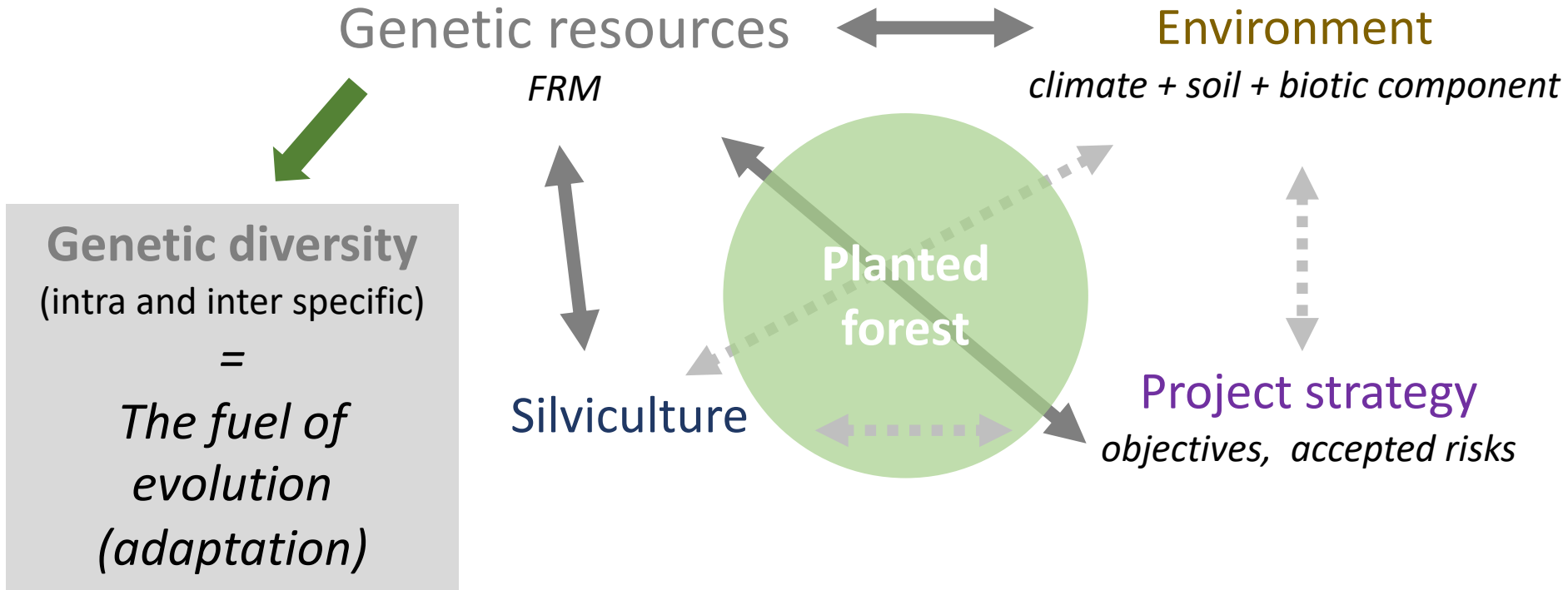


Adapting planted forests genetic to future climate and other risks

Catherine Bastien
INRA



The components of a successful planted forest project

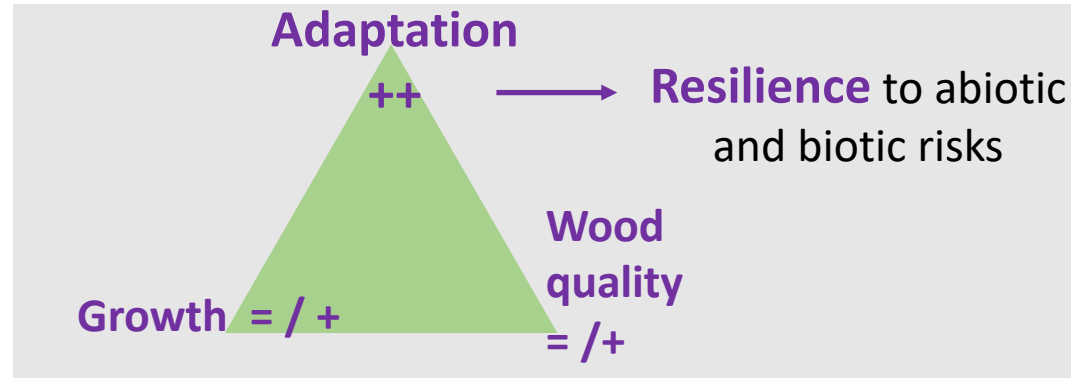


A positive perception of adaptive tree breeding from the European forest sector

Best 2019 survey coordinated by D. Roitsch & G. Winkel (EFI)
565 responses – 9 EU countries

