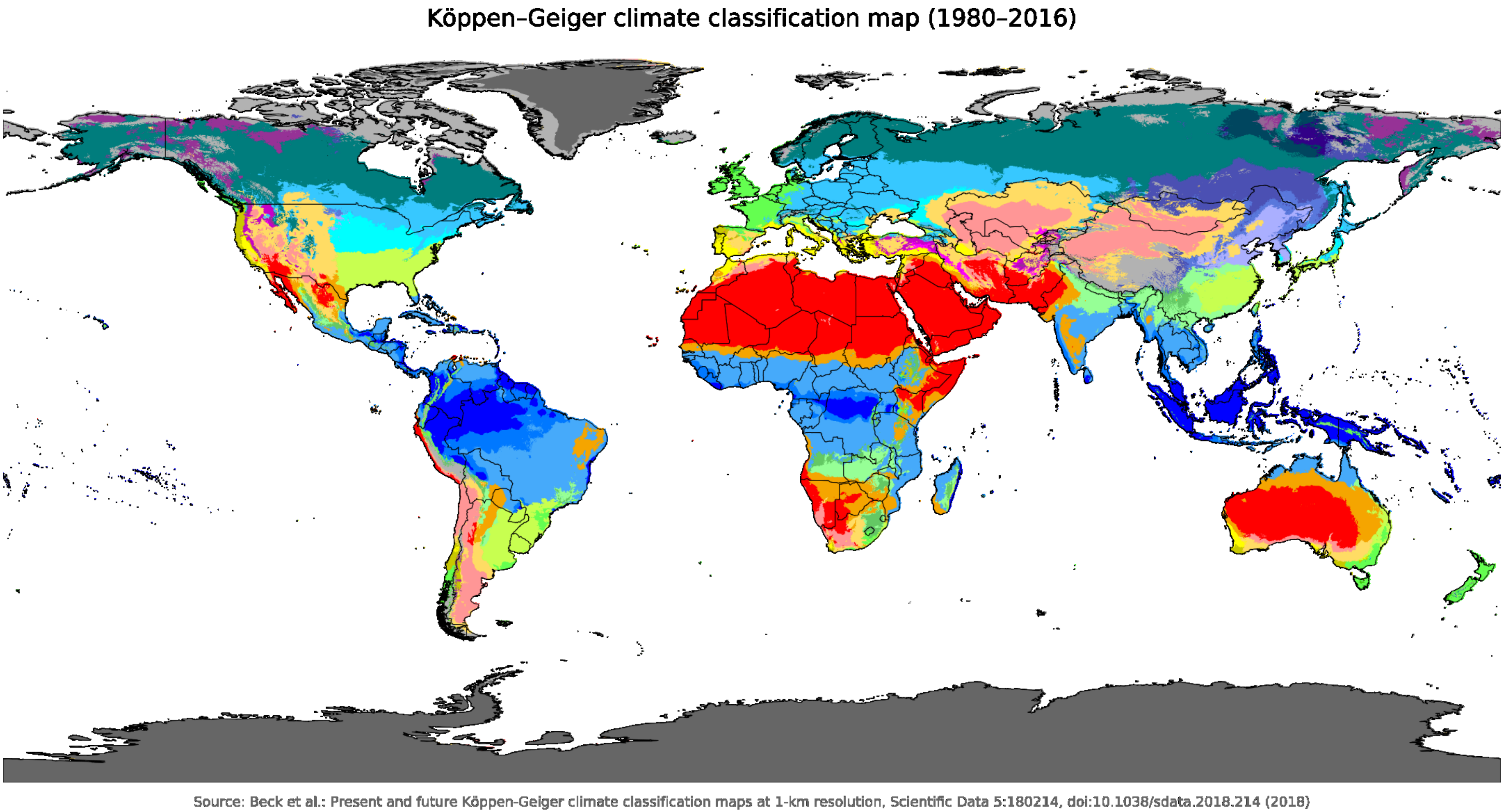
Indianapolis
Cleveland
Columbus
Cincinnati
Pittsburg
Philadelphia
New York
Boston
Baltimore
Virginia Beach
Atlanta
Memphis
Nashville
New Orleans
Jacksonville
Orlando
Tampa
Miami
Charlotte
Great Basin
Colorado Plateau
Appalachian Mts
Rocky Mountains
RUSSIAN FED.
ALASKA
Brooks Range
Alaska Range
Anchorage
Fairbanks
BEAUFORT SEA
BERING SEA
Gulf of Alaska
Aleutian Islands
ARCTIC CIRCLE
PACIFIC OCEAN
CANADA
300 km
HAWAII
Honolulu
Hawaiian Islands
150 km
Hawaii (USA)



- USA – Montana, Wyoming, Utah, Colorado
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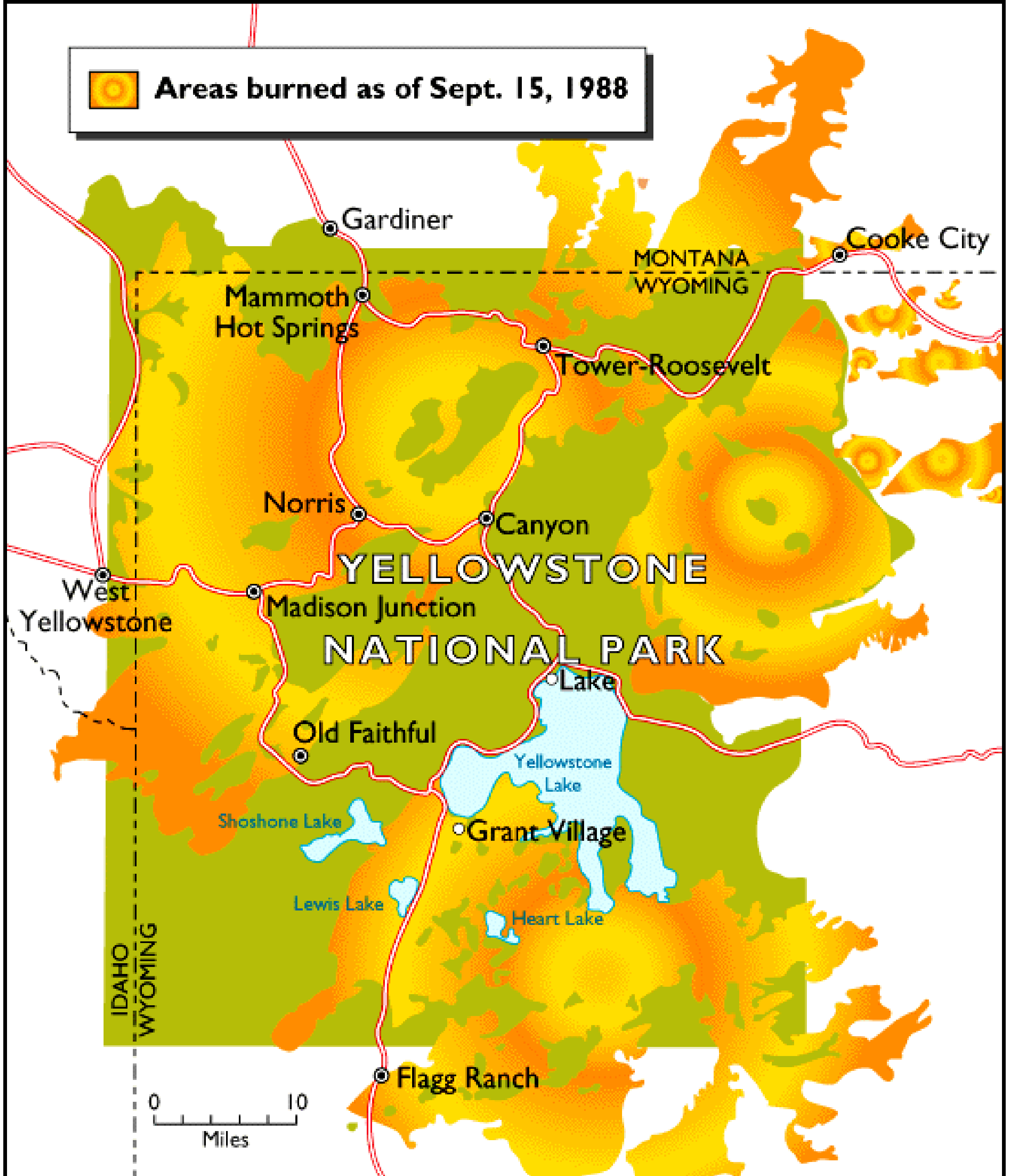


Areas burned as of Sept. 15, 1988
Gardiner
Cooke City
MONTANA
WYOMING
Mammoth
Hot Springs
Tower-Roosevelt
Norris
Canyon
YELLOWSTONE
NATIONAL PARK
West
Yellowstone
Madison Junction
Lake
Old Faithful
Yellowstone
Lake
Shoshone Lake
Grant Village
Lewis Lake
Heart Lake
IDAHO
WYOMING
Flagg Ranch
0
10
Miles


INSECT TRAP
GOVERNMENT PROPERTY
PLEASE DO NOT DISTURB
For information contact your County or State or Federal
Plant Protection Programs Office
State WY
County
Trap No. 38
Catch Date

Treeline

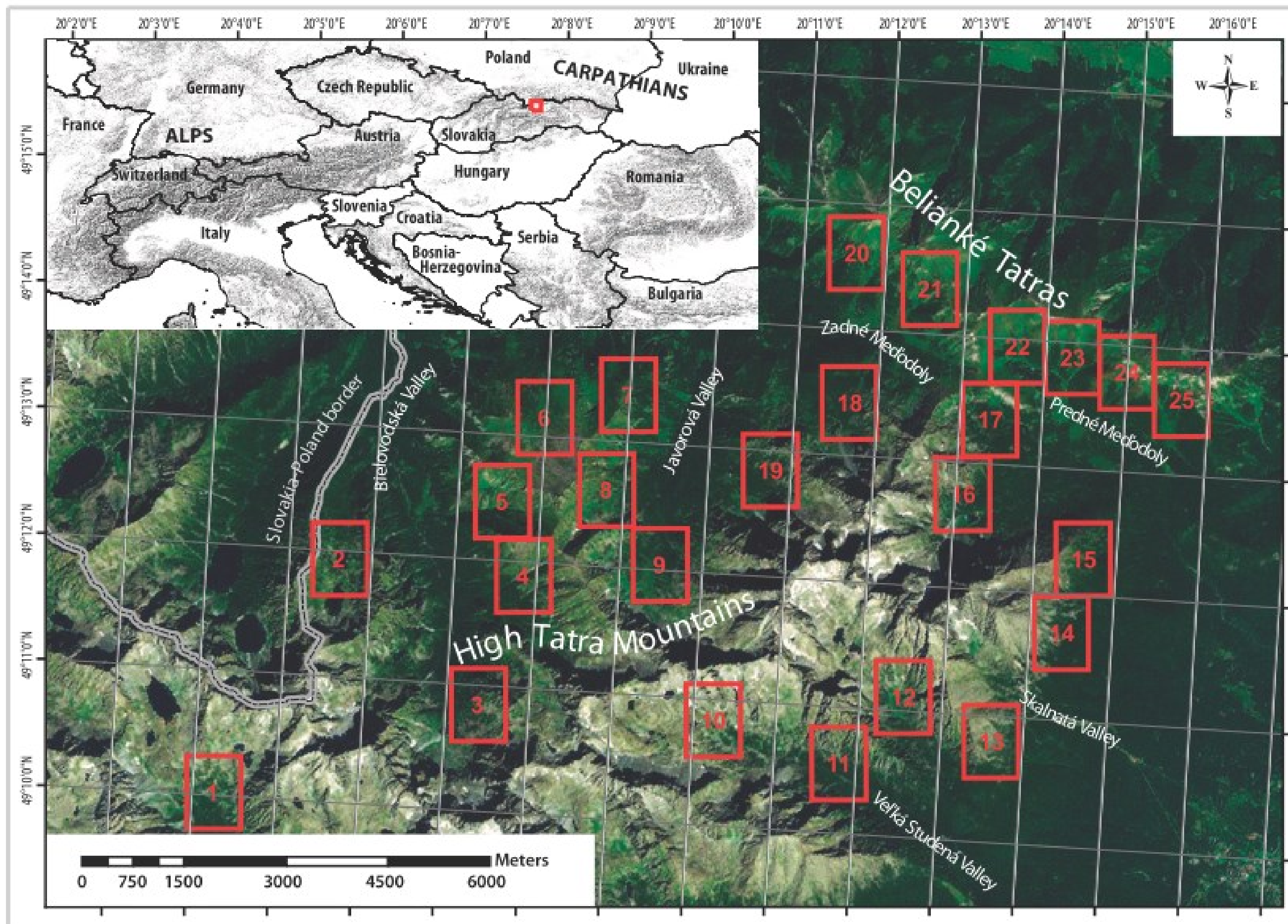
Long-term Changes in Dwarf Pine (*Pinus mugo*) Cover in the High Tatra Mountains, Slovakia

