



Silviculture in protection forest
example Switzerland

Monika Frehner

- History of silviculture in mountain forests
- Sustainability and success monitoring in protection forests (Nais)
- Implementation

history

several bans



prov. forest laws



report Landolt



1st nat. forest law



Normal logging in mountain forest



over logging



flood disaster



- Till about 1960 managing forest in Swiss alps was lucrative, protection forests were mainly important directly above the villages.
- 1980 a lot of mountain forests were no more managed, because the costs have been too high. Protection forests above railways and roads got very important, so the area of protection forests increased.



1980

PD Dr. Ernst Ott started with the lectures of «mountain silviculture» at the ETH Zürich

Since 2007 managing of protection forests

Since 1984 the “Swiss group for mountain silviculture” is meeting each year once in summertime outside in the forest and once in wintertime to discuss special problems.





How looks the different forest types naturally?

Several excursions to virgin forests in east Europa

For example 2000 to the dolines of Postojna

virgin forest Zdrolce, spruce subalpin

The trees or group of trees have long crowns regeneration you find on special sites

Development of Nais

1991 Swiss forest law

The cantons have to ensure that forest with a protective function are managed to guarantee protection

1996 Guidelines

Minimal forest management for forests with a protective function

The seven principales of Nais

1. With focus on the protective target

Silvicultural interventions in protection forests serve exclusively to reduce natural hazards.

The protective function doesn't automatically establish in the „wake“ of the timber production. It is possible that you have also timber production, but the main focus is the protective function.

The seven principales of Nais

2. In the right place

Silvicultural interventions are carried out in areas where the forest can prevent or reduce the effects of natural hazards on people and material assets.

Delineation of protection forests, silvaproduct.

The seven principales of Nais

3. At the right time

Silvicultural interventions are carried out at that point in time when an optimal effect can be attained with minimal effort.

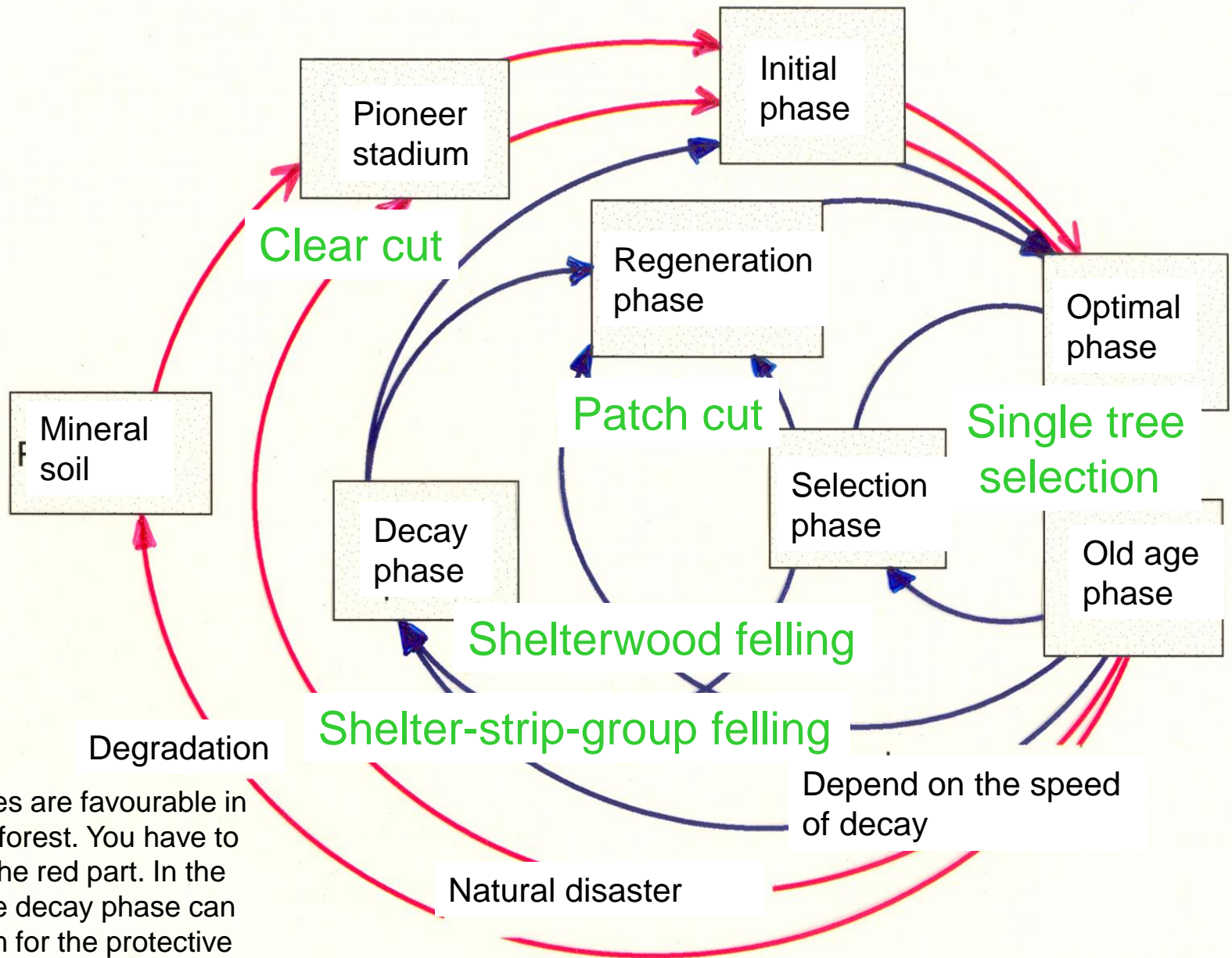
Sometimes it is better to make a small intervention in a stable stand if you can predict, that the development without intervention will not be favourable instead of waiting, till the stand will be in a disfavoured situation and you'll need expensive measures to maintain the protective function.

The seven principales of Nais

4. Consistent with the natural life processes

Silvicultural measures are tailored to site conditions to make use of the forces of natural forest dynamics.

Pattern of the dynamic of a forest eco-system



Not all phases are favourable in a protection forest. You have to try to avoid the red part. In the blue part, the decay phase can be a problem for the protective function.

The seven principales of Nais

5. Tailored to each stand, transparent, replicable and controllable

Silvicultural interventions are determined by experts in the spot. This makes it possible to adapt them to small-scale variation in site factors. A standard decision –making procedure is followed and documented. This makes it transparent, replicable and controllable.

The seven principales of Nais

6. Effective

The silvicultural interventions are very likely to lead to the targets.

The seven principales of Nais

7. With reasonable effort

The silvicultural interventions have a reasonable cost-benefit ratio.



Sustainability and success monitoring in protection forests - NaiS

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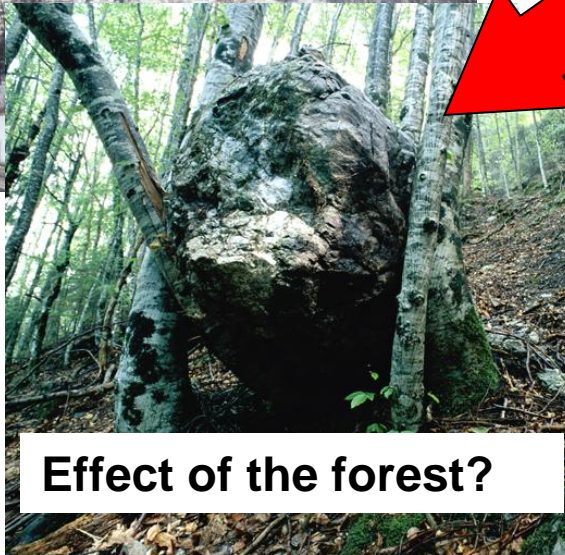
Tested by the Swiss group for mountain silviculture



What are we doing?

