Laboratory of Plant Conservation and Population Biology
- Honnay lab

hanne.dekort@kuleuven.be

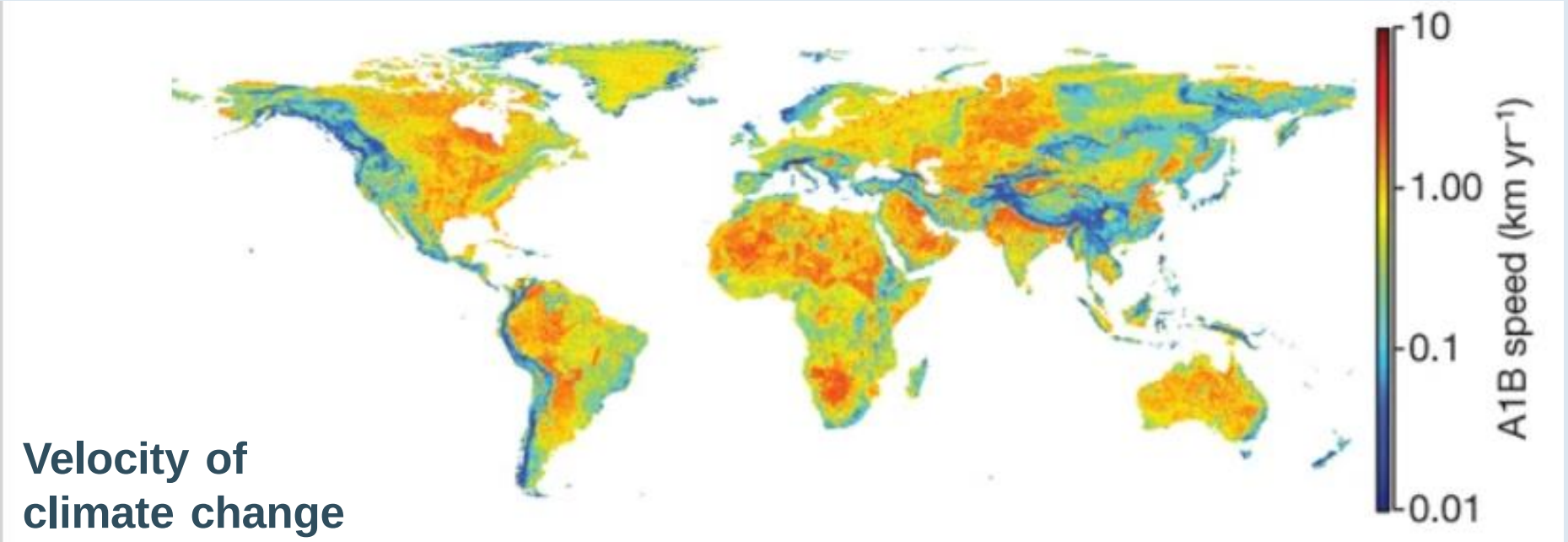
Assisted migration to the test *Primula elatior*

KU LEUVEN PLANT INSTITUTE

Assisted migration

1. The velocity of climate change: **can species move on their own**?
2. The sensitivity to climate change: **can species adapt on their own**?
3. **Assisted migration** – a smart pro-active conservation strategy?
4. *Primula elatior* – An assisted migration **case study** to test:
    - ~where collect plants?
    - ~where introduce plants?
    - ~**assisted migration vs. "local is best"**
5. Conclusions – Take home message

1. Can species move on their own?



Velocity of climate change

Loarie et al. 2009 *Nature*

Belgian climate change velocity: **ca. 500 m/yr**

Forest specialist migration velocity: **< 1m/yr**

1. Can species move on their own?

Bluebells: with 0.02m/year: kings of slow dispersers (Sanczuk et al. 2022 *Journal of Biogeography*)

1. Can species move on their own?

Forest specialists: due to their extremely low dispersal rates, large populations are typical of very **old forests**

