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Agroscope

Conserving the diversity of forage genetic resources in managed grassland in Switzerland – results and implementation”

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ECPGR-Meeting Alnarp, 10 November 2015



Contents

- Use of ecotypes in Swiss forage breeding programs
- Available data in national database – *ex situ* and *in situ*
- *Festuca pratensis*: Relationship between *ex situ* characterization data and *in situ* parameters
- Implementation of the *in situ* conservation concept for forages in Switzerland



Use of ecotypes in Agroscope breeding programs

Species	No. of Agroscope varieties on Swiss list	% breeding effort	% ecotype use in breeding	Non-ecotype origin of breeding pool
Grasses	52			
<i>Lolium multiflorum italicum/westerw.</i>	11	15	95	
<i>Lolium perenne</i>	13	15	90	
<i>Festuca pratensis</i>	6	10	80	
<i>Lolium x hybridum</i>	11	10	(90)	
<i>Poa pratensis</i>	2	10	100	
<i>Dactylis glomerata</i>	3	5	10	Cultivars
<i>Festuca arundinacea</i>	4	5	15	Cultivars
<i>Festuca rubra</i>	0	5	90	
<i>Alopecurus pratensis</i>	1	0	100	
<i>Cynosurus cristatus</i>	1	0	100	
Legumes	20			
<i>Trifolium pratense</i>	14	15	20	Landraces
<i>Trifolium repens</i>	4	5	85	
<i>Lotus corniculatus</i>	0	2.5	70	
<i>Onobrychis viciifolia</i>	2	2.5	0	Landraces



From ecotypes to elite cultivars



Ecotypes from diverse natural grassland

Benefit from the richness of forage genetic resources



15 to 20 years of selection and testing

Elite cultivars for grassland farmers





Using ecotypes in breeding process

Year
-1
0
1-4
or
longer
5-7
8-11
13-16
17-20

Collection



ecotypes

ecotypes x breeding pool

Starting material



Population improvement

Variety synthesis I: Polycross



Variety synthesis II: rows of hs families

Performance trials



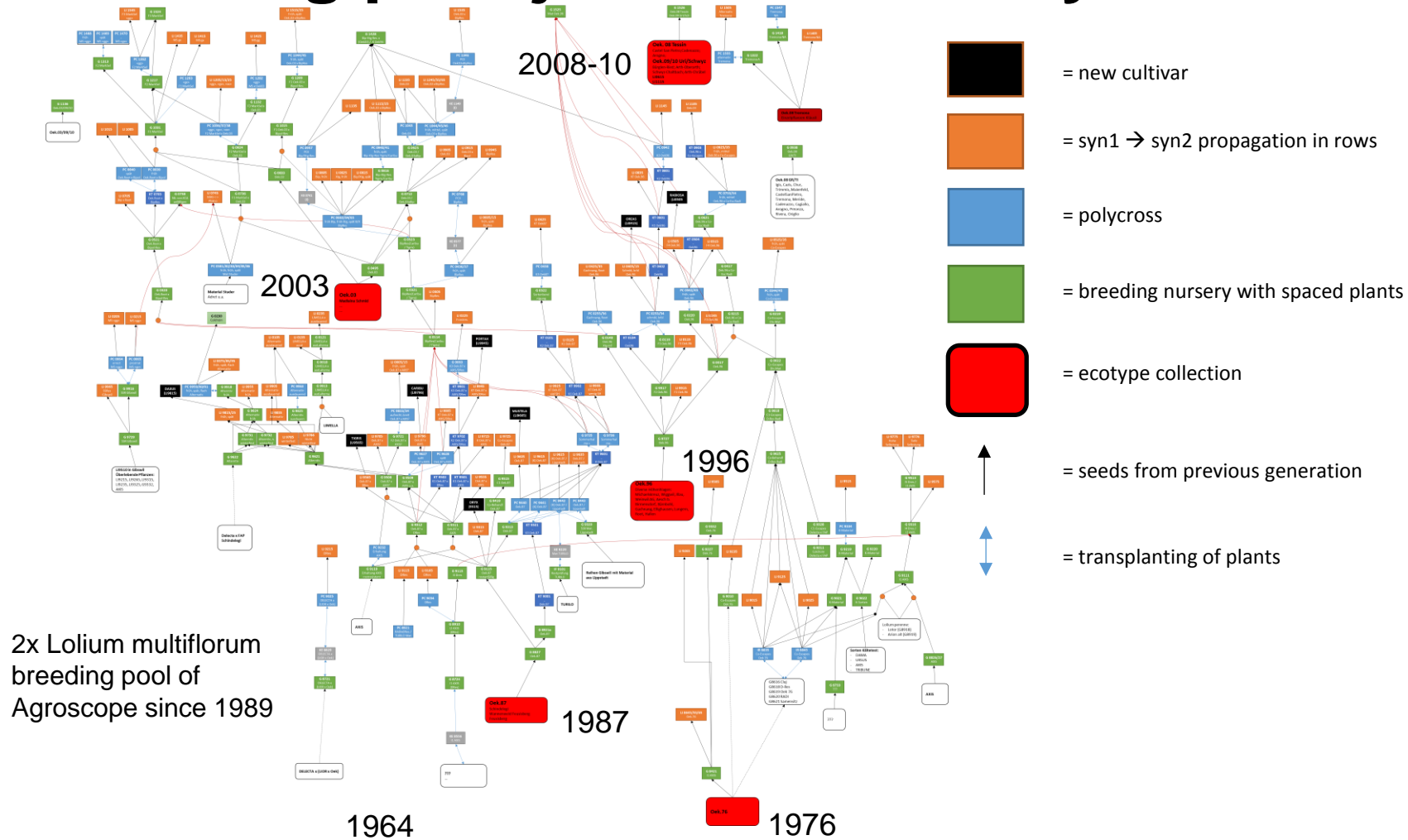
Official testing (DUS/VCU)