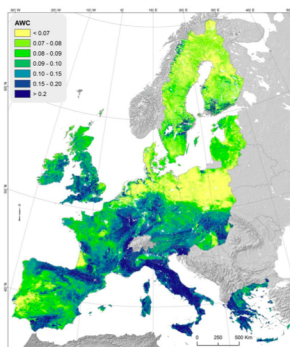
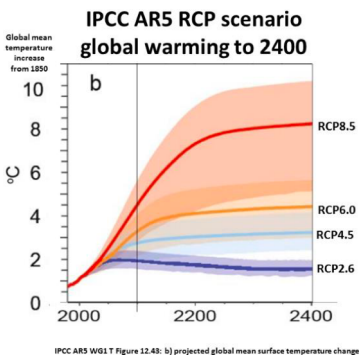
High expectations on

- **Diversification** of tree species
- **Plantation with improved FRM** and revision of **guidelines**
- **Enrichment** of natural regeneration with **better adapted FRM**

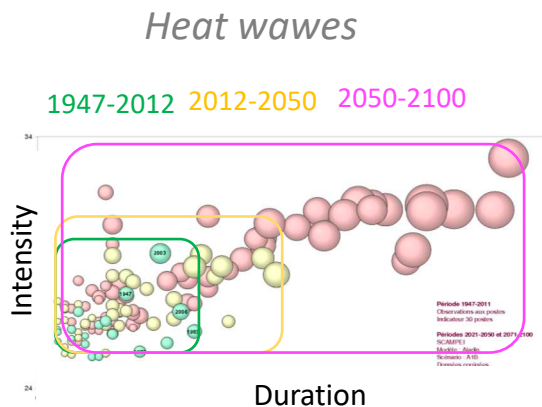


Adaptation to future climate and other risks *is dealing with*

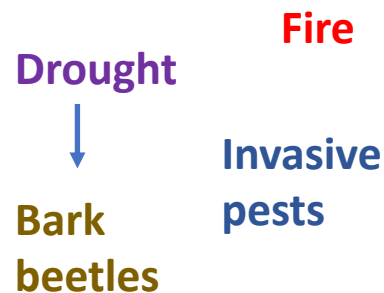
1- the uncertainty about climatic scenarios



2- increased *inter-annual variability*



3- Cumulative *risks* and *risk* cascades



Best WP1 : Combine decision theory, thresholds and scenarios with selected climatic indices

The Tree Breeder Tool box



Genetic Resources

Evaluation

Selection

Recombination

Deployment

Knowledge

Available

To be acquired

EU « local » Breeding

EU/international
« range » Breeding

Natural Genetic
Resources
In & ex situ



**Adaptation and growth
potential** to past and
present climate to a
limited range of
environments

Local adaptation
Genetic diversity

Performances
(Adaptation, Growth,
Quality) in a wider
range of environments

The Tree Breeder Tool box



Genetic Resources

Evaluation

Selection

Recombination

Deployment

Knowledge

Available

To be acquired

EU « local » Breeding

EU/international
« range » Breeding

Natural Genetic
Resources
In & ex situ



Adaptation and growth
potential to
present of
limited
envi

intensify the sharing of
information, expertises,
experiences and genetic
resources

Local ad
Genetic div

The Tree Breeder Tool box



Breeding targets

1950-2000

2000- 2050



Survival
Growth

Susceptibility to main
pests and diseases
Wood density

**Phenotypic
plasticity**

Resilience

Efficiency
(Water, Nutrient)

Experimentation costs



- More sites
- More climatic years
- Artificial environments

The Tree Breeder Tool box



Breeding targets

1950-2000

2000- 2050

Experimentation costs

- More sites

years

ts

Survival
Growth

Susceptibility to main
pests and diseases
Wood density

Phenotypic
plasticity

Resilience

Efficiency

(Water, Nutrient)

Coordination of efforts
at EU scale

+

Use new technologies (sensing)

