Looking for Cowslips

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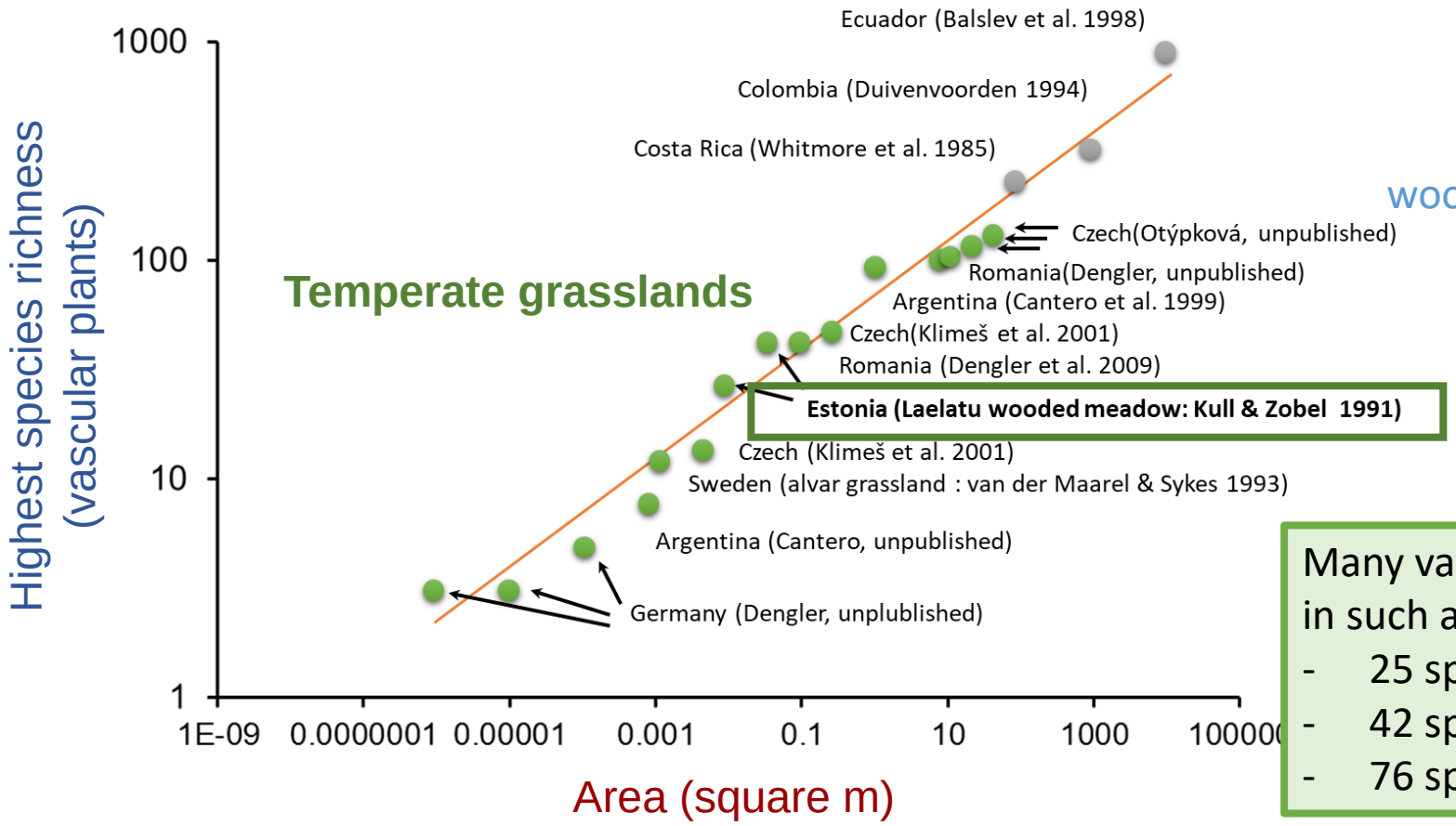
University of Tartu, Estonia

Plantlife webinar **Spring into Action** 26 February 2021

EUROPEAN GRASSLANDS

- Temperate grasslands offer habitats for exceptionally many plant and animal species
- **European grasslands are world's top-diverse habitats!**



Tropical rainforest

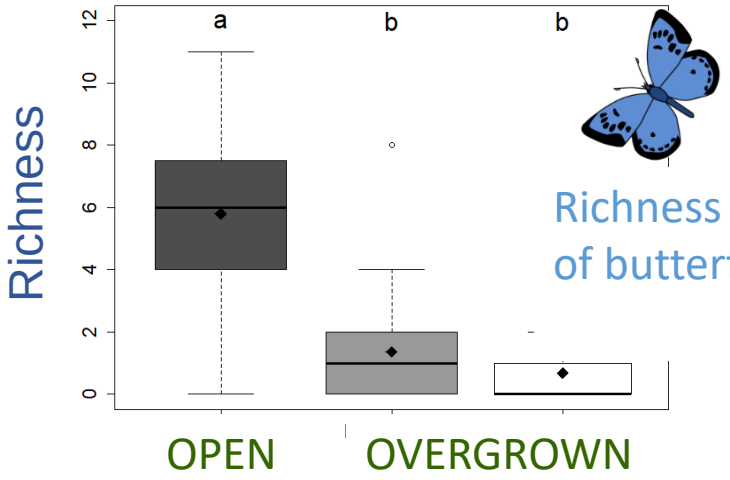
Temperate wooded meadow

Many vascular plant species in such a small area (!):
- 25 species 10 x 10 cm
- 42 species 20 x 20 cm
- 76 species 100 x 100 cm