Seed propagation / Marketing

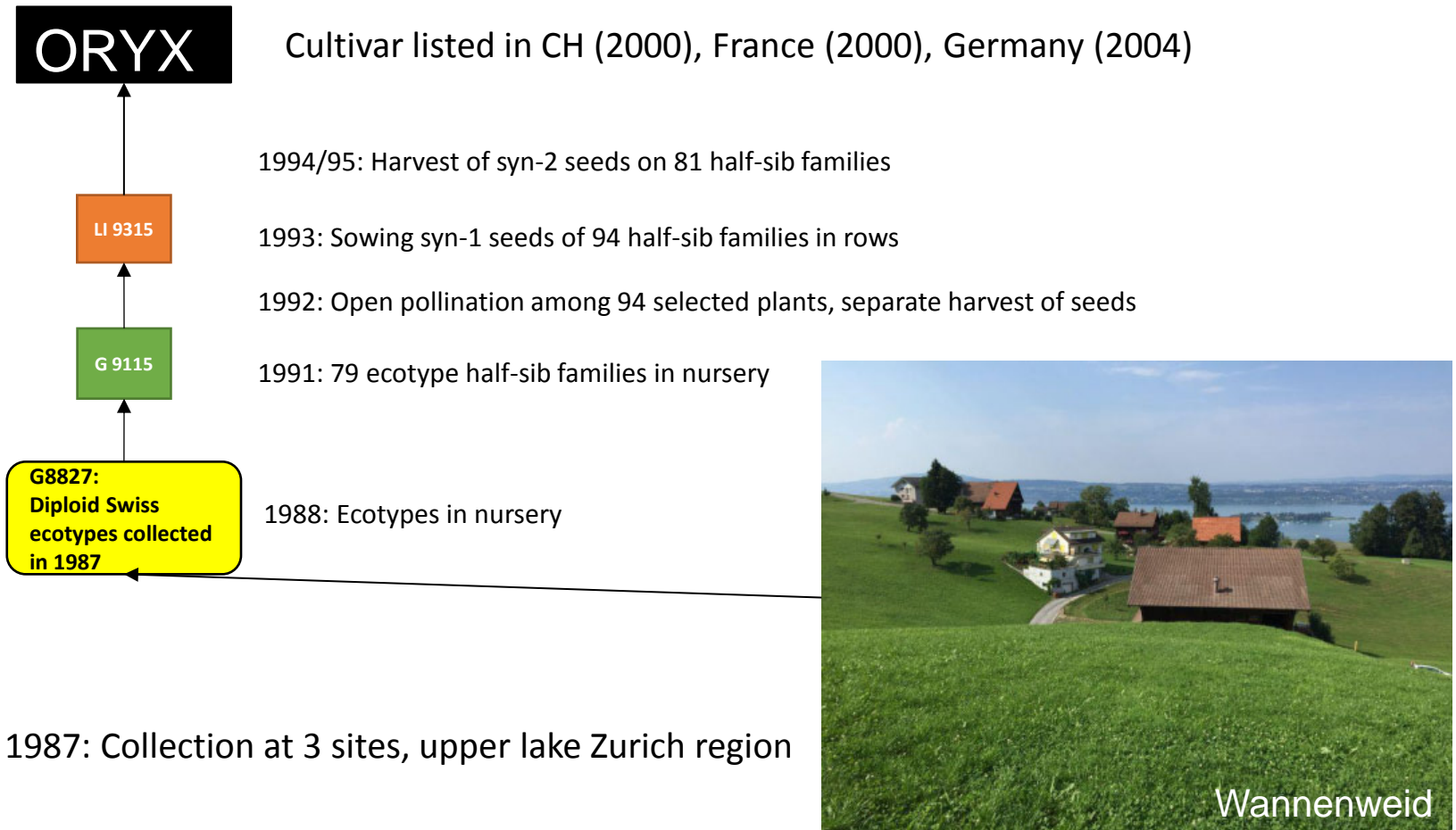




New ecotype collections enter the breeding pool just occasionally



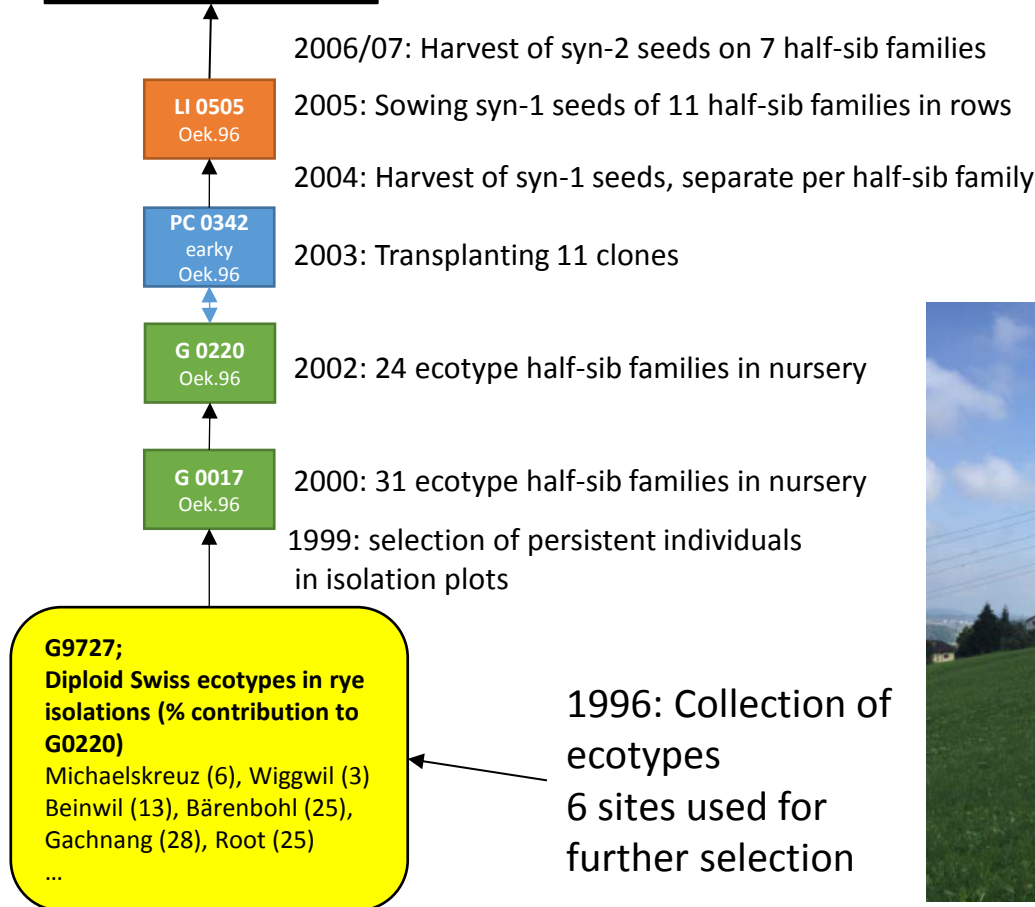
Italian ryegrass: direct development of cultivars from ecotypes promising (1)



Italian ryegrass: direct development of cultivars from ecotypes promising (2)

RABIOSA

Cultivar listed in CH (2015)