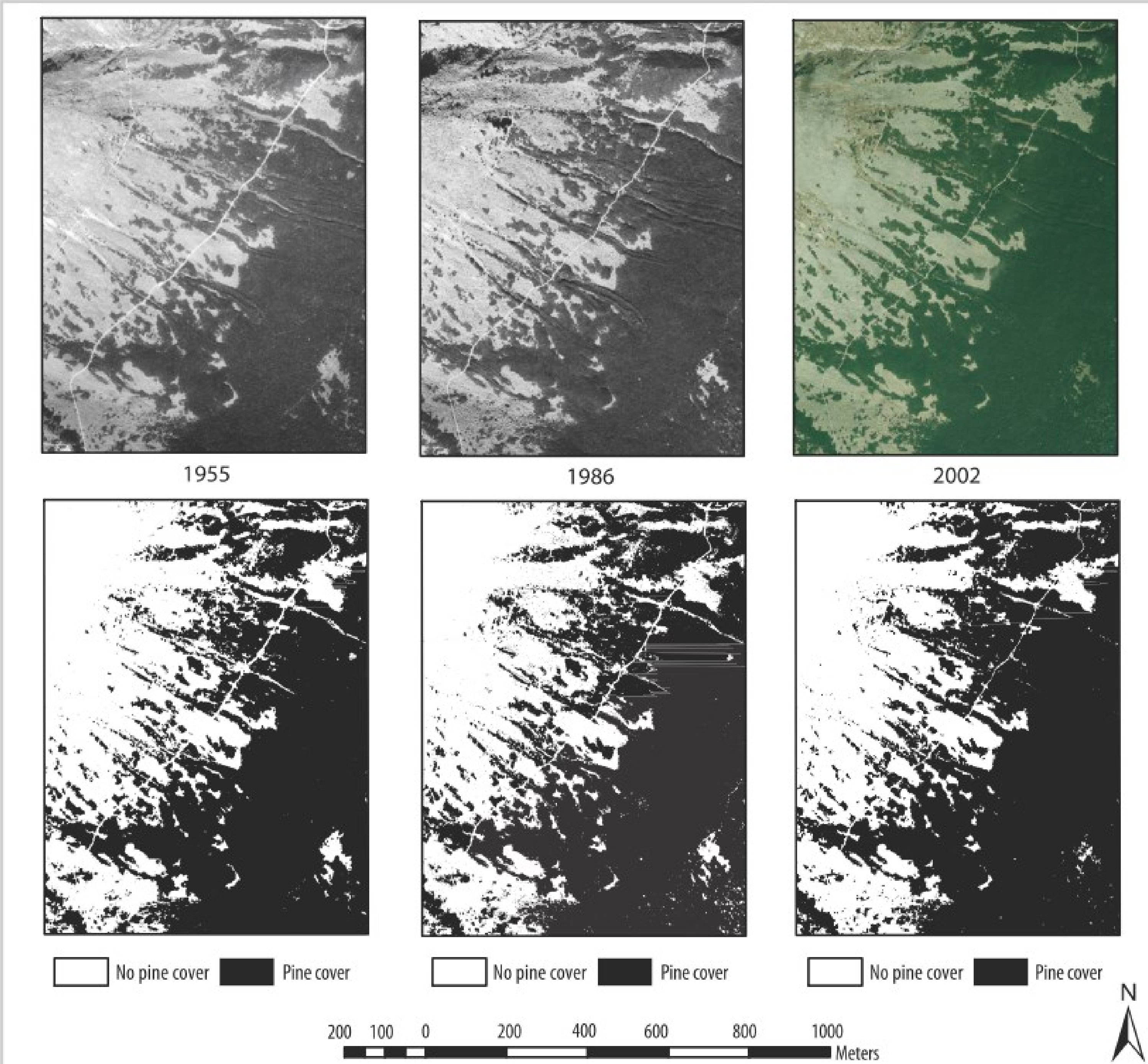
Jaroslav Solár* and Marián Janiga
** Corresponding author: solar@uniza.sk*
Institute of High Mountain Biology, University of Zilina, Tatranska Javorina 7, Zilina 05956, Slovakia

The present article focuses on the distribution of P... mugo under co... the central Tatr... Mountains, the... mountain range... Western Carpat... We analyze the... of P. mugo *distr... selected abiotic habitat conditions in the eastern... Mountains. The study also compares data on the... distribution of* P. mugo *in the higher central Tatra...*

identifiable boundary on the aerial photographs: 25 well-recognized localities were selected to examine the changes

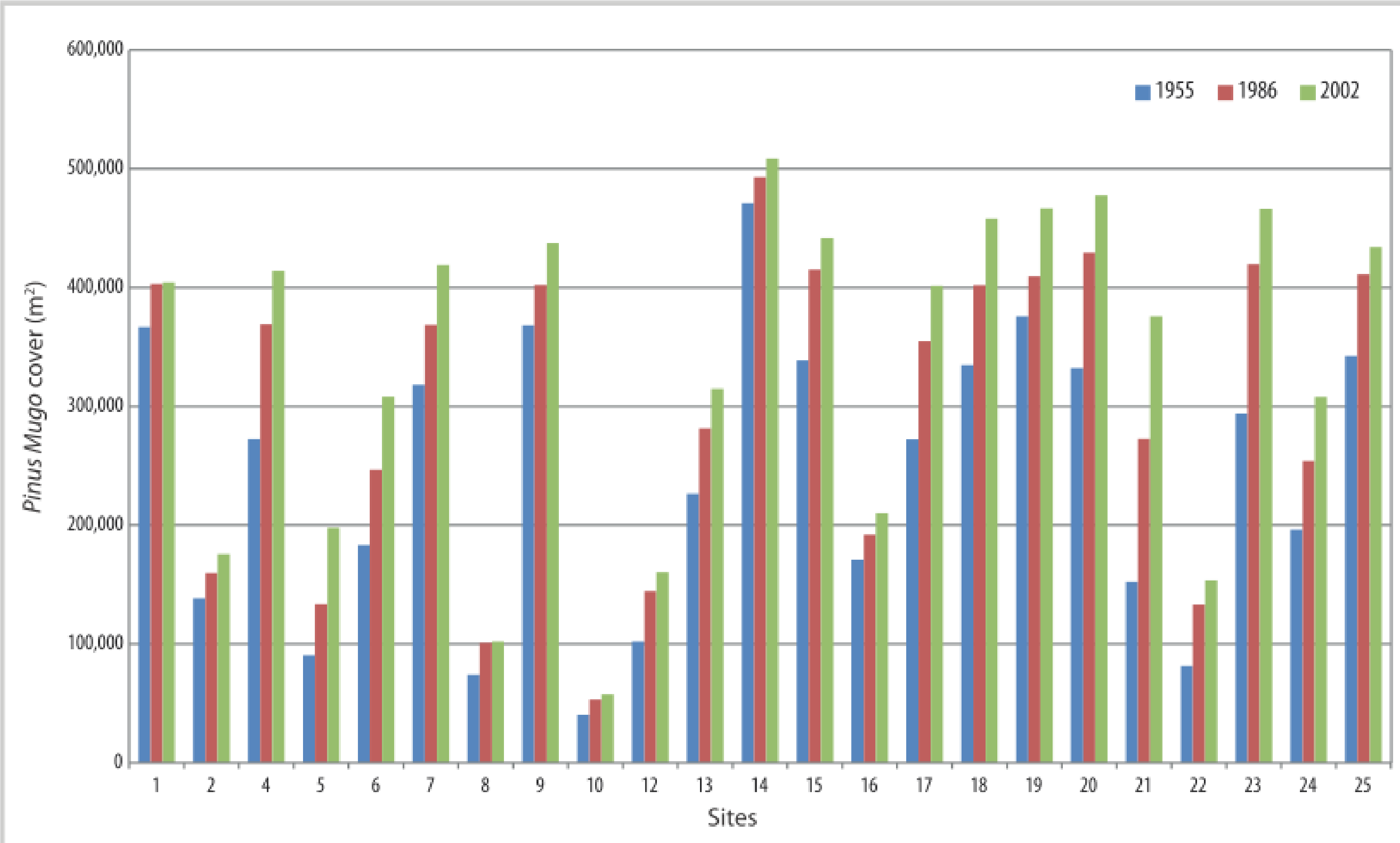
FIGURE 1 Central and eastern Tatra Mountains in Slovakia and detailed view of the 25 sites in the study area (from west to east: Mengusovská, Bielovodská... Litvorová, Rovienková valleys, Litvorový žlab, Široká, Javorová, Veľká Studená, Malá Studená, Skalnatá, Huncovská, Kolová valleys, Dolina Bielych plies, Zadné a... Predné Meďodoly). (Map by Jaroslav Solár)





1955
1986
2002
No pine cover
Pine cover
No pine cover
Pine cover
No pine cover
Pine cover
N
200 100 0 200 400 600 800 1000
Meters

FIGURE 3 Comparison of area covered with *P. mugo* (23 sites) in 1955, 1986, and 2002, in m^2.



Ecology Letters, (2009) **12**: 1040–1049 doi: 10.1111/j.1461-0248.2009.01355.x

LETTER

Are treelines advancing? A global meta-analysis of treeline response to climate warming

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Correspondence: E-mail: Melanie.Harsch@lincolnuni.ac.nz

Abstract

Treelines are temperature sensitive transition zones that are expected to respond to climate warming by advancing beyond their current position. Response to climate warming over the last century, however, has been mixed, with some treelines showing evidence of recruitment at higher altitudes and/or latitudes (advance) whereas others reveal no marked change in the upper limit of tree establishment. To explore this variation, we analysed a global dataset of 166 sites for which treeline dynamics had been recorded since 1900 AD. Advance was recorded at 52% of sites with only 1% reporting treeline recession. Treelines that experienced strong winter warming were more likely to have advanced, and treelines with a diffuse form were more likely to have advanced than those with an abrupt or krummholz form. Diffuse treelines may be more responsive to warming because they are more strongly growth limited, whereas other treeline forms may be subject to additional constraints.

Journal of Vegetation Science 18: 571-582, 2007

Tree line shifts in the Swiss Alps: Climate change or land abandonment?

Gehrig-Fasel, Jacqueline[1*]; **Guisan, Antoine**[2,3] & **Zimmermann, Niklaus E.**[1,2]

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[2]University of Lausanne, Department of Ecology and Evolution, CH-1015 Lausanne, Switzerland;
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Abstract

Questions: Did the forest area in the Swiss Alps increase between 1985 and 1997? Does the forest expansion near the tree line represent an invasion into abandoned grasslands (ingrowth) or a true upward shift of the local tree line? What land cover / land use classes did primarily regenerate to forest, and what forest structural types did primarily regenerate? And, what are possible drivers of forest regeneration in the tree line ecotone, climate and/or land use change?

Location: Swiss Alps.

Methods: Forest expansion was quantified using data from the repeated Swiss land use statistics GEOSTAT. A moving window algorithm was developed to distinguish between forest ingrowth and upward shift. To test a possible climate change influence, the resulting upward shifts were compared to a potential regional tree line.

Results: A significant increase of forest cover was found between 1650 m and 2450 m. Above 1650 m, 10% of the new forest areas were identified as true upward shifts whereas 90% represented ingrowth, and we identified both land use and climate change as likely drivers. Most upward shift activities were found to occur within a band of 300 m below the potential regional tree line, indicating land use as the most likely driver. Only 4% of the upward shifts were identified to rise above the potential regional tree line, thus indicating climate change.

Conclusions: Land abandonment was the most dominant driver for the establishment of new forest areas, even at the tree line ecotone. However, a small fraction of upwards shift can be attributed to the recent climate warming, a fraction that

Introduction

The higher elevation habitats of the Alps and other
mountain regions are chan
dramatically increased gro
Motta & Nola 2001), alpine
cies compositions are chan
et al. 2001; Walther et al.
tree establishment in fores
be observed in many locati
are the driving forces behin
ecosystem?

A first possible explanati
shift in climate. As alpine
determined ecotones (Kör
2004), they are considered
tered temperature regimes
Thus, the predicted climat
2001) is expected to result
composition as well as in
(Albrecht et al. 2002). The
is apparent already. Benist
annual minimum temperatu
the European Alps and foun
°C, which is clearly above
in temperatures of 0.7 °C (Jones & Moberg 2003). Newer

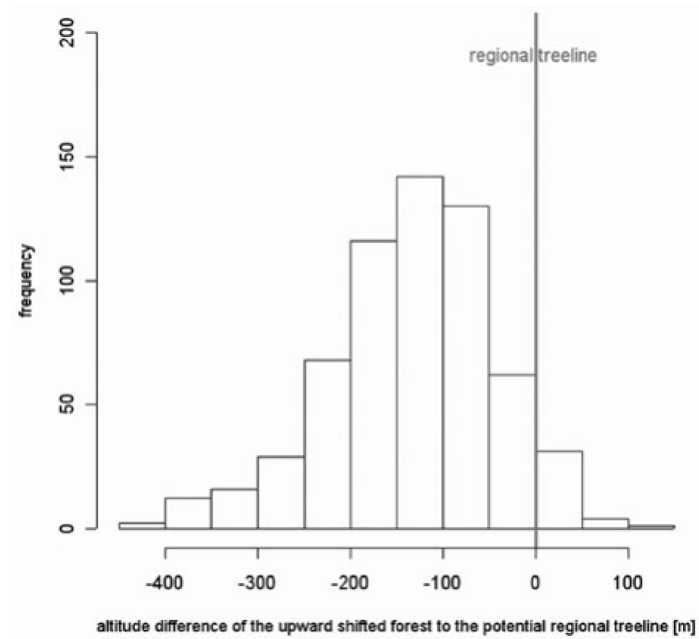

Fig. 11. Number of identified upward shifted forest pixels relative to the altitude of the potential regional treeline (vertical line).