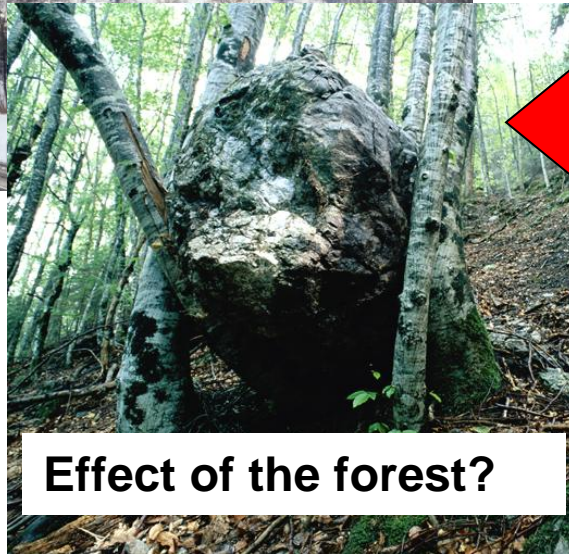


Forest management



Effect of the forest?

How has the forest to look like?



Effect of the forest?

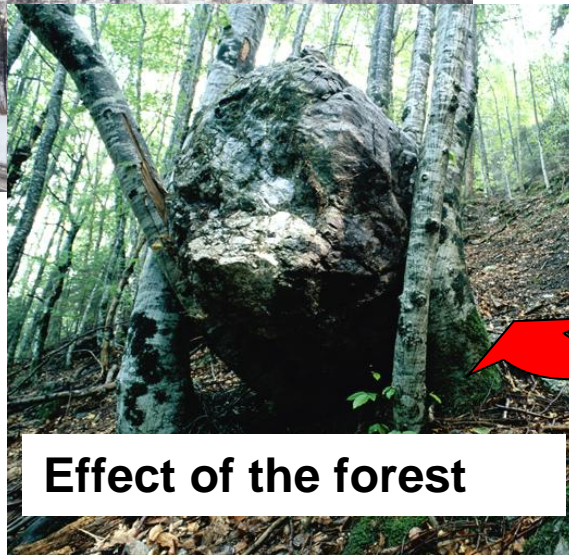


State of the forest

Target profiles describe stand conditions which should have a strong protective effect



Forest management



Effect of the forest



State of the forest



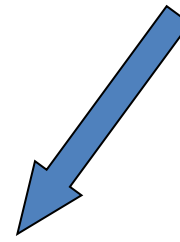
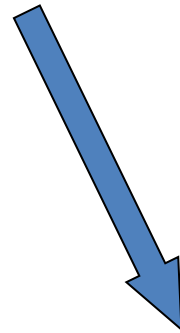
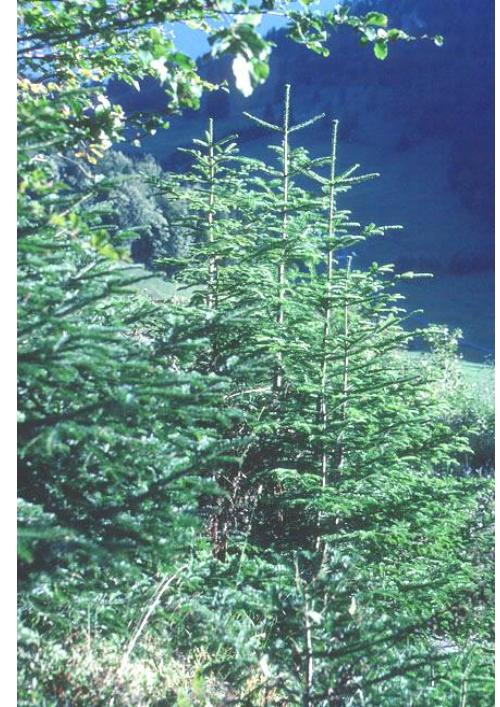


Hazard-specific targets

Avalanche,
Rock fall
Erosion,
landslide
High water

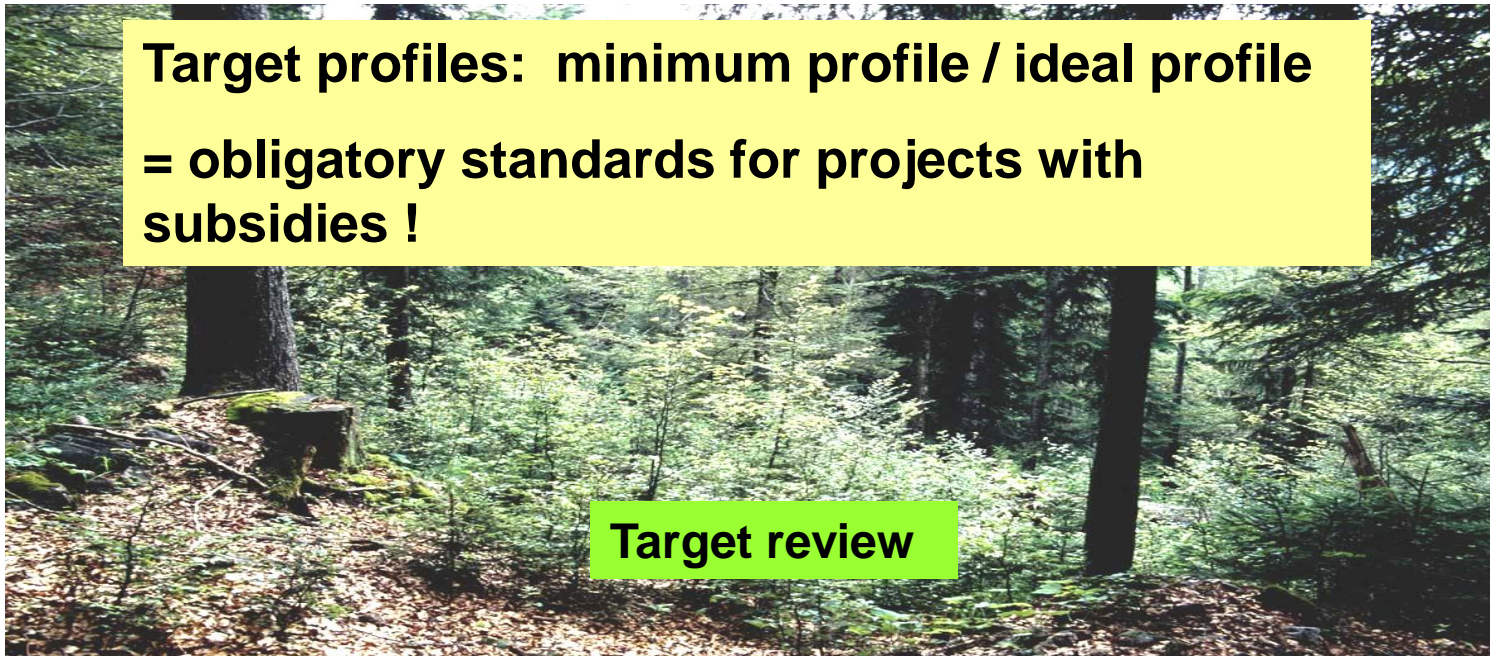
Site-related targets

Catalogue of
the Site-
related profiles



**Target profiles: minimum profile / ideal profile
= obligatory standards for projects with
subsidies !**

Target review



Natural hazard

Steinschlag im Transitgebiet
 massgebende Steingrösse ca. 50 cm
Anforderungen siehe Anhang 1, Seite

Site conditions

Typischer Karbonat -Tannen-Buchenwald (18M)
 Anforderungen siehe Anhang 2B, Seite ...:

Stand and tree characteristics

Mixture

Art und Grad

Minimum profile

Bu	30 – 80 %
Ta	10 - 60 %
Fi	0 - 30 %
B'Ah	Samenbäume

Ideal profile

Bu	40 - 60 %
Ta	30 - 50 %
Fi	0 - 20 %
B'Ah, Es	10 – 30 %

Structure

BHD-Streuung
 Horizontal

Genügend entwicklungsfähige Bäume in mind. 2 verschiedenen Durchmesserklassen pro ha Einzelbäume, allenfalls Kleinkollektive

Mind. 300 Bäume/ha mit BHD > 24cm

Genügend entwicklungsfähige Bäume in mind. 3 verschiedenen Durchmesserklassen pro ha Einzelbäume, allenfalls Kleinkollektive, Schlussgrad locker

Mind. 400 Bäume/ha mit BHD > 24cm

Bei Öffnungen in der Fallinie Stammabstand < 20 m.

