22. Januar 2021

Workshop «Erfahrungen und Erkenntnisse bei der Ansiedlung gefährdeter Pflanzenarten»

Populationsbiologische und -genetische Grundlagen für (Wieder)-Ansiedlungen

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Universität Bern

UNIVERSITÄT BERN

Projekt: Ex-situ Erhaltung und Wiederansiedlung

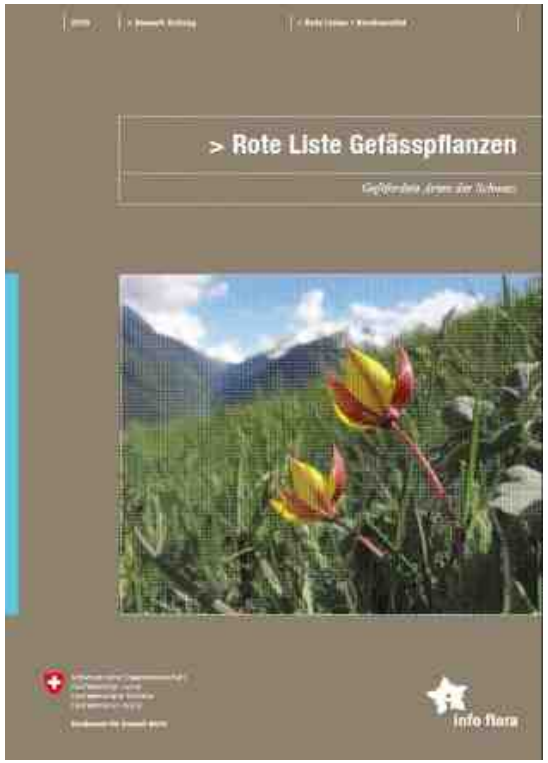
- Sicherung prioritärer Arten in Samenbank und Lebendkultur
- Planung und Durchführung von (Wieder-)Ansiedlungen
- Forschung rund um wichtige Themen in der (Wieder-) Ansiedlungsökologie
- Stärkung des Schweizer Netzwerks

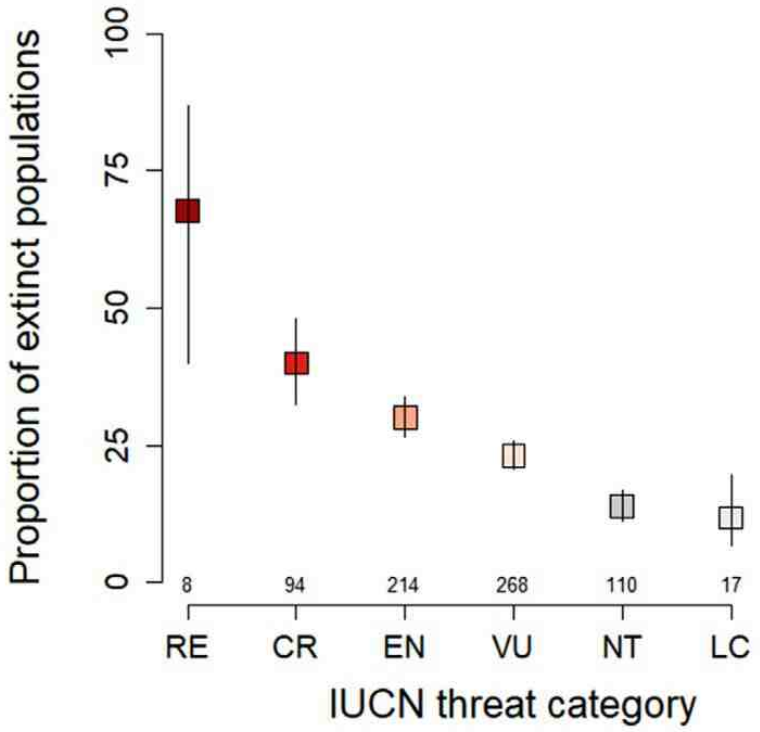
Wiederansiedlungen, Verstärkungen und Neuansiedlungen sind sinnvoll und machbar

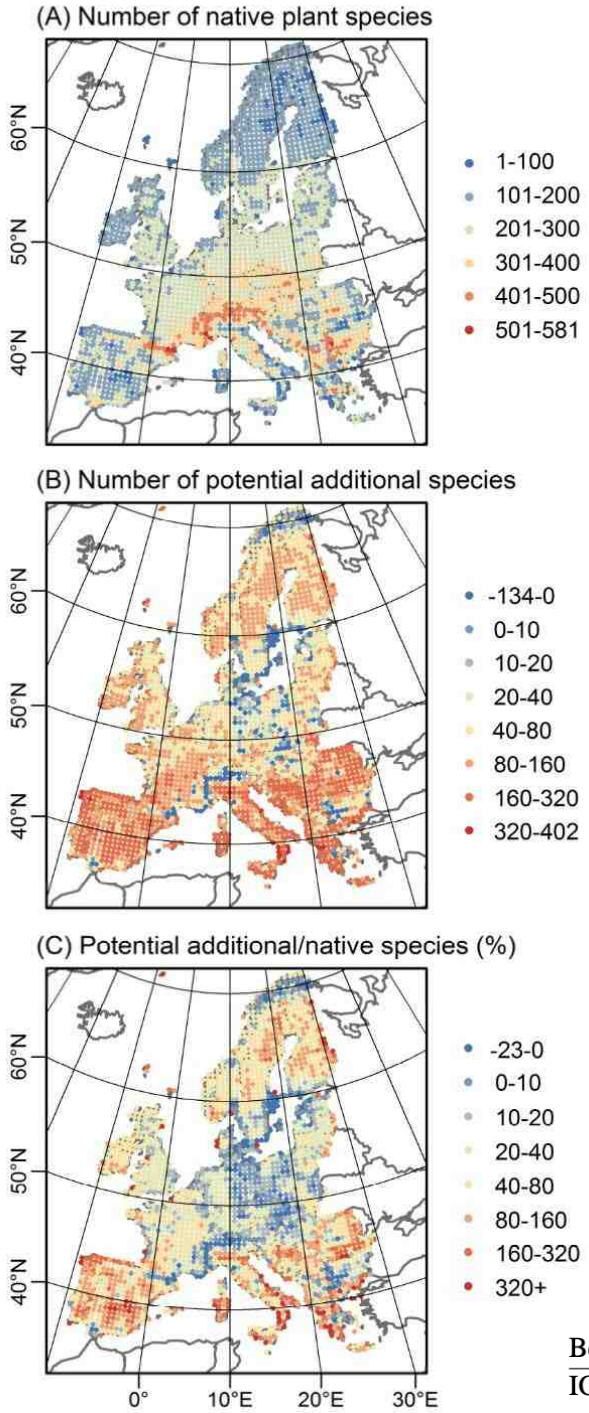
Nationwide revisitation reveals thousands of local extinctions across the ranges of 713 threatened and rare plant species

Conservation Letters. 2020;e12749.

Anne Kempel[1,2] | **Christophe N. Bornand**[3] | **Andreas Gygax**[3] | **Philippe Juillerat**[4] | **Michael Jutzi**[3] | **Lionel Sager**[4] | **Beat Bäumler**[5] | **Stefan Eggenberg**[3] | **Markus Fischer**[1,2,6]







Big moving day for biodiversity? A macroecological assessment of the scope for assisted colonization as a conservation strategy under global warming

Jens-Christian Svenning[1]*

Camilla Fløjgaard[1,2]

Naia Morueta-Holme[1]

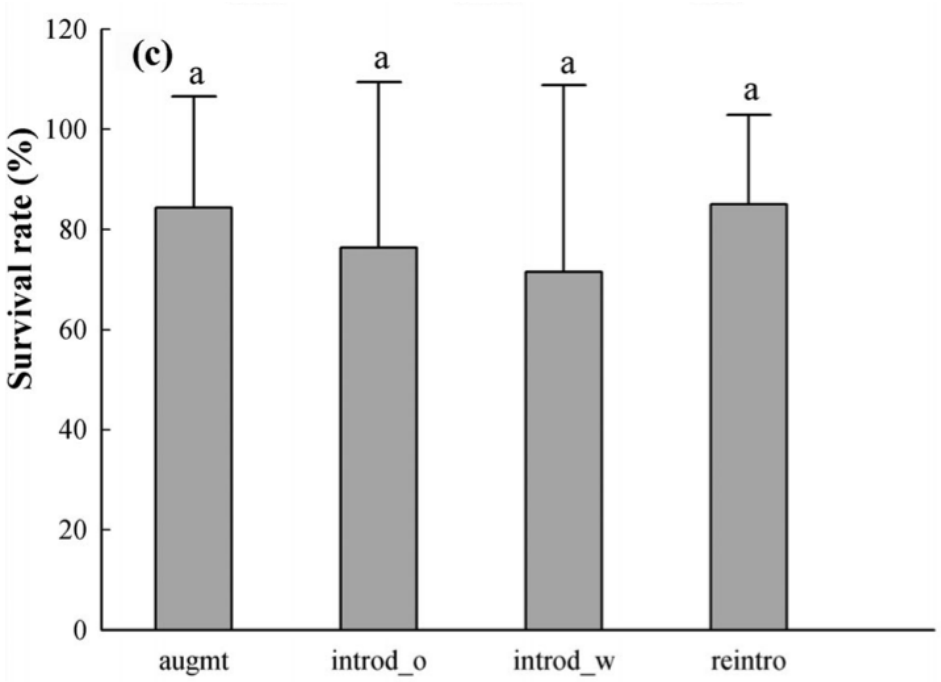
Jonathan Lenoir[1]