Vol. 73: 135–150, 2017
https://doi.org/10.3354/cr01465

CLIMATE RESEARCH
Clim Res

Published August 21

Contribution to CR Special 34 'SENSFOR: Resilience in SENSitive mountain FORest ecosystems under environmental change'

Drivers of treeline shift in different European mountains

Pavel Cudlín[1,*], Matija Klopčič[2], Roberto Tognetti[3,4], Frantisek Máliš[5,6], Concepción L. Alados[7], Peter Bebi[8], Karsten Grunewald[9], Miglena Zhiyanski[10], Vlatko Andonowski[11], Nicola La Porta[12], Svetla Bratanova-Doncheva[13], Eli Kachaunova[13], Magda Edwards-Jonášová[1], Josep Maria Ninot[14], Andreas Rigling[15], Annika Hofgaard[16], Tomáš Hlásny[17], Petr Skalák[1,18], Frans Emil Wielgolaski[19]

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[2]University of Ljubljana, Biotechnical Faculty, Department of Forestry and Renewable Forest Resources, Slovenia

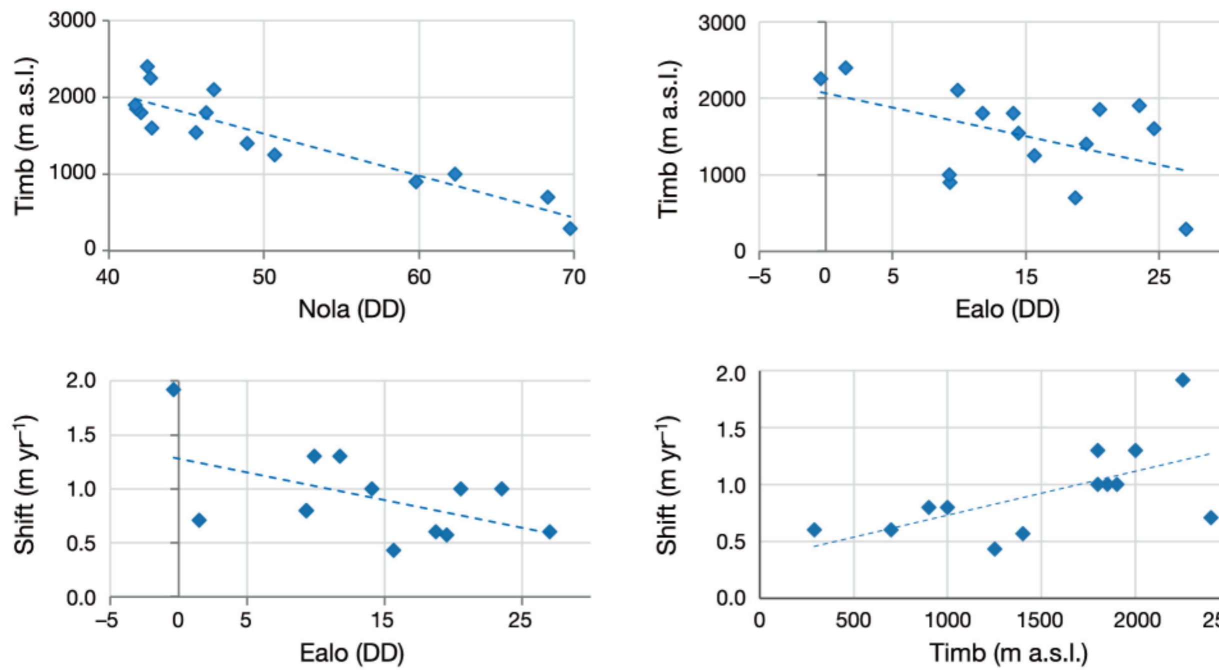

Fig. 5. Univariate graphs of the relationships of dependent variables, viz. timberline (Timb) and treeline shift per year (Shift), and their explanatory variables. Nola: north latitude; Ealo: east longitude; DD: decimal degrees

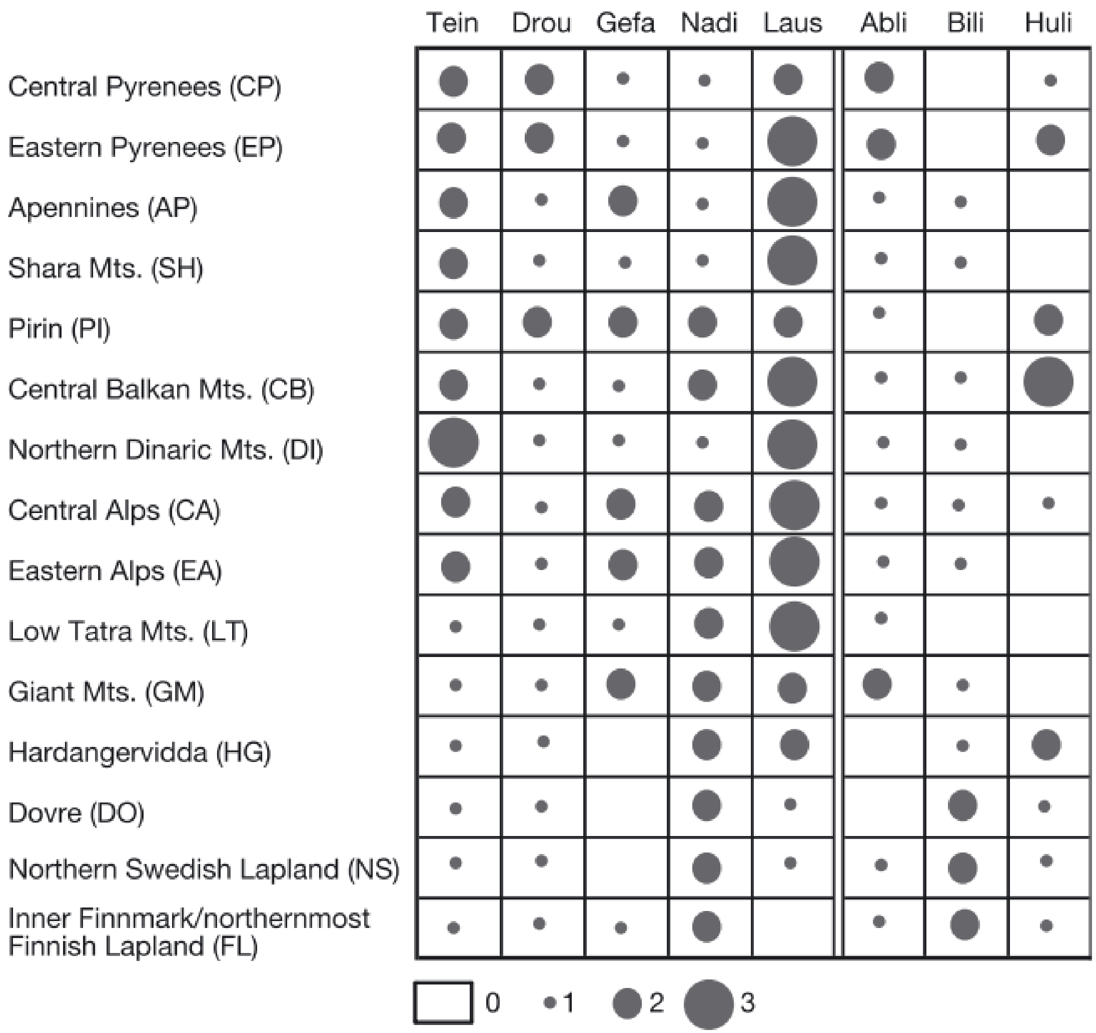

Fig. 2. Rates of treeline drivers (temperature increase [Tein], land use change [Laus]) and treeline shift limits (drought [Drou], geomorphological factors [Gefa], natural disturbances [Nadi], other abiotic, biotic and human factors) in selected European mountains. Abli, Bili and Huli: abiotic, biotic and human treeline shift limits, respectively). Rate of treeline driver influence — 0: no influence; 1: weak influence; 2: middle influence; 3: strong influence

Global Change Biology

Global Change Biology (2016) **22**, 1904–1914, doi: 10.1111/gcb.13210

Life stage, not climate change, explains observed tree range shifts

FRANTIŠEK MÁLIŠ[1,2], MARTIN KOPECKÝ[3], PETR PETŘÍK[4], JOZEF VLADOVIČ[2], JÁN MERGANIČ[1] and TOMÁŠ VIDA[1]

[1]*Faculty of Forestry, Technical University in Zvolen, T.G. Masaryka 24, SK-960 53 Zvolen, Slovak Republic,* [2]*Forest Research Institute Zvolen, National Forest Centre, T.G. Masaryka 22, SK-960 52 Zvolen, Slovak Republic,* [3]*Department of Vegetation Ecology, Institute of Botany, The Czech Academy of Sciences, Lidická 25/27, CZ-602 00 Brno, Czech Republic,* [4]*Department of GIS and Remote Sensing, Institute of Botany, The Czech Academy of Sciences, Zámek 1, CZ-252 43 Průhonice, Czech Republic*

Abstract

Ongoing climate change is expected to shift tree species distri
ecosystem services. To assess and project tree distributional shift
nile and adult trees under the assumption that differences betw
gered by climate change. However, the distribution of tree li
therefore, we hypothesize that currently observed distributional

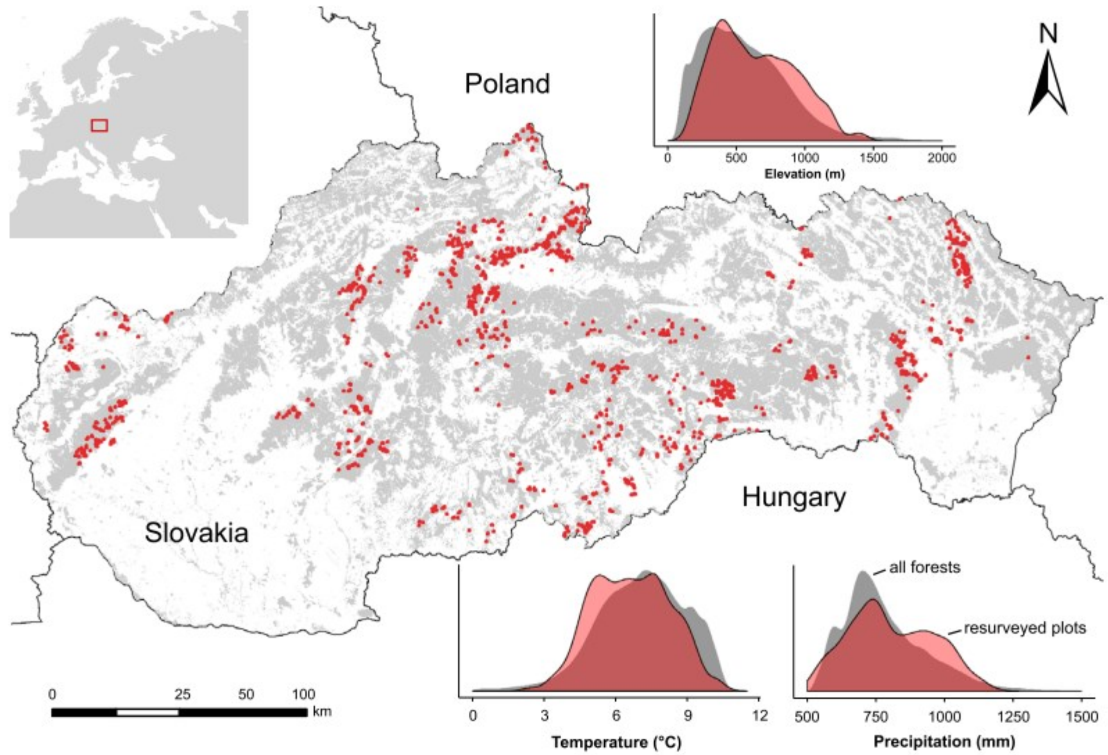

Fig. 1 Distribution of 1435 forest vegetation plots resurveyed after more than three decades (old survey 1966–1979, new survey 2005–2007) across Slovakia, East-Central Europe. The location of resurveyed plots (indicated as dots) is shown on the background of forest area. The inserted density plots show the relative frequency of elevation, annual mean temperature and annual precipitation of the 1435 resurveyed plots compared to the relative frequency of the same variables in all Slovakian forests (details in Appendix S2).