Liegendes Holz und hohe Stöcke: als Ergänzung zu stehenden Bäumen, falls keine Sturzgefahr

Stability carriers

Kronen
 Schlankheitsgrad
 Stand/Verankerung

Kronenlänge Ta mind. 2/3, Fi mind. 1/2 < 80

Lotrechte Stämme mit guter Verankerung, nur vereinzelt starke Hänger

Kronenlänge mind. 2/3 < 70

Lotrechte Stämme mit guter Verankerung, keine starken Hänger

Regeneration

Keimbett

Fläche mit starker Vegetationskonkurrenz < 1/3

Anwuchs (10 cm bis 40 cm Höhe)

Bei Deckungsgrad < 0,6 mindestens 10 Buchen / Tannen pro a (durchschn. alle 3 m) vorhanden. In Lücken B'Ah vorhanden

Aufwuchs (bis und mit Dichtung, 40 cm Höhe bis 12 cm BHD)

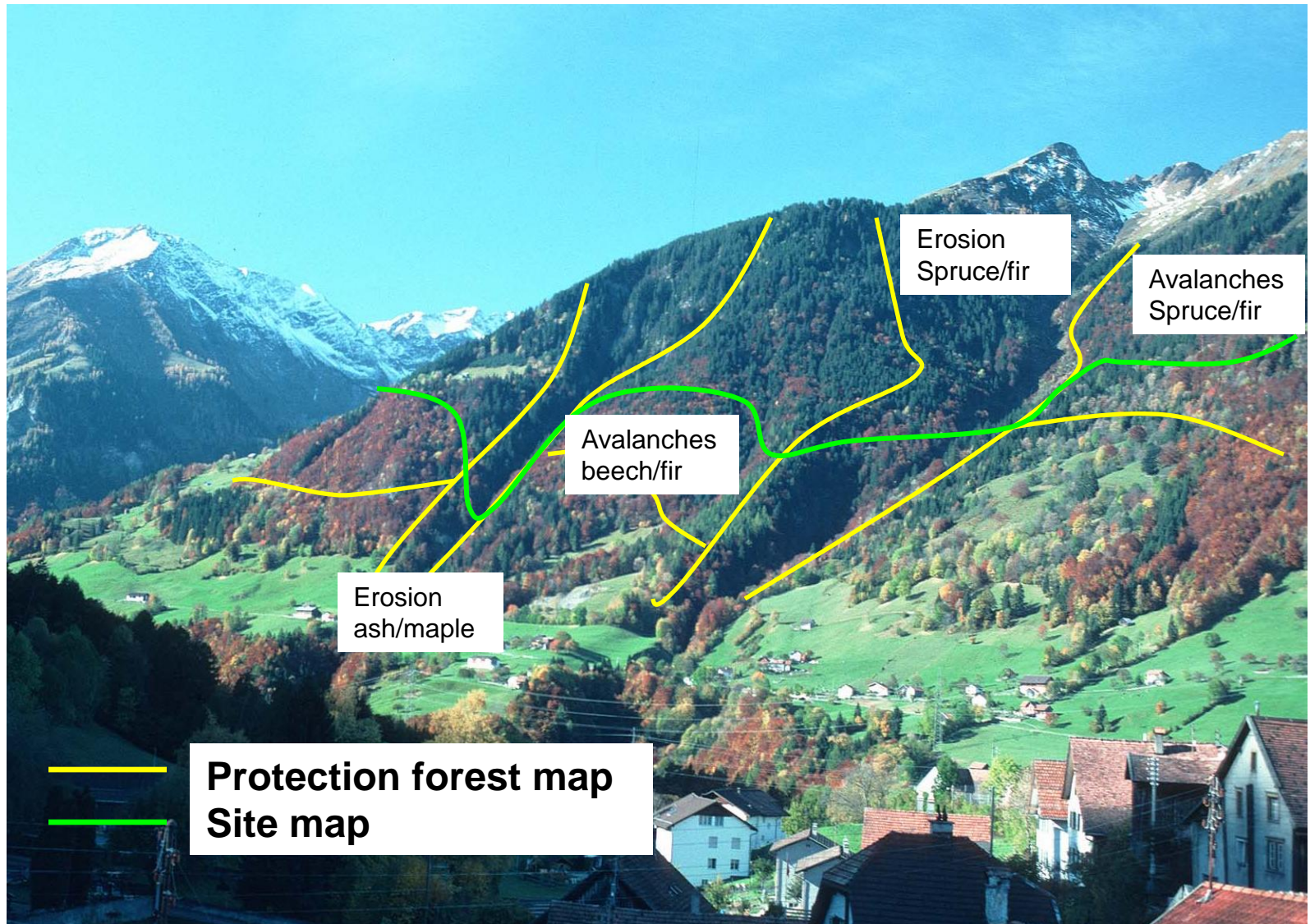
Pro ha mind. 1 Trupp (2 – 5 a, durchschnittlich alle 100 m) oder Deckungsgrad mind. 4 % Mischung zielgerecht

Fläche mit starker Vegetationskonkurrenz < 1/4

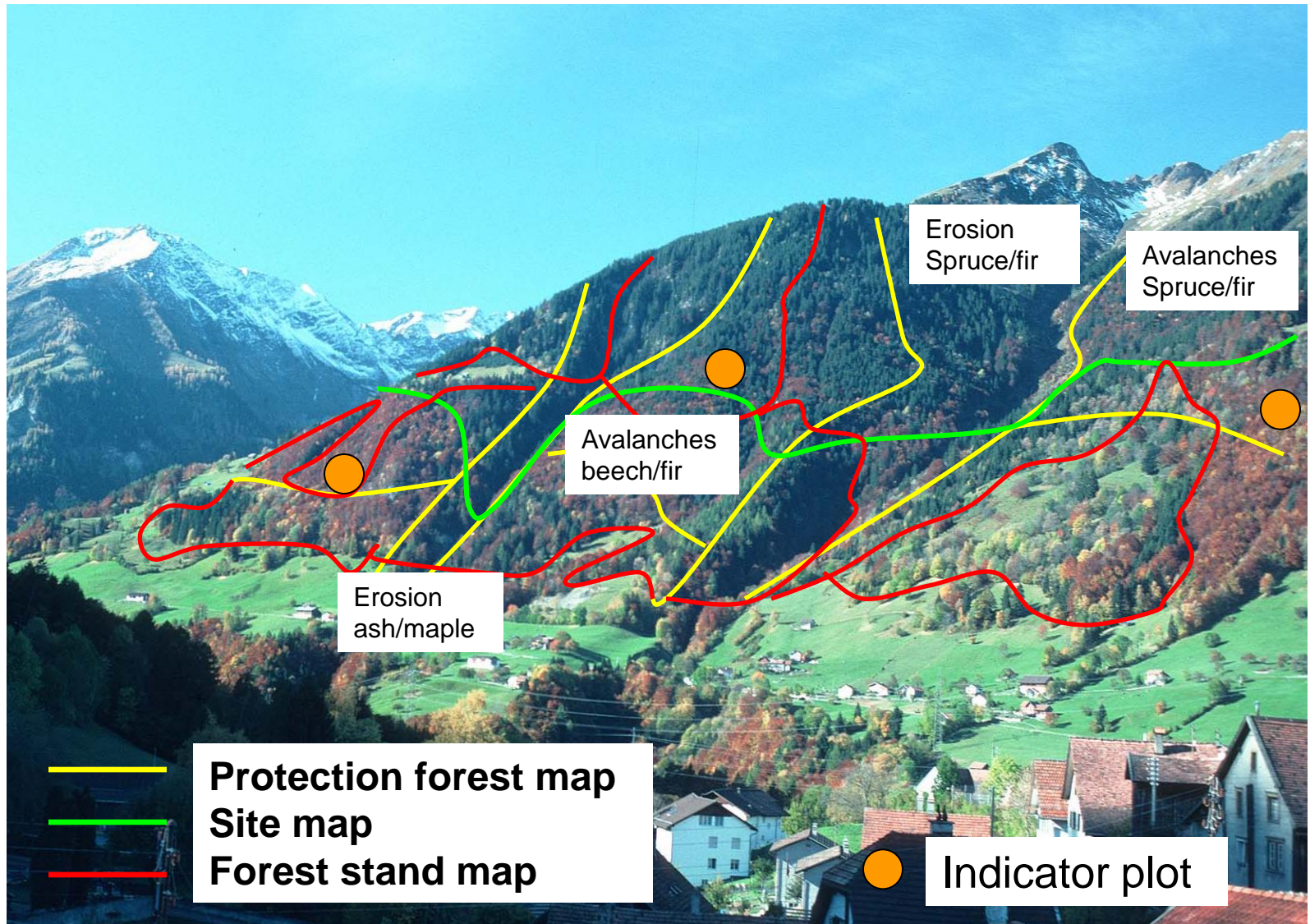
Bei Deckungsgrad < 0,6 mindestens 50 Buchen / Tannen pro a (durchschn. alle 1.5 m) vorhanden. In Lücken B'Ah vorhanden