+

Develop prediction models

The Tree Breeder Tool box



Genetic Resources

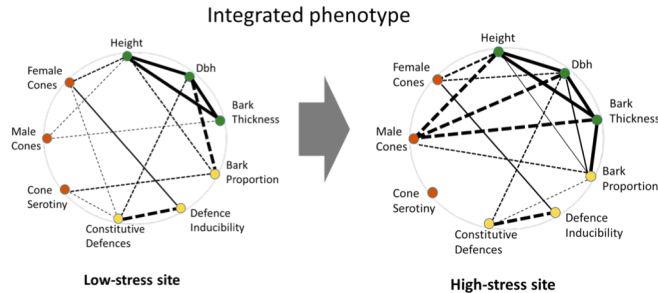
Evaluation

Selection

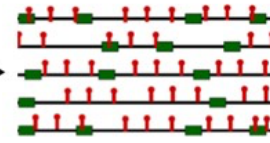
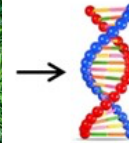
Recombination

Deployment

A multitrait selection
which manages trade-offs



Genomic selection to
accelerate breeding
cycles



Excellent
Good
Average
Poor

Genomic selection to
compromise genetic gain 
and genetic diversity 

The Tree Breeder Tool box



Genetic Resources

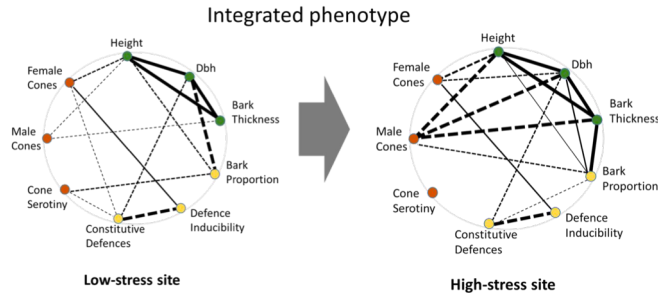
Evaluation

Selection

Recombination

Deployment

A multitrait selection
which manages trade-offs



Genomic selection to
accelerate breeding
cycles

Genomic selection to
compromise genetic gain 
and genetic diversity 

Share information
about trade-offs and
DNA-based tools





The Tree Breeder Tool box



Longer term options -> Explore new genetic diversity

Controlled crosses between complementary genotypes



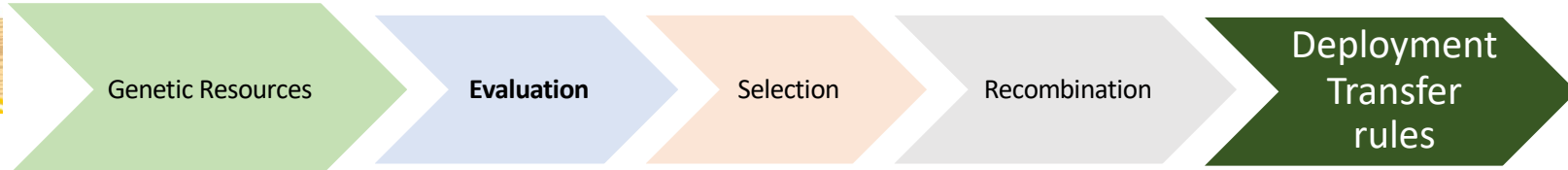
Increase frequency of « adapted » alleles
and genotypes
Infusion of genetic diversity

« Orchards for future generations »
Ex-situ collections with high genetic diversity
in multiple environments





The Tree Breeder Tool box



2019 Survey
Difficulty to access
information on FRM



PLANTER'S GUIDE - Scots pine - Skogforsk & Luke



Map of the suitable
deployment area for
each seed orchard

Comparison of
deployment maps
for different seed
orchards

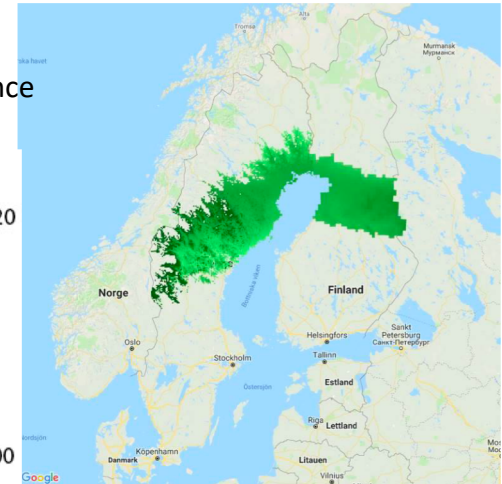
Conditions for recommendations

Altitude (m.a.s.l.) ⓘ	320 m
Temperature sum ⓘ	890 degree days
Climate scenario ⓘ	+2.5°C (SRES-A1B) ▼
Adjustment for local conditions ⓘ	Average ▼
Seed orchard origin	Finland & Sweden Finland Sweden