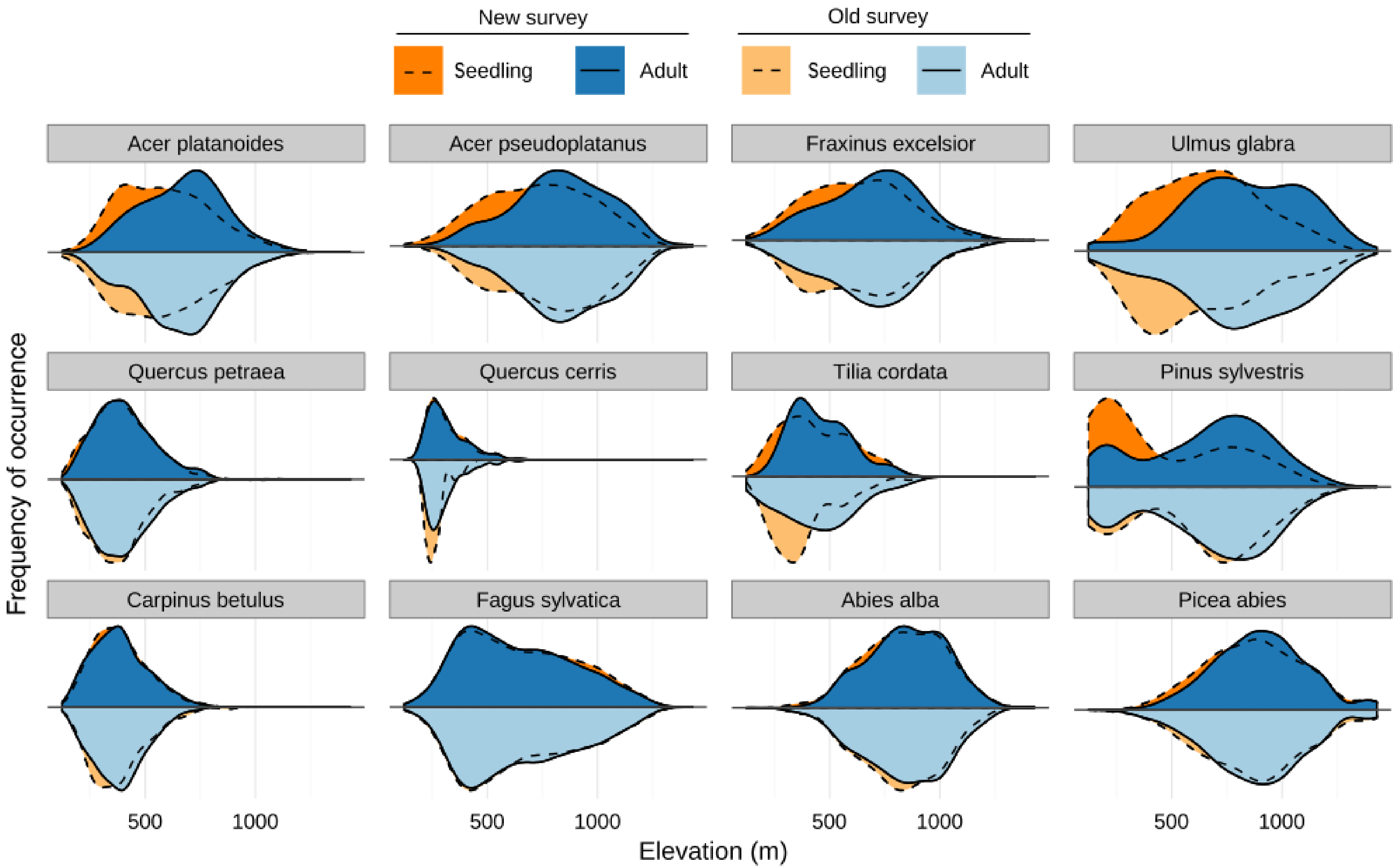

Fig. 3 Distribution of seedling and adult trees along an elevational gradient in the old (1966–1979) and new (2005–2007) surveys. While the distribution of individual life stages remained similar despite ongoing climate change, the seedlings of most species occurred at lower elevations than adult trees in both survey periods.

Aký je budúci vývoj

nature climate change

REVIEW ARTICLE

PUBLISHED ONLINE: 31 MAY 2017 | DOI: 10.1038/NCLIMATE3303

Forest disturbances under climate change

Rupert Seidl[1*], Dominik Thom[1], Markus Kautz[2], Dario Martin-Benito[3,4], Mikko Peltoniemi[5], Giorgio Vacchiano[6], Jan Wild[7,8], Davide Ascoli[9], Michal Petr[10], Juha Honkaniemi[5], Manfred J. Lexer[1], Volodymyr Trotsiuk[11], Paola Mairota[12], Miroslav Svoboda[11], Marek Fabrika[13], Thomas A. Nagel[11,14] and Christopher P. O. Reyer[15]

Forest disturbances are sensitive to climate. However, our understanding of disturbance dynamics in response to climatic changes remains incomplete, particularly regarding large-scale patterns, interaction effects and dampening feedbacks. Here we provide a glob
(insects and path
turbances, while
between agents a
long-term disturb
forests and the bo
future of forests.

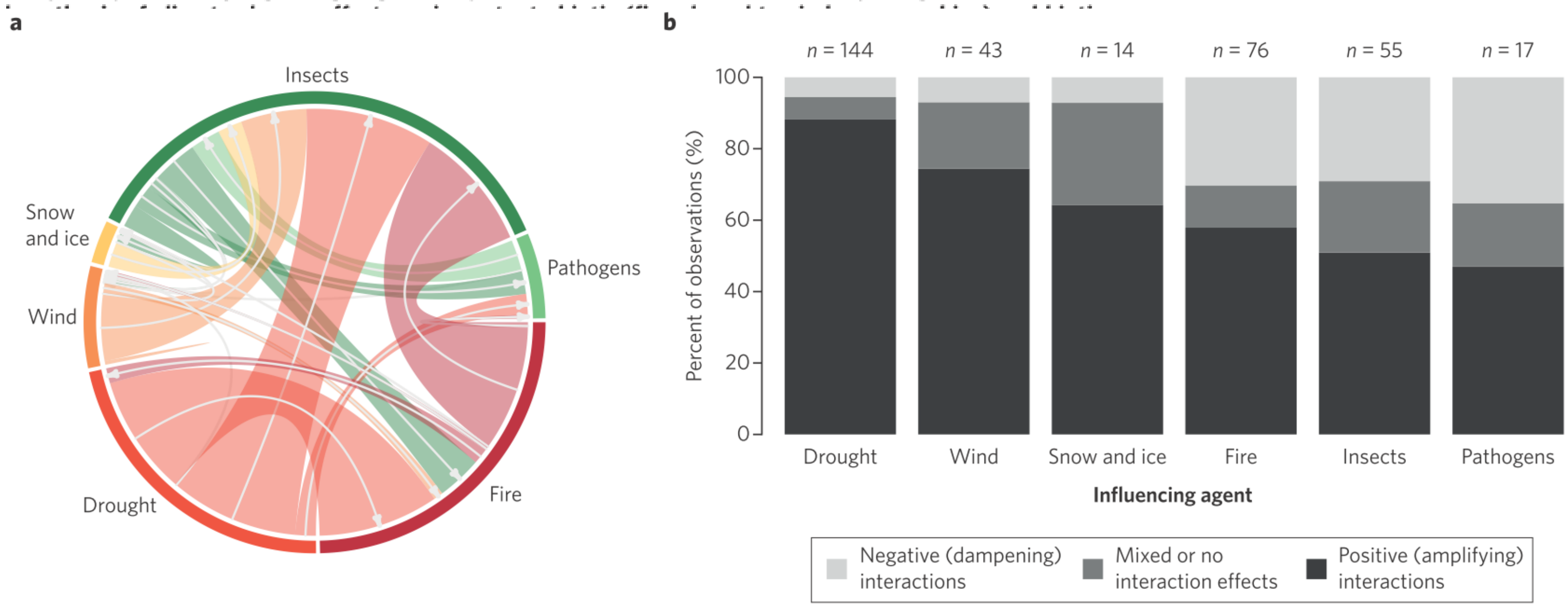

Figure 2 | Interactions between forest disturbance agents. a, The sector size in the outer circle indicates the distribution of interactions over agents, while the flows through the centre of the circle illustrate the relative importance of interactions between individual agents (as measured by the number of observations reporting on the respective interaction). Arrows point from the influencing agent to the agent being influenced by the interaction. **b**, Sign of the interaction effect induced by the influencing agent on the influenced agent. *n*, number of observations.

Global Change Biology

Global Change Biology (2017) **23**, 269–282, doi: 10.1111/gcb.13506

Disturbances catalyze the adaptation of forest ecosystems to changing climate conditions

DOMINIK THOM, WERNER RAMMER and RUPERT SEIDL

Department of Forest- and Soil Sciences, Institute of Silviculture, University of Natural Resources and Life Sciences (BOKU) Vienna, Peter-Jordan Straße 82, 1190 Vienna, Aus

Abstract

The rates of anthropogenic climate change immobile, long-lived organisms – are able to effects on ecosystem functioning. Furthermo ing tree species, a delayed response of the la

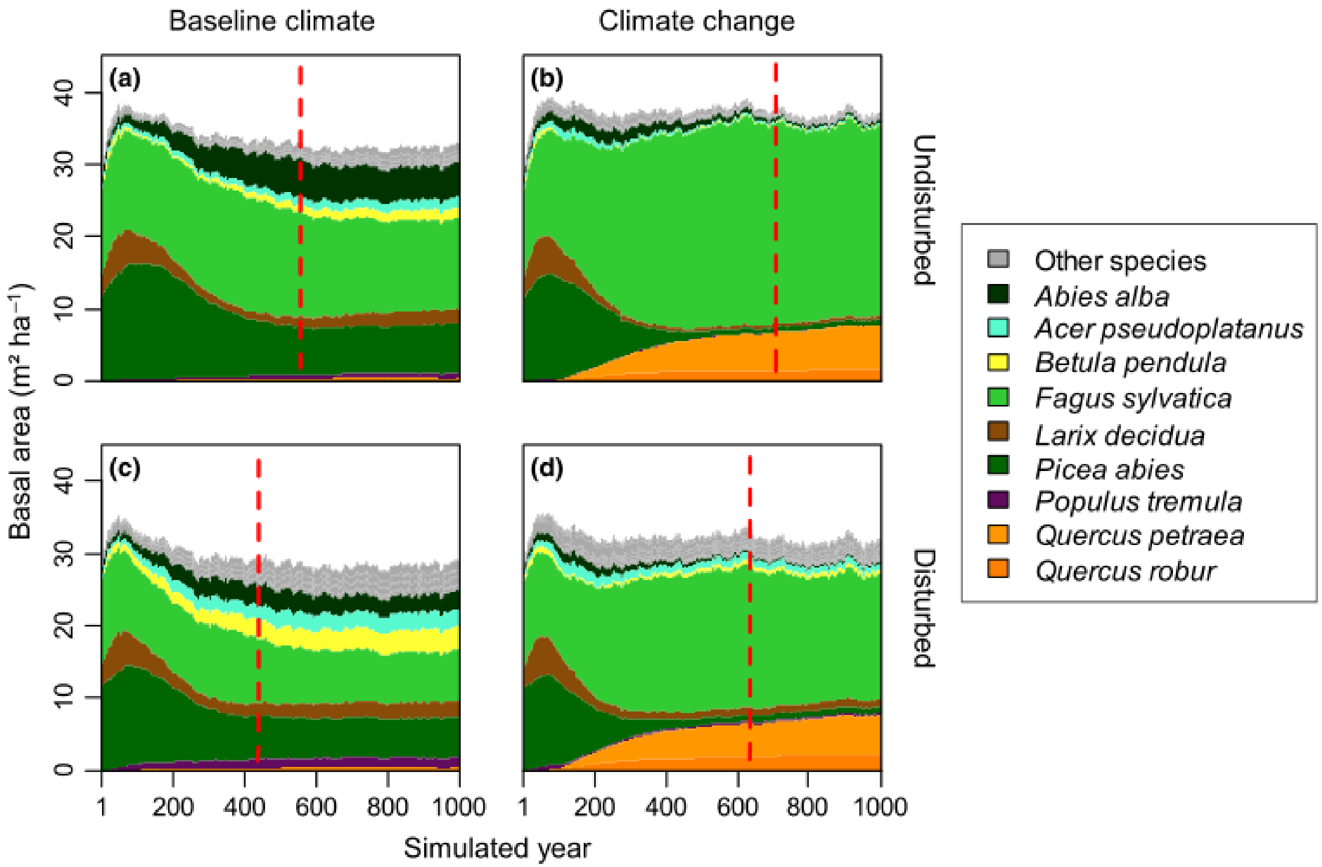

Fig. 2 Trajectories of forest succession at KANP, summarized for four scenarios: (a) baseline climate without disturbance, (b) climate change without disturbance, (c) baseline climate with disturbance, and (d) climate change with disturbance. Values are averages over all scenarios and replicates in the respective categories. Climate change includes projections for all three A1B scenarios. Tree species with ≥5% basal area in at least one of the four scenarios are shown explicitly (see Table S2 for more information). The red-dashed line indicates the point in time when a dynamic equilibrium was reached on average.