Characterisation and evaluation of Swiss ecotype accessions

- Targeted conservation efforts since 2003 in connection with «NAP» National Plan of Action PGFRA
- Collection, seed increase, characterisation (40 to 60 spaced plants per accession), evaluation (plot trials, 2 to 3 locations with 3 replications each, plots 1.5 x 6 m)
- *ex situ* characterisation and evaluation to complete by 2018:
 - 66 acc. *Festuca pratensis* (meadow fescue)
 - 52 acc. *Lolium multiflorum* (Italian ryegrass)
 - 31 acc. *Festuca rubra*
 - 10 acc. each of *Lolium perenne*, *Dactylis glomerata* and *Festuca arundinacea*
- Data included in www.bdn.ch with link to *in situ* data



Meadow fescue (*Festuca pratensis*)



Drawing by Carl Schröter in Stebler (1913)



Drawing by Manuel Jorquera in Dietl (2003)



Ex situ data in National Database (www.BDN.ch)

Conservation of plant genetic resources
Swiss National Database

Home | Data | Actors | Modules | Search | Log in

Search

Search criteria

Text to search

Object type

- All objects
- Accessions
- Varieties
- Lists

Category

forage plants
forage grasses
meadow fescue

Attachments

Contains photos/images: -----
Contains files: -----

Searching for accessions of a species....



Ex situ data in National Database (www.BDN.ch)

- ▶ **plant: growth habit at inflorescence emergence** (UPEMERGEGROWTH) ⓘ
- ▶ **Plant: natural height at inflorescence emergence** (UPINFLOGROWTH) ⓘ
- ▶ **Inflorescence: number of spikelets** (UPNUMSPIKE) ⓘ
- ▼ **Plant: time of inflorescence emergence** (UPEMERGETIME) ⓘ

very early ▼

UPEMERGETIME descriptor	
Work code	LIUPOV-11
Separate code	-
English name	Plant: time of inflorescence emergence
French name	Plante: époque d'épiaison
German name	Pflanze: Zeitpunkt Ährenschieben
Italian name	-
English help	Number of days after the 1 May
French help	Nombre de jours à partir du 1er mai
German help	Anzahl Tage ab 1. Mai
Italian help	-
Data type	vocab
Vocabulary	1=very early 2=very early to early 3=early 4=early to medium 5=medium 6=medium to late 7=late 8=late to very late 9=very late
Domain	Category (General/160)
Mandatory field	No
Computed automatically	No
Multiple values permitted	Yes

.... with possibility to restrict results depending on C&E data ...



Ex situ data in National Database (www.BDN.ch)



Search results

8 items match your criteria.

- Acquarossa_TI_Motto_Maragno_08 — RHZ110028 — Switzerland — Acquarossa_TI_Motto
- Ehrendingen_AG_Rieden_03 — RHZ080035 — Switzerland — Ehrendingen_AG — Agroscope
- Giornico_TI_Nante_08 — RHZ110008 — Switzerland — Giornico_TI_Nante — Agroscope Reck
- Grindelwald_BE_Milibach-Moos_09 — RHZ110035 — Switzerland — Grindelwald_BE_Milibach
- Hasliberg_BE_Wasserwendi_03 — RHZ080026 — Switzerland — Hasliberg_BE — Agroscope
- Hausen am Albis_ZH_Pfisterboden_03 — RHZ080039 — Switzerland — Hausen am Albis_Z
- Regensdorf_ZH_Holenbach_03 — RHZ080029 — Switzerland — Regensdorf_ZH — Agrosco
- Weiningen_ZH_Folenmoos_03 — RHZ080032 — Switzerland — Weiningen_ZH — Agroscope

Compare

[Export search results \(More export details...\)](#)

.... delivers list of accessions with chosen restrictions



Ex situ data in National Database (www.BDN.ch)

Regensdorf_ZH_Holenbach_03

Unique id: Festuca-pratensis--0-CHE002-64607-0-0

Variety: Regensdorf_ZH_Holenbach (2-002-37)

Category: forage plants → forage grasses → meadow fescue

Accession

General

National Inventory code:
(NICODE)

Switzerland

Referenzakzession:
(EVALCHECKACC)

- Preval_02_58
- Merifest_02_58
- Cosmolit_02_58
- Pradel_02_58

Institute code:
(INSTCODE)

Agroscope Reckenholz

Accession number:
(ACCENUMB)

RHZ080029

Collecting number:



Each accession with available passport data including a map and indication of reference cultivar for C&E data



Ex situ data in National Database (www.BDN.ch)