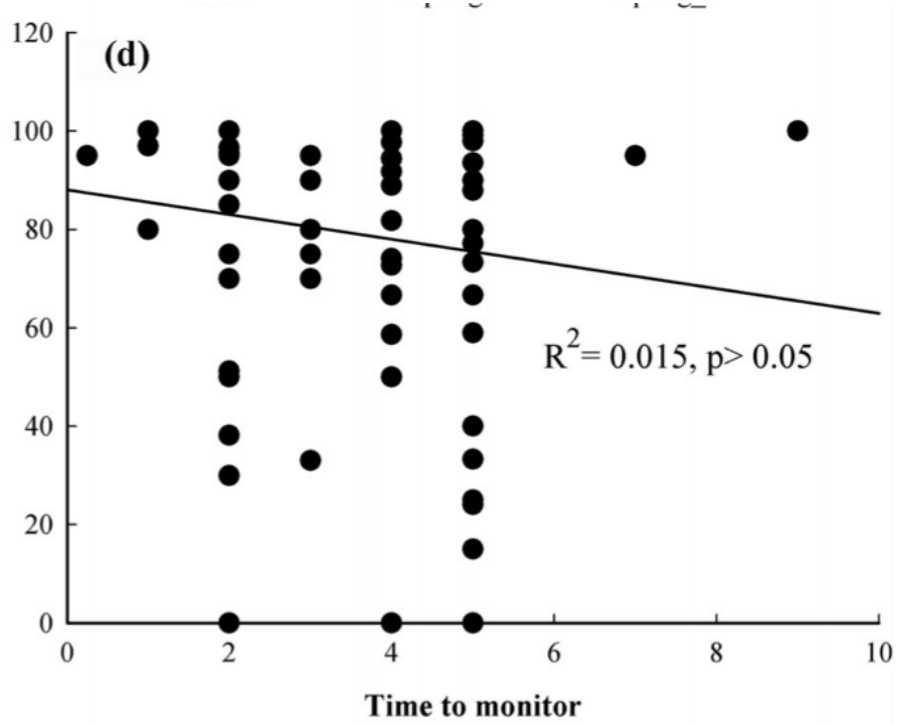
Signe Normand[1]

Flemming Skov[2]

Translocation of threatened plants as a conservation measure in China

Hong Liu,*†‡§ ¶ Hai Ren,** ¶ Qiang Liu,† XiangYing Wen,†† Michael Maunder,‡‡ and JiangYun Gao† **



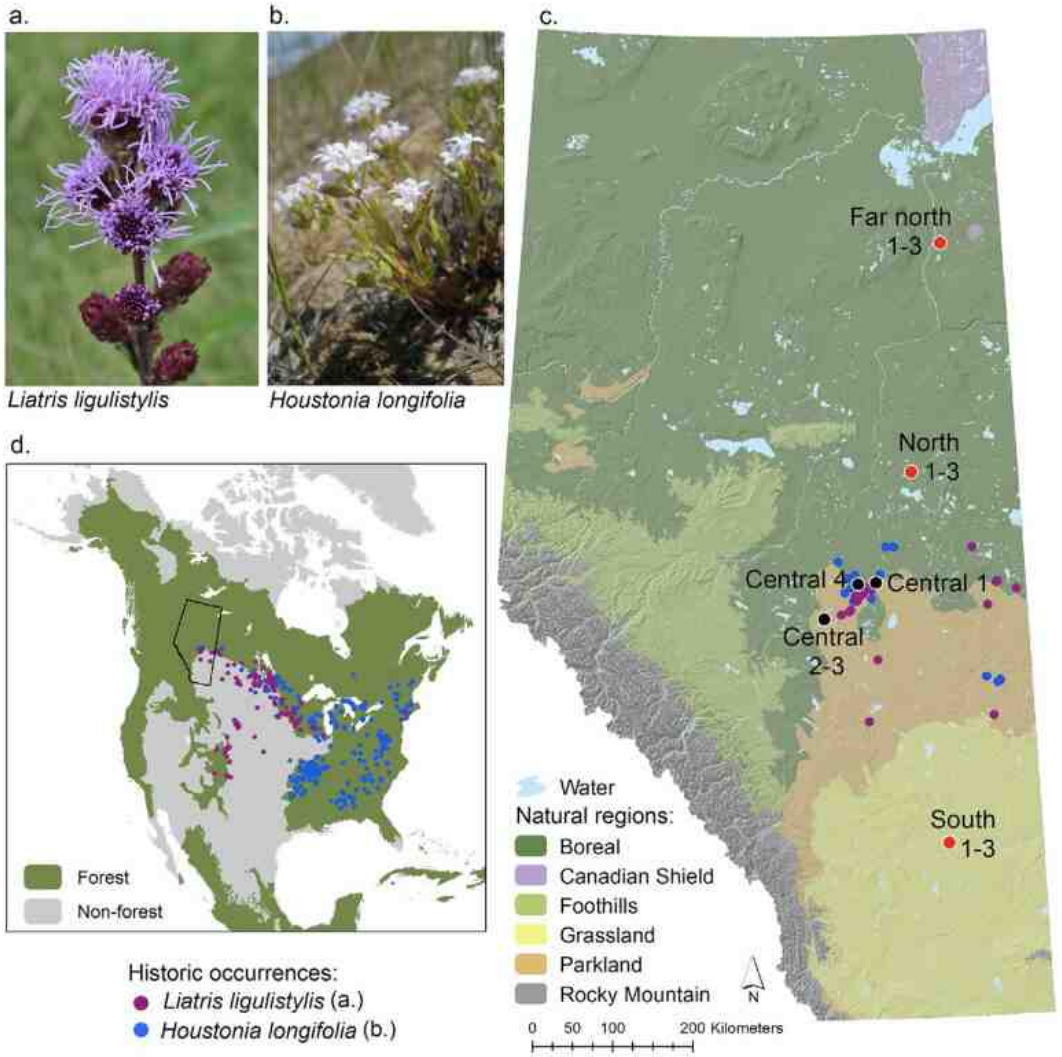


Conservation Biology 2015

154 Arten, 101 davon gefährdet

Experimental test of assisted migration for conservation of locally range-restricted plants in Alberta, Canada

Yuzhuo Wang [a, b, 1], Jennine L.M. Pedersen [c, 1], S. Ellen Macdonald [c], Scott E. Nielsen [c, *], Jian Zhang [a, b, **]



Ansiedlungen sollten gut geplant sein und dazu einige Regeln beachten

Pre-translocation considerations in rare plant reintroductions: implications for designing protocols

Sandrine Godefroid · Sarah Le Pajolec · Fabienne Van Rossum

Plant Ecol (2016) 217:169–182

Ex situ collections and their potential for the restoration of extinct plants

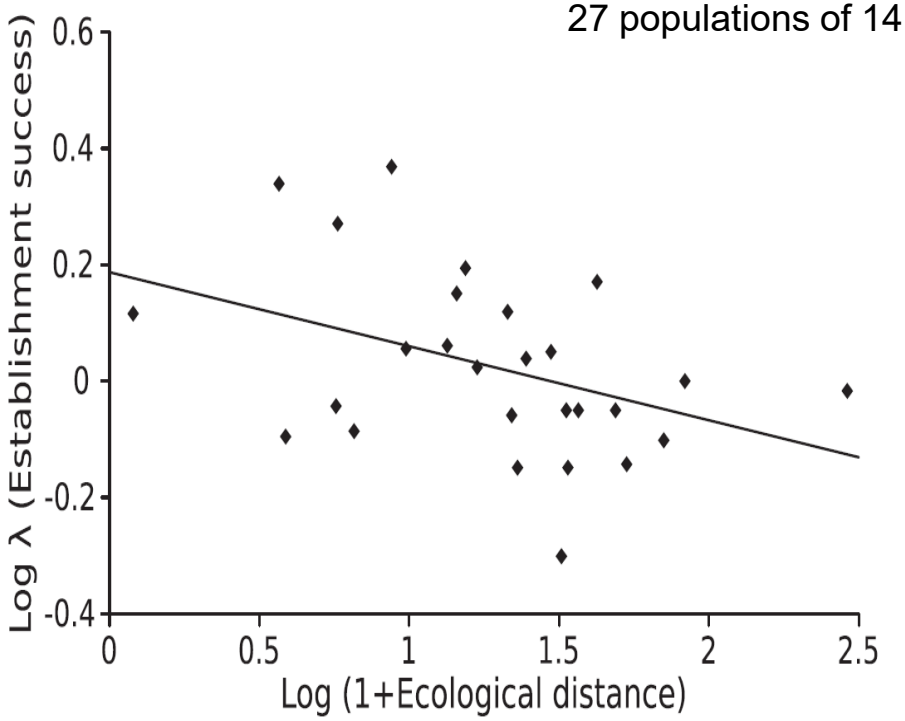
Thomas Abeli,[1]* Sarah Dalrymple,[2] Sandrine Godefroid,[3,4,5] Andrea Mondoni,[6] Jonas V. Müller,[7] Graziano Rossi,[6] and Simone Orsenigo[6]

Conservation Biology, Volume 34, No. 2, 303–313
© 2019 Society for Conservation Biology

Das Habitat muss passen

Natürliche Selektion ist für seltene Arten nur «schädlich», wenn das Habitat nicht passt

27 populations of 14 species



Noël et al.

Biological Conservation 144 (2011) 602–609

Ecological Applications, 29(2), 2019, e01850
© 2019 by the Ecological Society of America

Landscape heterogeneity is key to forecasting outcomes of plant reintroduction

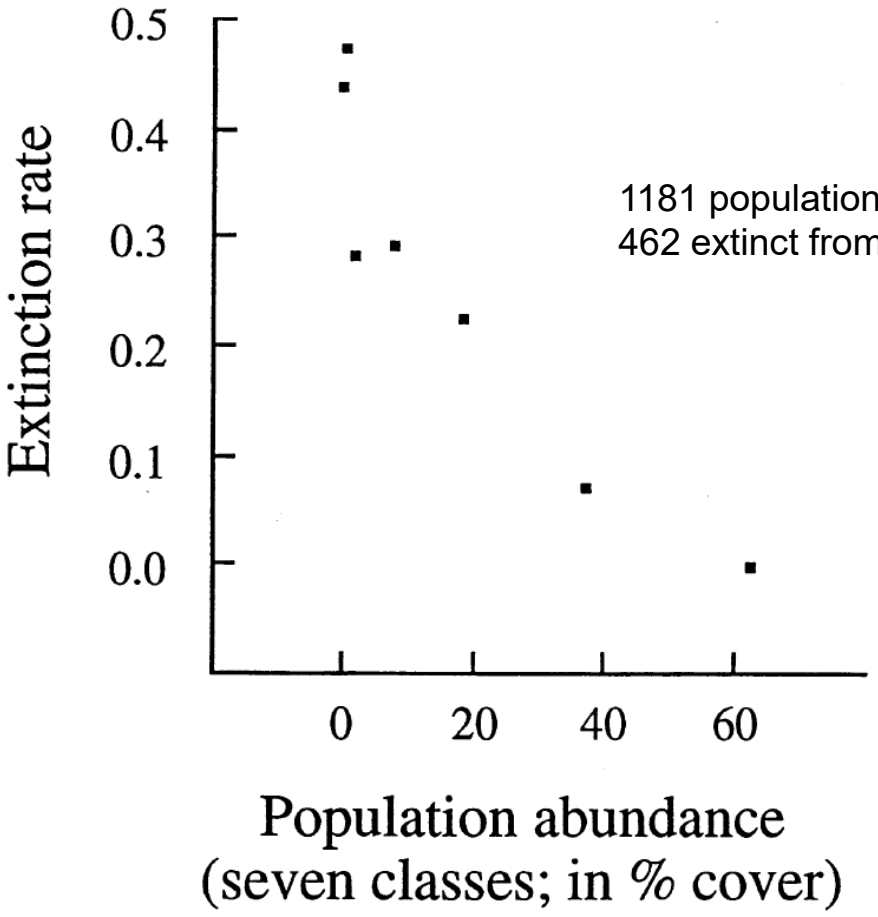
T. Trevor Caughlin [1,6], Ellen I. Damschen,[2] Nick M. Haddad,[3] Douglas J. Levey,[4] Christopher Warneke,[5] and Lars A. Brudvig[5]