Pro ha mind. 3 Trupps (je 2 – 5 a, durchschnittlich alle 60 m) oder Deckungsgrad mind. 7 % Mischung zielgerecht

Protection forest – Target types



Protection forest – Target types – treatment types

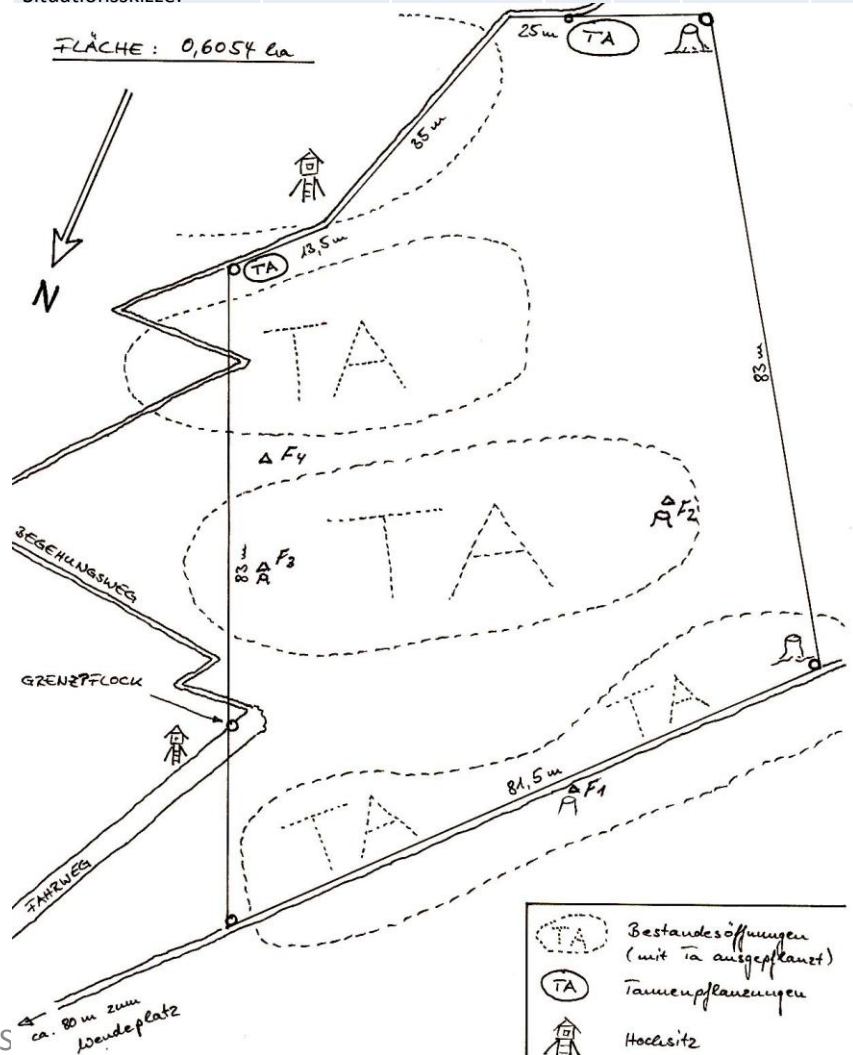


indicator plots

A photograph of a snowy forest. The ground is covered in a thick layer of white snow. Numerous bare, dark tree trunks and branches are visible, some leaning over. The background shows a dense stand of trees, creating a misty or hazy atmosphere. The overall scene is a winter forest landscape.

- Determination of interventions to be applied
- Effectivity analysis to acquire and improve skills in forest management
- Practical training
- Public relations

Situation, target typ, reason to make an indicator plot

Waldbauprojekt			Situation		
Ortsgemeinde Pfäfers	Ort: Tristeliwald	Weiserfl. Nr. 3	Fläche (ha): 0.6	Datum: 2000	BearbeiterIn: R.Schwitter
Koordinaten: 756'800 / 205'300	Meereshöhe: 1170 m	Beilagen: Form. 2 " Form. 3 " Form. 4 "		Plan 1:5000 " Fotoprotokoll " Andere:	
Situationsskizze: 			Waldfunktion(en): Schutzwald		
			Zieltyp: Typischer Karbonat-Tannen-Buchenwald (18M) / Steinschlag Transitgebiet, mittlere Steingrösse		
			Grund für Weiserfläche (Geltungsbereich u. Fragestellung): Repräsentativ für den verbreiteten Karbonat-Tannen-Buchenwald im Steinschlaggebiet. Überführung gleichförmiger Bestände in Bestände mit besserer Strukturierung. Wie erfolgreich ist die Pflanzung von Tanne? Wie wachsen die Tannen bei unterschiedlichen Lichtverhältnissen? Wie entwickelt sich die Naturverjüngung? Wie entwickelt sich die Bodenvegetation in Abhängigkeit von der Lückengrösse?		
			Bestandesbild (Profilskizze, Kurzbeschreibung): gleichförmiges Baumholz II (III), Fi / Ta		



Locality: Pfafers / Tristelwald		Plot no:	Date: 01.06.2000	Author: R. Schwitter	
1. Site type: Fir - Beech forest (18M)					
2. Natural hazard and effectiveness: Rockfall, rock-diameter 40 to 60 cm; large contribution of the forest					
3. State of the forest, trend analysis and interventions					
Stand and single tree characteristics	Minimum profile (including natural hazards)	Current state of the forest Year 2000	Current state, trend in 10 & in 50 years	Effective interventions	6. Stage targets with check values To be checked in 10 years (year 2010)
• Species mixture (type and degree)	Beech 30 - 70 % Fir 10 - 60 % / Spruce 0 - 30 % Sycamore seedtrees Conifers 30 - 70 % (avalanches)	Beech + Fir 40 % / Spruce 60 % Sycamore seedtrees Larch +		(see regeneration)	<input type="checkbox"/> equal 2000
• Vertikal structure (dbh variation)	viable trees in minimum 2 different diamter classes	viable trees: 0 - 12 cm none 12 - 30 cm single trees 30 - 50 cm sufficient < 50 cm single trees			<input type="checkbox"/> viable trees: 0 - 12 cm sufficient 12 - 30 cm single trees 30 - 50 cm sufficient < 50 cm single trees
• Horizontal structure (% cover, gap length, stem density)	Single trees or small groups; at least 300 trees/ha with dbh > 24cm; in openings in the fall line stem distance < 20 m; lying logs and high stumps	Single trees; canopy density approx. 80 %; approx. 400 trees/ha with dbh > 24cm; openings in the fall line stem distance < 20 m;			<input type="checkbox"/> Single trees; canopy density at least 60 %; at least 300 trees/ha with dbh > 24cm; openings in the fall line stem distance < 20 m; lying logs and high stumps
• State of the stability carriers (crown develop., slenderness, target dbh)	Crown develop. Fir min. 2/3, Spruce min. 1/2; slenderness <80; stright trunks, single leaning trees only	Crown develop. Approx. 1/3; slenderness approx. 80; some leaning trees		(no thinning - no additional reduction of number of trees)	<input type="checkbox"/> Crown develop. Approx. 1/3; slenderness approx. 80; single leaning trees only
• Regeneration - seedbed	Area covered with vegetation competition < 1/3	Area covered with vegetation competition < 1/3			<input type="checkbox"/> Area covered with vegetation competition < 1/3
• Regeneration - small saplings (10 - 40 cm tall)	When crown density < 0.6, min 10 pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings	When crown density < 0.6, some saplings of Fir, Spruce, Beech, Sycamore; influence of game!			<input type="checkbox"/> When crown density < 0.6, min 10 pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings
• Regeneration - large saplings (40 cm tall to 12 cm dbh)	Min. 1 group (size 2 - 5 are) per ha or canopy density > 4 %; species composition corresponding target	no large saplings		To help existing samplings - create openings; to plant Fir and Beech; reduce game influence	<input checked="" type="checkbox"/> in the openings Fir, Spruce, Sycamore, Beech 40 to 100 cm tall