Regensdorf
Holenbach

cv.
PREVAL

Plant: number of culms: (CULMSNUMBER)	41.27	62.07
Plant: time of inflorescence emergence: (EMERGETIME)	7.09	18.49
Plant: vegetative growth habit (without vernalization): (VEGEGROWTH)	4.74	5.11
Plant: winter hardiness at beginning of vegetation: (WINTHARDNESS)	3.96	4.65
plant: growth habit at inflorescence emergence: (UPEMERGEGROWTH)	intermediate	erect to semi-erect
Plant: time of inflorescence emergence: (UPEMERGETIME)	very early	medium

C&E data are displayed, result of reference cultivar is easily found to make results more meaningful

Connection of *ex situ* with *in situ* data

This accession has been collected in the following 'insitu' parcel:

-  [Regensdorf/Holenbach/O8212/03](#)  — (26) — Agroscope Reckenholz



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Federal Office for Agriculture (FOAG)
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If *in situ* data of the site of origin of an accession are available, these can be accessed by a direct link



In situ data in national database (www.bdn.ch)

Description

Content

Regensdorf/Holenbach/O8212/03

Remarks about habitat: (HABITATREMARK)	sehr viel Ranunculus und andere Kräuter,
Homogeneity of the target habitat: (HABITATHOMOGENEITY)	very homogeneous
Coverage by gramineae: (GRAMCOVER)	60.0
Coverage by leguminosae: (LEGCOVER)	10.0
Total coverage: (TOTALCOVER)	85.0
Grassland habitat: (GRAHABIT)	conservation only
Classification of the alliance: (ALLIANCECLASSIFICATION)	Arrhenatherion W. Koch 26

Parcel situation

Municipality: (MUNICIPALITY)	Regensdorf
Locality: (FIELDNAME)	Holenbach
Elevation of collecting site: (ELEVATION)	448
Aspect: (ASPECT)	Northwest
Slope: (SLOPE)	5 4
Biogeographic region: (BIOGEOREGION)	Eastern Swiss Plateau
Physiography of site: (SITEPHYS)	valley slope
Remarks about physiography of the site: (SITEPHYSREMARKS)	gleichmässig
Canton: (CANTON)	Zürich
Longitude (Swiss system): (SWISSLONGITUDE)	676838.0
Latitude (Swiss system): (SWISSLATITUDE)	253712.0

30 to 50
site de-
scriptors

Description

Content

Regensdorf/Holenbach/O8212/03

This list contains 26 objects.

Species list

Full taxonomic name	Abundance of specie in reference surface
Ranunculus acris subsp. friesianus	16-25% degree of coverage (2b)
Ajuga reptans	1-5 items, <5% degree of coverage (+)
Anthoxanthum odoratum	6-15% degree of coverage (2a)
Arrhenatherum elatius	16-25% degree of coverage (2b)
Bromus hordeaceus	6-15% degree of coverage (2a)
Cardamine pratensis	1-5 items, <5% degree of coverage (+)
Crepis capillaris	1-5 items, <5% degree of coverage (+)
Dactylis glomerata	26-50% degree of coverage (3)
Bromus erectus s.str.	1-5 items, <5% degree of coverage (+)
Festuca pratensis	26-50% degree of coverage (3)
Galium album	16-25% degree of coverage (2b)
Veronica hederifolia s.str.	1-5 items, <5% degree of coverage (+)
Holcus lanatus	6-15% degree of coverage (2a)
Lolium perenne	16-25% degree of coverage (2b)
Sanguisorba minor s.str.	1-5 items, <5% degree of coverage (+)
Plantago lanceolata	6-15% degree of coverage (2a)
Ranunculus ficaria	>5 items, <5% degree of coverage (1)
Festuca rubra aggr.	>5 items, <5% degree of coverage (1)
Rumex acetosa	16-25% degree of coverage (2b)
Rumex obtusifolius	1-5 items, <5% degree of coverage (+)
Taraxacum officinale	>5 items, <5% degree of coverage (1)
Trifolium pratense	>5 items, <5% degree of coverage (1)
Trifolium repens	6-15% degree of coverage (2a)
Trisetum flavescens	6-15% degree of coverage (2a)
Veronica serpyllifolia	>5 items, <5% degree of coverage (1)
Vicia sepium	>5 items, <5% degree of coverage (1)