Die Population muss gross sein

Extinction risk depends strongly on factors contributing to stochasticity

Brett A. Melbourne[1] & Alan Hastings[2]

Vol 454|3 July 2008 nature



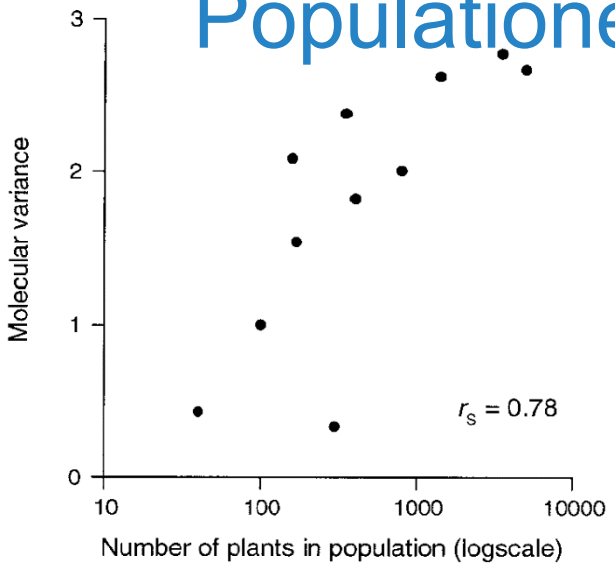
1181 populations of 185 species
462 extinct from 1950-1985

Viele Pflanzen wiederansiedeln!

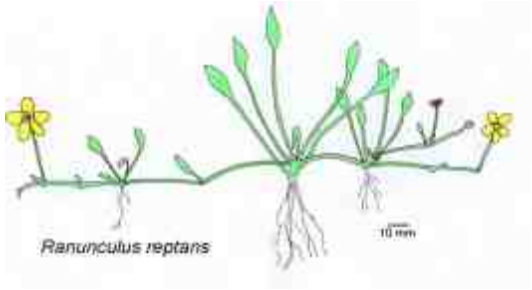
Fischer, Stöcklin, Cons Biol 1997
Stöcklin, Fischer Oecologia 1999

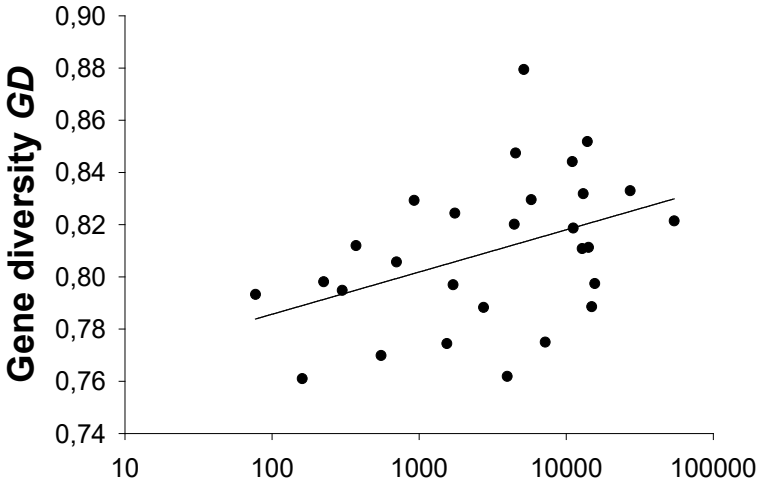
Die Population muss genetisch vielfältig sein

Genetische Drift ist in kleinen isolierten Populationen sehr wichtig

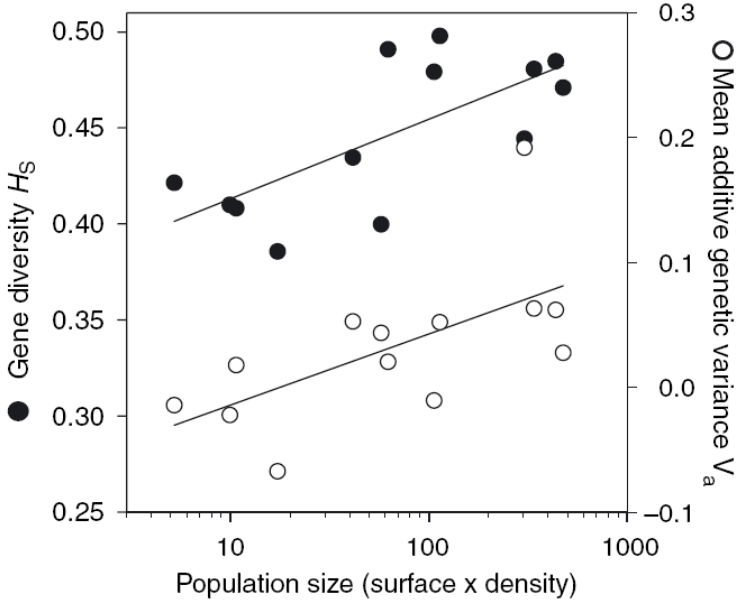


Fischer & Matthies
AJB, 1998





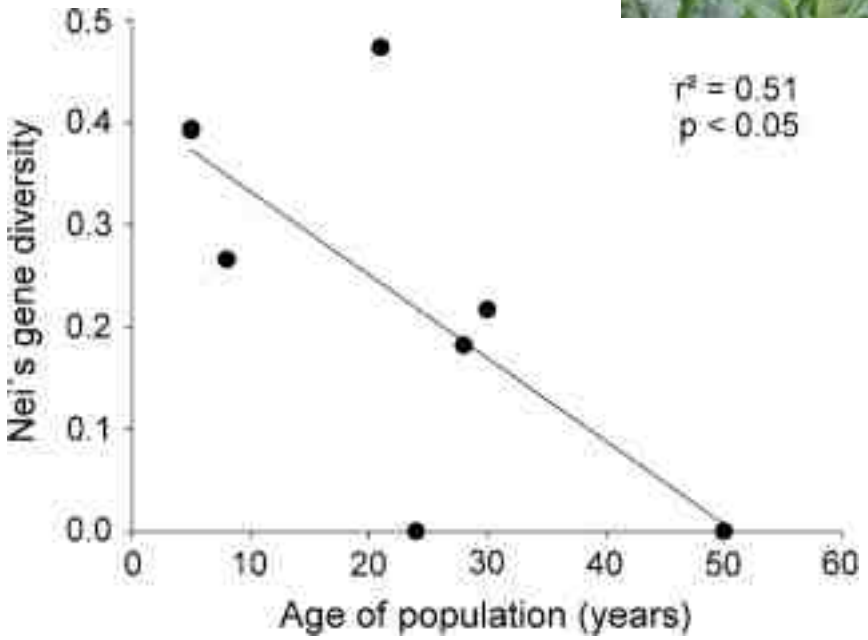
Galeuchet et al.,
Molecular Ecology, 2005



Willi et al., J Evol Biol, 2007

... also auch in ex-situ Populationen

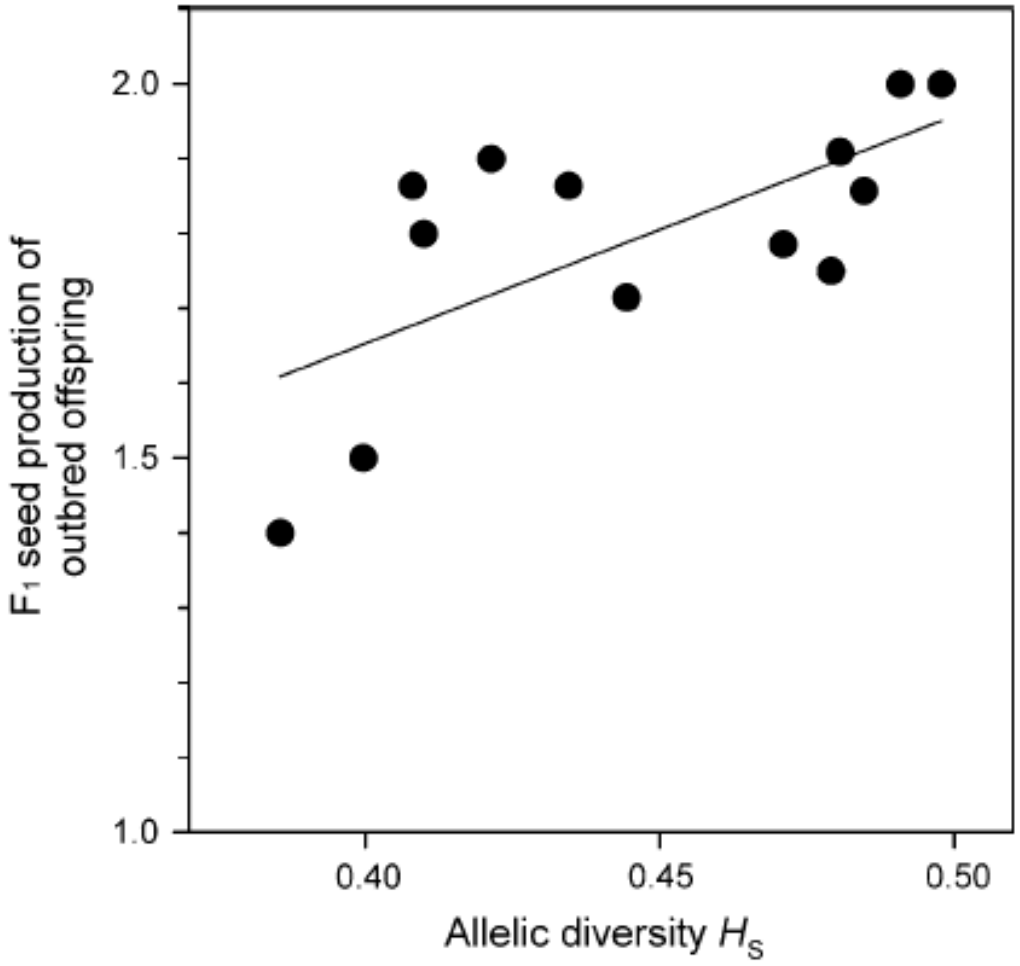
Schlumbergera orssichiana



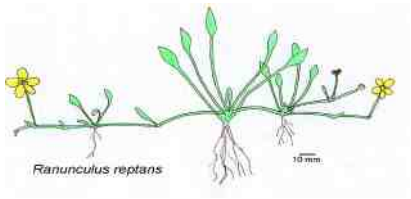
Cynoglossum officinale in botanical gardens