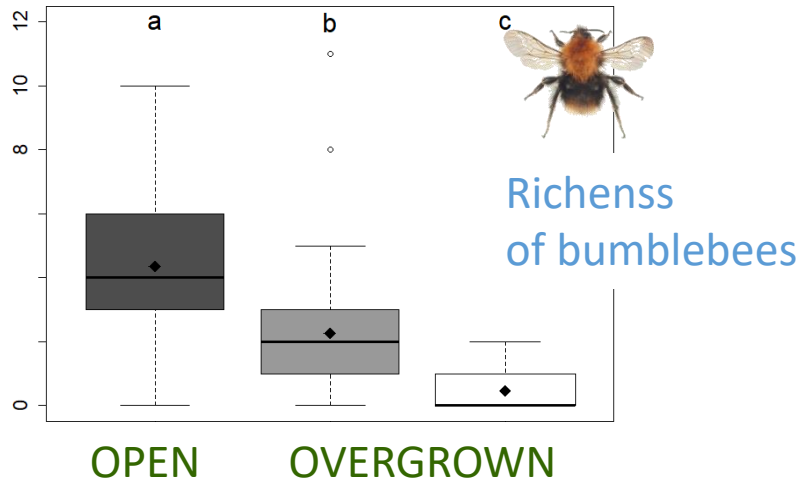
Wilson, Dengler, Peet & Pärtel, J. Veg. Sci. 2012

EUROPEAN GRASSLANDS

- Semi-natural grasslands are critical for maintaining **vital ecosystem services** (nature's benefits for people)
- Important nesting and feeding habitats for numerous insects
- Species involved in biological control
- Cultural, recreative and aesthetic value

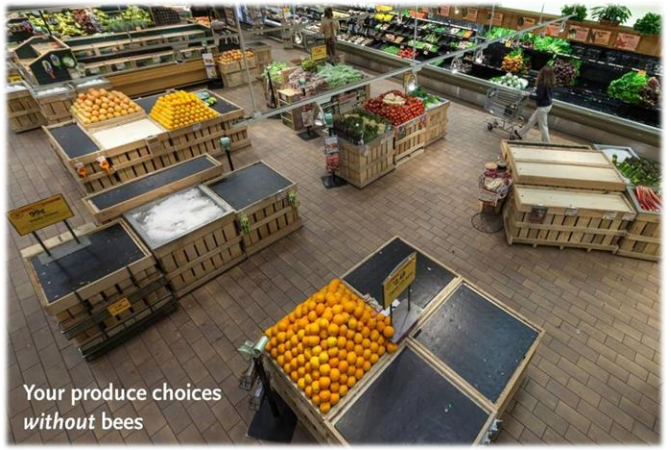


Richness of butterflies



Richenss of bumblebees

The overgrowth of calcareous grasslands has brought along substantial decrease in the abundance of butterflies and bumblebees.



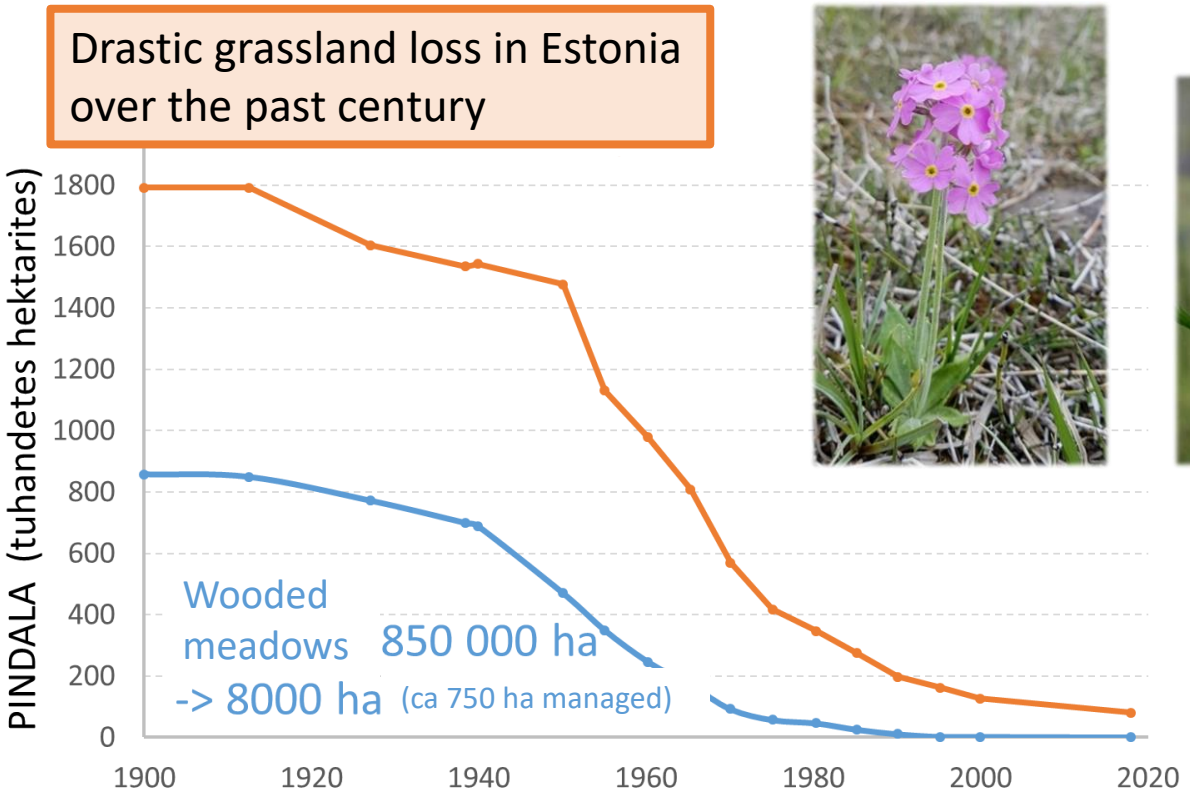
Ca 75 % of most important food crops depend on pollinators.
At least half of „pollinations service" is secured by **wild pollinating insects.**