very bad minimum ideal

4. Need for action yes no

Next intervention:

5. Urgency small medium high

Decision –making table (Nais)

NaiS / Form 2

Decision-making table

Locality: Pfä Date: 01.06.2000 Author: R. Schwitter

1. Site type: Fir - Bee

2. Natural hazard and

3. State of the forest

Stand and single tree characteristics

• Species mixture (type and degree)

• Vertical structure (dbh variation)

• Horizontal structure (% cover, gap length, stem density)

• State of the stability carriers (crown develop., slenderness, target dbh)

• Regeneration - seedbed

• Regeneration - small saplings (10 - 40 cm tall)

• Regeneration - large saplings (40 cm tall to 12 cm dbh)



cm; large contribution of the forest

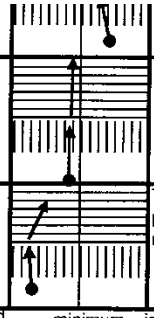
6. Stage targets with

Mixture

Vertical structure, dbh variation

Horizontal structure, canopy cover, size of openings

Stability carriers, crown development, slenderness



very bad minimum ideal

4. Need for action yes no

Next intervention:

5. Urgency small medium high

When pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings	saplings of Fir, Spruce, Beech, Sycamore; influence of game!	<input type="checkbox"/>	When crown density < 0.6, min 10 pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings
Min. 1 group (size 2 - 5 are) per ha or canopy density > 4 %; species composition corresponding target	no large saplings	<input checked="" type="checkbox"/>	in the openings Fir, Spruce, Sycamore, Beech 40 to 100 cm tall

Decision –making table (Nais)



Regeneration Seed bed

01.06.2000	Author:	R. Schwitter
Location of the forest		
Current state of the forest Year 2000	Current state, trend in 10 & in 50 years	Effective interventions
	(see regeneration)	appropriate
		6. Stage targets with check values To be checked in 10 years (year 2010)

Species mixture
(type and degree)

Fir 40 - 60 % / Spruce 0 - 30 %
Sycamore
Conifers 30 %

Vertical structure
(dbh variation)

viable tree
diameter cl

Horizontal structure
(% cover, gap length, stem density)

Single tree
at least 30
4cm; in c
stem dista
high stum

State of the stability carriers
(crown develop., slenderness, target dbh)

Crown develop.
min. 1/2; s
trunks, sin

Regeneration - seedbed

Area covered with vegetation
competition < 1/3

Area covered with vegetation
competition < 1/3

Regeneration - small saplings
(10 - 40 cm tall)

When crown density < 0.6, min 10
pieces of Beech/Fir per are (approx.
Every 3m); there is Sycamore in the
openings

When crown density < 0.6, some
saplings of Fir, Spruce, Beech,
Sycamore;
influence of game!

Regeneration - large saplings
(40 cm tall to 12 cm dbh)

Min. 1 group (size 2 - 5 are) per are
canopy density > 4 %; species
composition corresponding target

no large saplings



Regeneration Saplings (10 cm up to 40 cm height)



bu %; at least 300 trees/ha with dbh > 24cm; openings in the fall line stem distance < 20 m; lying logs and high stumps

Crown develop. Approx. 1/3; slenderness approx. 80; single leaning trees only

Thicket stage (height of 40 cm to diameter of 12 cm)

very bad minimum ideal

4. Need for action yes no

Next intervention:

5. Urgency small medium high

Decision –making table (Nais)

Nais / Form 2

Decis

Minimum profile

00

Author:

R. Schwitter

Locality: Pfäfers / Tristelwald					
1. Site type: Fir - Beech forest (18M)					
2. Natural hazard and effectiveness: Rockfall, rock-diameter 40 to 60 cm; large contribution of the forest					
3. State of the forest, trend analysis and interventions					
Stand and single tree characteristics	Minimum profile (including natural hazards)	Current state of the forest Year 2000	Current state, trend in 10 & in 50 years	Effective interventions	6. Stage targets with check values To be checked in 10 years (year 2010)
• Species mixture (type and degree)	Beech 30 - 70 % Fir 10 - 60 % / Spruce 0 - 30 % Sycamore seedtrees Conifers 30 - 70 % (avalanches)	Beech 30 – 70 % Fir 10 – 60 % Spruce 0 – 30 % Sycamore seedtrees			<input type="checkbox"/> equal 2000
• Vertikal structure (dbh variation)	viable trees in minimum 2 different diamter classes				<input type="checkbox"/> viable trees: 0 - 12 cm sufficient 12 - 30 cm single trees 30 - 50 cm sufficient < 50 cm single trees
• Horizontal structure (% cover, gap length, stem density)	Single trees or small groups; at least 300 trees/ha with dbh > 24cm; in openings in the fall line stem distance < 20 m; lying logs and high stumps	24cm; openings in the fall line stem distance < 20 m;			<input type="checkbox"/> Single trees; canopy density at least 60 %; at least 300 trees/ha with dbh > 24cm; openings in the fall line stem distance < 20 m; lying logs and high stumps
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• Regeneration - large saplings (40 cm tall to 12 cm dbh)	Min. 1 group (size 2 - 5 are) per ha of canopy density > 4 %; species composition corresponding target	no large saplings		To help existing saplings - create openings; to plant Fir and Beech; reduce game influence	<input checked="" type="checkbox"/> in the openings Fir, Spruce, Sycamore, Beech 40 to 100 cm tall

very bad minimum ideal

4. Need for action

yes no

Next intervention:

5. Urgency

small medium high

Decision –making table (Nais)

Nais / Form 2

Decis

Minimum profile

00

Author:

R. Schwitter

1. Site type: Fir - Beech forest (18M)

2. Natural hazard and effectiveness: Rockfall, rock-diameter 40 to 60 cm; large contrib

3. State of the forest, trend analysis and interventions

Ideal profile

Stand and single tree characteristics	Minimum profile (including natural hazards)	Current state of the forest Year 2000	Current state, trend in 10 & in 50 years	Interventions	appropriate	6. Stage targets with check values (year 2010)
• Species mixture (type and degree)	Beech 30 - 70 % Fir 10 - 60 % / Spruce 0 - 30 % Sycamore seedtrees Conifers 30 - 70 % (avalanches)	Beech + Fir 40 % / Spruce 60 % Sycamore seedtrees Larch +		(see regeneration)	<input type="checkbox"/>	equal 2000
• Vertical structure (dbh variation)	viable trees in minimum 2 different diameter classes	viable trees: 0 - 12 cm none 12 - 30 cm single trees 30 - 50 cm sufficient < 50 cm single trees			<input type="checkbox"/>	viable trees: 0 - 12 cm sufficient 12 - 30 cm single trees 30 - 50 cm sufficient < 50 cm single trees
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• Regeneration - seedbed	Area covered with vegetation competition < 1/3	Area covered with vegetation competition < 1/3			<input type="checkbox"/>	Area covered with vegetation competition < 1/3
• Regeneration - small saplings (10 - 40 cm tall)	When crown density < 0.6, min 10 pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings	When crown density < 0.6, some saplings of Fir, Spruce, Beech, Sycamore; influence of game!			<input type="checkbox"/>	When crown density < 0.6, min 10 pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings
• Regeneration - large saplings (40 cm tall to 12 cm dbh)	Min. 1 group (size 2 - 5 are) per ha of canopy density > 4 %; species composition corresponding target	no large saplings		To help existing saplings plant Fir and Beech reduce game influence	<input type="checkbox"/>	Min. 1 group (size 2 - 5 are) per ha of canopy density > 4 %; species composition corresponding target