Enßlin et al. Biological Conservation, 2011

In kleinen Populationen werden schädliche Mutationen eher fixiert

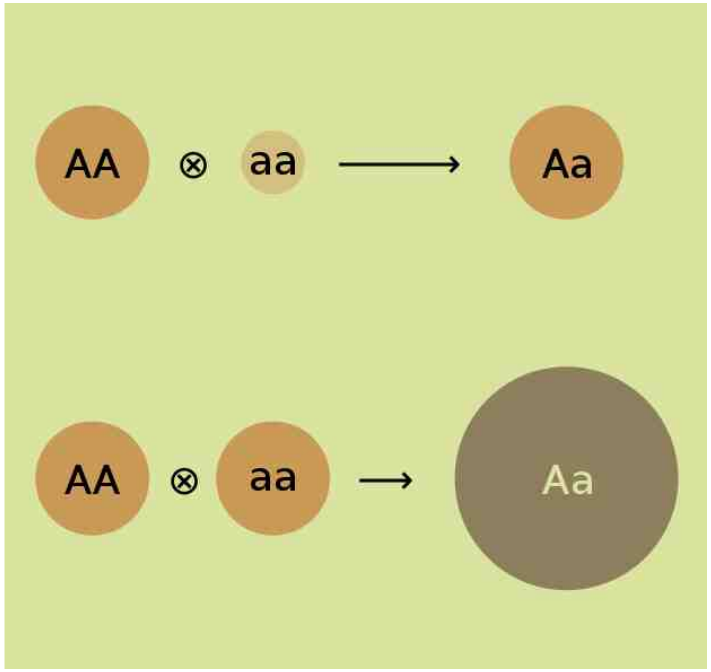


Jeweils Kreuzungen zwischen ähnlich verwandten Pflanzen



Willi, van Buskirk & Fischer, 2005, Genetics

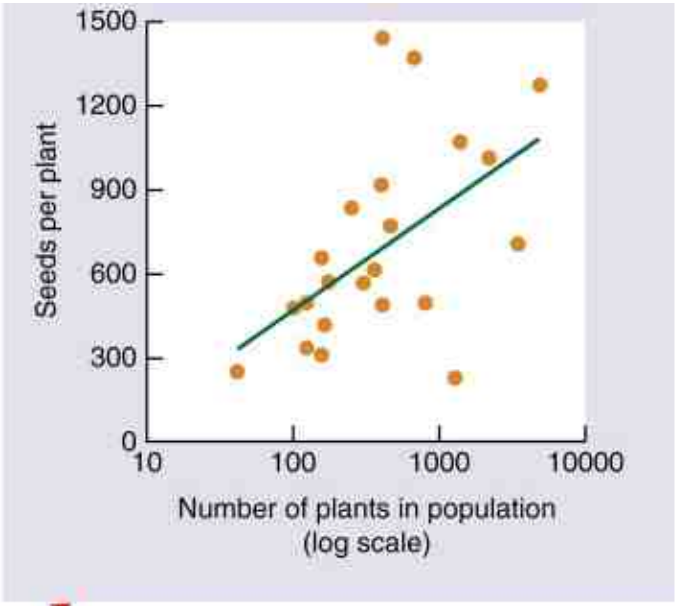
Inzuchtdepression: Dominanz oder Überdominanz



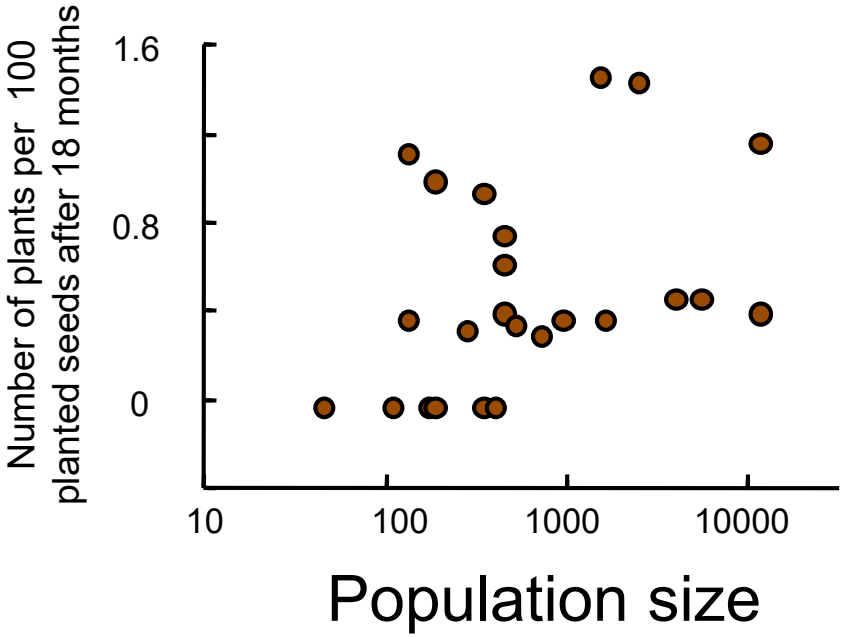
Die Dominanzhypothese gilt als Haupterklärung für Inzuchtdepression.

Crow 1998 Genetics

Fitness im Feld und ex-situ

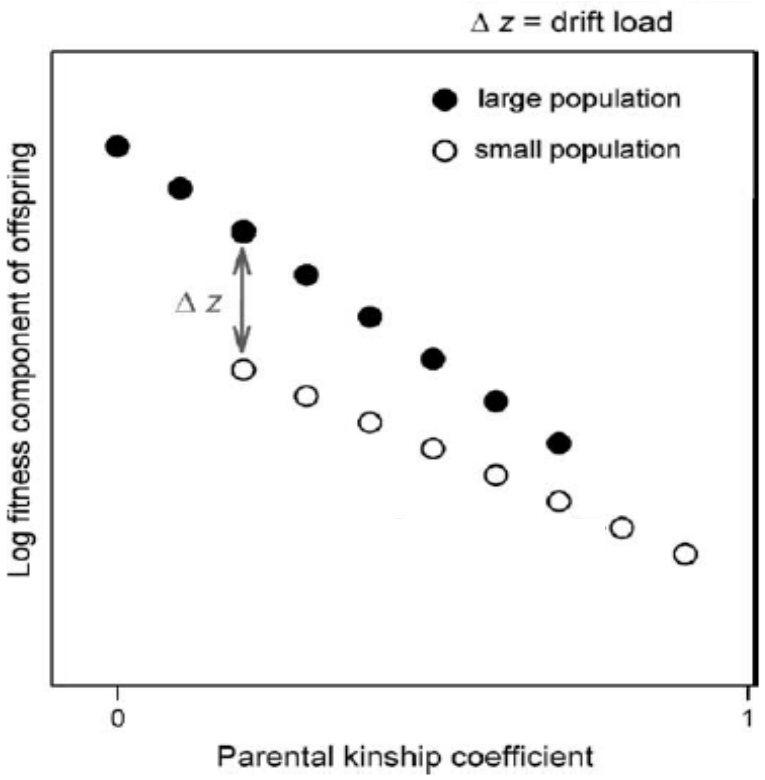


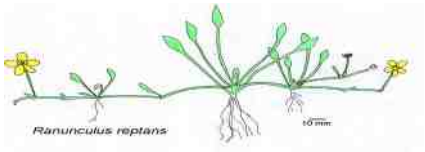
Townsend, Harper, Begon
Essentials of Ecology
Blackwell Science