Oikos 124: 122–129, 2015
doi: 10.1111/oik.01416

Subject Editor: Christopher Lortie. Editor-in-Chief: Dries Bonte. Accepted 18 May 2014

Non-native plant species benefit from disturbance: a meta-analysis

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Åbo Akademi Univ. and Novia Univ. of Applied Sciences, Aronia C
Finland. – S. Gripenberg, Sect. of Biodiversity and Env. Research, D
Present address: Dept of Zoology, South Parks Road, Univ. of Oxford*

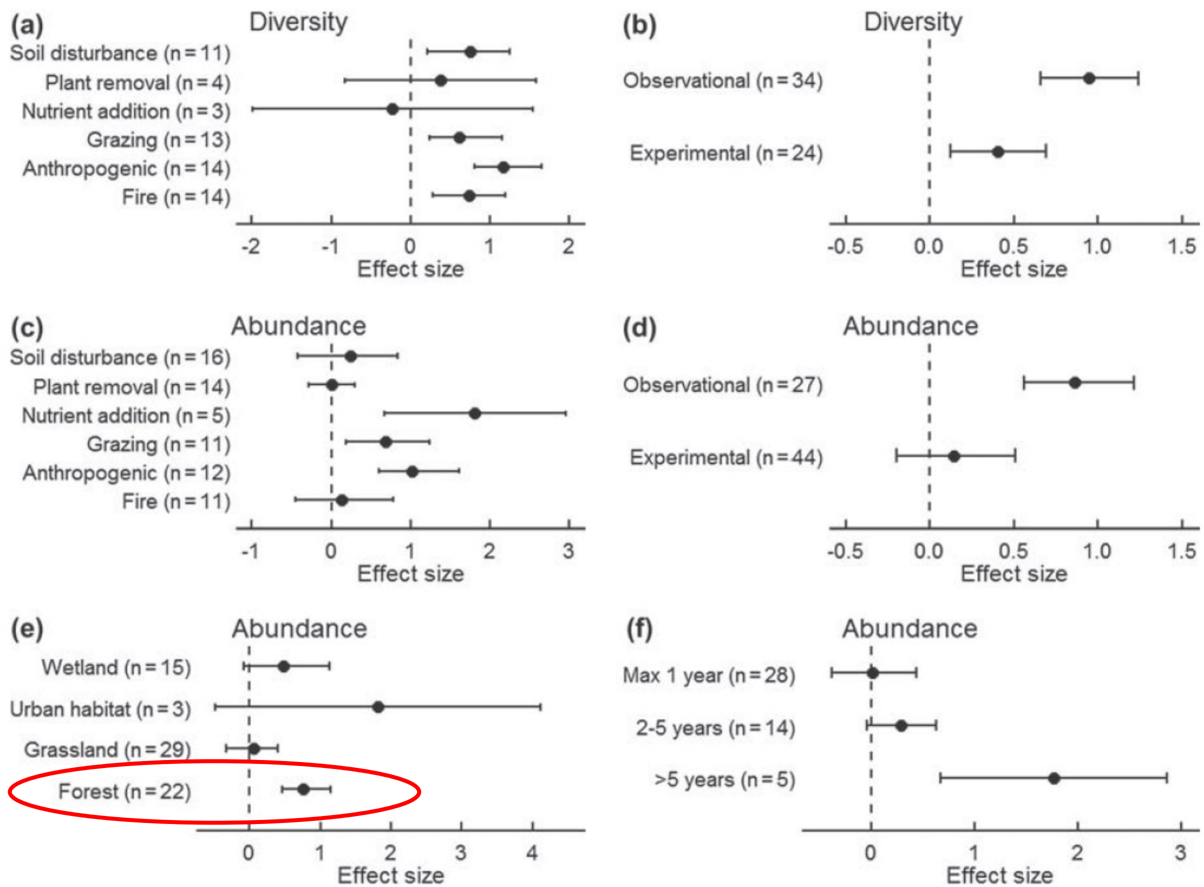

Figure 2. Group-specific mean effect sizes from meta-analyses assessing the effects of disturbance on the diversity (panels a and b) and abundance (panels c–f) of non-native plant species. Effect sizes have been grouped according to disturbance type (a, c), study approach (b, d), habitat type (e), and temporal scale of the study (f). Error bars depict 95% CIs (bias-corrected CIs for grouping variables with ≥ 10 entries and parametric ones for grouping variables with < 10 entries), and effects are considered significant when CIs do not overlap zero. Positive effects sizes indicate that disturbed sites have on average greater diversity or abundance of non-native species than undisturbed sites.

Review & synthesis

Ecography 40: 253–266, 2017
doi: 10.1111/ecog.02788

Subject Editor: Catherine Graham. Editor-in-Chief: Miguel Araújo. Accepted 1 November 2016

Climatic microrefugia under anthropogenic climate change: implications for species redistribution

Jonathan Lenoir*, Tarek Hattab* and Guillaume Pierre

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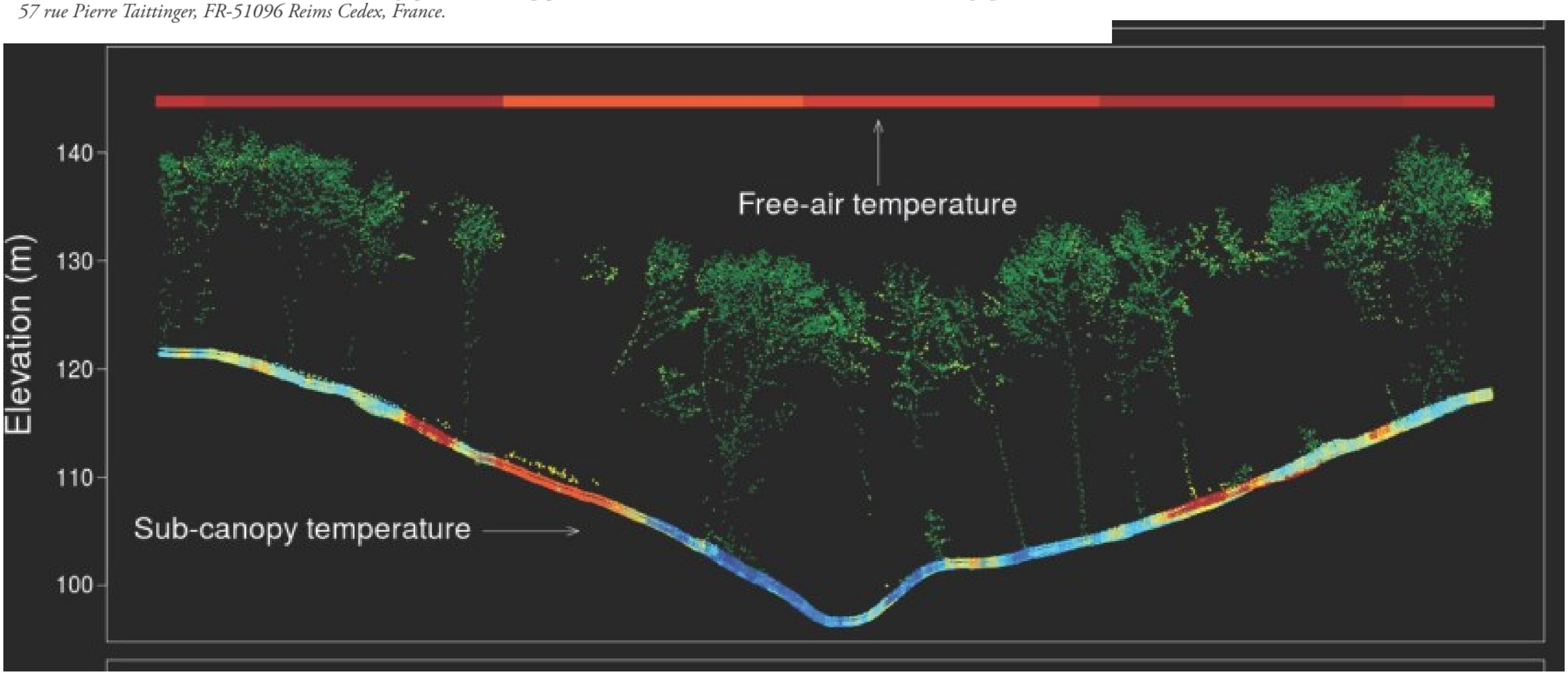


100 YEARS Journal of Ecology
British Ecological Society

Journal of Ecology 2015, **103**, 1253–1263 doi: 10.1111/1365-2745.12426

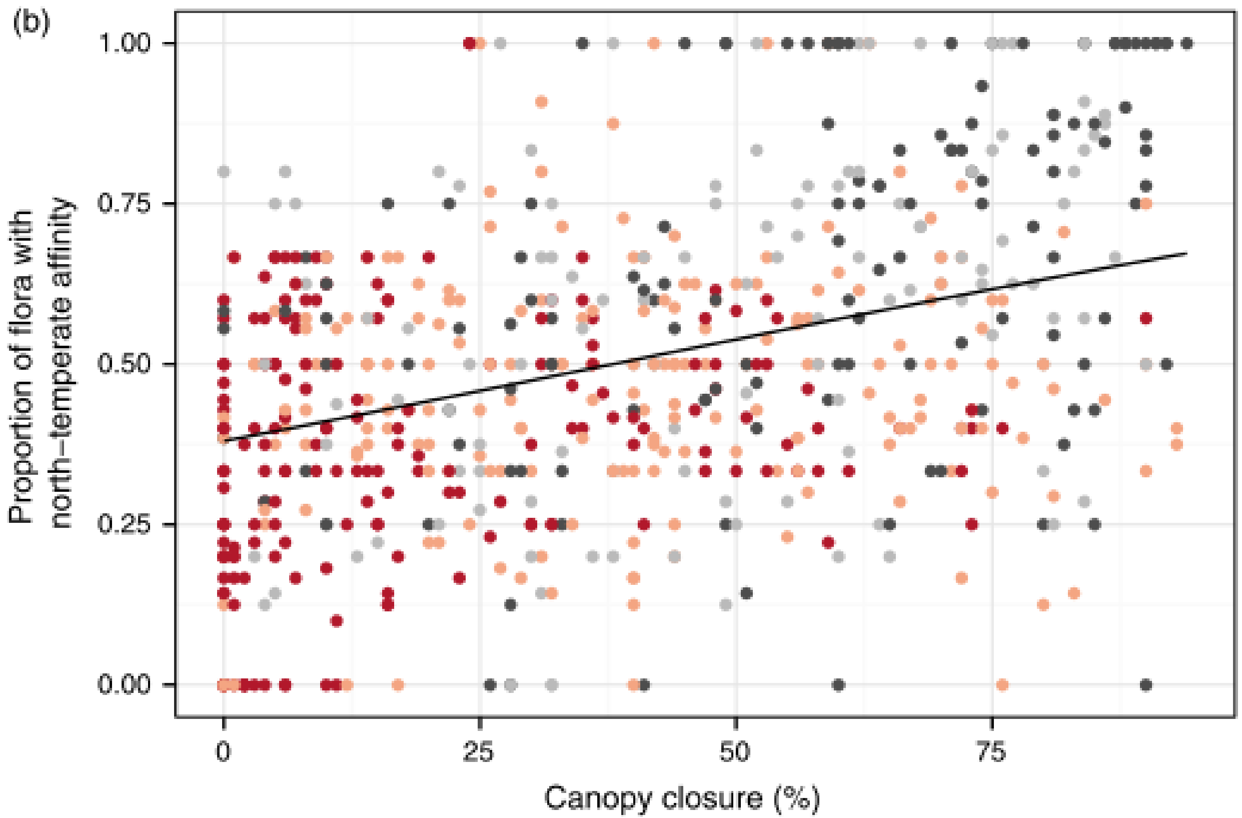
Forest disturbance accelerates thermophilization of understory plant communities

Jens T. Stevens[1,2]*, Hugh D. Safford[3,4], Susan Harrison[4] and Andrew M. Latimer[2]

[1]Graduate Group in Ecology, University of California, Davis, CA 95616, USA; [2]Department of Plant Sciences, University of California, Davis, CA 95616, USA; [3]USDA Forest Service, Pacific Southwest Region, Vallejo, CA 94592, USA; and [4]Department of Environmental Science and Policy, University of California, Davis, CA 95616, USA

Summary

1. Climate change is likely to shift plant
cess termed 'thermophilization'. In forests
by increasing temperature and moisture st
nisms that might drive such shifts, or the
2. We sampled understory vegetation ac
natural experiment created by the factoria



nature plants
LETTERS
PUBLISHED: 17 AUGUST 2015 | ARTICLE NUMBER: 15110 | DOI: 10.1038/NPLANTS.2015.110

Light accelerates plant responses to warming

Pieter De Frenne[1]*, Francisco Rodríguez-Sánchez[2], An De Schrijver[1], David A. Coomes[3], Martin Hermy[4], Pieter Vangansbeke[1] and Kris Verheyen[1]