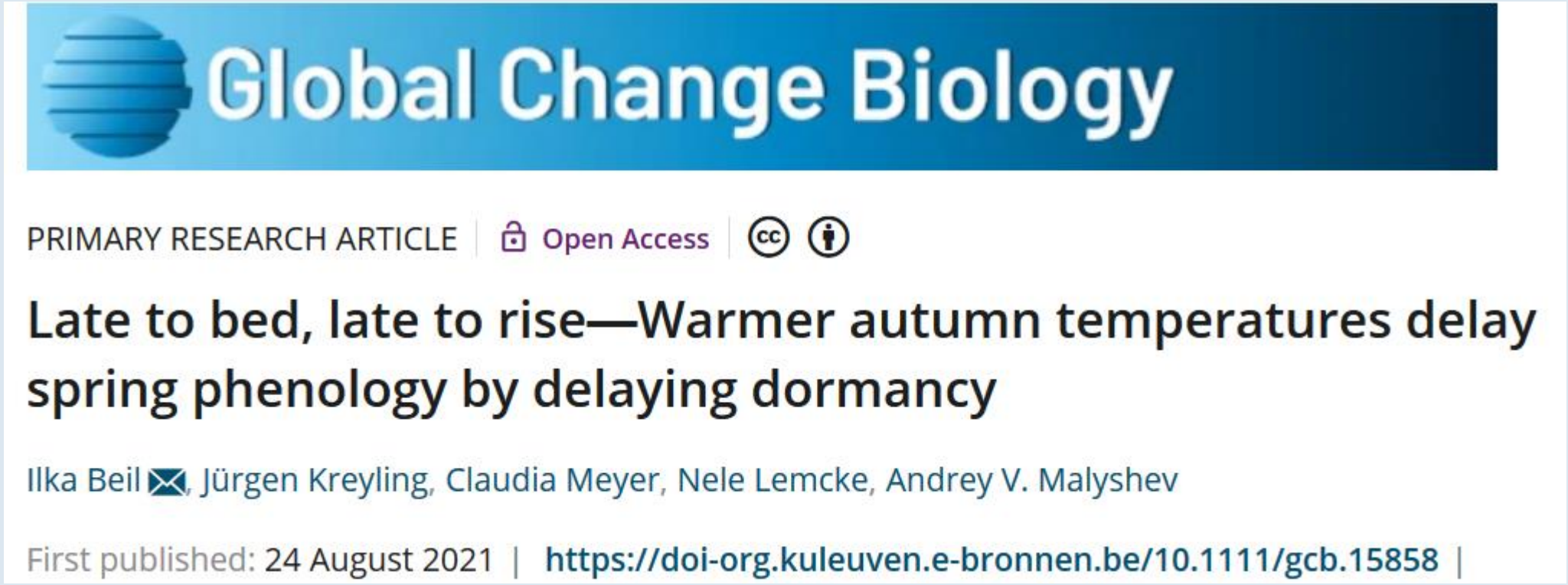
1. Can species move on their own?

Probably not

-

2. Can species adapt on their own?

- Cold **winter temperatures** required for growing season, flowering and germination



Global Change Biology

PRIMARY RESEARCH ARTICLE | Open Access

Late to bed, late to rise—Warmer autumn temperatures delay spring phenology by delaying dormancy

Ilka Beil, Jürgen Kreyling, Claudia Meyer, Nele Lemcke, Andrey V. Malyshev

First published: 24 August 2021 | https://doi-org.kuleuven.e-bronnen.be/10.1111/gcb.15858 |