Gentianella germanica: Fischer, Matthies, J Ecol, 1998

Inzuchtlast

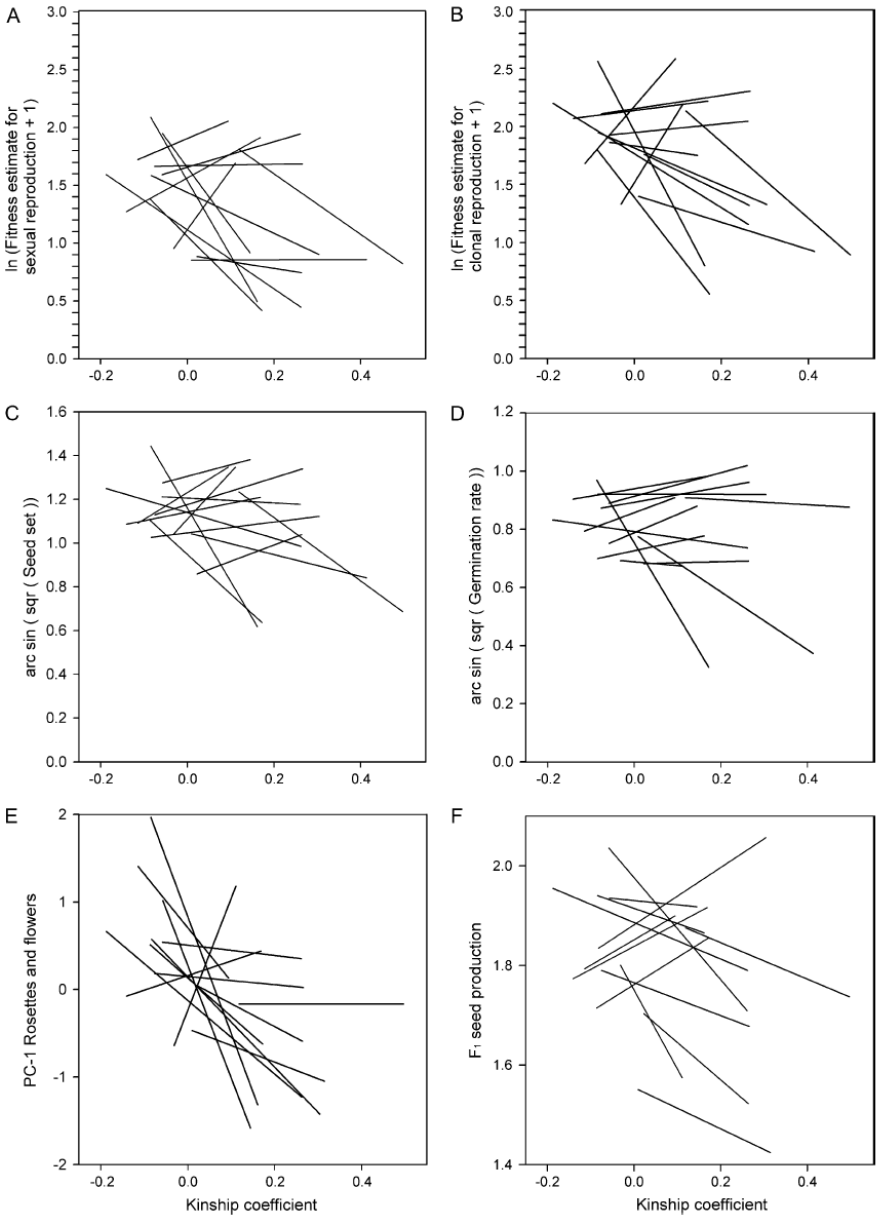




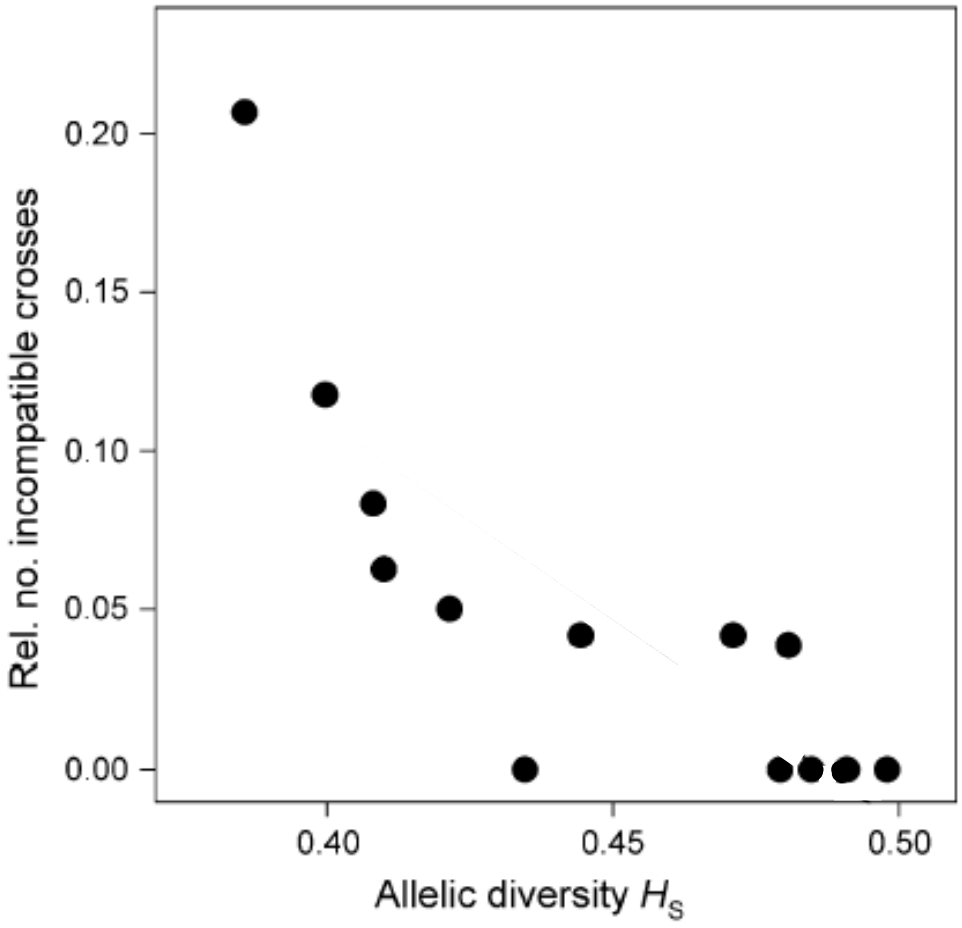
Inzuchtlast wird aus kleinen Populationen nicht ausgemerzt.

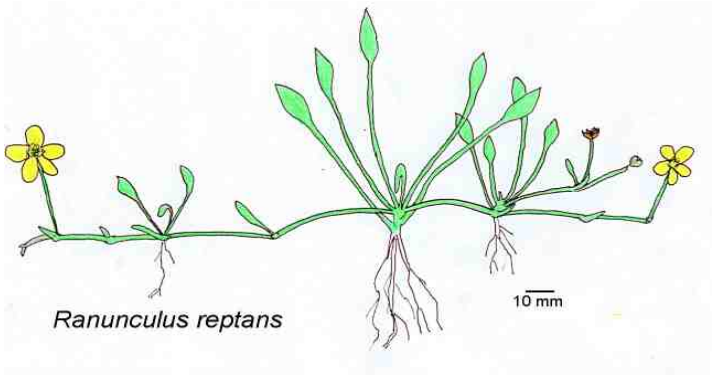
Willi et al. 2005, Genetics

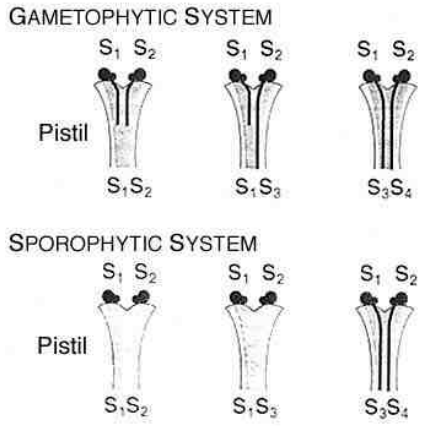
Similar in *Swertia perennis*
Lienert & Fischer, 2004, Basic and Applied Ecology