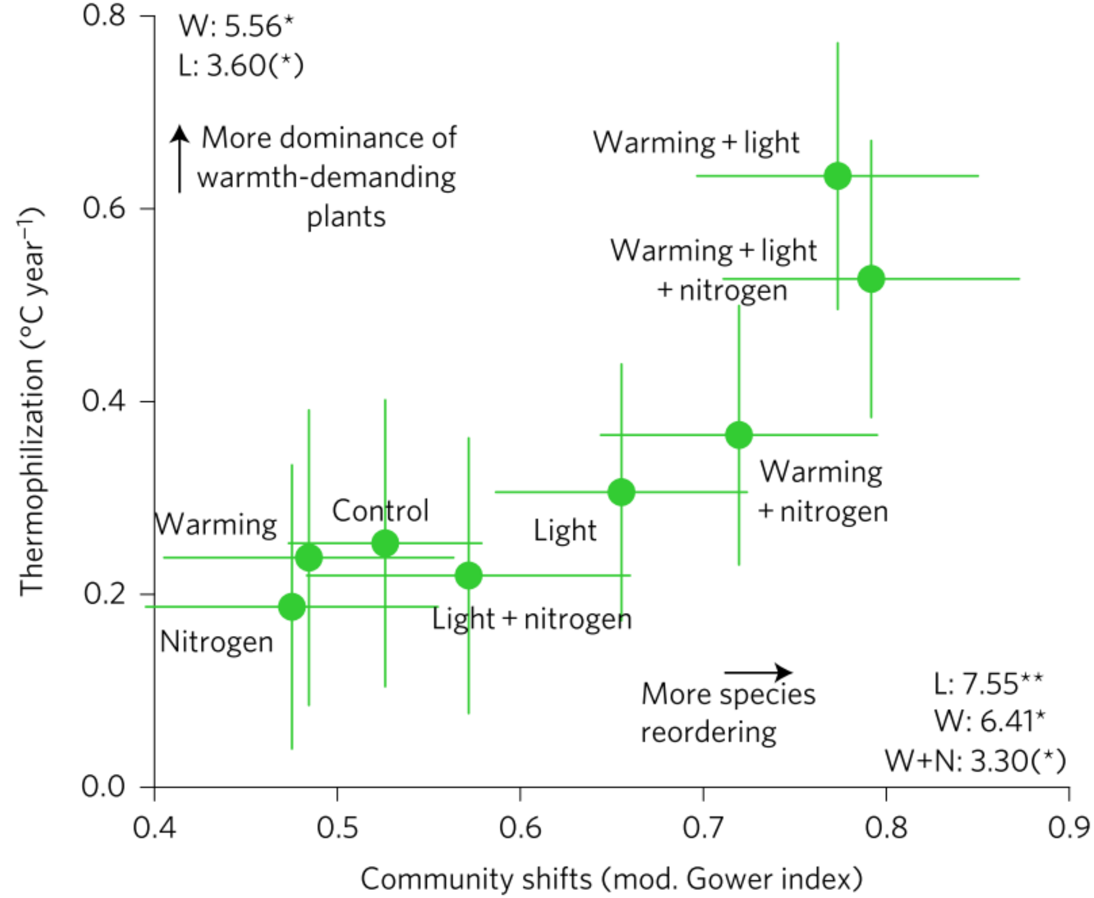


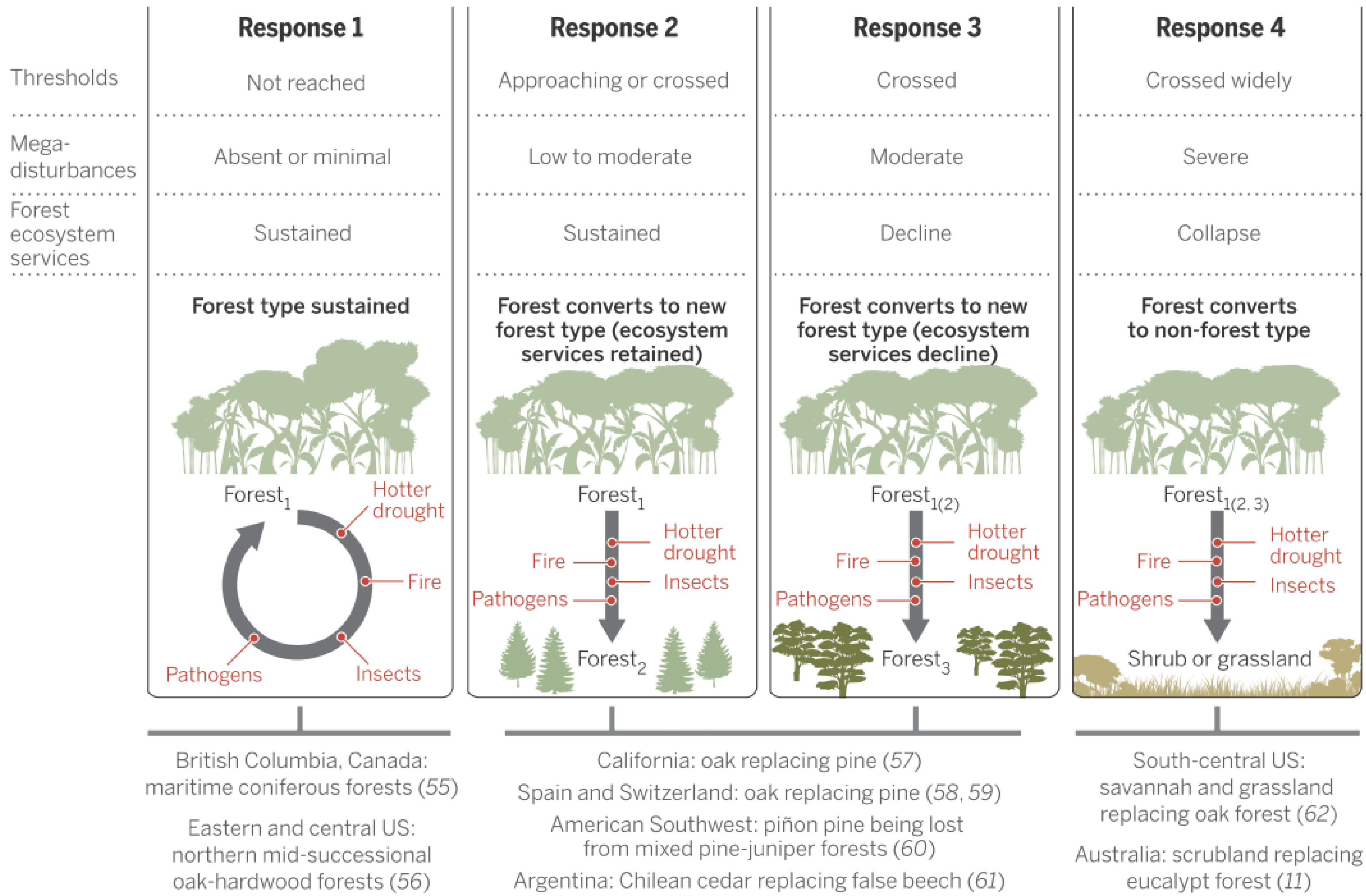
Figure 1 | Community-level effects of light, warming and nitrogen addition in forest understoreys. Each circle refers to the mean value of five plots. Plots receiving increased light and warming together experienced the largest

Temperate forest health in an era of emerging megadisturbance

Constance I. Millar[1]* and Nathan L. Stephenson[2]

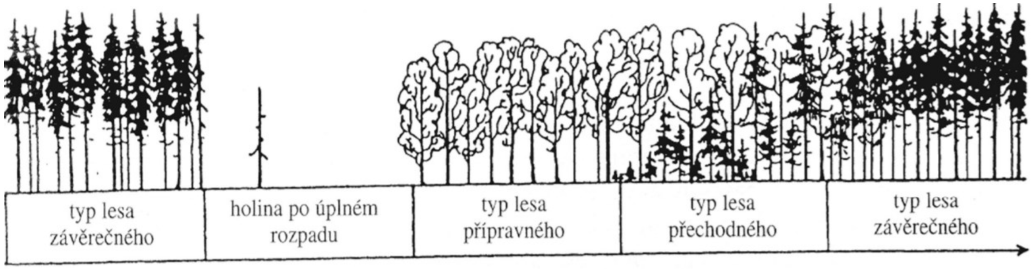
Although disturbances such as fire and native insects can contribute to natural dynamics of forest health, exceptional droughts, directly and in combination with other disturbance factors, are pushing son
from increasing tempera
severe wildfire are resul
Additional anthropogeni
further weaken trees in
many areas of temperat
help ease transitions an

several trends: increasing frequency, extent, and severity of disturbances; growing recognition of the profound effects of anthropogenic climate change; presence of novel anthropogenic stressors; and a burgeoning global human population that imposes escalating demands on forests (*9*). The focus of forest health has shifted toward evaluating forest conditions relative to supporting human needs—that is, the capacity of forests to sustainably provide ecosystem services. These services include provisioning (e.g., water), regulating (e.g., carbon sequestration),

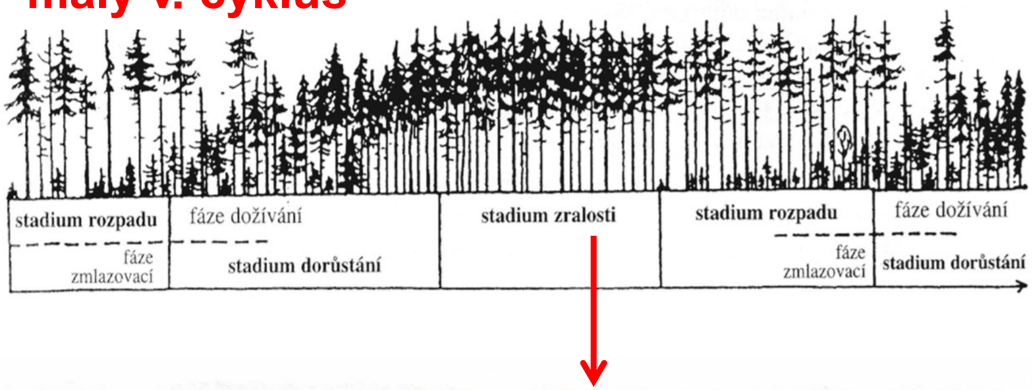


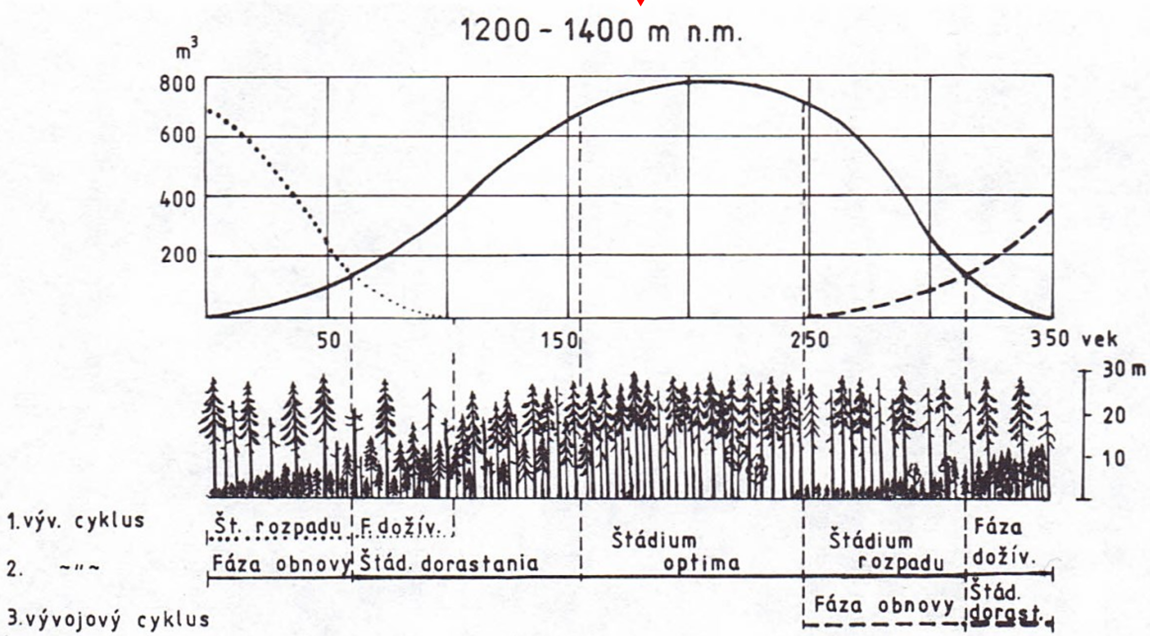
veľký vývojový cyklus

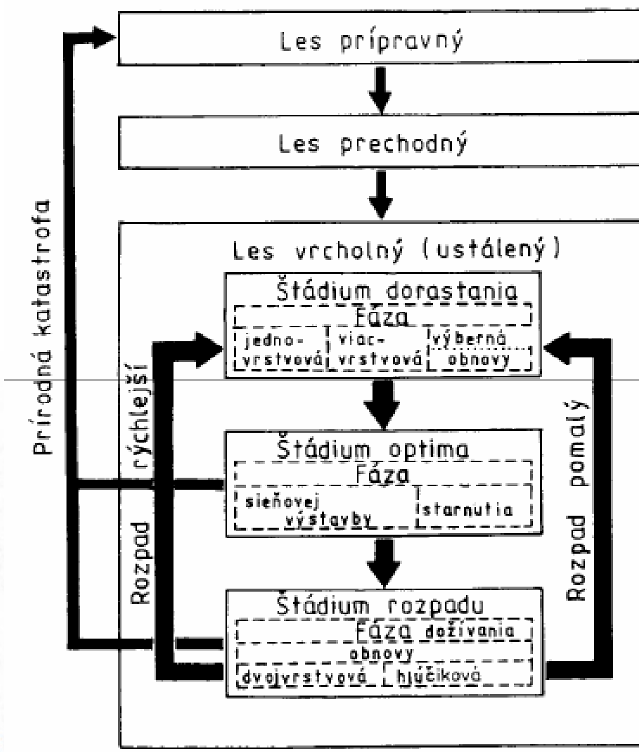
Schmidt-Vogt 1985 in Míchal et al. (1992)