→ Short winters threaten growing season and reproduction

2. Can species adapt on their own?

- Climate change can cause **mismatches** between interacting species

ECOLOGY LETTERS

Letter | Full Access

Phenological mismatch with trees reduces wildflower carbon budgets

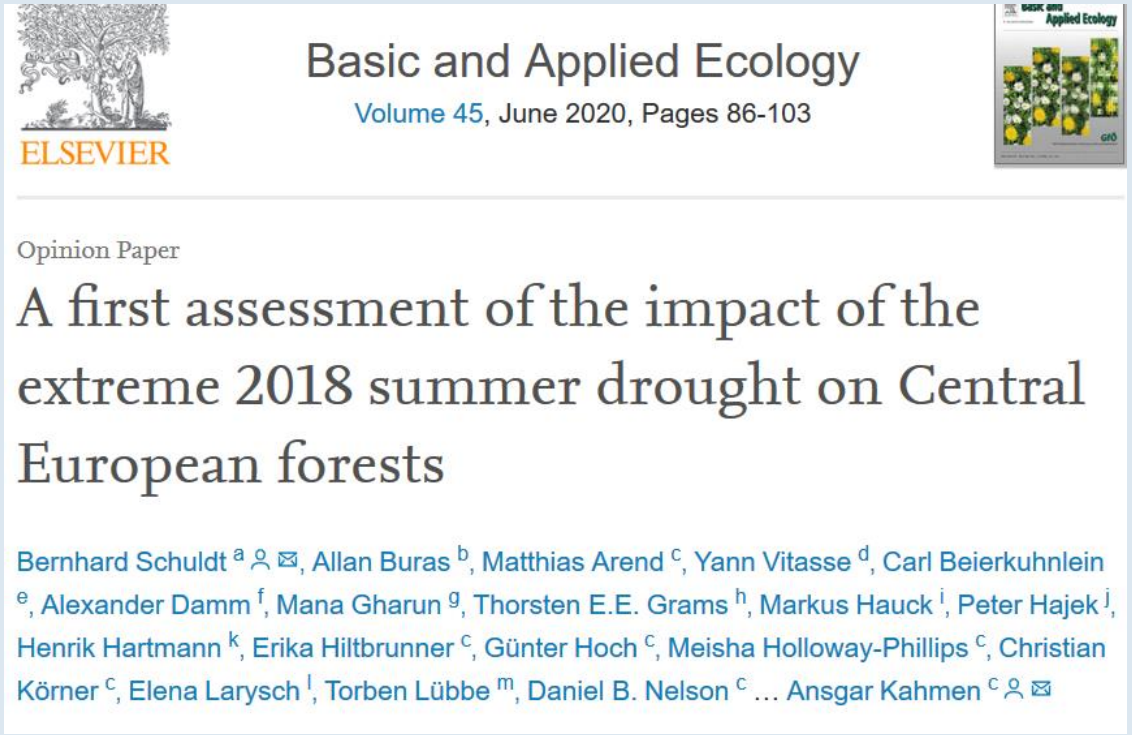
J. Mason Heberling, Caitlin McDonough MacKenzie, Jason D. Fridley, Susan Kalisz, Richard B. Primack

First published: 03 February 2019 | https://doi-org.kuleuven.e-bronnen.be/10.1111/ele.13224 |

→ Understorey species respond slower to climate warming than trees

2. Can species adapt on their own?

- Extreme weather >>> average temperature changes



ELSEVIER

Basic and Applied Ecology

Volume 45, June 2020, Pages 86-103

Opinion Paper

A first assessment of the impact of the extreme 2018 summer drought on Central European forests

Bernhard Schuldt [a] ✉, Allan Buras [b], Matthias Arend [c], Yann Vitasse [d], Carl Beierkuhnlein [e], Alexander Damm [f], Mana Gharun [g], Thorsten E.E. Grams [h], Markus Hauck [i], Peter Hajek [j], Henrik Hartmann [k], Erika Hiltbrunner [c], Günter Hoch [c], Meisha Holloway-Phillips [c], Christian Körner [c], Elena Larysch [l], Torben Lübbe [m], Daniel B. Nelson [c] … Ansgar Kahmen [c] ✉

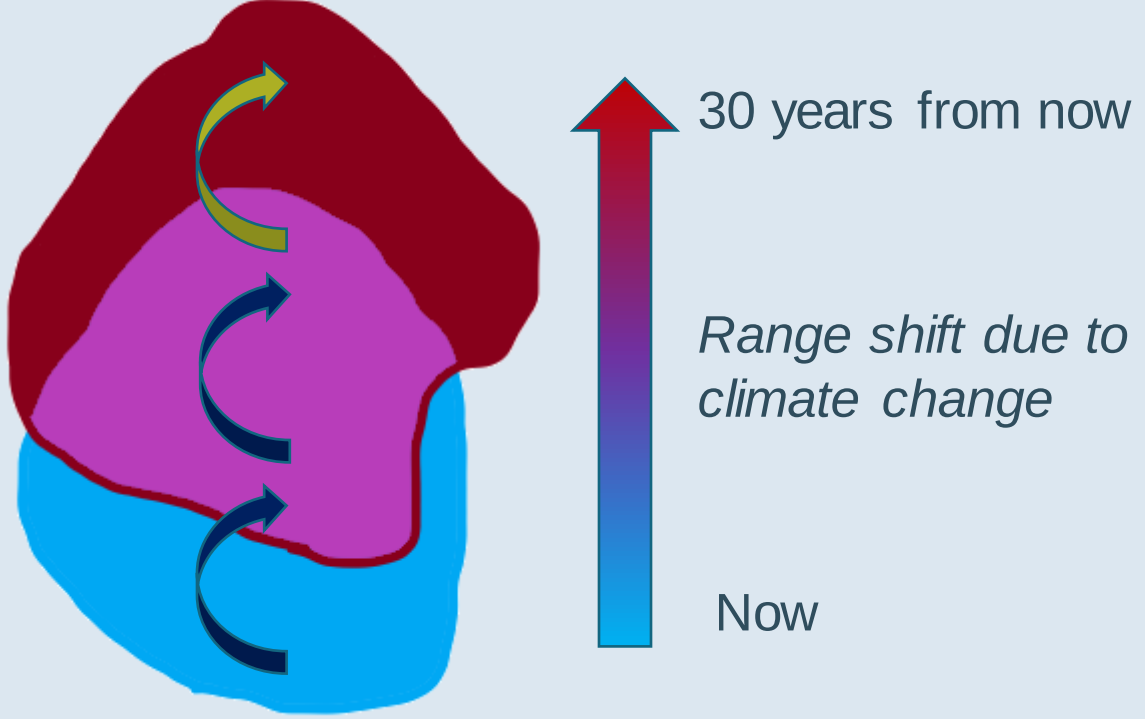
→ Widespread tree mortality and premature leaf shedding