Drift führt zu geringerer Kreuzkompatibilität in kleineren Populationen





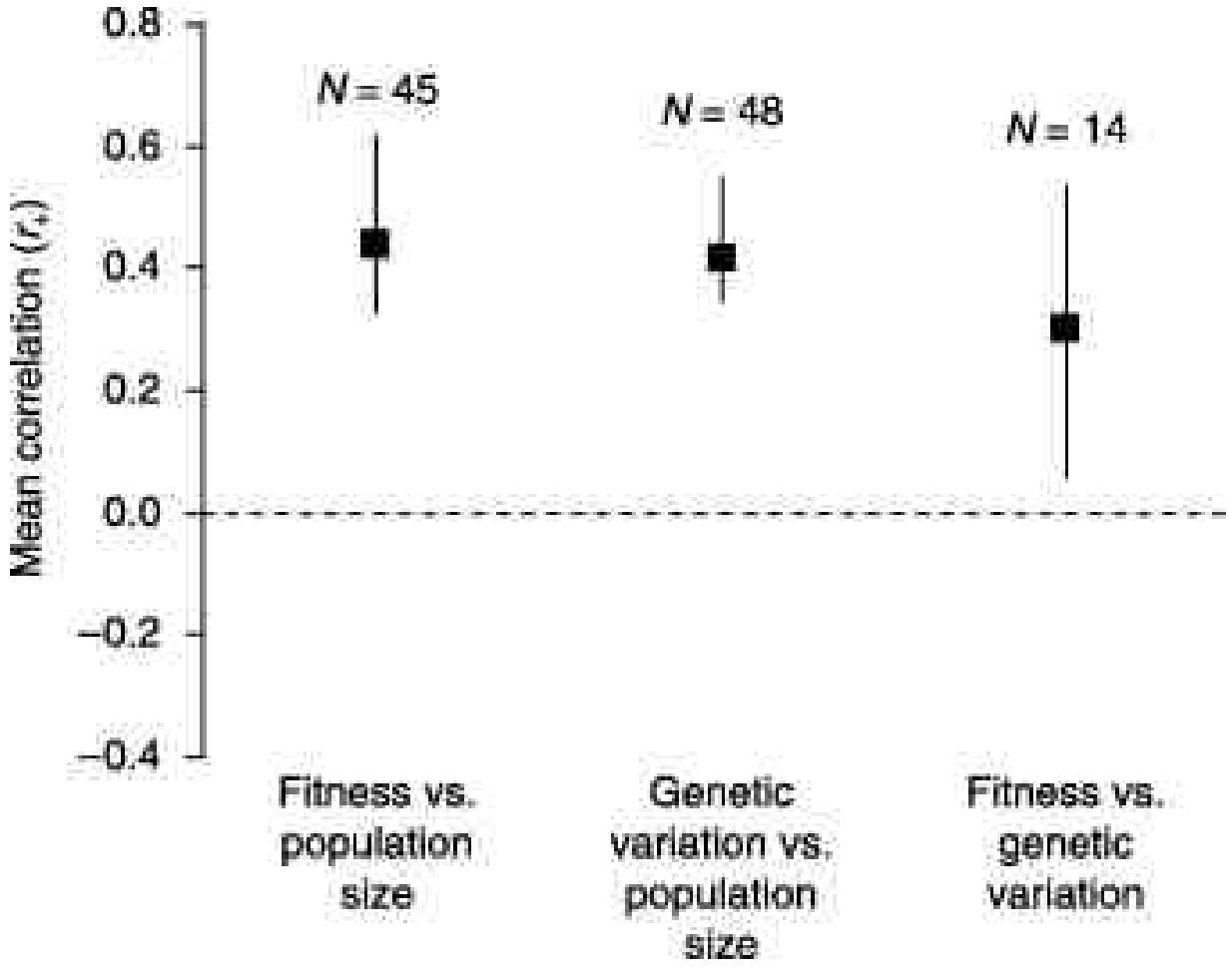


Ähnlich in *Cochlearia bavarica* mit sporophytischem SI System

Willi et al., 2005, Genetics

Fischer et al., 2003, Conservation Genetics

Populationsgrösse, genetische Variation und Fitness

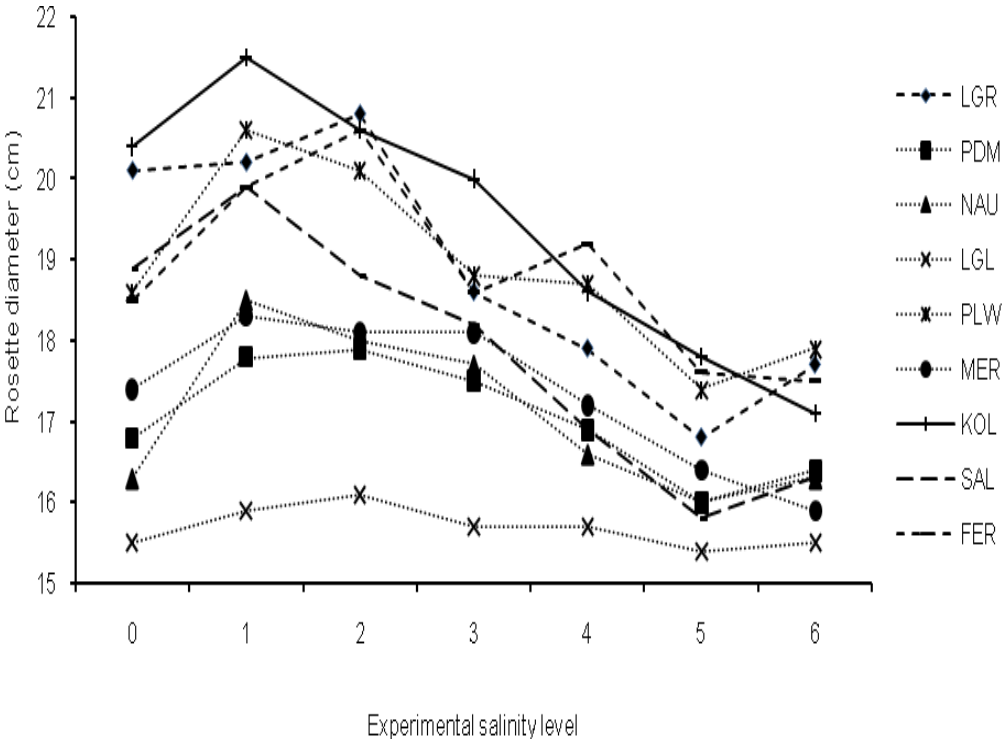


Leimu et al. J Ecol 2006

Genetisch diverses Material ansiedeln!

Lokale Anpassung und Auszuchtdepression stellen kein Problem dar, so dass Herkünfte gemischt werden können

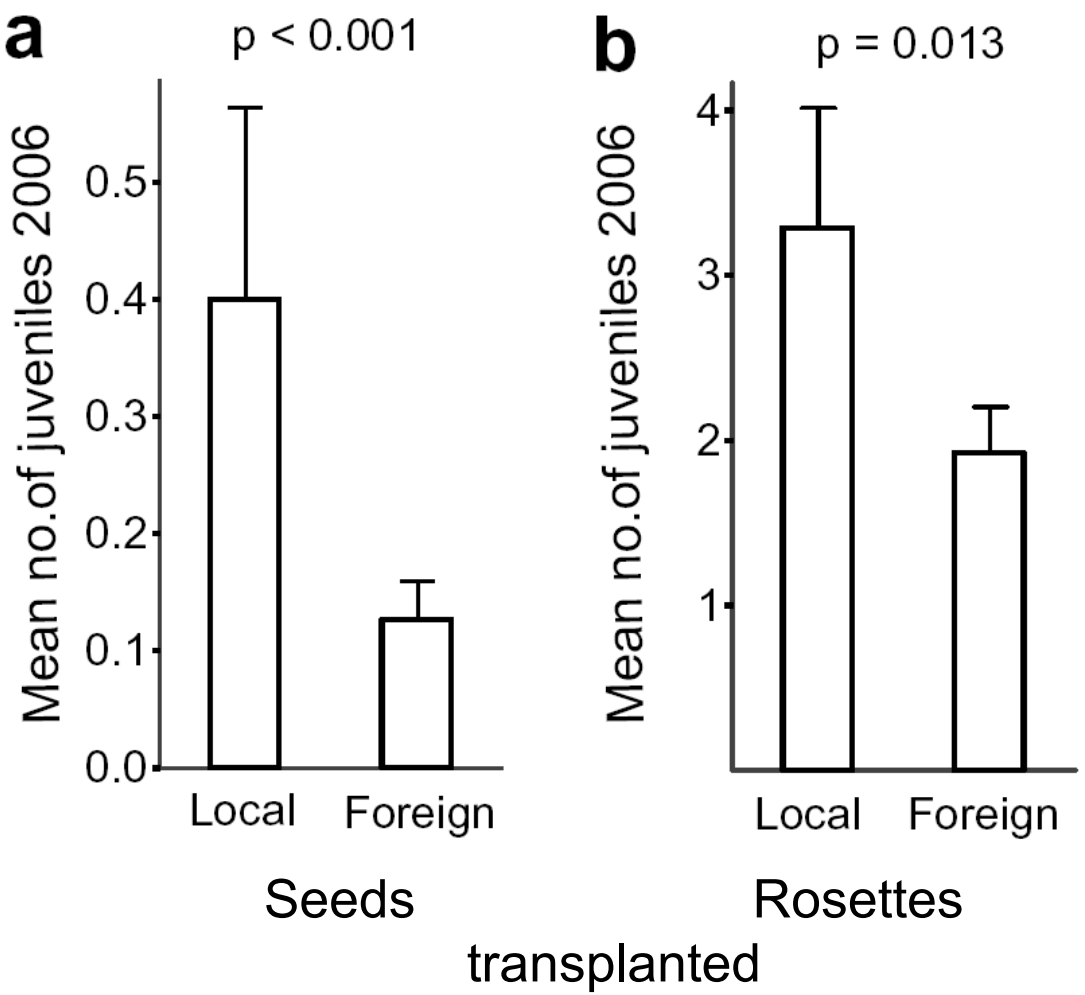
Sind seltene Arten lokal angepasst?



Samolus valerandi L

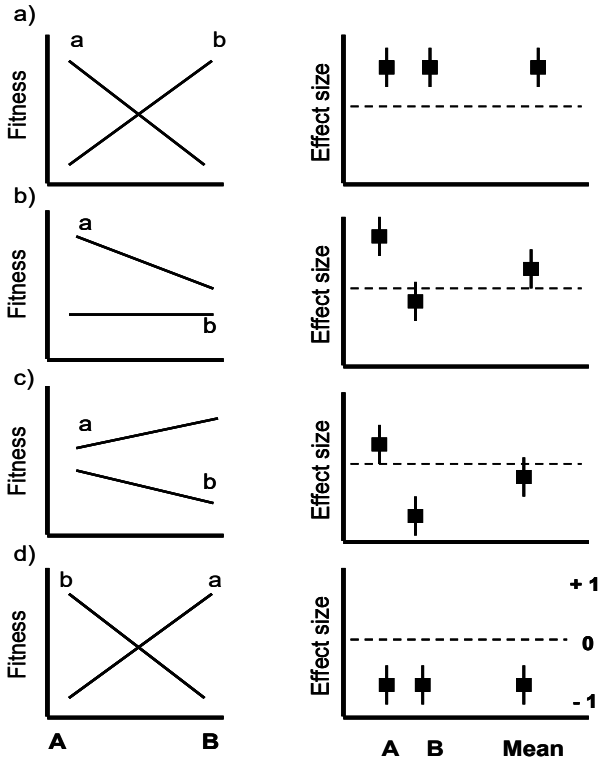
Chrobock 2006, MSc thesis, U Potsdam

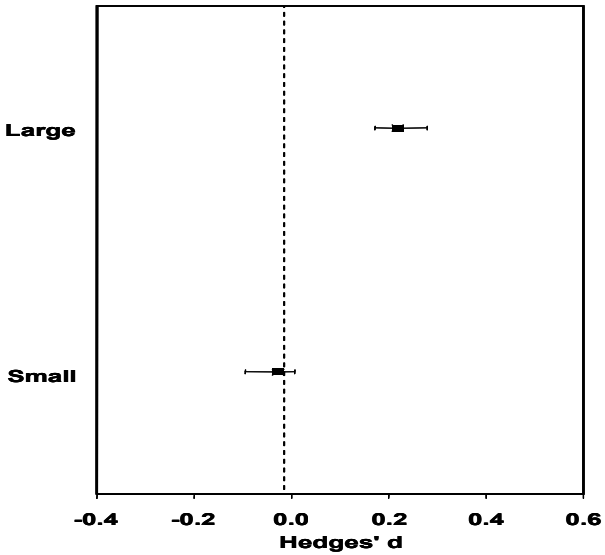
Lokale Anpassung in *Aster amellus*

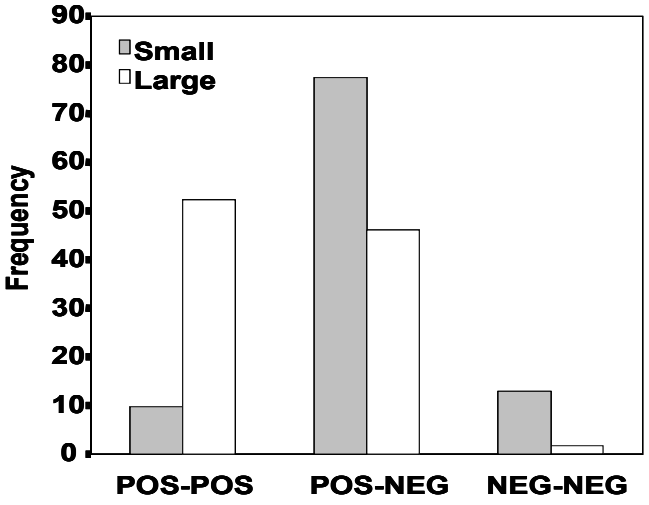


Raabova, Munzbergova, Fischer 2007 Biol Cons

Sind alle Populationen lokal angepasst?