Seed orchards

No ⓘ	Name ⓘ	Country ⓘ	Ind ⓘ ▼	Sur ⓘ ⬆	Grow ⓘ ⬆	PC ⓘ	Lat ⓘ	ⓘ
	Local origin		100	74.6	100		62.7	
FP-621	Västerhus Tio	Sweden	122	80.2	120.7	40	63.6	☐
FP-630	Sundsvall Elit	Sweden	119	83.7	115.5	40	63.9	☐
Sv405	Peräsuo	Finland	118	68.6	127.3	49	62.1	☐
Sv404	Suhola 2	Finland	118	67.3	128.8	40	62	☐

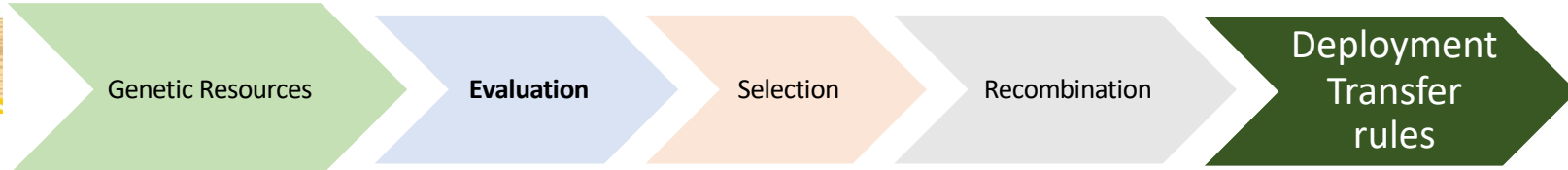
Performance
index



100= unimproved local seed stand



The Tree Breeder Tool box



2019 Survey

Difficulty to access information on FRM



PLANTER'S GUIDE - Scots pine - Skogforsk & Luke



Map of the suitable deployment area for each seed orchard

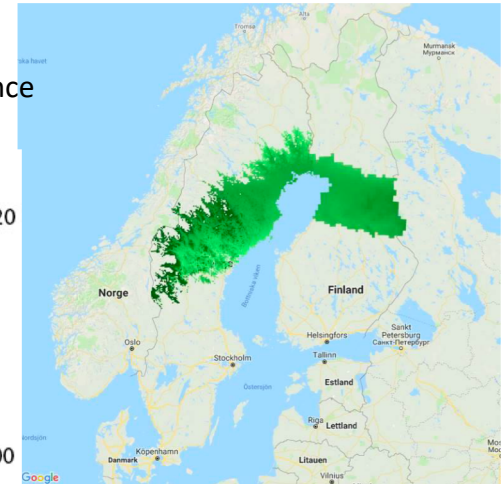
Comparison of deployment maps for different seed orchards

Conditions for recommendations

Altitude (m.a.s.l.) ①	320 m
Temperature sum ①	890 degree days
Climate scenario	▼
Adjustment	▼
Seed orchard	
FP-62	
FP-630	
Sv405	Peräsuo
Sv404	Suhola 2

Share reference FRMs and information from evaluation tests

Performance index



100= unimproved local seed stand

Take home messages

- Forest reproductive materials need human help to **adapt quickly** to future climate and increased biotic and abiotic risks
- **Maintain genetic diversity** in selected FRM will ensure higher adaptive potential for an uncertain future
- **High phenotypic plasticity** has been observed in selected FRM and in natural genetic resources
- Evaluation of performances in **wider range of environments** is needed : how to share resources, evaluation efforts, expertises on different risks and performance information?
- **User-friendly decision support tools** are needed to promote updated deployment guidelines of a more diverse portfolio of improved FRM.

Acknowledgments

- EFI for the invitation to the 2019 annual meeting in Aberdeen
- All partners of the  H2020 project (2018-2022)
- All respondents from forest-based sector to 2019  survey
- Partners from other national or European initiatives involved in a **responsible** management of forest genetic resources that will secure the future of forests