2. Can species adapt on their own?

Perhaps not

-

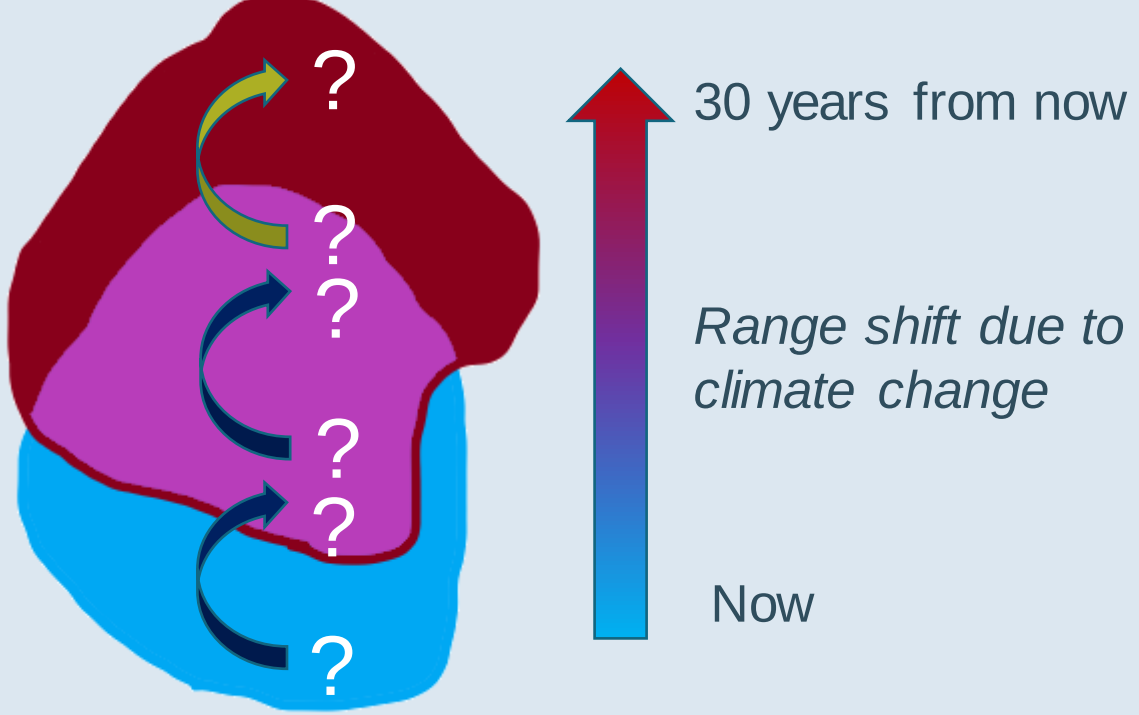
3. Assisted migration?



Assist plants with their northward migration

→ Assisted gene flow
→ Assisted range expansion

3. Assisted migration?

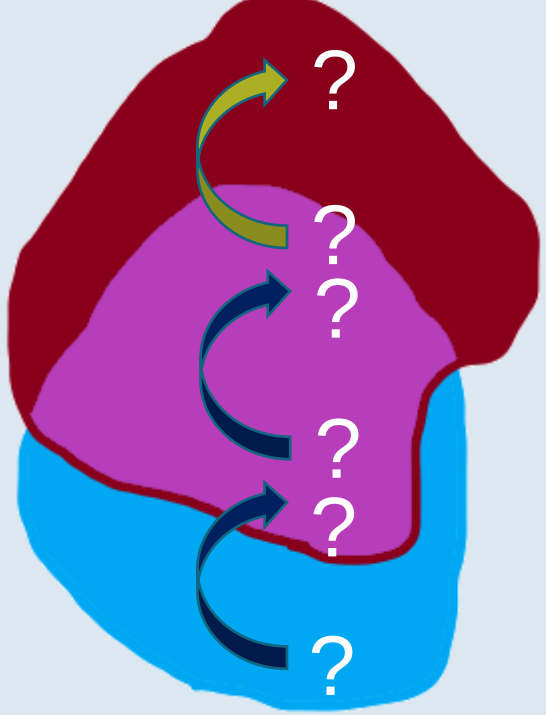


Assisted gene flow: which part of the range is most sensitive to climate change?