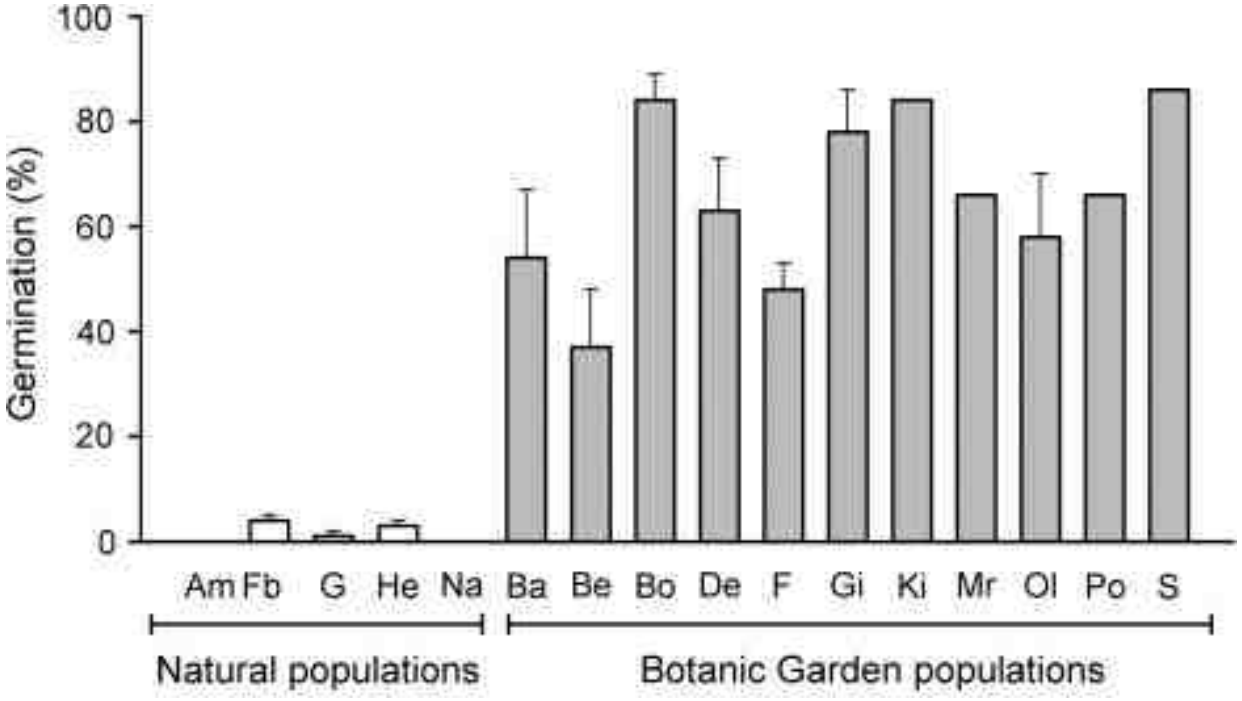


32 species, 1032 local-foreign comparisons

Kleine Populationen < 1000 sind nicht lokal angepasst

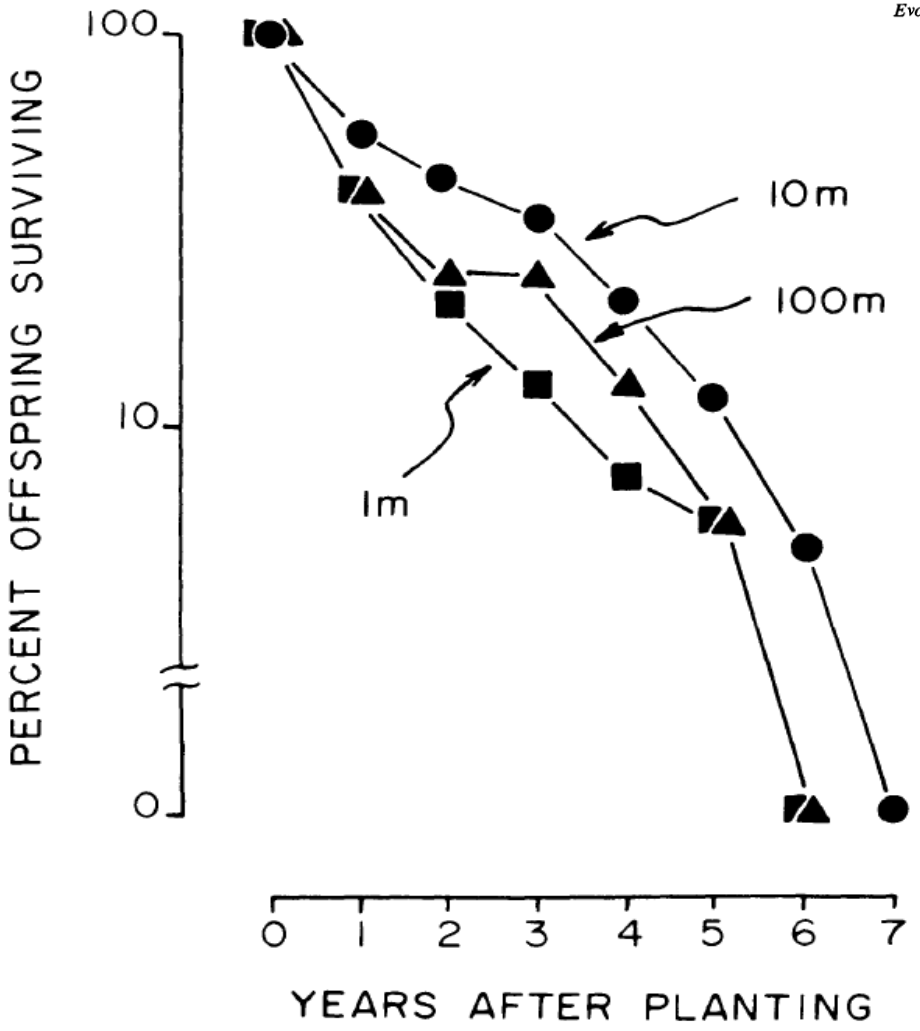
Leimu, Fischer, PLoS One 2008

(Fehl)-Anpassung ex-situ



Enßlin et al. Biological Conservation, 2011

Auszuchtdepression existiert,...



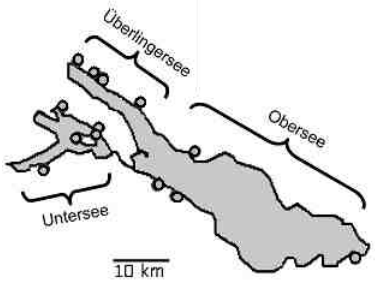
Evolution, 43(5), 1989, pp. 1097–1109

OPTIMAL OUTCROSSING IN *IPOMOPSIS AGGREGATA*: SEED SET AND OFFSPRING FITNESS

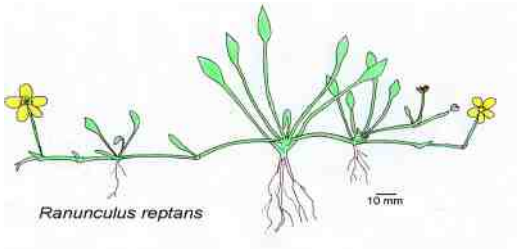
NICKOLAS M. WASER AND MARY V. PRICE

Photo: Teresa Prendusi

...ist das ein Problem?

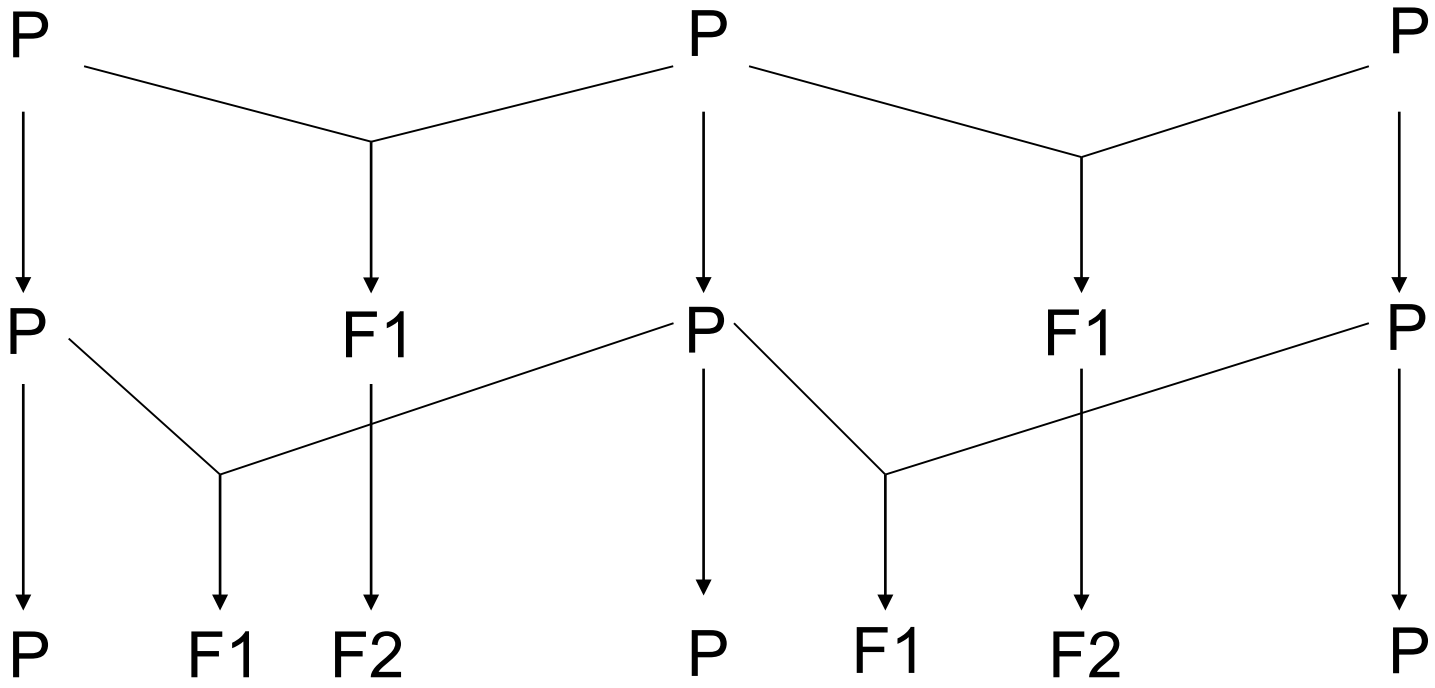


„Genetische Rettung“

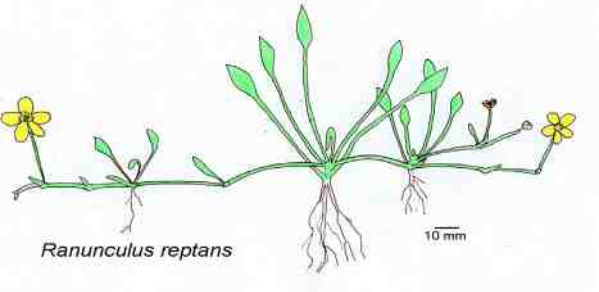


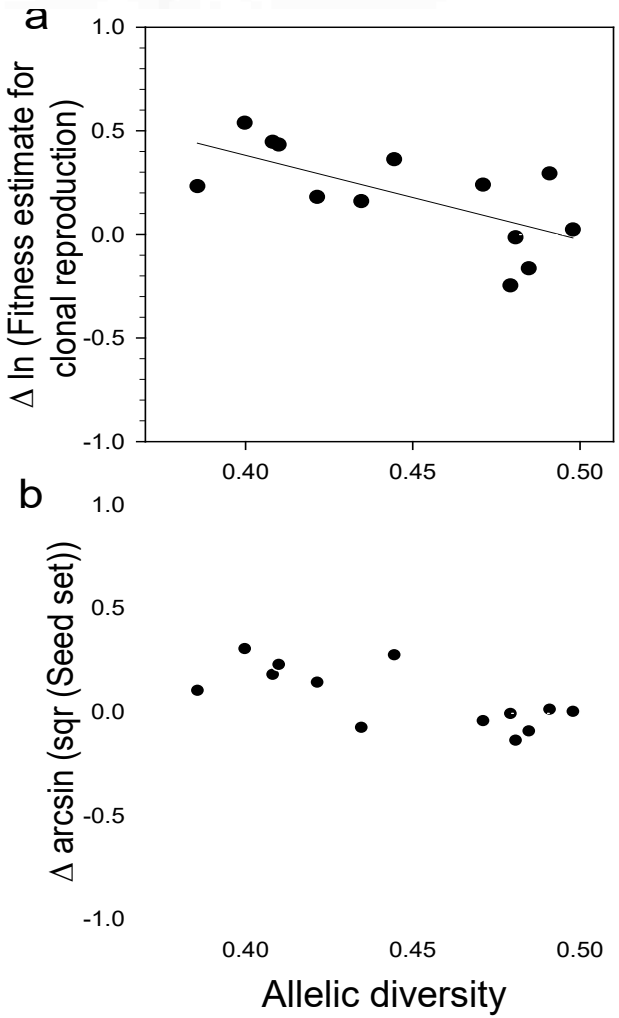
13 x

Near population | Target population | Far population



Genetische Rettung funktioniert!