In situ database can be searched for sites where a given species is present

Search

Search criteria

Text to search

Object type

- All objects
- Accessions
- Varieties
- Lists

Species collection

Category

forage plants

forage grasses

meadow fescue

Attachments

Contains photos/images: -----

Contains files: -----

This search yields a list of all sites containing meadow fescue (*Festuca pratensis*)

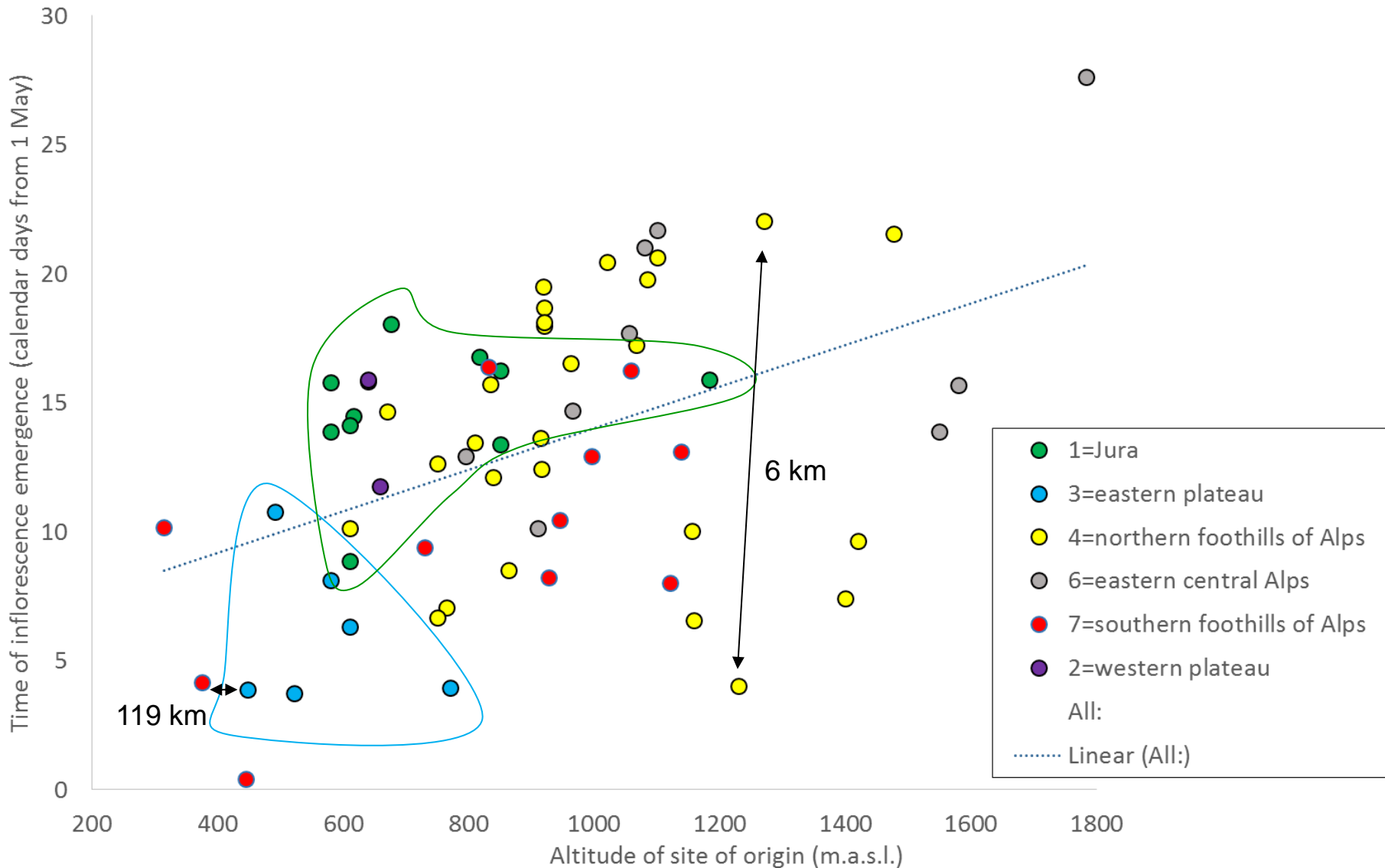


Significant effects of site factors on UPOV characters of *Festuca pratensis*

	GROHABITSPR Growth habit in spring	SPRINGHEIGHT natural height in spring	EMERGEGROWTH Growth habit at spike emergence	INFLOGROWTH natural height at spike emergence	STEMLGTH Stem length at full development	INFLORENGTH Length of inflorescence	UPINTERLENGTH length of top internode	FLAGLEAFLENGTH Flag leaf length	FLAGLEAFWIDTH Flag leaf width	EMERGETIME time of spike emergence
Continuous variables: linear correlation and significance (p < 0.05=significant)										
Altitude m.a.s.l		-0.56 <0.0001					-0.30 0.01			+0.43 <0.0001
Slope		-0.28 0.02					-0.22 0.07			
No. of species in sward at site	-0.21 0.09									
% gramineae in sward	+0.33 0.02									
% festuca pratensis in sward					-0.32 0.02					
Longitude			+0.24 0.05	-0.51 <0.0001						
Latitude			-0.27 0.03	+0.34 0.005						
Discrete variables (number of levels): significance of F-test from analysis of variance (p < 0.05=significant)										
Aspect (9)		0.002		0.01						
Grassland community (10)		0.03					0.02	0.09		0.005
Biogeographic region (6)		0.001	0.06	0.0002	0.06	0.04		0.03		0.0003
Canton (17)		0.02	0.01	0.001				0.009		