Prangel. 2017 (Master thesis, Uni. Tartu)

EUROPEAN GRASSLANDS

- Drastic decrease in the area and connectivity of grasslands
- Europe has lost > 90 % of semi-natural grasslands
- Land use change as the main cause

Drastic grassland loss in Estonia over the past century



97% of Britain's wildflower meadows have gone. Here's why it matters

Patrick Barkham

The loss of natural habitat since WWII is vividly reflected in the fate of the marsh fritillary butterfly. So it's worrying when meadows are shaved like football pitches

English grasslands in 'catastrophic decline'

Conservationists warn wildlife-rich grasslands are vanishing due to development, farming practices or neglect

Search International The Guardian

Kukk & Kull 1997. Estonia Maritima 2

https://www.theguardian.com/international

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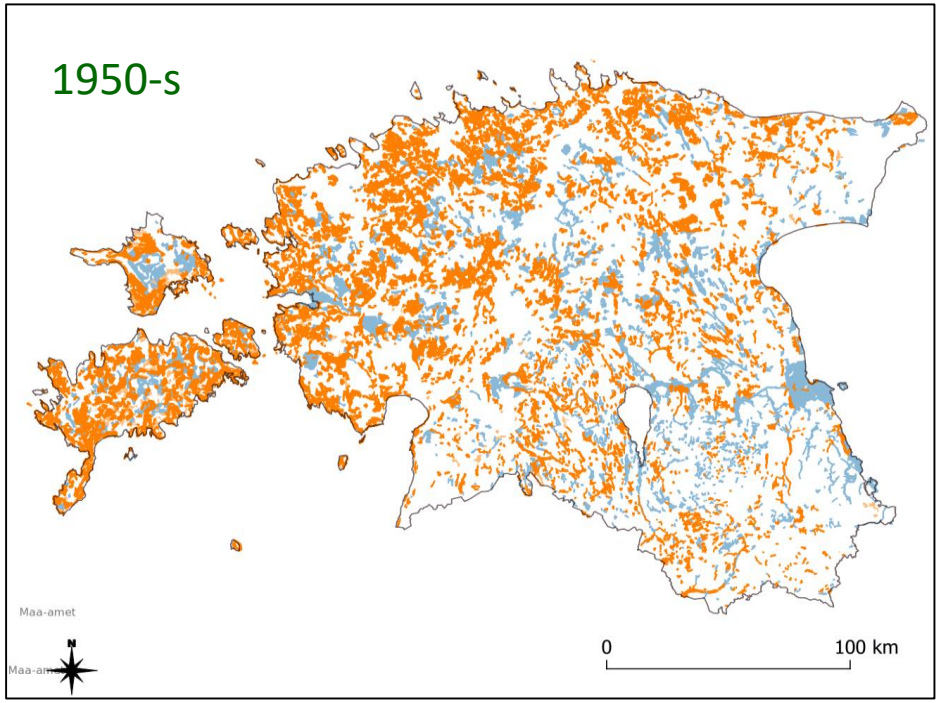
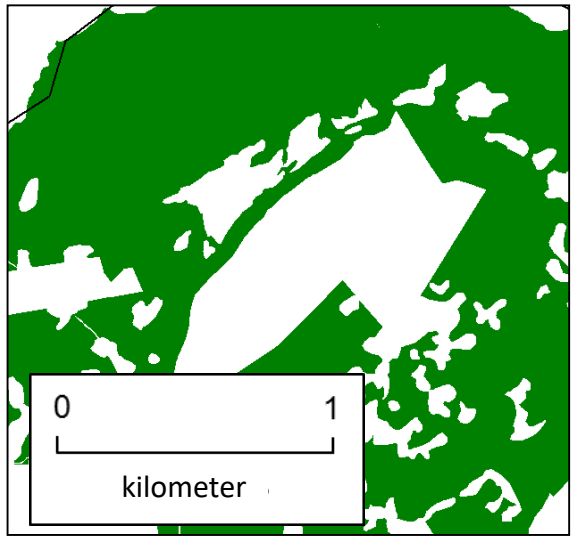


Overall change in the area of grasslands



Calcareous grassland in 1913
Pääsuke 1913 (ERM 214:208)

Laasimer 1965. Estonian Vegetation

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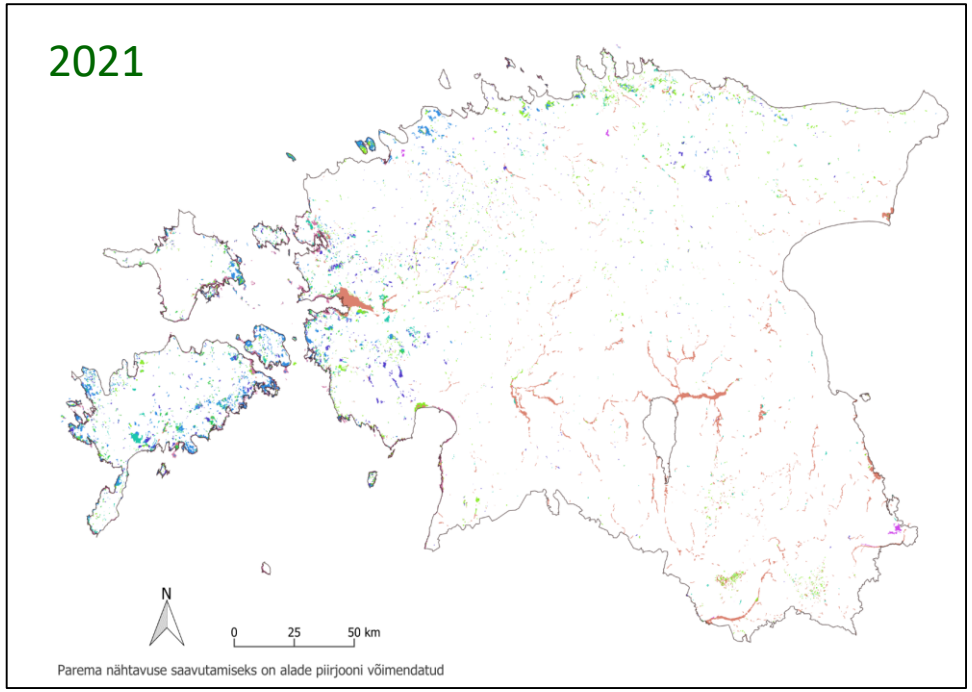