Target profiles: minimum profile / ideal profile



Target type

4. Need for action yes no

Next intervention:

very bad minimum ideal

Decision –making table (Nais)

Nais / Form 2

Decision-making table

Locality: Pfäfers / Tristelwald		Plot no:	Date: 01.06.2000	Author: R. Schwitter			
1. Site type: Fir - Beech forest (18M)							
2. Natural hazard and effectiveness: Ro							
Current state of the forest							
3. State of the forest, trend analysis and							
6. Stage targets with check values							
Stand and single tree characteristics	Minimum profile (including natural hazards)	Current state of the forest Year 2000	Current state, trend in 10 & in 50 years	Effective interventions	To be checked in 10 years (year 2010)		
<ul style="list-style-type: none"> Species mixture (type and degree) 	Beech 30 - 70 % Fir 10 - 60 % / Spruce 0 - 30 % Sycamore seedtrees Conifers 30 - 70 % (avalanches)	Beech + Fir 40 % / Spruce 60 % Sycamore seedtrees Larch +	<p style="text-align: center;">very bad minimum ideal</p>	<p style="font-size: 2em; text-align: center;">Beech + Fir 40 % Spruce 60 % Sycamore seedtrees</p>	10		
<ul style="list-style-type: none"> Vertical structure (dbh variation) 	viable trees in minimum 2 different diameter classes	viable trees: 0 - 12 cm none 12 - 30 cm single trees 30 - 50 cm sufficient < 50 cm single trees			es: n sufficient n single trees n sufficient 1 single trees		
<ul style="list-style-type: none"> Horizontal structure (% cover, gap length, stem density) 	Single trees or small groups; at least 300 trees/ha with dbh > 24cm; in openings in the fall line stem distance < 20 m; lying logs and high stumps	Single trees; canopy density approx. 80 %; approx. 400 trees/ha with dbh > 24cm; openings in the fall line stem distance < 20 m;			es; canopy density at least east 300 trees/ha with dbh openings in the fall line stem distance < 20 m; lying logs and high stumps		
<ul style="list-style-type: none"> State of the stability carriers (crown develop., slenderness, target dbh) 	Crown develop. Fir min. 2/3, Spruce min. 1/2; slenderness <80; straight trunks, single leaning trees only	Crown develop. Approx. 1/3; slenderness approx. 80; some leaning trees			(no thinning - no additional reduction of number of trees)	<input type="checkbox"/>	Crown develop. Approx. 1/3; slenderness approx. 80; single leaning trees only
<ul style="list-style-type: none"> Regeneration - seedbed 	Area covered with vegetation competition < 1/3	Area covered with vegetation competition < 1/3				<input type="checkbox"/>	Area covered with vegetation competition < 1/3
<ul style="list-style-type: none"> Regeneration - small saplings (10 - 40 cm tall) 	When crown density < 0.6, min 10 pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings	When crown density < 0.6, some saplings of Fir, Spruce, Beech, Sycamore; influence of game!				<input type="checkbox"/>	When crown density < 0.6, min 10 pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings
<ul style="list-style-type: none"> Regeneration - large saplings (40 cm tall to 12 cm dbh) 	Min. 1 group (size 2 - 5 are) per ha or canopy density > 4 %; species composition corresponding target	no large saplings			To help existing samplings - create openings; to plant Fir and Beech; reduce game influence	<input checked="" type="checkbox"/>	In the openings Fir, Spruce, Sycamore, Beech 40 to 100 cm tall
4. Need for action <input checked="" type="checkbox"/> yes <input type="checkbox"/> no		Next intervention:		5. Urgency <input type="checkbox"/> small <input type="checkbox"/> medium <input checked="" type="checkbox"/> high			

Decision –making table (Nais)

Nais / Form 2

Decision-making table

Locality: Pfäfers / Tristeliwald		Plot no:		Date: 01.06.2000	Author: R. Schwitter
1. Site type: Fir - Beech forest (18M)					
2. Natural hazard and effectiveness: Rockfall, rock-diameter 40 to 60 cm; large contribution of the forest					
3. State of the forest, trend analysis and interventions					
Stand and single tree characteristics	Minimum profile (including natural hazards)	Current profile Year 2000	Trend in 10 & 50 years	Ideal profile	6. Stage targets with check values To be checked in 10 years (year 2010)
<ul style="list-style-type: none"> Species mixture (type and degree) 	Beech 30 - 70 % Fir 10 - 60 % / Spruce 0 - 30 % Sycamore seedtrees Conifers 30 - 70 % (avalanches)	Beech + Fir 40 % / Spruce 60 % Sycamore seedtrees Larch +		see regeneration)	
<ul style="list-style-type: none"> Vertikal structure (dbh variation) 	viable trees in minimum 2 different diameter classes	viable trees: 0 - 12 cm none 2 - 30 cm single trees 30 - 50 cm sufficient < 50 cm single trees			viable trees:
<ul style="list-style-type: none"> Horizontal structure (% cover, gap length, stem density) 	Single trees or small groups; at least 300 trees/ha with dbh > 24cm; in openings in the fall line stem distance < 20 m; lying logs and high stumps	Single trees; canopy density approx. 40 %; approx. 400 trees/ha with dbh > 24cm; openings in the fall line stem distance < 20 m;			distance < 20 m; lying logs and high stumps
<ul style="list-style-type: none"> State of the stability carriers (crown develop., slenderness, target dbh) 	Crown develop. Fir min. 2/3, Spruce min. 1/2; slenderness <80; straight trunks, single leaning trees only	Crown develop. Approx. 1/3; slenderness approx. 80; some leaning trees		(no thinning - no trees)	
<ul style="list-style-type: none"> Regeneration - seedbed 	Area covered with vegetation competition < 1/3	Area covered with vegetation competition < 1/3			<input type="checkbox"/> Area covered with vegetation competition < 1/3
<ul style="list-style-type: none"> Regeneration - small saplings (10 - 40 cm tall) 	When crown density < 0.6, min 10 pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings	When crown density < 0.6, some saplings of Fir, Spruce, Beech, Sycamore; influence of game!			<input type="checkbox"/> When crown density < 0.6, min 10 pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings
<ul style="list-style-type: none"> Regeneration - large saplings (40 cm tall to 12 cm dbh) 	Min. 1 group (size 2 - 5 are) per ha or canopy density > 4 %; species composition corresponding target	no large saplings		To help existing samplings - create openings; to plant Fir and Beech; reduce game influence	<input checked="" type="checkbox"/> In the openings Fir, Spruce, Sycamore, Beech 40 to 100 cm tall

current state of the forest

Trend without intervention in 10 years

Trend without intervention in 50 years

4. Need for action yes no

Next intervention:

5. Urgency small medium high

Decision –making table (Nais)