Assisted range expansion: how far north can the species survive in 30 years?

How far south for selecting pre-adapted plants?

4. Assisted migration case study



30 years from now

Range shift due to climate change

Now

Assisted gene flow: which part of the range is most sensitive to climate change?

→ Genetic analysis

Assisted range expansion: how far north can the species survive in 30 years?

→ Species distribution modeling

How far south for selecting pre-adapted plants?

→ Genetic analysis

4. Assisted migration case study

A. Assisted gene flow: which part of the range is most sensitive to climate change?

→ Genetic analysis

B. Assisted range expansion: how far north can the species survive in 30 years?

→ Species distribution modeling

C. How far south for selecting pre-adapted plants?

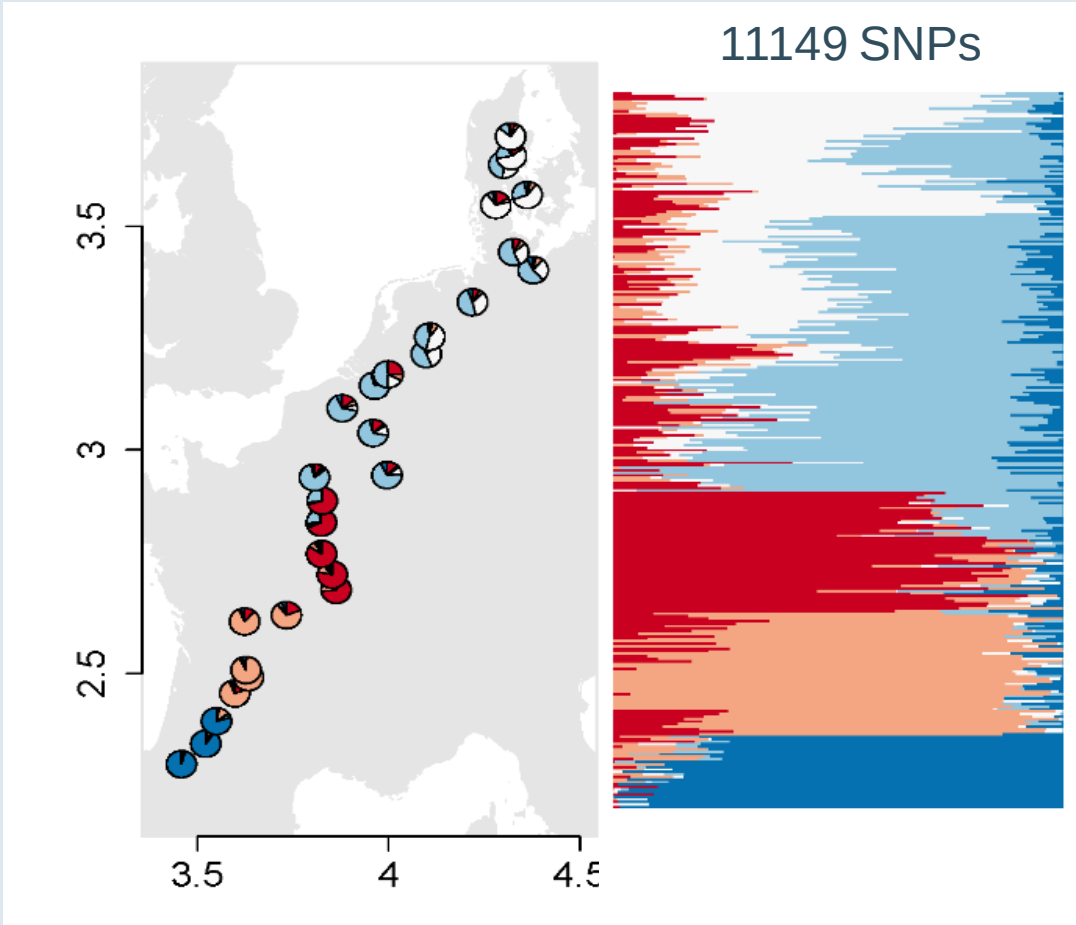
→ Genetic analysis

4. Assisted migration case study

A. Assisted gene flow: which part of the range is most sensitive to climate change?

→ Genetic analysis: **genetic diversity low at the northern range edge?**

But this genetic variation may not be relevant for climate change



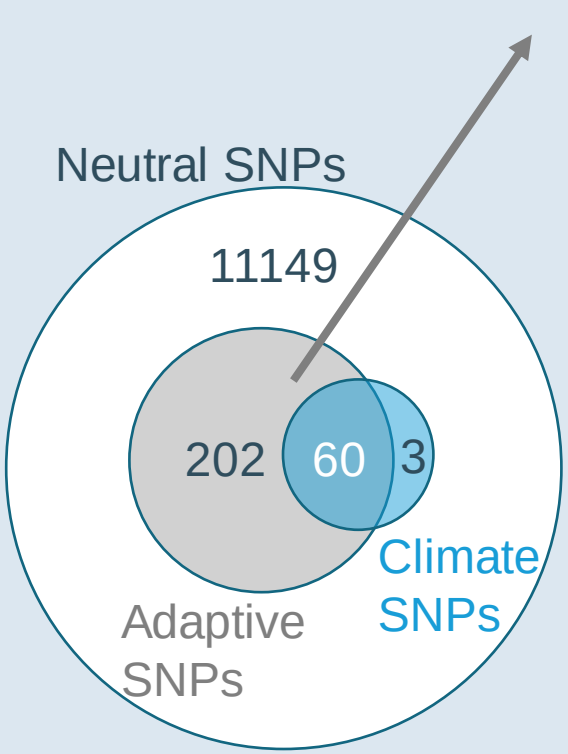
Van Daele et al. 2021 D&D

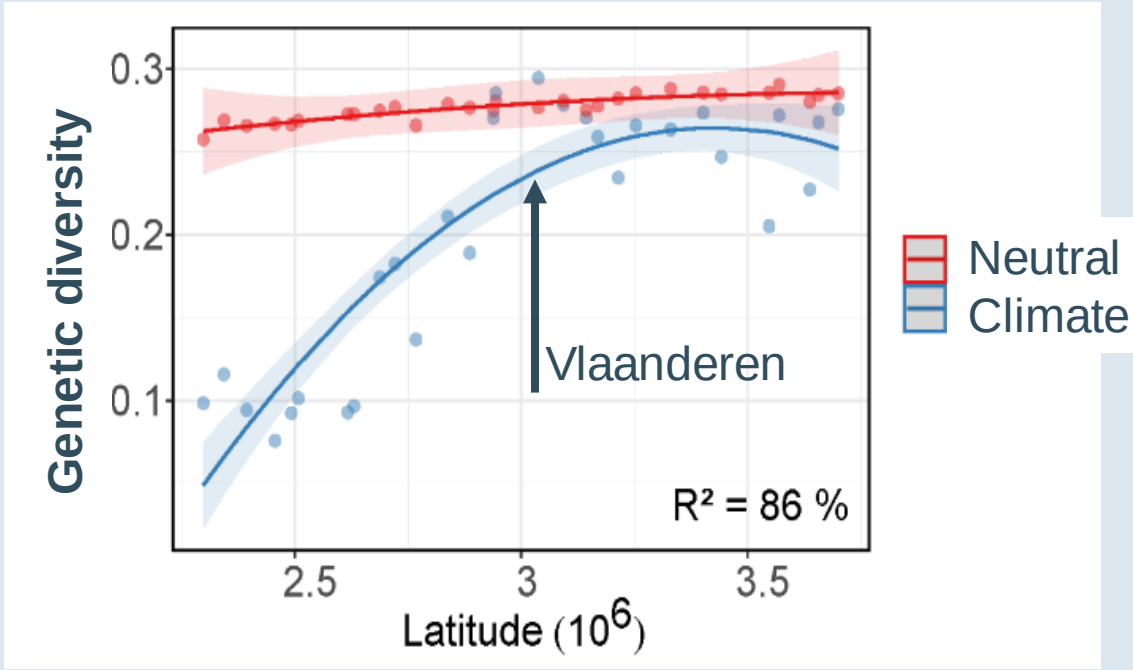
4. Assisted migration case study

A. Assisted gene flow: which part of the range is most sensitive to climate change?

→ Genetic analysis: genetic diversity low at the northern range edge?