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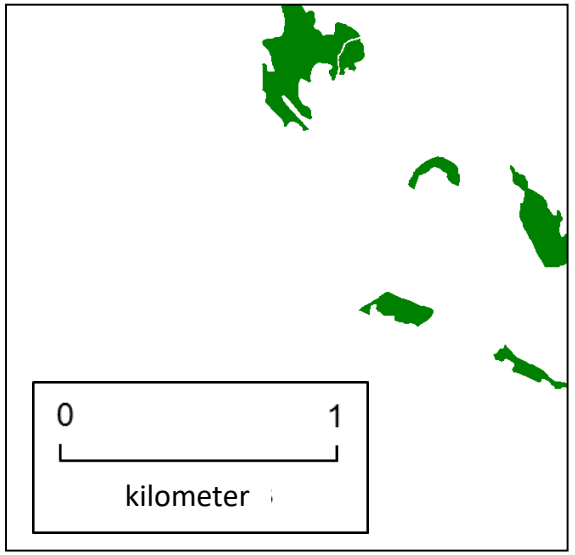


Overgrown grassland in 2016

The **total area** of grasslands has decreased.
Landscape-scale connectivity has drastically declined.
<u>Both pose serious threats for biodiversity.</u>

Helm & Toussaint 2020.

ESTONIAN GRASSLANDS – floodplain meadows

Photo: Tsipe Aavik

ESTONIAN GRASSLANDS – coastal meadows

Photo: Tsipe Aavik

ESTONIAN GRASSLANDS – wooded meadows

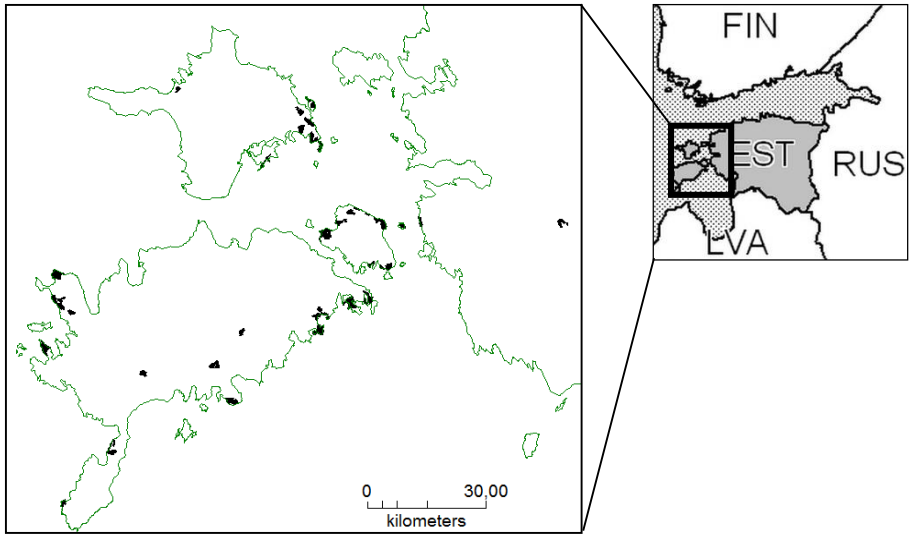
Photos: Tsipe Aavik

ESTONIAN GRASSLANDS – calcareous alvar grasslands

Photo: Tsipe Aavik

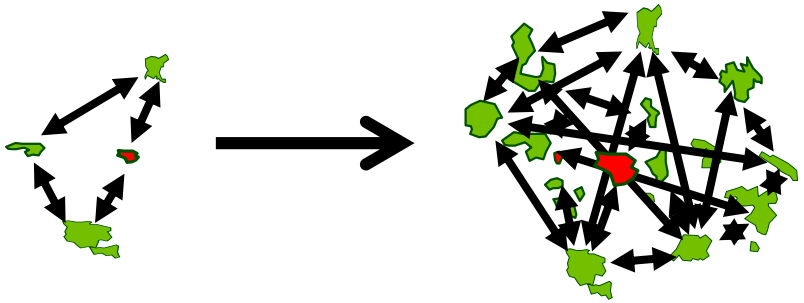
RESTORATION OF GRASSLANDS

- LIFE TO ALVARS – a large-scale restoration project to recover calcareous semi-natural grasslands (alvars) on > 2500 ha in Estonia



Meeting of the experts to select most valuable regions:
(1) Historical distribution
(2) Regions where grasslands with high diversity had preserved