malý v. cyklus







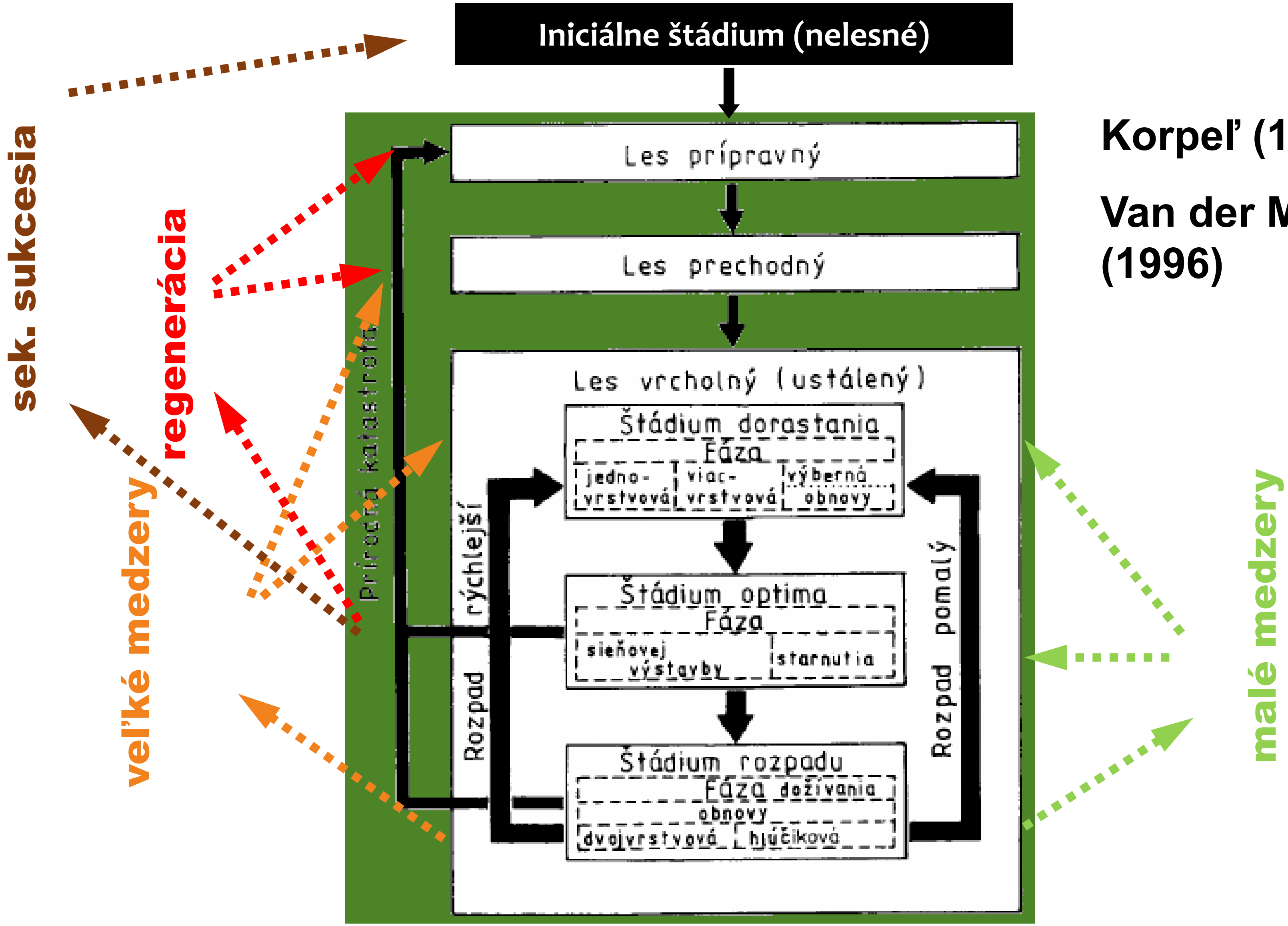
Korpeľ (1989)

Malý či veľký, rýchly či pomalý cyklus?

Po veľkoplošnom odumretí väčšiny stromovej etáže sa ide ku optimu cez:

1. malý vývojový cyklus?
2. veľký vývojový cyklus?
3. regeneráciu?
4. sekundárnu sukcesiu?

Vývojové cykly a formy dynamiky



Korpeľ (1989)

Van der Maarel (1996)

REVIEW

Temperate forest health in an era of emerging megadisturbance

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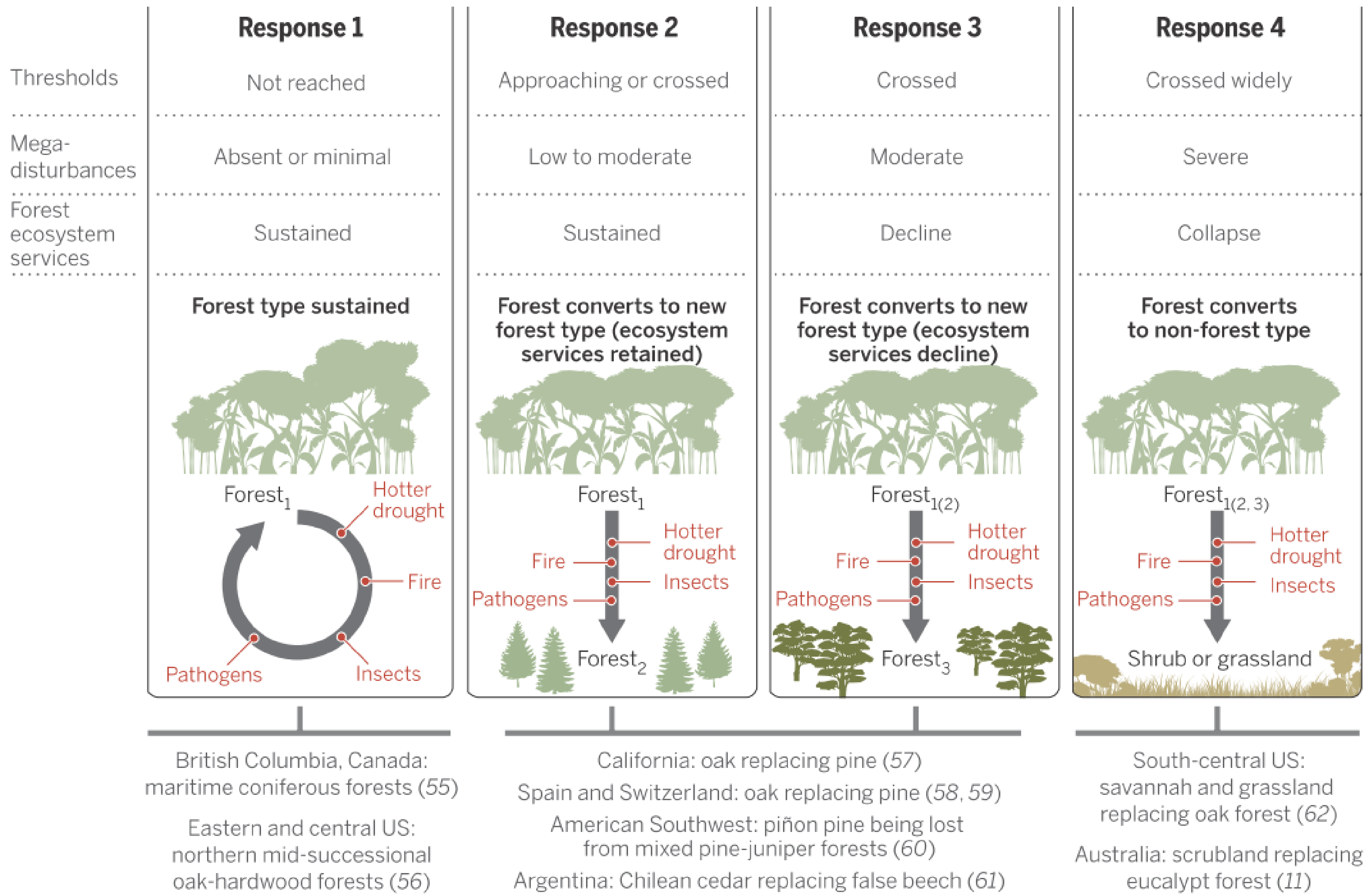
Although disturbances such as fire and native insects can contribute to natural dynamics of forest health, exceptional droughts, directly and in combination with other disturbance factors, are pushing son from increasing tempera severe wildfire are resull Additional anthropogeni further weaken trees in many areas of temperat help ease transitions an



several trends: increasing frequency, extent, and severity of disturbances; growing recognition of the profound effects of anthropogenic climate change; presence of novel anthropogenic stressors; and a burgeoning global human population that imposes escalating demands on forests (*9*). The focus of forest health has shifted toward evaluating forest conditions relative to supporting human needs—that is, the capacity of forests to sustainably provide ecosystem services. These services include provisioning (e.g., water), regulating (e.g., carbon sequestration), Fabova hoľa 2013

Závery pre manažment

PRIMARY RESEARCH ARTICLE

WILEY Global Change Biology

Tropical forests are thermally buffered despite intensive selective logging

Rebecca A. Senior[1] | Jane K. Hill[2] | Suzan Benedick[3] | David P. Edwards[1]

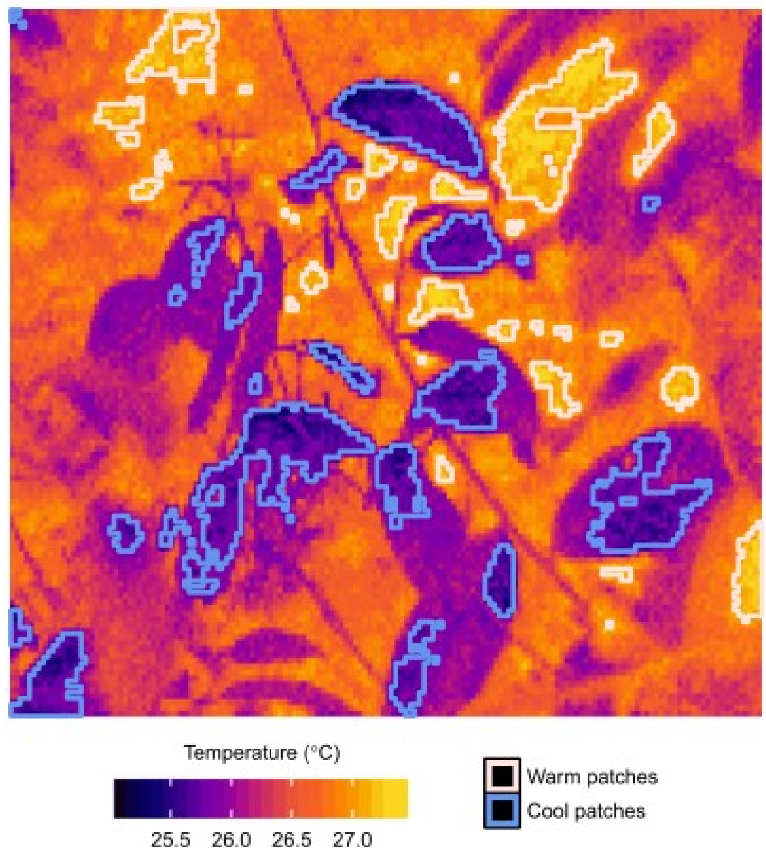


FIGURE 2 Example thermal image. Pixels are shaded from cold (purple) to hot (yellow). Warm patches (outlined in pink) and cool patches (outlined in blue) were identified using the Getis–Ord local statistic of each pixel

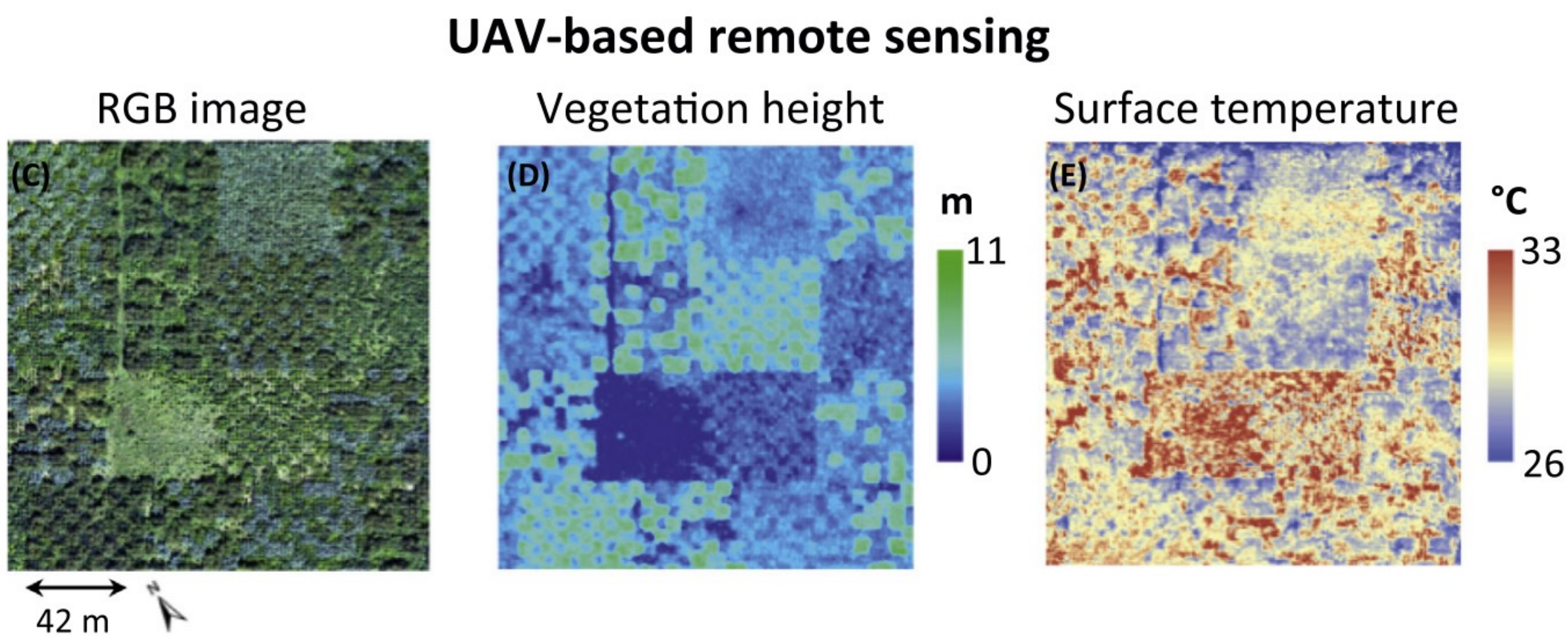
Trends in Ecology & Evolution

Cell Press REVIEWS

Review

Advances in Microclimate Ecology Arising from Remote Sensing

Florian Zellweger,[1,*] Pieter De Frenne,[2] Jonathan Lenoir,[3] Duccio Rocchini,[4,5,6] and David Coomes[1,*]