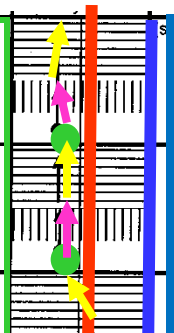
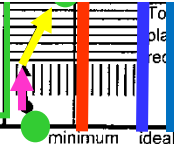
Nais / Form 2		Decision-making table		
Locality:	Pfäfers / Tristeliwald	Plot no:	Date: 01.06.2000	
1. Site type: Fir - Beech forest (18M)		Author:	R. Schwitter	
2. Natural hazard and effectiveness: Rockfall, rock-diameter 40 to 60 cm; large contribution of the forest				
3. State of the forest, trend analysis and interventions			6. Stage targets with check values	
Stand and single tree characteristics	Minimum profile (including natural hazards)	Ideal profile	To be checked in 10 years (year 2010)	
<ul style="list-style-type: none"> Species mixture (type and degree) Vertikal structure (dbh variation) Horizontal structure (% cover, gap length, stem density) State of the stability carriers (crown develop., slenderness, target dbh) Regeneration - seedbed Regeneration - small saplings (10 - 40 cm tall) Regeneration - large saplings (40 cm tall to 12 cm dbh) 	<p>Minimum profile</p> <p>Beech 30 - 70 % Fir 10 - 60 % / Spruce 0 - 30 % Sycamore seedtrees Conifers 30 - 70 % (avalanches)</p> <p>viable trees in minimum 2 different diameter classes</p> <p>Single trees or small groups; at least 300 trees/ha with dbh > 24cm; in openings in the fall line stem distance < 20 m; lying logs and high stumps</p> <p>Crown develop. Fir min. 2/3, Spruce min. 1/2; slenderness <80; straight trunks, single leaning trees only</p> <p>Area covered with vegetation competition < 1/3</p> <p>When crown density < 0.6, min 10 pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings</p> <p>Min. 1 group (size 2 - 5 are) per ha or canopy density > 4 %; species composition corresponding target</p>	<p>Ideal profile</p> <p>Beech + Fir 40 % / Spruce 60 % Sycamore seedtrees Larch +</p> <p>viable trees: 0 - 12 cm none 2 - 30 cm single trees 30 - 50 cm sufficient < 50 cm single trees</p> <p>Single trees; canopy density approx. 40 %; approx. 400 trees/ha with dbh > 24cm; openings in the fall line stem distance < 20 m;</p> <p>Crown develop. Approx. 1/3; slenderness approx. 80; some leaning trees</p> <p>Area covered with vegetation competition < 1/3</p> <p>When crown density < 0.6, some saplings of Fir, Spruce, Beech, Sycamore; influence of game!</p> <p>no large saplings</p>	<p>50 years</p>	<p>By all characteristics which in 50 years don't reach the minimum profile we are looking for effective interventions to improve the situation. If you find one, you have a need for action.</p> <p><input checked="" type="checkbox"/> In the openings Fir, Spruce, Sycamore, Beech 40 to 100 cm tall</p>
4. Need for action <input checked="" type="checkbox"/> yes <input type="checkbox"/> no		Next intervention:		
5. Urgency <input type="checkbox"/> small <input type="checkbox"/> medium <input checked="" type="checkbox"/> high				



Decision –making table (Nais)

Nais / Form 2

Decision-making table

Locality: Pfäfers / Tristeliwald		Plot no:	Date: 01.06.2000	Author: R. Schwitter	
1. Site type: Fir - Beech forest (18M)					
2. Natural hazard and effectiveness: Rockfall, rock-diameter 40 to 60 cm; large contribution of the forest					
3. State of the forest, trend analysis and interventions					
Stand and single tree characteristics	Minimum profile (including natural hazards)	Minimum profile	Ideal profile	Interventions	appropriate
<ul style="list-style-type: none"> Species mixture (type and degree) 	Beech 30 - 70 % Fir 10 - 60 % / Spruce 0 - 30 % Sycamore seedtrees Conifers 30 - 70 % (avalanches)	Beech + Fir 40 % / Spruce 60 % Sycamore seedtrees Larch +		<ul style="list-style-type: none"> seed regeneration) 	<input type="checkbox"/>
<ul style="list-style-type: none"> Vertikal structure (dbh variation) 	viable trees in minimum 2 different diameter classes	viable trees: 0 - 12 cm none 2 - 30 cm single trees 30 - 50 cm sufficient < 50 cm single trees			<input type="checkbox"/>
<ul style="list-style-type: none"> Horizontal structure (% cover, gap length, stem density) 	Single trees or small groups; at least 300 trees/ha with dbh > 24cm; in openings in the fall line stem distance < 20 m; lying logs and high stumps	Single trees; canopy density approx. 40 %; approx. 400 trees/ha with dbh >			<input type="checkbox"/>
<ul style="list-style-type: none"> State of the stability carriers (crown develop., slenderness, target dbh) 	Crown develop. Fir min. 2/3, Spruce min. 1/2; slenderness <80; straight trunks, single leaning trees only				<input type="checkbox"/>
<ul style="list-style-type: none"> Regeneration - seedbed 	Area covered with vegetation competition < 1/3				<input type="checkbox"/>
<ul style="list-style-type: none"> Regeneration - small saplings (10 - 40 cm tall) 	When crown density < 0.6, min 10 pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings				<input type="checkbox"/>
<ul style="list-style-type: none"> Regeneration - large saplings (40 cm tall to 12 cm dbh) 	Min. 1 group (size 2 - 5 are) per ha or canopy density > 4 %; species composition corresponding target	no large saplings		To help existing samplings - create openings; to protect Fir and Beech; reduce game influence	<input checked="" type="checkbox"/>
<p>Stage target with check values (to be checked in 10 years) Did we reach the targets? Why? Why not?</p>					
6. Stage targets with check values					
To be checked in 10 years (year 2010)					
equal 2000					
viable trees: 0 - 12 cm sufficient 12 - 30 cm single trees 30 - 50 cm sufficient < 50 cm single trees					
Single trees; canopy density at least 40 %; at least 300 trees/ha with dbh > 24cm; openings in the fall line stem distance < 20 m; lying logs and high stumps					
Crown develop. Approx. 1/3; slenderness approx. 80; single leaning trees only					
Area covered with vegetation competition < 1/3					
When crown density < 0.6, min 10 pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings					
In the openings Fir, Spruce, Sycamore, Beech 40 to 100 cm tall					
4. Need for action <input checked="" type="checkbox"/> yes <input type="checkbox"/> no		Next intervention:		5. Urgency <input type="checkbox"/> small <input type="checkbox"/> medium <input checked="" type="checkbox"/> high	



success monitoring - controlling

Get a high protection effect on a way as efficient as possible.

New knowledge and experience should be used as fast as possible in the practice.

- 1. Implementation assessment**
- 2. Effectivity analysis**
- 3. Silvicultural monitoring**
- 4. Target review**



Implementation assessment

Are the planned intervention carried out professionally and on the right sites?

The implementation of the protection forest management should be able to get checked with a simple sampling method in the field.

You need an implementation plan and a basic intervention description for every unit.



1997



2000

Effectivity analysis

Do the completed interventions have the expected effect on the state of the forest?

The local manager monitors and documents the development.

The experiences enable the protection forest management to be highly effective.

The effectivity analysis promotes the professional competence of the manager.



Requirements on indicator plot for effectivity analysis

- Establishment for long-term use (durable markings)**
- Involvement of local manager (identification)**
- Implementation assessment after harvesting**
- Continuous observation of development (1 visit / year)**
- Periodical effectivity analysis (every 5 or 10 years)**