Aims:
(1) Increase habitat connectivity
(2) Increase habitat area



Photos: Aveliina Helm

LIFE TO ALVARS: http://life.envir.ee/english-project-life-alvars

RESTORATION OF GRASSLANDS

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2015

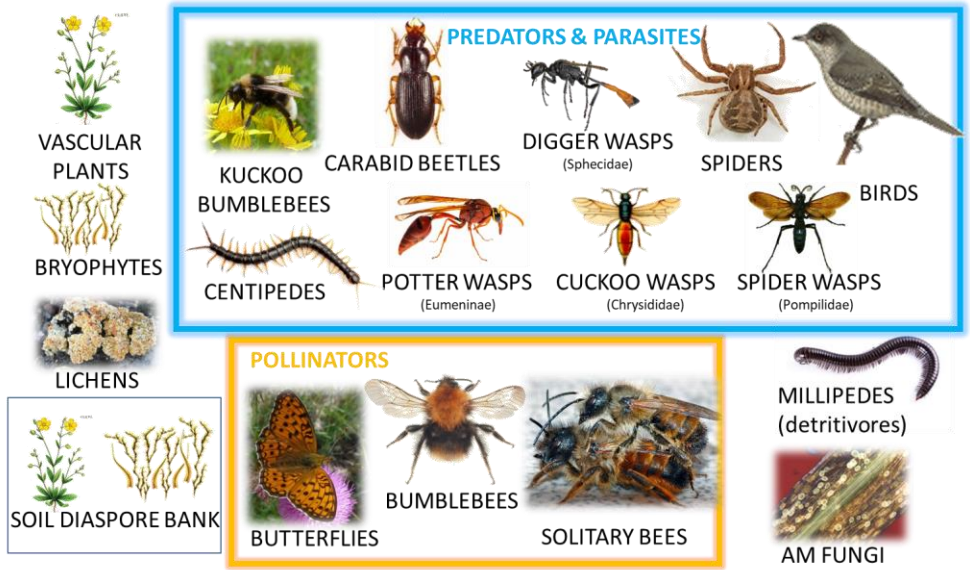
2017

Photos: Aveliina Helm

LIFE TO ALVARS: http://life.envir.ee/english-project-life-alvars

RESTORATION OF GRASSLANDS

- Inventory and long-term monitoring of the effectiveness of grassland restoration
  - Landscape and environmental change
  - Species diversity of various organism groups
  - Genetic diversity and gene flow of plants
  - Ecosystem services



Open grassland

GENETIC DIVERSITY
OF GRASSLAND PLANTS

Overgrown grassland

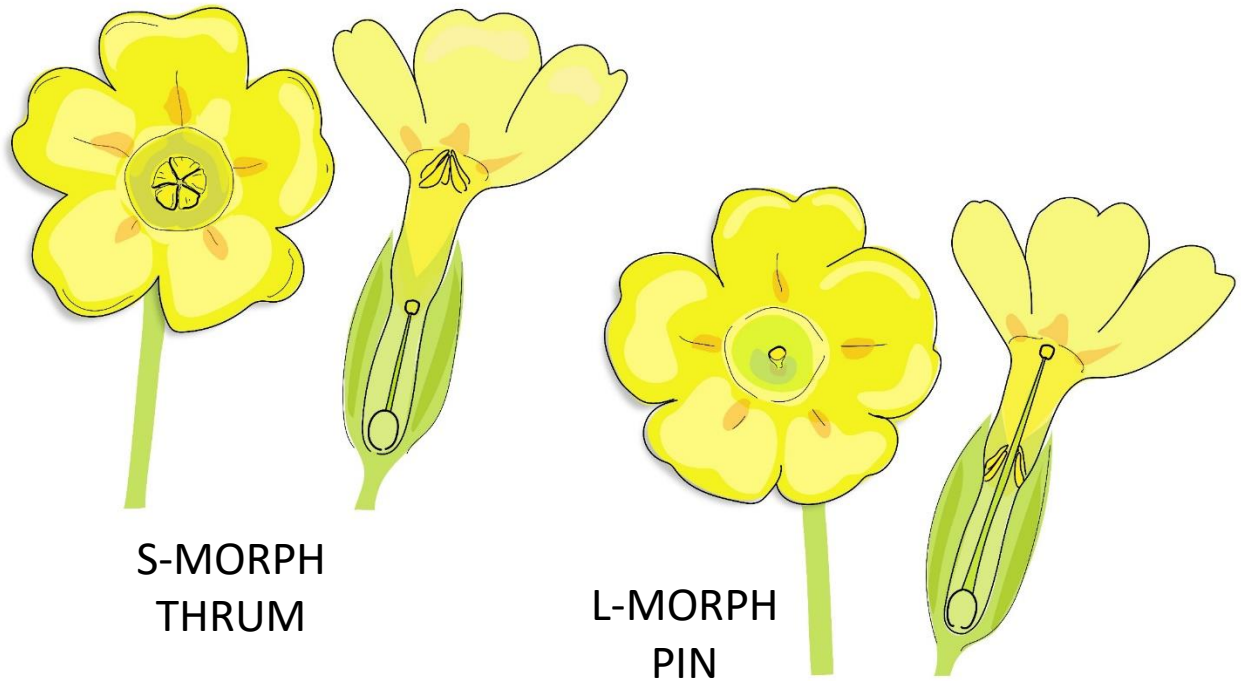
Photos: Aveliina Helm, Tsipe Aavik /right/

COWSLIP (*PRIMULA VERIS*)

Photos: Tsipe Aavik /left/, Kaarel Kaisel /upper right, lower right/, Iris Reinula /middle/

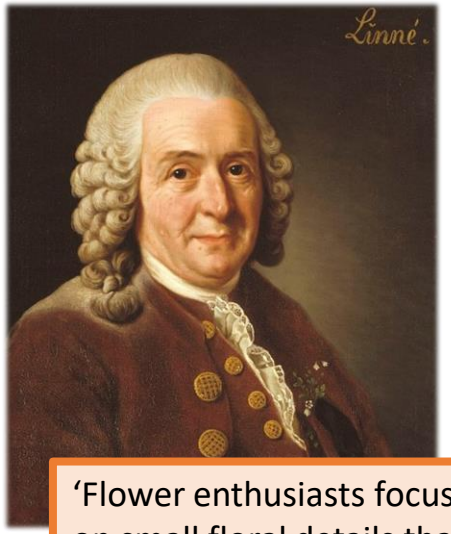
„COMPLEX MARRIAGE“ OF COWSLIPS

- **Heterostyly** - the condition of having styles of different lengths relative to stamens in the flowers of different individual plants
- The pollen from a flower of one morph cannot fertilize another flower of the same morph
- Avoidance of inbreeding and enhancing of outcrossing (160 years since Darwin’s study)
- Thus, also plants „care“ with whom they mate