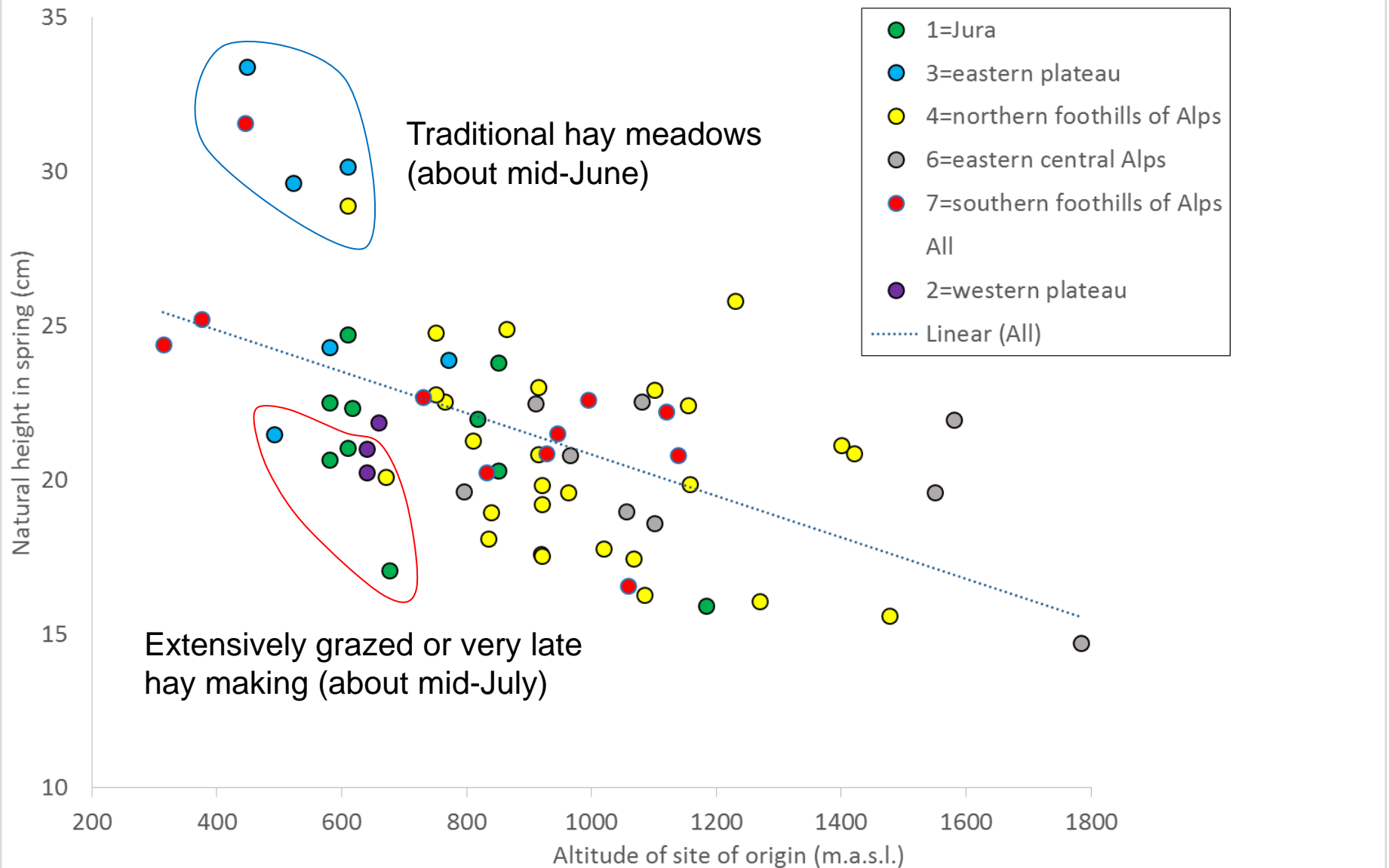


Altitude, Biogeographic region and earliness of *Festuca pratensis*





Altitude, Biogeographic region and spring height of *Festuca pratensis*





Conclusions from *ex situ* results as explained by *in situ* site factors

- Strong effect of altitude at site of origin
- Clear differentiation with biogeographic region on top of altitudinal gradients
- Agricultural management important
- Classification of vegetation (grassland communities) less strictly related to ecotype differentiation than expected

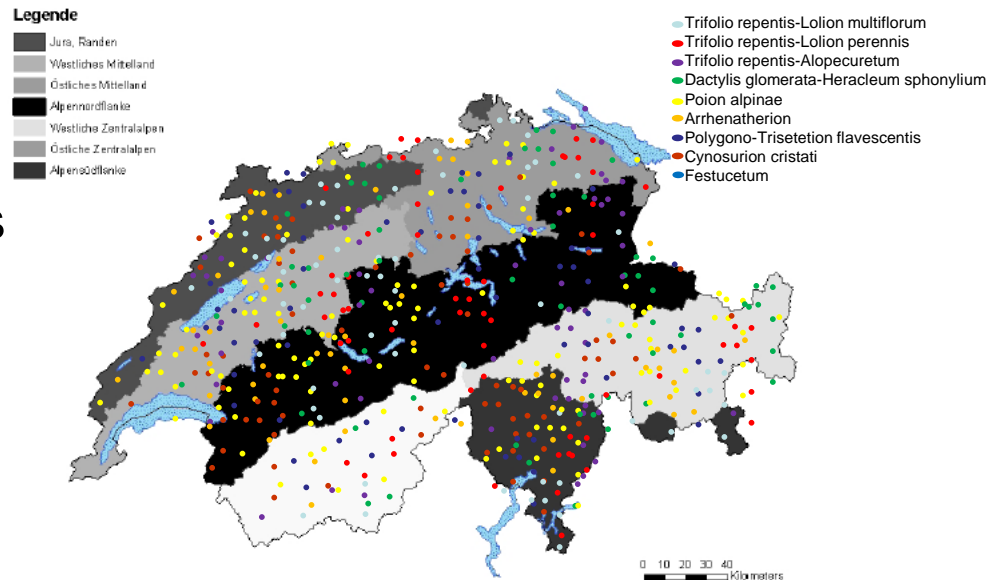
- => *in situ* efforts should aim at maximizing variation in altitude, geography and agricultural management

Implementation of the *in situ* conservation concept for forages in Switzerland

- Controversial discussion among experts on:
 - Degree and localisation of endangerment
 - Best practice for protection
 - Influence of geneflow from cultivars
 - Distribution of genetic diversity (within field, region, country)
 - How to monitor the effect of *in situ* conservation
 - Implementation separately in the National Plan of Action for PGRFA or by mainstreaming into biodiversity policy
- Solution: Three immediate actions, one long-term goal

Immediate Action 1

- Small Inventory
 - in each of the 7 biogeographical regions of Switzerland
 - 9 key grassland communities
 - conserved 5-9 fold
- Yearly compensation for safeguarding genetic diversity



- No reseeding with modern cultivars, continue traditional use
- Goal:
 - Safeguard minimal genetic diversity
 - Site for ecotype collection, analysis of genetic diversity and scientific studies



Immediate Action 2 & 3

- Pilot: Harvest and use regional seeds from natural grasslands
 - Successful application in biodiversity conservation site
 - Goal: self-supporting system for safeguarding the genetic diversity
- Establish effective tool to measure the genetic diversity of an entire field
 - Key-feature: simple sampling
 - compare genetic diversity in space and time



Long-Term Goal: mainstream into general agricultural biodiversity policy

- direct-payment system that is well established in Switzerland
- Currently: 16 types of biodiversity-priority areas
- Goal: include genetic diversity into agricultural biodiversity policy





Thank you for your attention



Agroscope good food, healthy environment