→ **More specifically: climate-related genetic diversity low at the northern edge?**





Van Daele et al. 2022 Evol Appl

4. Assisted migration case study

A. Assisted gene flow: which part of the range is most sensitive to climate change?

→ Genetic analysis: genetic diversity low at the northern range edge?

→ **More specifically: climate-related genetic diversity low at the northern edge?**

No: Genetic resilience to climate change increases from south to north
Southern populations most at risk (do we want to protect them?)

4. Assisted migration case study

B. Assisted range expansion: how far north can the species survive in 30 years?

→ Species distribution modeling

Current climate + **forest cover** → current distribution

↓

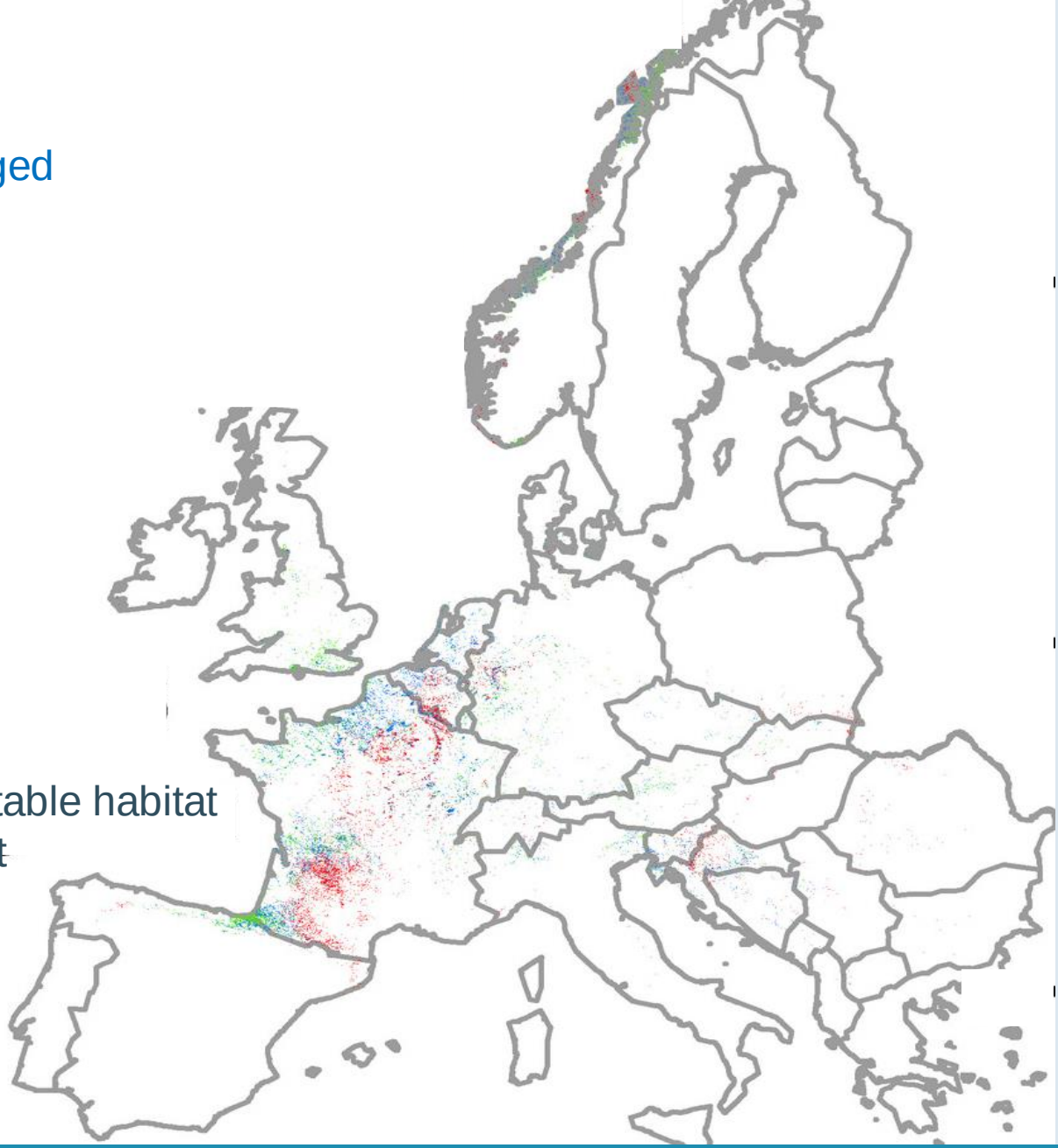
Predicted climate + forest cover 2050 → predicted habitat 2050

4. Assisted migration case study

Loss
Gain
Unchanged

→ Mild climate scenario
→ Reforestation (+0.5% broadleaved forest each year)

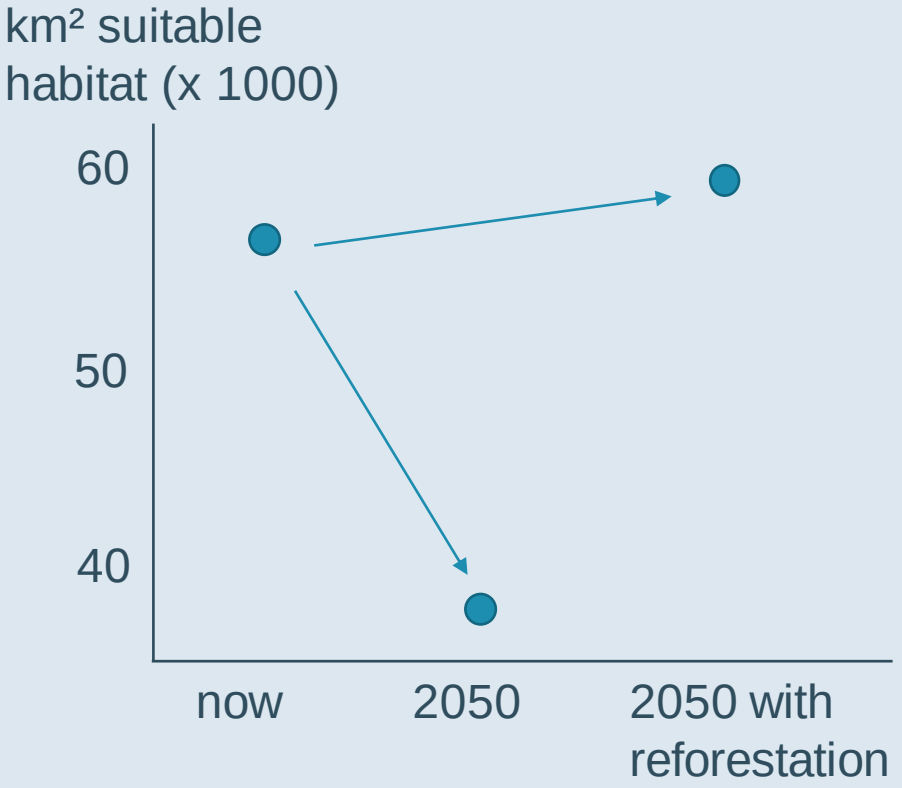
Range-wide: Net **no loss** of suitable habitat
Belgium: **loss** of suitable habitat



Van Daele et al. 2021 *D&D*

4. Assisted migration case study

→ Mild climate scenario



Van Daele et al. 2021 *D&D*

4. Assisted migration case study

B. Assisted range expansion: how far north can the species survive in 30 years?

→ Species distribution modeling

→ More specifically: **do we predict range shifts towards the north?**

No: Under balanced climate scenarios and reforestation we do not see significant shifts northward. Across the range, we notice important **regional shifts in suitable habitat**.

5. Conclusion – take home message

- **No assisted gene flow recommended**: Northern populations not senstive to climate change
- **No assisted range expansion recommended**: No range expansion to the north predicted, IF emissions will reduce in the future and IF reforestation efforts

- **Belgian populations**: high capacity to adapt to climate change, but we need to protect and increase our forests

C. How far south for sele g pre-adapted plants?

5. Conclusion – take home message

- Introducing plants from the south = risk for **maladaptation** to light conditions

- Increasing landscape connectivity and structure >>> assisted migration
  → benefit entire communities
  → allow natural dynamics and regeneration (cfr “Local is best”)
  → increase possibility for long-distance dispersal events by animals

5. Conclusion – take home message

- more research is needed to map far dispersal events

5. Conclusion – take home message

The effects of defaunation on plants' capacity to track climate change

EVAN C. FRICKE , ALEJANDRO ORDONEZ , HALDRE S. ROGERS , AND , JENS-CHRISTIAN SVENNING Authors Info & Affiliations

SCIENCE · 13 Jan 2022 · Vol 375, Issue 6577 · pp. 210-214 · DOI: 10.1126/science.abk3510

"We conservatively estimate that **mammal and bird defaunation has already reduced the capacity of plants to track climate change by 60%** globally."

Frederik Van Daele
Olivier Honnay
Kasper Van Acker

Thank you!