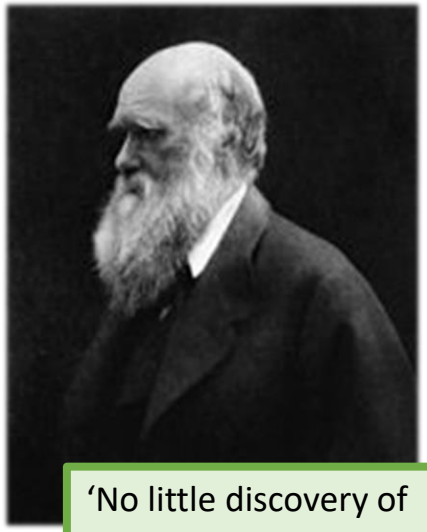
S-MORPH
THRUM

L-MORPH
PIN



‘Flower enthusiasts focus on small floral details that no sane botanist would consider important.’

Carl von Linné



‘No little discovery of mine ever gave me so much pleasure as making out the meaning of heterostyled flowers.’

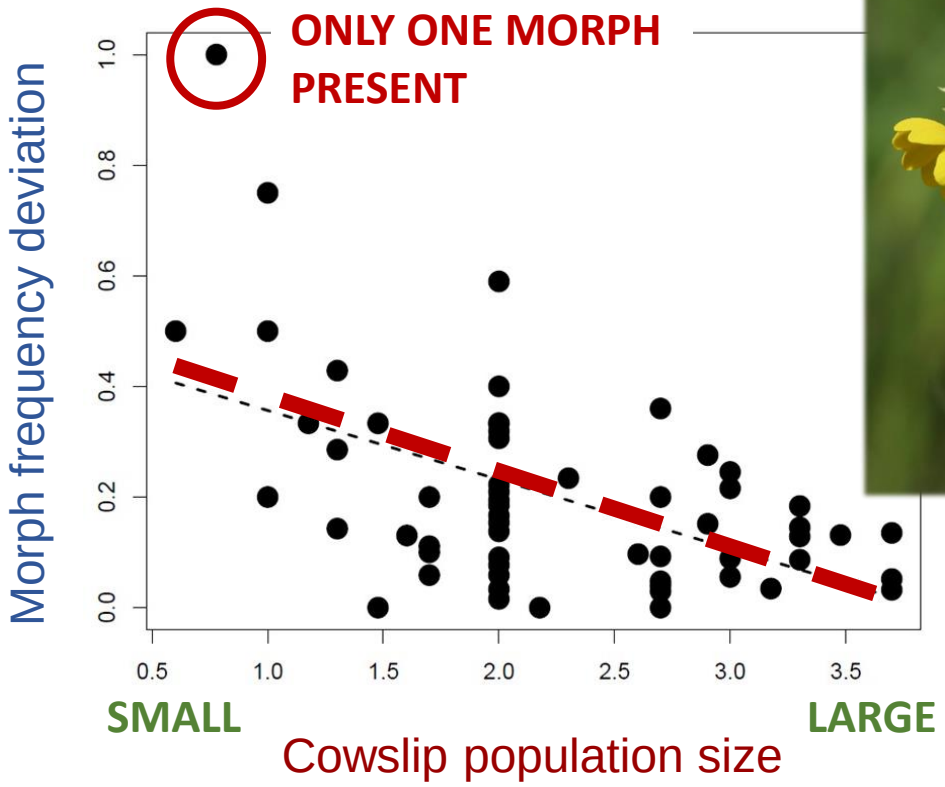
Charles Darwin

Darwin 1862. J. Proc. Linn. Soc.

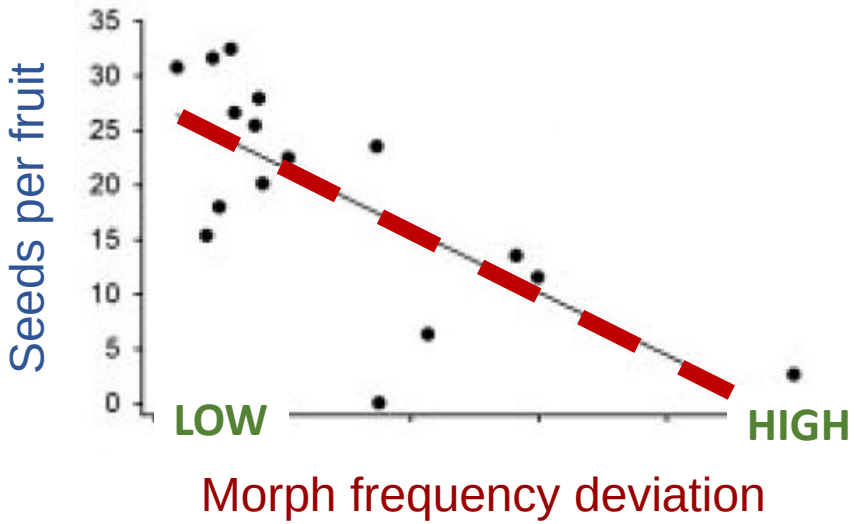
Gilmartin 2015. New Phytologist

„COMPLEX MARRIAGE“ OF COWSLIPS

- The frequencies of L- and S-morphs are **generally equal**, with a **ratio of 1:1**
- The 1:1 ratio may deviate as a consequence of **habitat loss**
- The latter means **FEWER COMPATIBLE MATES** for fertilisation
- **Loss of pollinators** further intensifies the problem



Deviations in morph frequencies leads to **lower reproductive output** (e.g. lower number of seeds) in cowslip populations.



Kaldra et al. (in prep.)