Willi, and Fischer, 2005, Heredity
Willi et al. 2007, Proc. R. Soc. B

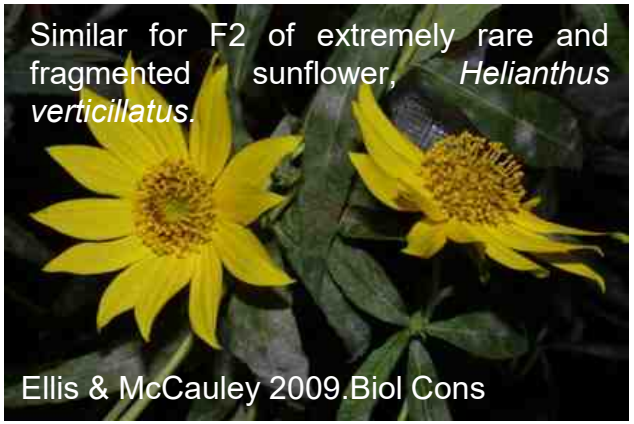
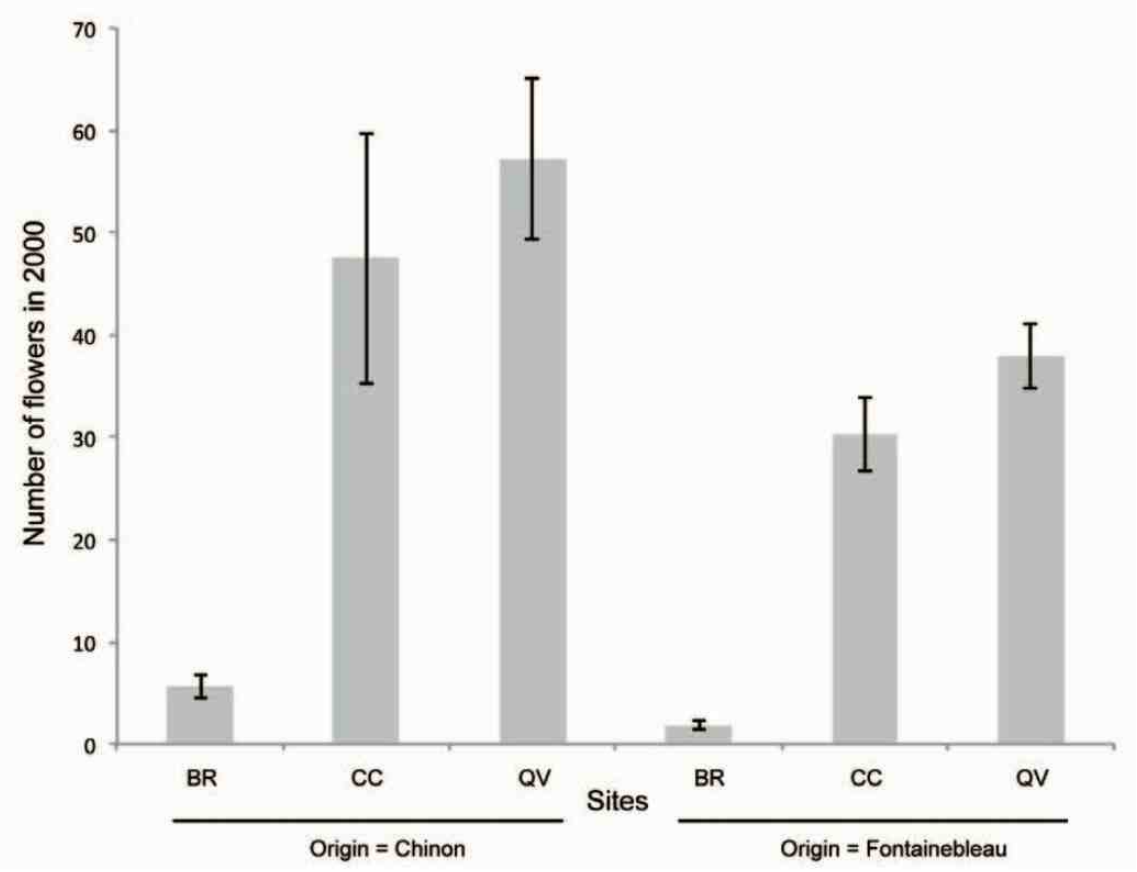


Photo: Stephen J. Baskauf

OPEN ACCESS Freely available online 2013 PLOS ONE

Mixing Plants from Different Origins to Restore a Declining Population: Ecological Outcomes and Local Perceptions 10 Years Later

Anne-Claire Maurice[1,2], Jawad Abdelkrim[1], Matthieu Cisel[1], Monika Zavodna[1¤], Philippe Bardin[3], Alexis Matamoro[1], Richard Dumez[2], Nathalie Machon[1]*

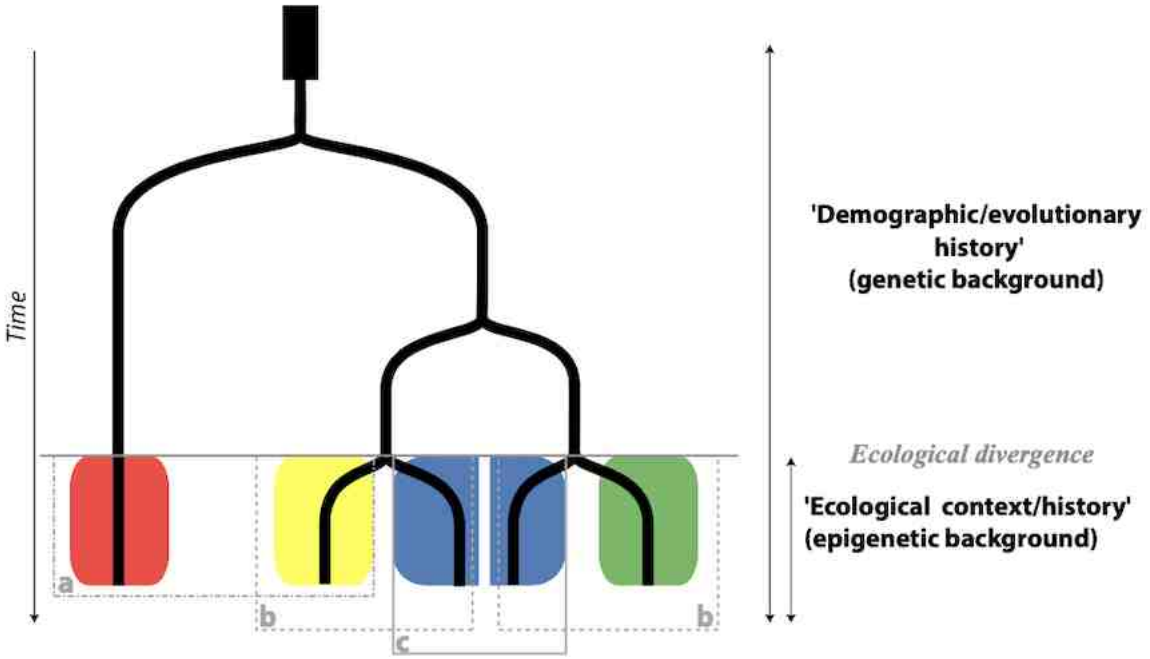


EPIGENETICS IN ECOLOGY
AND EVOLUTION – A PRIMER

2019 Functional Ecology BRITISH ECOLOGICAL SOCIETY

Linking epigenetics and biological conservation: Towards a *conservation epigenetics* perspective

Olivier Rey[1] | Christophe Eizaguirre[2] | Bernard Angers[3] | Miguel Baltazar-Soares[4] | Kostas Sagonas[2] | Jérôme G. Prunier[5] | Simon Blanchet[5,6]



Populationsbiologische Schlüsse

Wiederansiedlung ist experimentelle Populationsbiologie.

Habitatqualität muss stimmen.

Viele Pflanzen müssen angesiedelt werden, so dass sich grosse Population mit gesunder Alterstruktur bilden kann.

Wiederansiedlung, Verstärkung und assisted migration sind alle wichtig.

Hybridisierung, Verbreitung von Pathogenen und neue Invasionen müssen vermieden werden.

Viele Populationen ansiedeln, denn Erfolg bleibt Frage der Wahrscheinlichkeit, nach Jahren meist <50%.

Populationsgenetische Schlüsse

Wiederansiedlung ist auch experimentelle Populationsgenetik.

Drift und Inzucht sind grosse Probleme und erfordern viele «Quellenpflanzen» (Material von 180 Pflanzen (6-15 Populationen x 12-30 Pflanzen), wenn möglich) und grosse Auspflanzungen.

Lokale Anpassung und Auszuchtdepression sind vernachlässigbar (wenn Quellenhabitat dem Ansiedlungshabitat ähnlich genug ist).

Verschiedene Provenienzen kann man mischen, es sei denn, sie kommen von ökologisch sehr verschiedenen Habitaten.

Pflanzenmaterial so natürlich wie möglich behandeln.

Fazit

Wiederansiedlung, Verstärkung und Neuansiedlung (inkl. assisted migration) sind essentiell und machbar.

Es gilt, einige einfache Faustregeln einhalten.