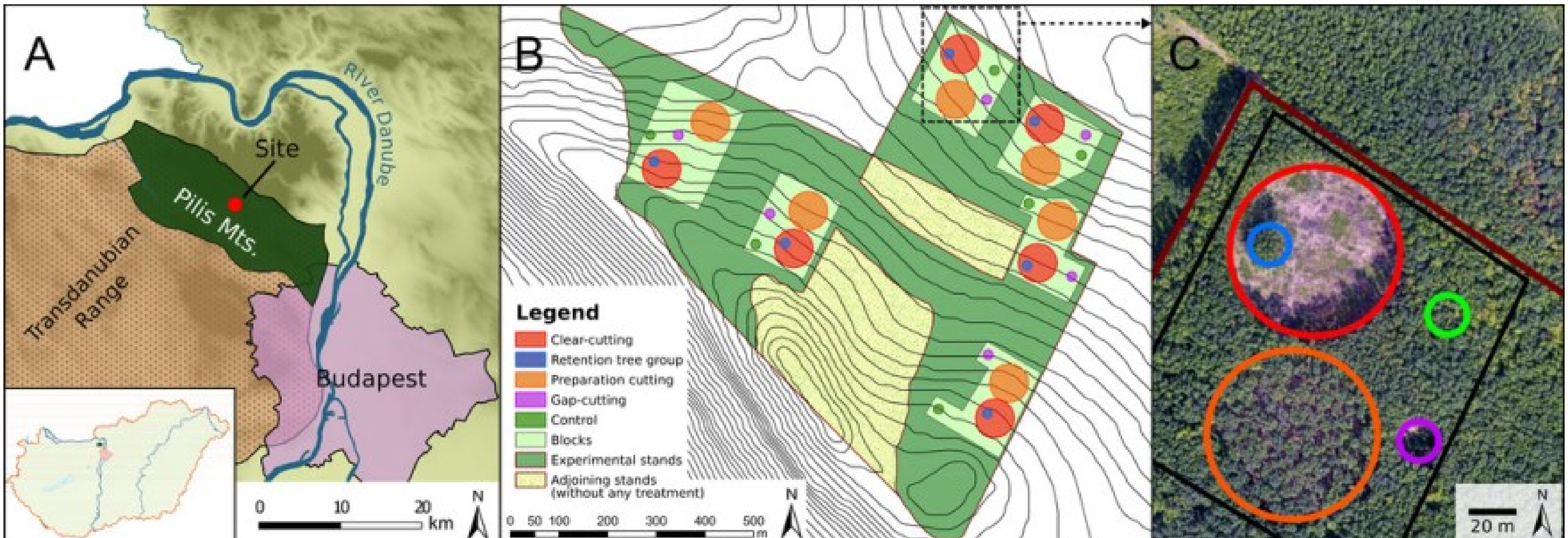


European Journal of Forest Research
https://doi.org/10.1007/s10342-018-1154-8

ORIGINAL PAPER

Initial understory response to experimental silvicultural treatments in a temperate oak-dominated forest

Flóra Tinya[1] · Bence Kovács[1,2] · Aurora Prättälä[3] · Péter Farkas[4] · Réka Aszalós[1] · Péter Ódor[1]

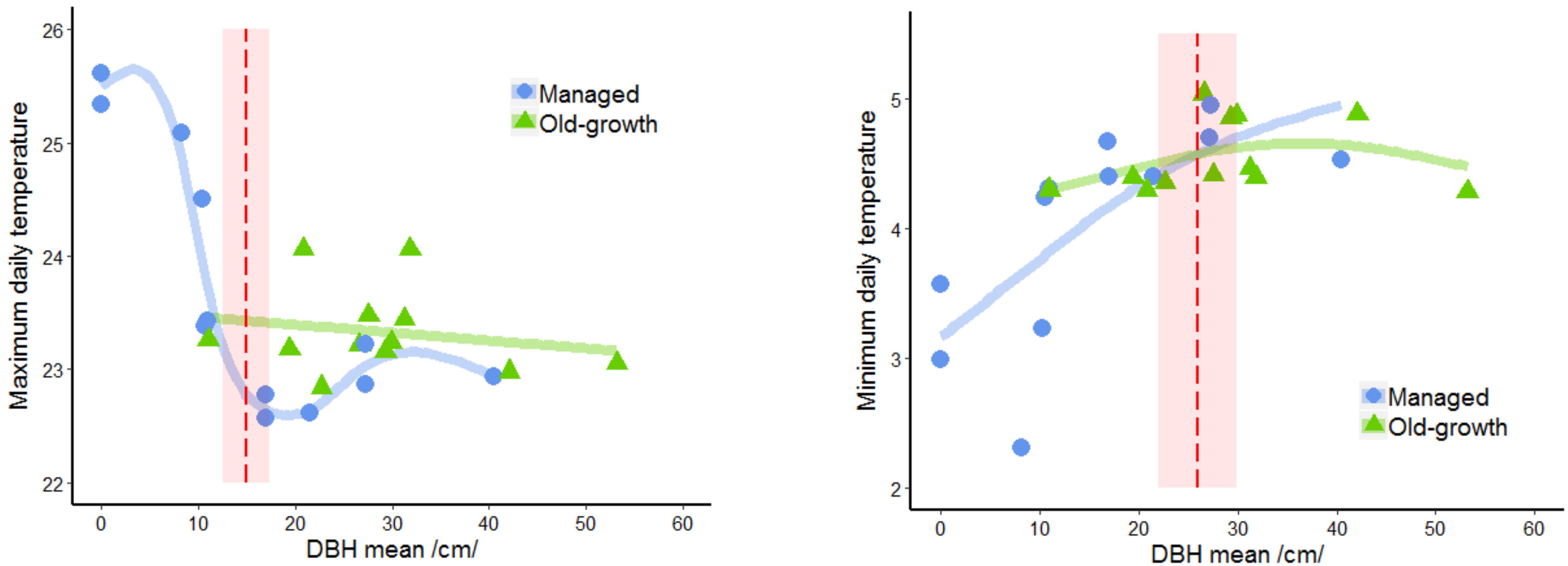


Niečo nase – polana klima, db experiment, nech navnadim


Gap - old-growth

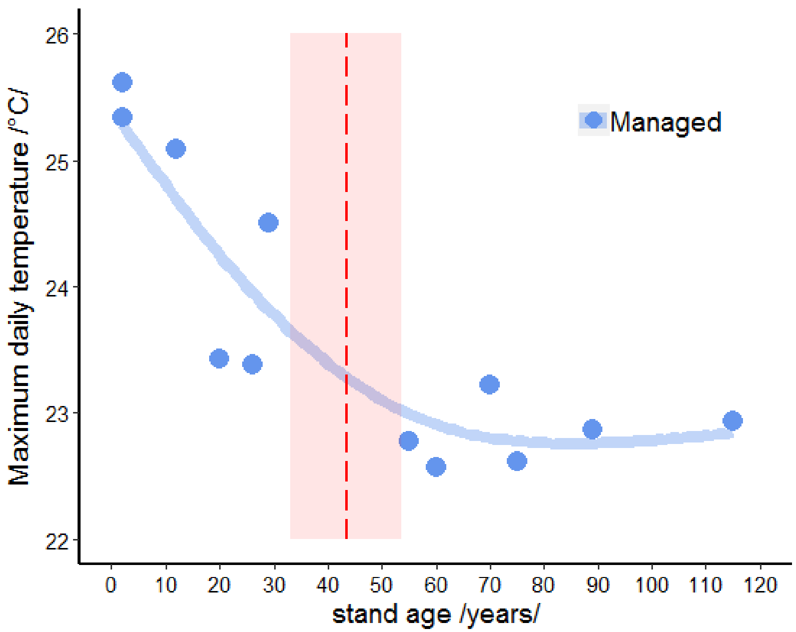

cutting managed

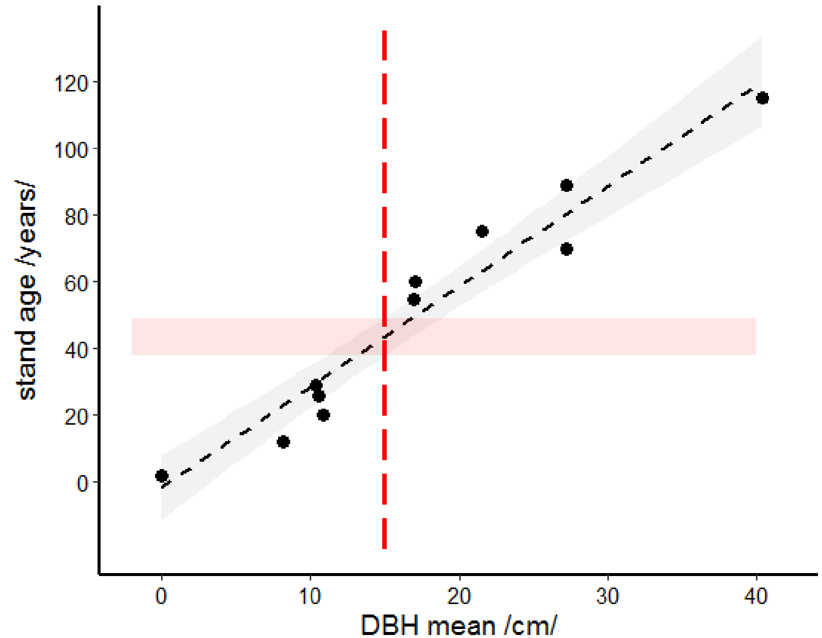
Results



Red line indicates the breakpoint estimated by piecewise regression in *segmented* packaged for R, red transparent polygon shows the standard error of the breakpoint

Results – when after cutting (age)





Red line indicates the breakpoint estimated by piecewise regression in *segmented* packaged for R, red transparent polygon shows the standard error of the breakpoint

Lesn. Cas. For. J. 61 (2015) 157–166 DE GRUYTER OPEN DOI: 10.1515/forj-2015-0024

Lesnícky časopis - Forestry Journal
http://www.nlcsk.sk/fj/

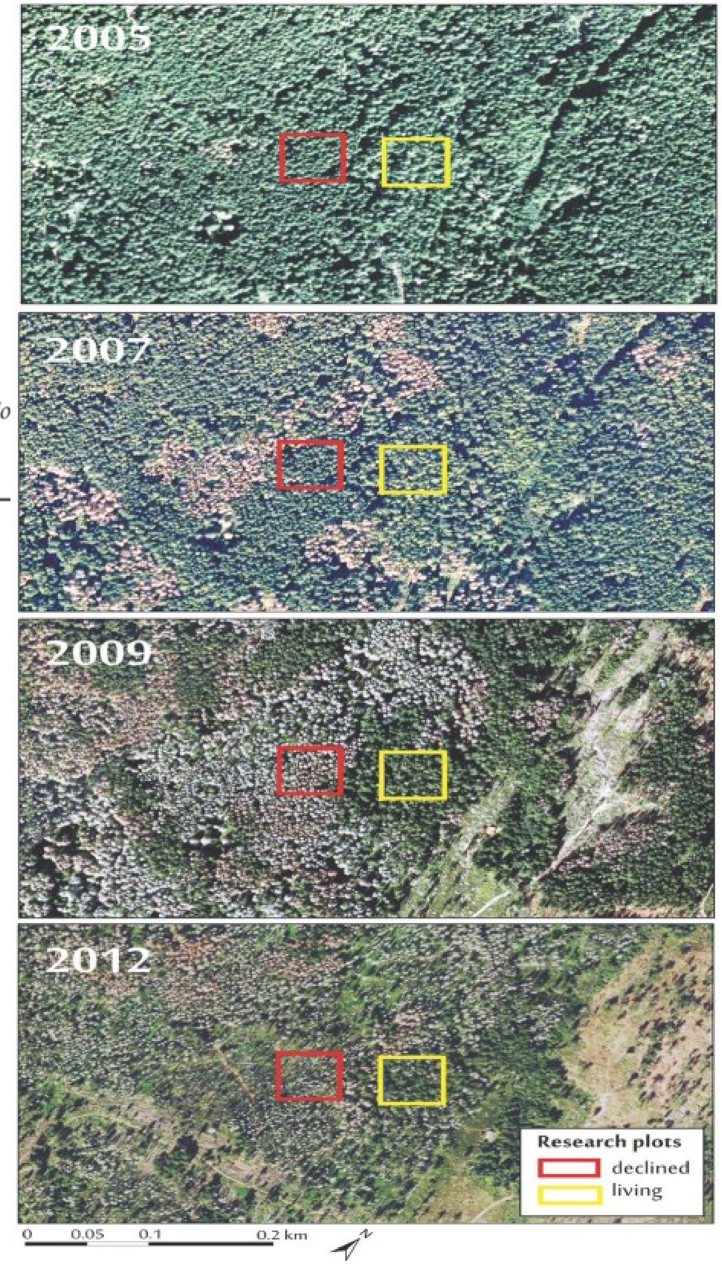
PÔVODNÁ PRÁCA – ORIGINAL PAPER

Contrasting development of declining and living larch-spruce stands after a disturbance event: A case study from the High Tatra Mts.

Rôzny vývoj odumierania a prežívania smrekovcových smrečín po kalamite – prípadová štúdia z Vysokých Tatier

Vladimír Šebeň[1]*, Bohdan Konôpka[1, 2], Michal Bošeľa[1, 2], Jozef Pajtík[1, 2]

[1]National Forest Centre - Forest Research Institute Zvolen, T. G. Masaryka 2175/22, SK – 960 92 Zvolen, Slovakia
[2]Czech University of Life Sciences Prague, Faculty of Forestry and Wood Sciences, Kamýcká 129, CZ – 165 21 Praha 6 - Suchdol, Czech Republic



Abstract