Kery et al. 2003. Basic. Appl. Ecol.

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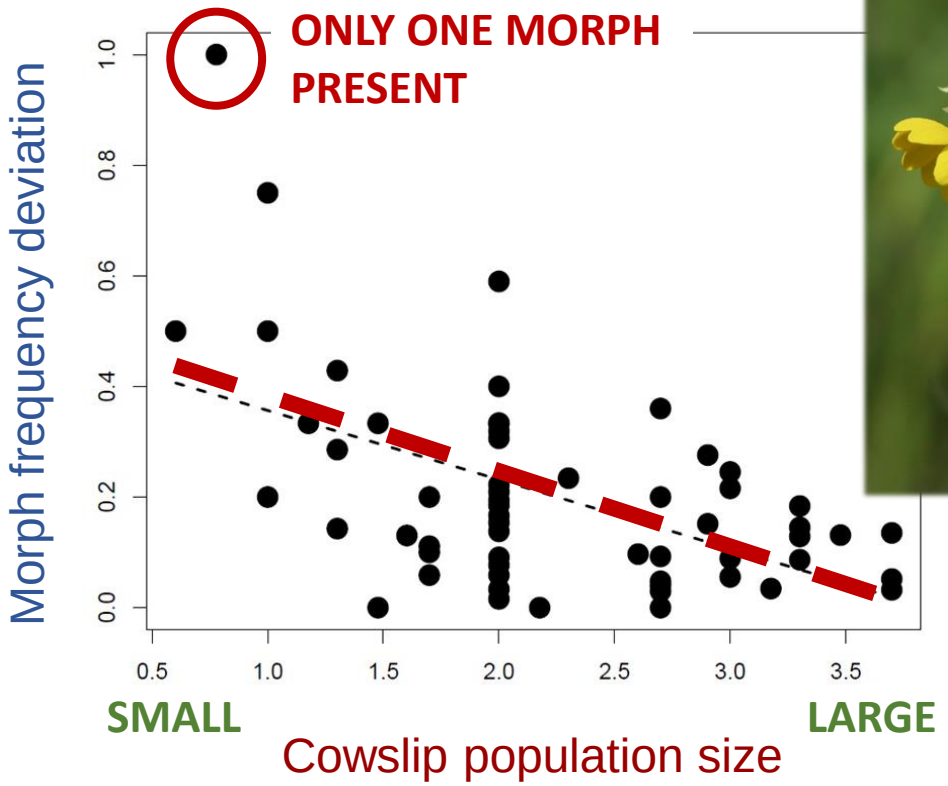
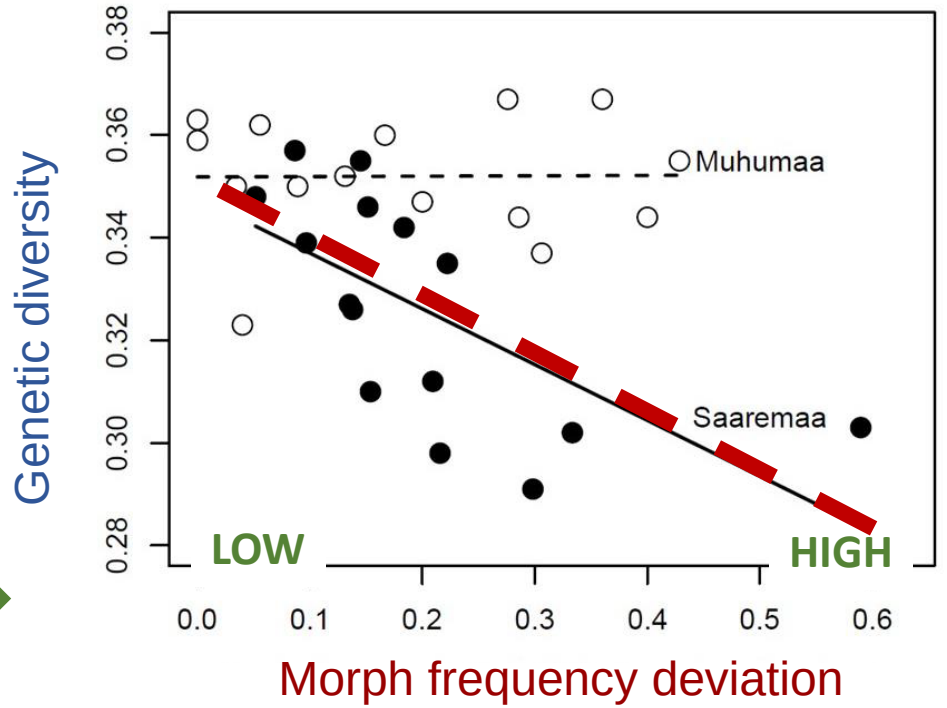
Deviations in morph frequencies can also cause **reduced genetic diversity.**





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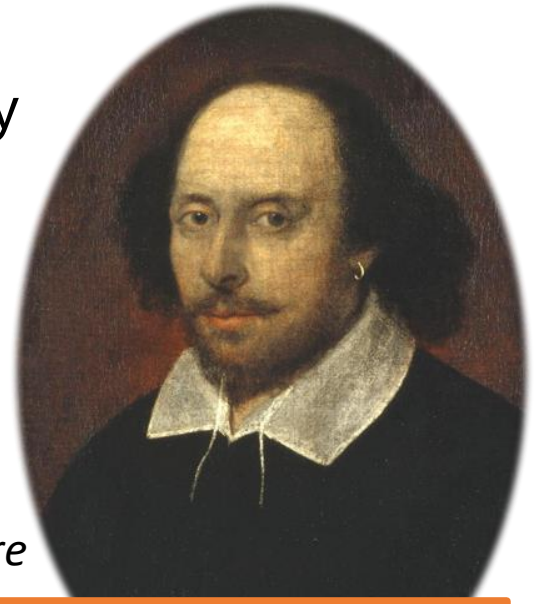
CITIZEN SCIENCE INITIATIVE „LOOKING FOR COWSLIPS“

- A well-known grassland plant
- Cultural value - the county flower for Essex, Northamptonshire, Surrey and Worcestershire
- A lot of folk names (in Estonia **116 folk names** in 1930s)
  - Key of Heaven, Paigles, Bunch of Keys, Herb Peter

DO YOU KNOW ANY?