- simple database (no cemetery of data)**
- strict database management**

Effectivity analysis

NaiS / Form 5

Effectivity analysis

Locality: Pfäfers / Tristelwald		Date:		Effectivity analysis Are the stage targets achieved? - What changed? yes/ - What is the reason? No - Was the action effective?	
Indicator plot no.:		Author:			
Stand a char:	minimum profile	state of the forest	stage target	Current state of the forest	Year
• Species mixture (type and degree)	Beech 30 - 70 % Fir 10 - 60 % / Spruce 0 - 30 % Sycamore seedtrees Conifers 30 - 70 % (avalanches)	Beech + Fir 40 % / Spruce 60 % Sycamore seedtrees Larch +	equal 2000		<input type="checkbox"/>
• Vertikal structure (dbh variation)	viable trees in minimum 2 different diameter classes	viable trees: 0 - 12 cm none 12 - 30 cm single trees 30 - 50 cm sufficient < 50 cm single trees	viable trees: 0 - 12 cm sufficient 12 - 30 cm single trees 30 - 50 cm sufficient < 50 cm single trees		<input type="checkbox"/>
• Horizontal structure (% cover, gap length, stem density)	Single trees or small groups; at least 300 trees/ha with dbh > 24cm; in openings in the fall line stem distance < 20 m; lying logs and high stumps	Single trees; canopy density approx. 80 %; approx. 400 trees/ha with dbh > 24cm; openings in the fall line stem distance < 20 m;	Single trees; canopy density at least 60 %; at least 300 trees/ha with dbh > 24cm; openings in the fall line stem distance < 20 m; lying logs and high stumps		<input type="checkbox"/>
• State of the stability carriers (crown develop., slenderness, target dbh)	Crown develop. Fir min. 2/3, Spruce min. 1/2; slenderness < 80; stright trunks, single leaning trees only	Crown develop. Approx. 1/3; slenderness approx. 80; some leaning trees	Crown develop. Approx. 1/3; slenderness approx. 80; single leaning trees only		<input type="checkbox"/>
• Regeneration - seedbed	Area covered with vegetation competition < 1/3	Area covered with vegetation competition < 1/3	Area covered with vegetation competition < 1/3		<input type="checkbox"/>
• Regeneration - small saplings (10 - 40 cm tall)	When crown density < 0.6, min 10 pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings	When crown density < 0.6, some saplings of Fir, Spruce, Beech, Sycamore; influence of game!	When crown density < 0.6, min 10 pieces of Beech/Fir per are (approx. Every 3m); there is Sycamore in the openings		<input type="checkbox"/>
• Regeneration - large saplings (40 cm tall to 12 cm dbh)	Min. 1 group (size 2 - 5 are) per ha of canopy density > 4 %; species composition corresponding target	no large saplings	in the openings Fir, Spruce, Sycamore, Beech 40 to 100 cm tall		<input type="checkbox"/>
Remarks:					

This informations you get from form 2 which was filled out 5 – 10 years ago







Silvicultural monitoring

Does the state of the forest correspond to the target profiles?

The silvicultural monitoring gives information about the protective effect of the forests in a region.

The silvicultural monitoring gets carried out on a superior level.

The target profiles give the criteria for the silvicultural monitoring.



Target review

Are the defined target profiles advisable?

It is the job of the research to examine the effect of the forest on the natural hazards.

With the effectivity analysis on the indicator plots we get experience of the field.

Controlling and monitoring in protection forests (Nais)

Protection forest

success monitoring

Site types

Natural hazards

Target profiles

Target review

Target types, treatment types

Indicator plots

Effectivity analysis

Deciding about the need for
action on indicator plots

Implementations of
interventions

Implementation
assessment

Sustainably effective
protection forests

Silvicultural monitoring



Management of protection forests:

- ▶ **Actual level of knowledge - ready for practical use**
- ▶ **Target review - basis gets improved**
- ▶ **Effectivity analysis – the realization gets accompanied critically**

Implementation

Education on all levels:

Education center of forest in Maienfeld and Lyss

University of applied sciences (BFH) in Zollikofen

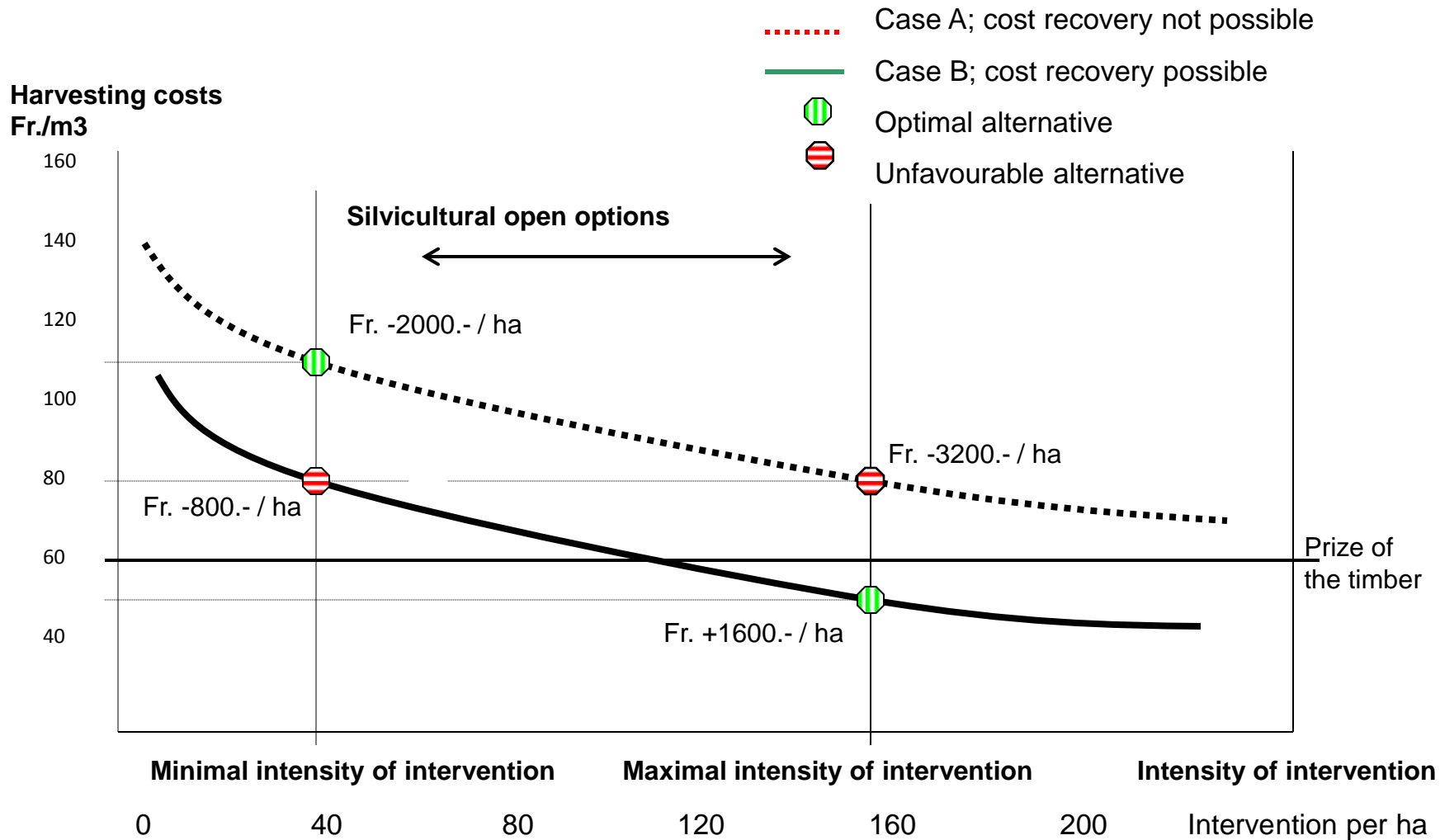
Swiss federal institute of technology (ETH) in Zürich

Center for mountain forestry in Maienfeld

A lot of **Implementation-workshops** in the field
– each forester with protection forest was at
least in one workshop.

Workshops treating the **intensity of
intervention**

Influence of the intensity of the intervention on the costs per handled area



Normally the silvicultural open options are much more narrow in stands with rockfall than in stands with other natural hazards, and they are also decreasing if the present condition is far away from the minimum profile, on the bad side.

Homepage for storing data indicator plots

SuisseNaiS Weiserflächen-Plattform

Weiserflächen Suche

Kanton	Alle	▼
Gemeinde	Alle	▼
Naturgefahr	Alle	▼
Standortstypen-Gruppe	Alle	▼
Standortstyp	Alle	▼

Erweiterte Suche :

Behandlungstyp 1	Alle	▼
Behandlungstyp 2	Alle	▼
Schlagwort Waldbau 1	Alle	▼
Schlagwort Waldbau 2	Alle	▼
Schlagwort Holzernte 1	Alle	▼
Schlagwort Holzernte 2	Alle	▼
Wirkungsanalyse	Alle	▼

Suchen