- Important plant in folk medicine



William Shakespeare

***The cowslip** tall her pensioners be*
In their gold coats, spots you see,
Those be rubies, fairy’s favours
In those freckles live their saviours
I must go seek dewdrops here
*And hang a pearl in every **cowslip’s ear**.*

A Midsummer’s Night Dream

*Where the bee sucks, there suck I; In **a cowslip’s** bell I lie.*

The Tempest

Greece wages losing battle against Albanian herb raiders

by Vassilis Kyriakoulis

*„Eighteen Albanians have been arrested during the past month, with **over 600 kilograms of cowslip** confiscated, along with the pack mules used to carry it.“*

https://phys.org/news/2018-06-greece-wages-albanian-herb-raiders.html

CITIZEN SCIENCE INITIATIVE „LOOKING FOR COWSLIPS“

- Estonia, 2019 and 2020
- Latvia, 2020

L-morph
PIN

S-morph
THRUM

- More than 1700 observations all across Estonia
- **‘Cowslip infection’ rate**: at least 300-400 per 100 000 in 2019
- More than **220 000 observed cowslip individuals**

CITIZEN SCIENCE INITIATIVE „LOOKING FOR COWSLIPS“

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DOI: 10.1111/1365-2745.13488

Journal of Ecology | BRITISH ECOLOGICAL SOCIETY

CITIZEN SCIENCE

Research Article

Landscape context and plant population size affect morph frequencies in heterostylous *Primula veris*—Results of a nationwide citizen-science campaign

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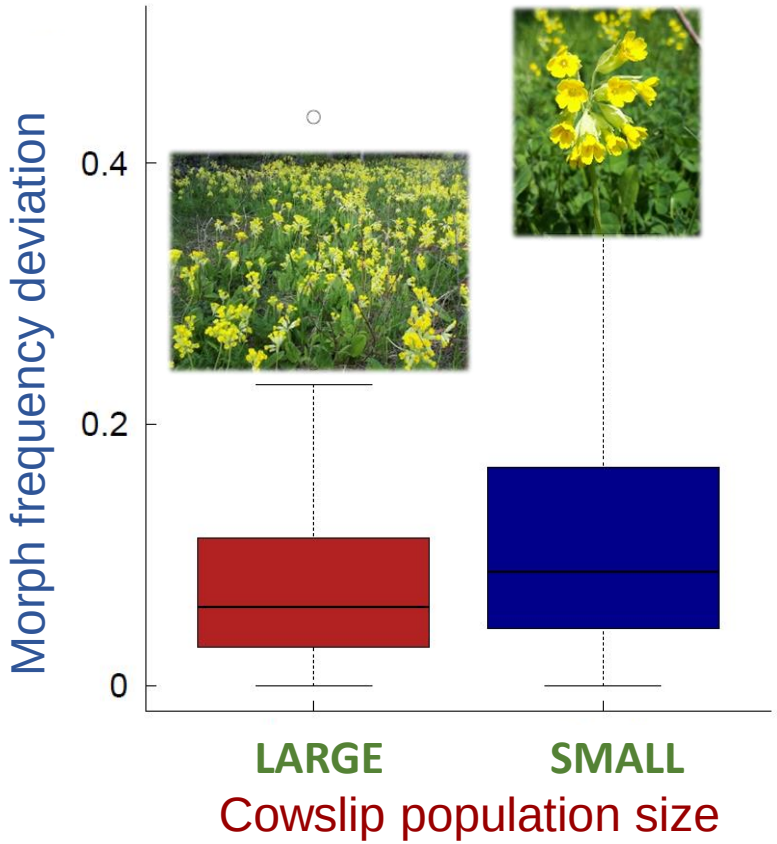
… and thousands of citizen scientists!

Morph frequencies deviate more in smaller cowslip populations.



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S-morphs (thrums) were systematically more abundant.

CITIZEN SCIENCE INITIATIVE „LOOKING FOR COWSLIPS“

- Warm welcome and very positive feedback from observers
- Lot’s of additional benefits – education, well-being (COVID-19)
- Surprising scientific findings!

EDUCATION
- schools
- kindergartens
- families

HABITATS
- road verges
- old quarries
- playgrounds
- graveyards
- verges of a crater
- airfield
- health trails

Photo: Kaarel Kaisel

Photos: cowslip observers

CITIZEN SCIENCE INITIATIVE „LOOKING FOR COWSLIPS“

- Evolutionary processes shaped by **habitat loss** (development of monomorphism and self-fertilisation)
- **Advantage of a specific morph** over the other
- The relative role of **habitat fragmentation**
- **Latitudinal effects**





Loss and fragmentation of semi-natural grasslands

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S-morph
THRUM

L-morph
PIN

Loss and fragmentation of semi-natural grasslands

Let’s go and follow the steps of Charles Darwin this spring!

Go in to the nature

Take a smartphone/tablet with internet access with you or print out observation form on paper

Find cowslips

Cowslips are common in grasslands, coastal areas, on forest edges and at roadsides

Observe and fill in the online form

Fill in the observation form online

Enjoy!

Take photos of yourself and cowslips. Share in social media

Thank you!

TARTU ÜLIKOOL
1632
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TEADUSE TIPPKESKUS
ECOL CHANGE

Euroopa Liit
Euroopa Regionaalarengu Fond

Eesti tuleviku heaks

CONSERVE Plants

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY