agroselviter

Dipartimento di Agronomia,
Selvicoltura e Gestione del territorio

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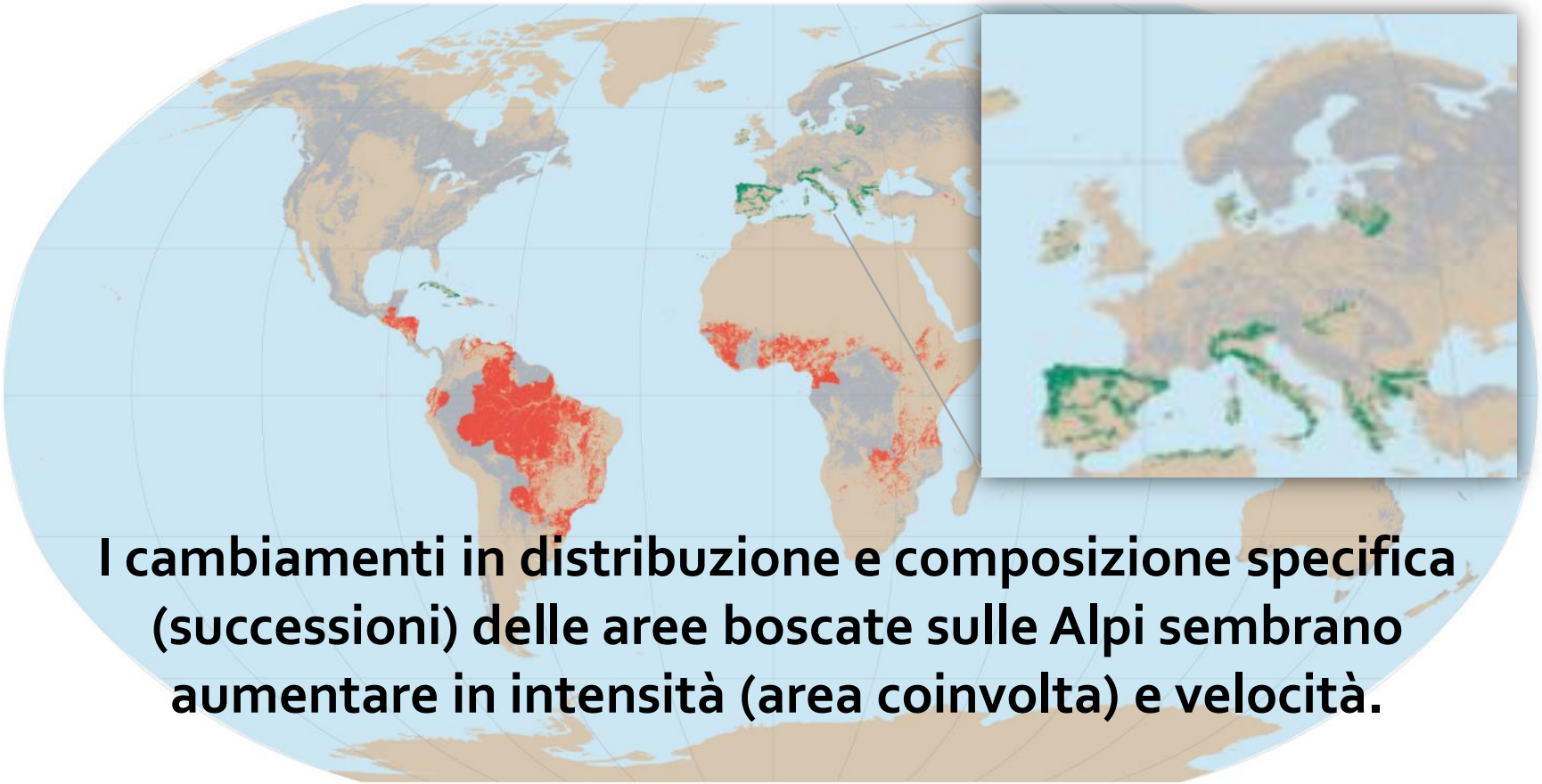
Dinamiche forestali nelle pinete di pino silvestre delle Alpi occidentali

Paesaggio forestale, "land use change" e "climate change"
Strumenti di analisi, modelli ed applicazioni in foreste europee e dell'America Settentrionale

29 Settembre 2008. Facoltà di Agraria – Università degli Studi di Torino, Grugliasco (TO)

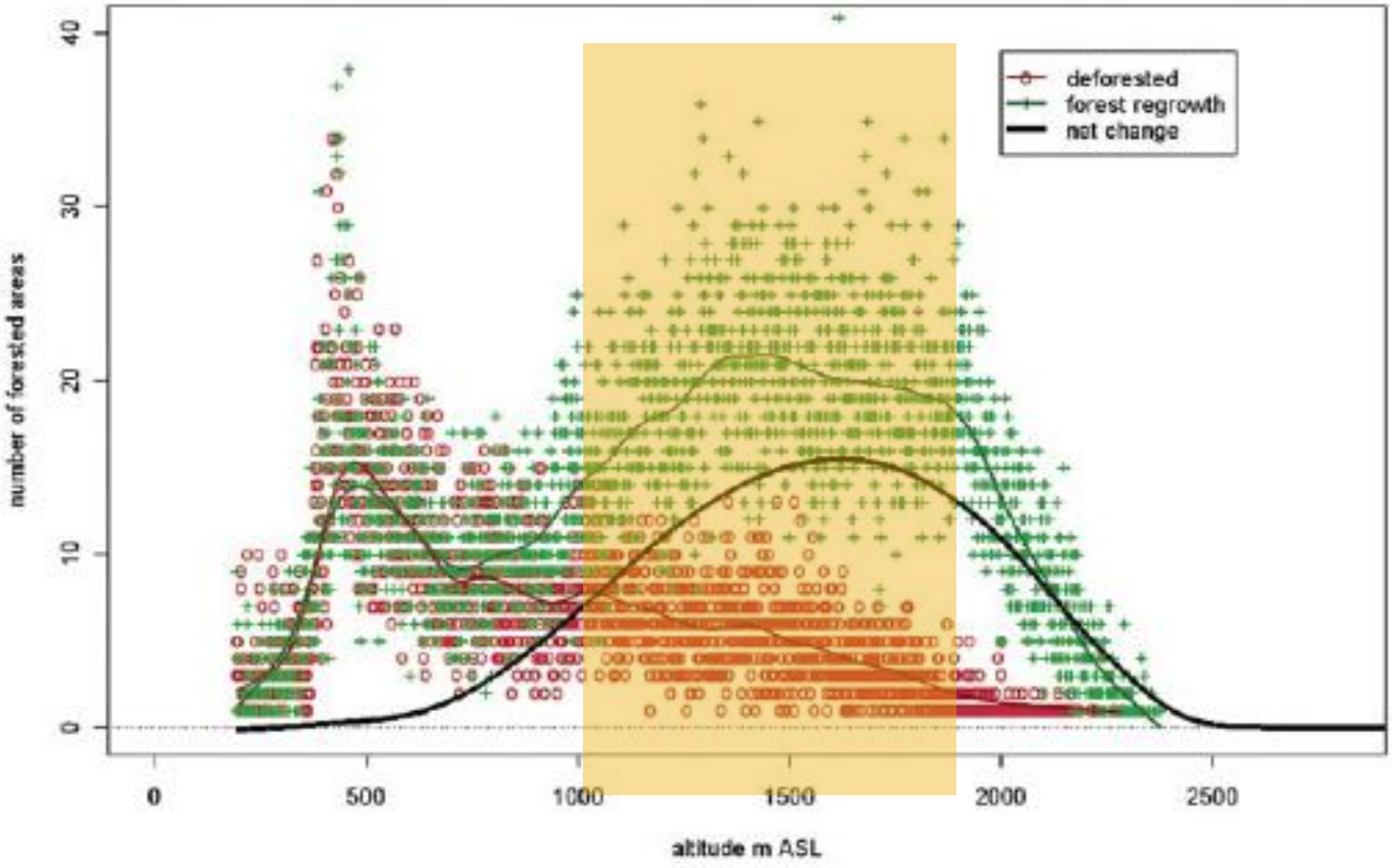
Successioni



I cambiamenti in distribuzione e composizione specifica (successioni) delle aree boscate sulle Alpi sembrano aumentare in intensità (area coinvolta) e velocità.

Successioni

Changes in forested areas 1985-1997 (grain: 1 ha)

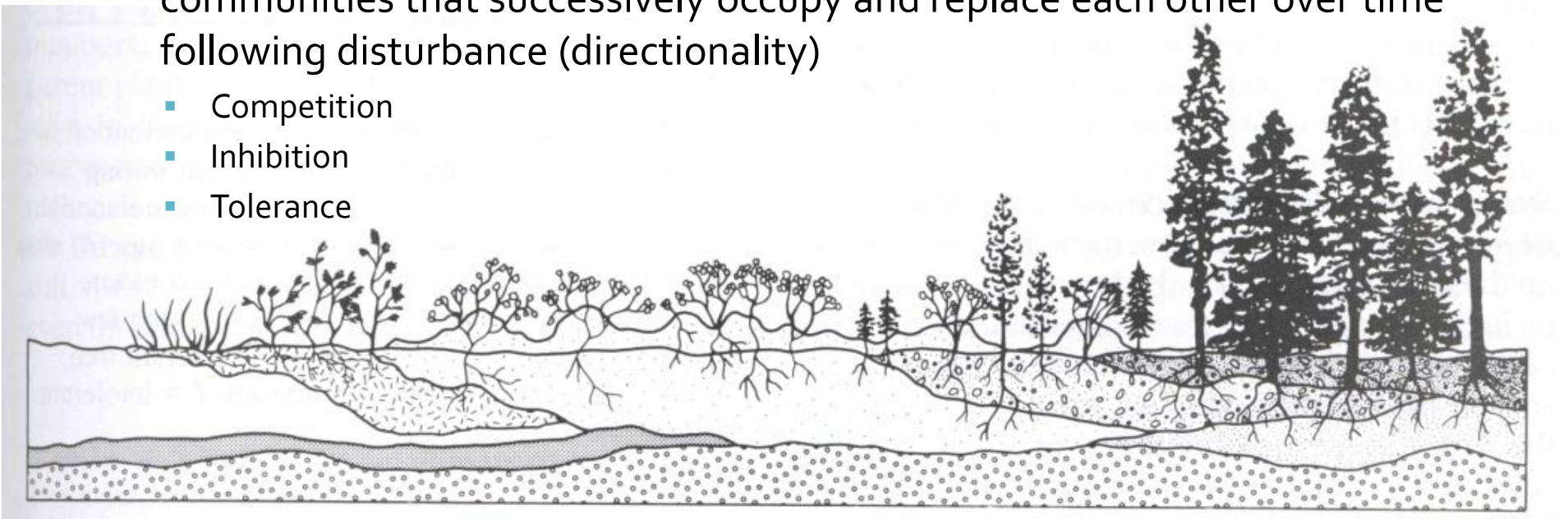


Data source: Swiss land use statistics. *GEOSTAT 2007*

Successioni

- The orderly and directional process of one plant community gradually or rapidly replacing another
  - AUTOGENIC: driven by stand development and evolution of the ecosystem itself
  - ALLOGENIC: driven by outer sources, often abiotc

- In a particular environment, there is a characteristic sequence of biotic communities that successively occupy and replace each other over time following disturbance (directionality)
  - Competition
  - Inhibition
  - Tolerance



Successioni

- **Primary succession** is the establishment and development of plant communities in newly formed habitats previously lacking any life form:
  - sand dunes
  - lava flows
  - rock bared by landslides or retreating glaciers
  - drained bogs

16.8.1888 **27.8.2006**

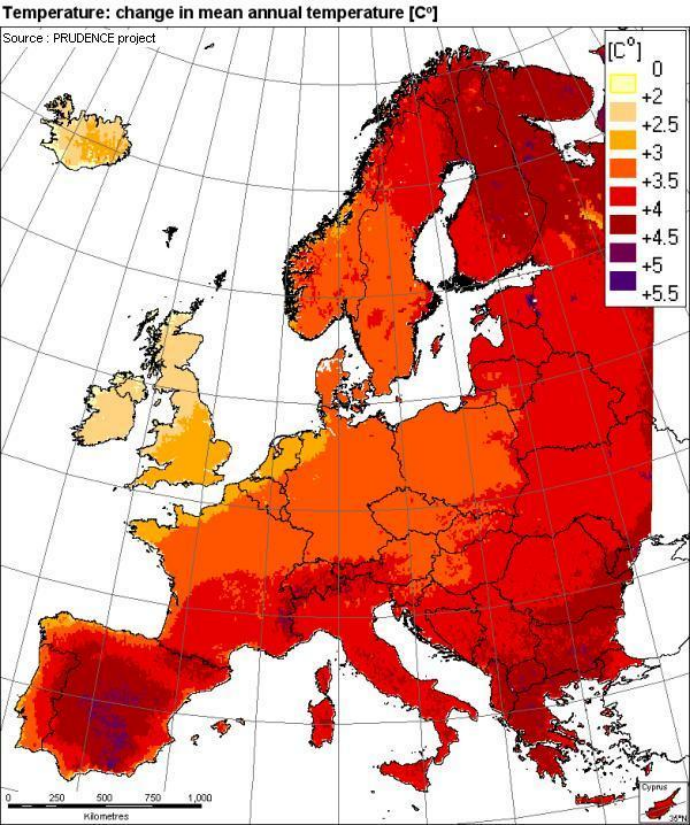

Successioni

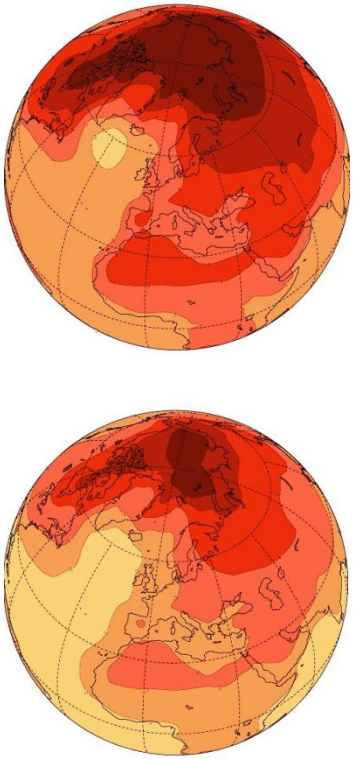
- **Secondary succession** occurs after a disturbance (establishment of the new community):
  - breaks in a forest canopy are closed as individuals take advantage of new opportunities (light and other resources) – "gap succession"
  - secondary successions may be initiated by a number of different processes:
    - abandonment of agricultural land
    - various kinds of wind disturbances, such as hurricanes
    - fires or disturbances by animals

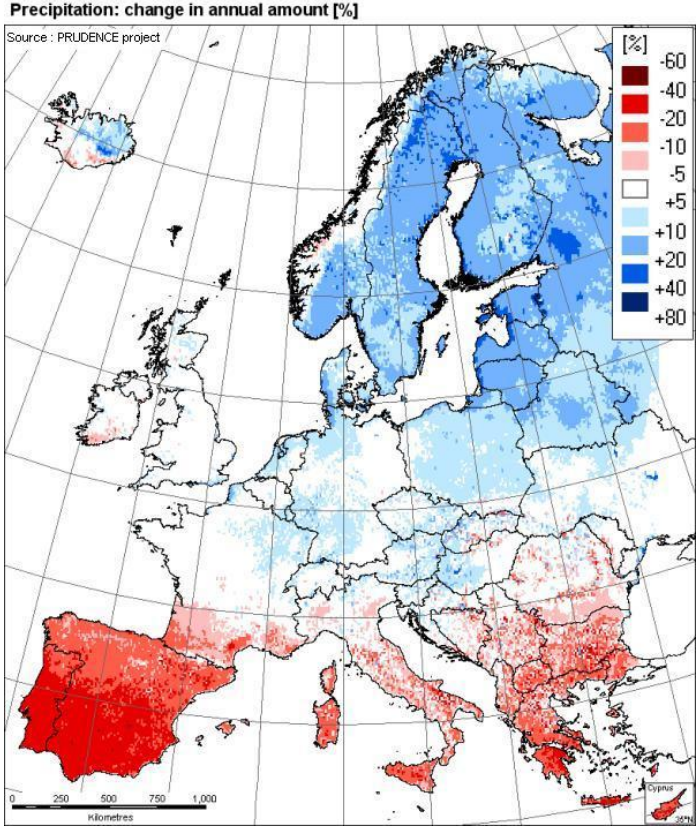


Cause: Climate change

Average of all IPCC Models: Temperature Change in 2070
IPCC SRES Scenarios a2 (left) und b2 (right)

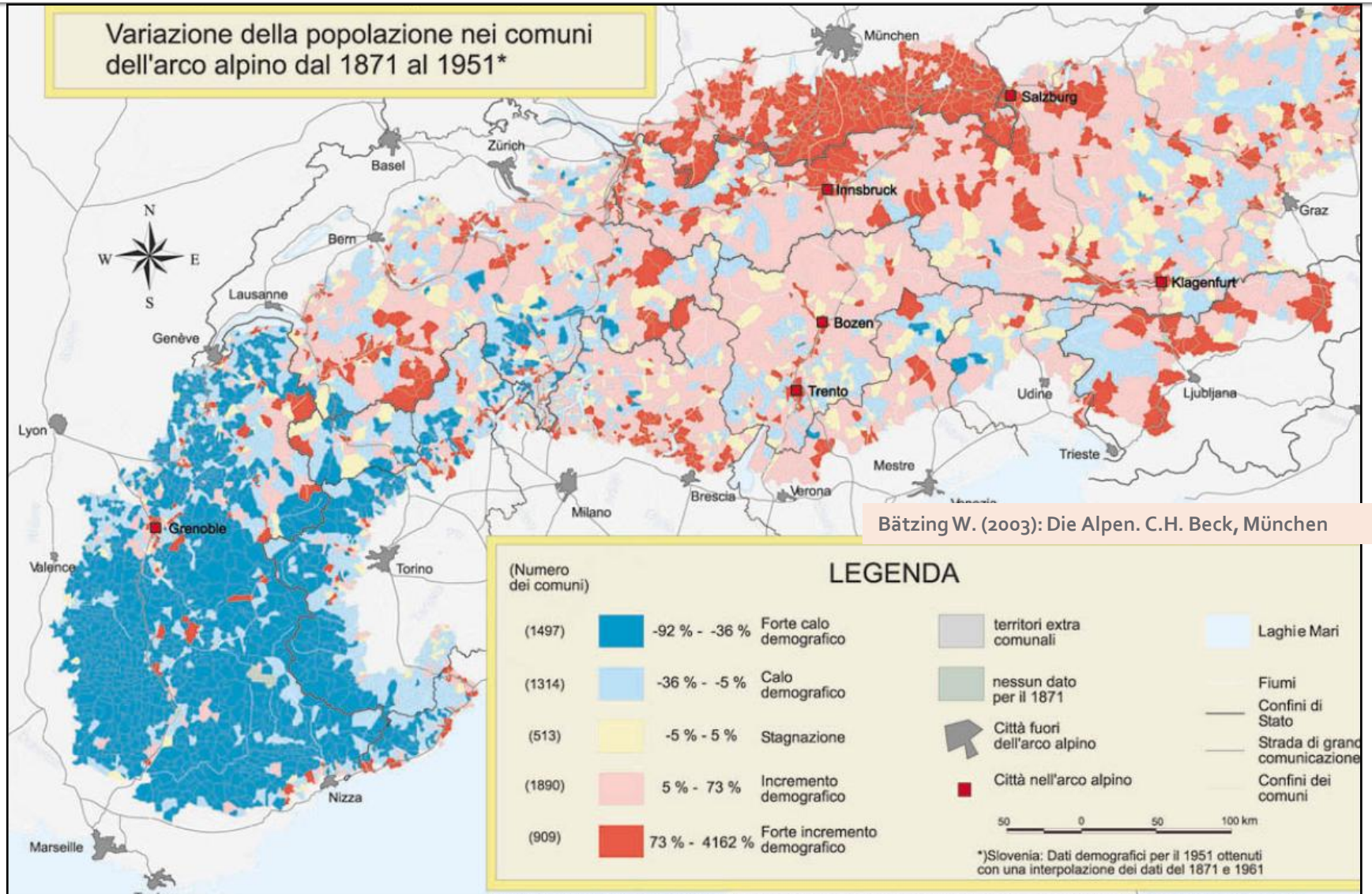






Data source: IPCC 4th assessment report, *2007*

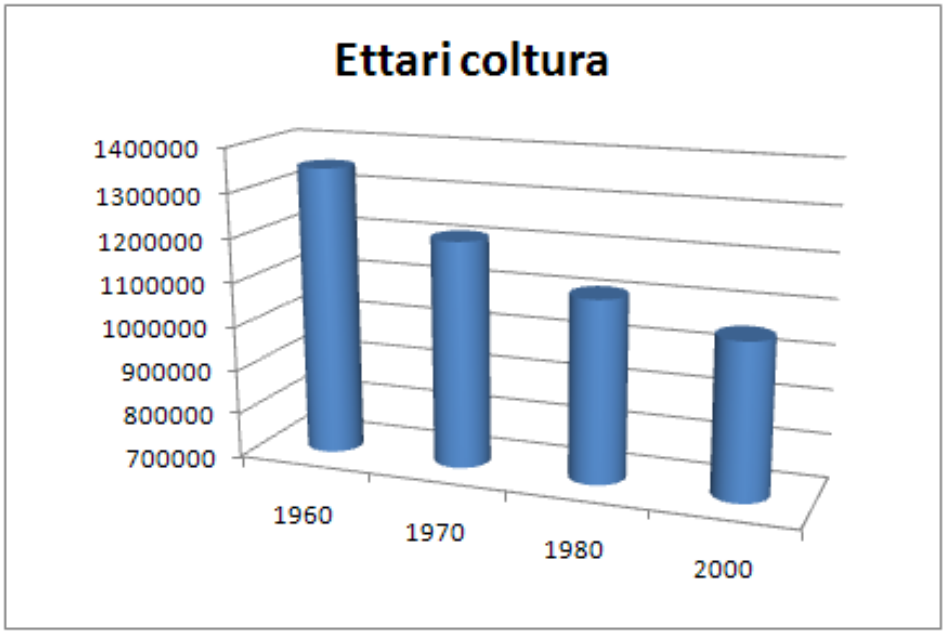
Cause: Land abandonment

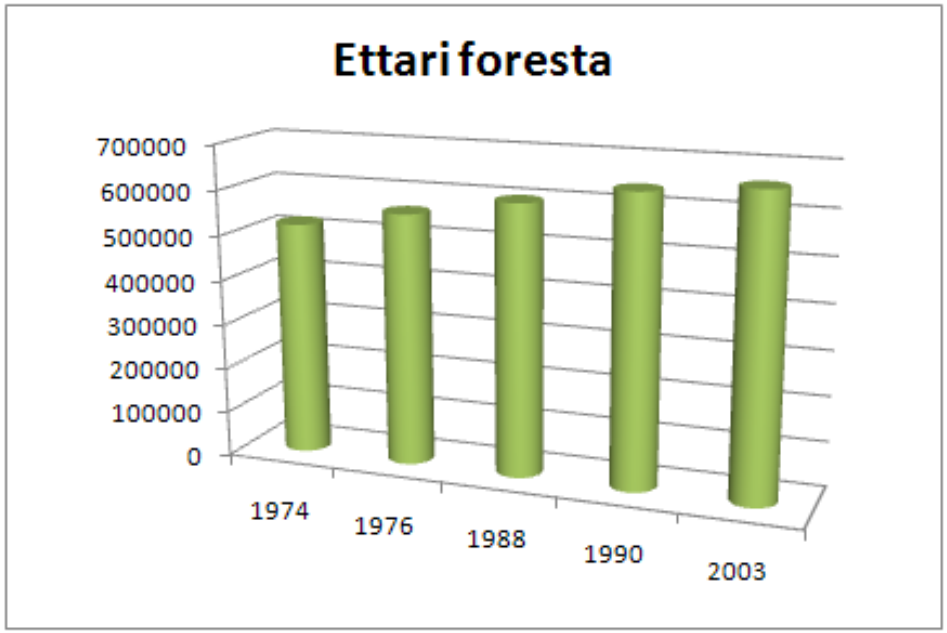


Bätzing W. (2003): Die Alpen. C.H. Beck, München

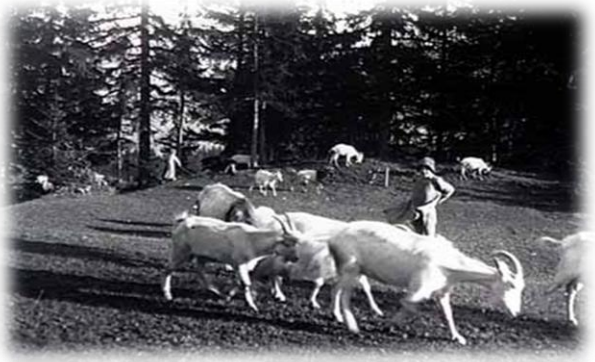
Land use change

Decreasing trend of <u>cultivated lands</u> and increase of <u>forest cover</u> in Piedmont region (ISTAT, 2000)

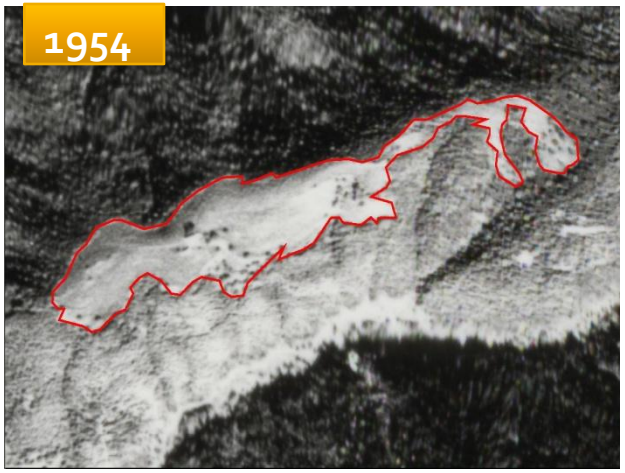


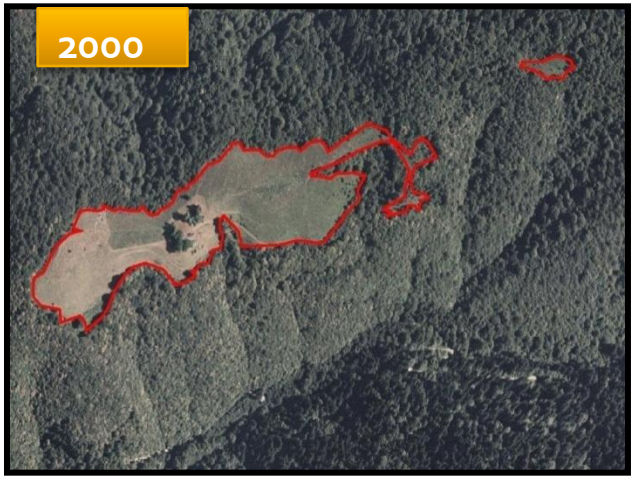


Land use change



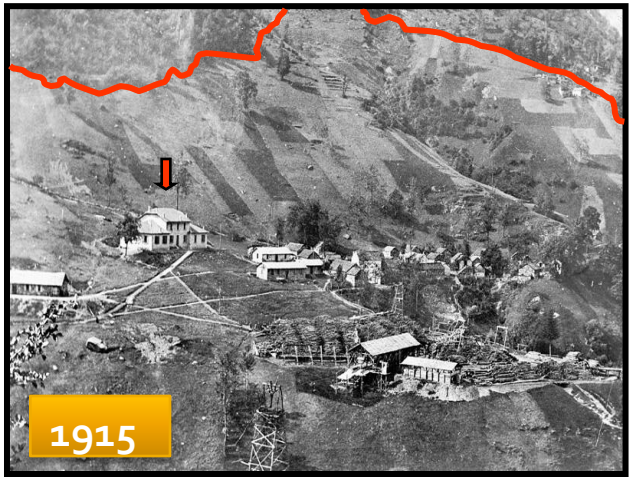
Traditional practices in Wallis (CH)

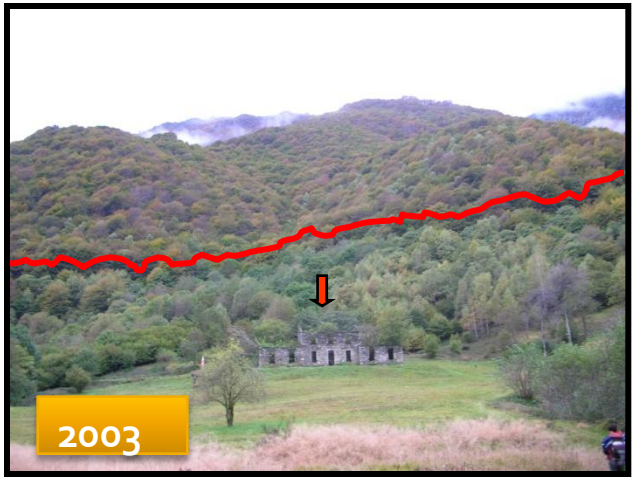




Old field succession in Valle Pesio (CN,) above, and Valle Grande (VB), below

(Calvo 2007, MS thesis Univ.Turin; Garbarino & Pividori 2006, Forest@ 3)



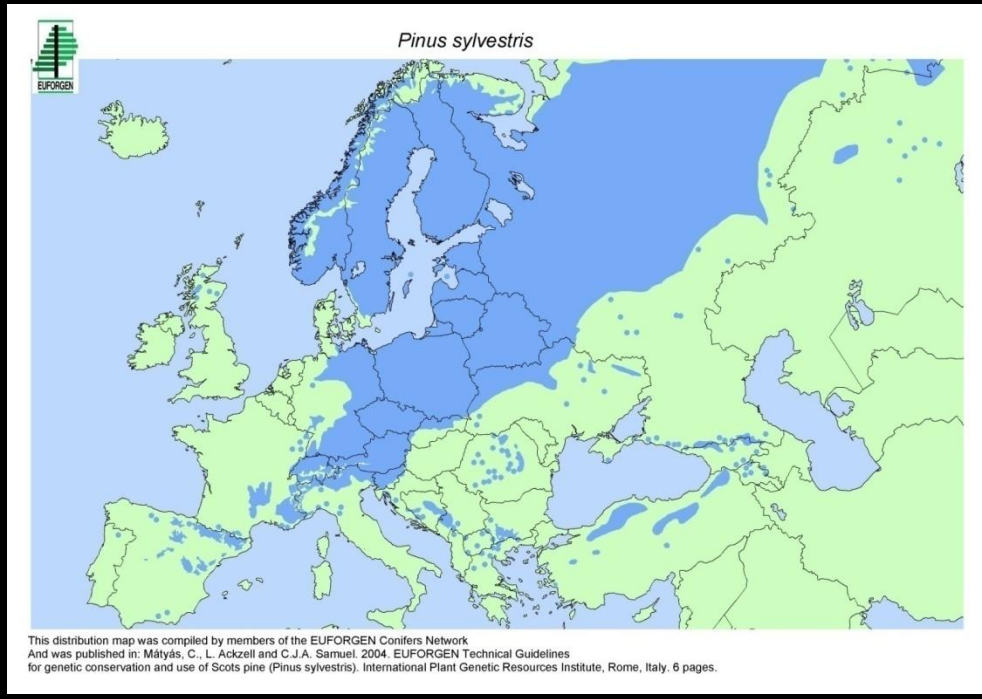


Problem statement

Cambiamenti di uso del suolo
Cambiamento climatico

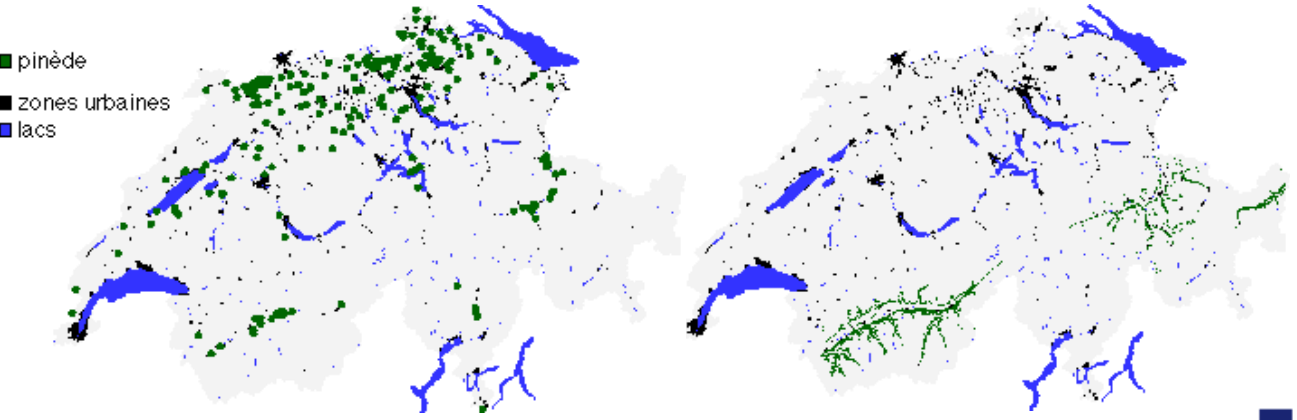
Espansione e contrazione dei popolamenti
Impatto sull'accrescimento e sulla struttura
Dinamiche successionali

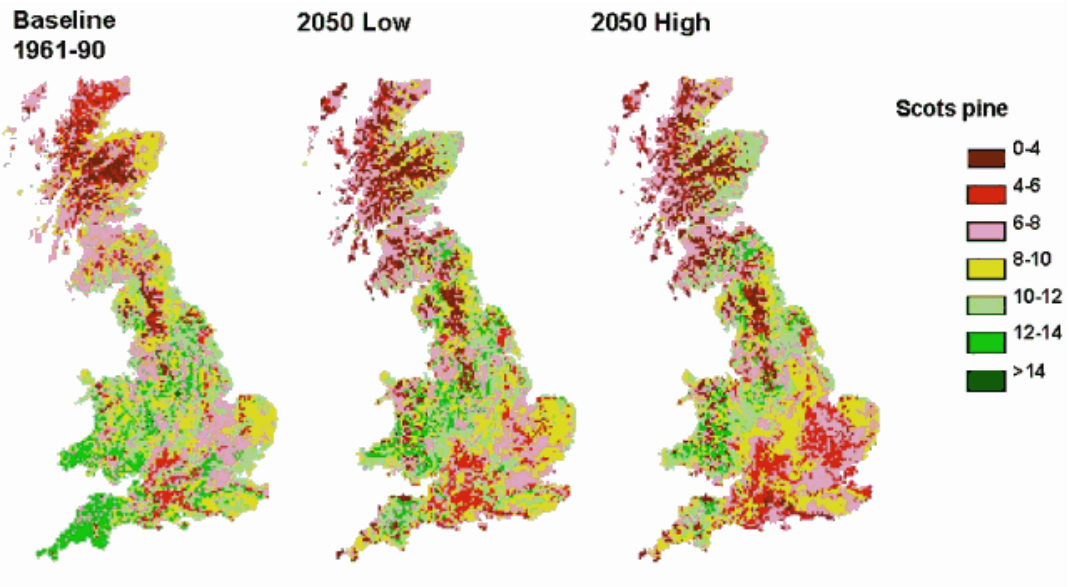
Il pino silvestre

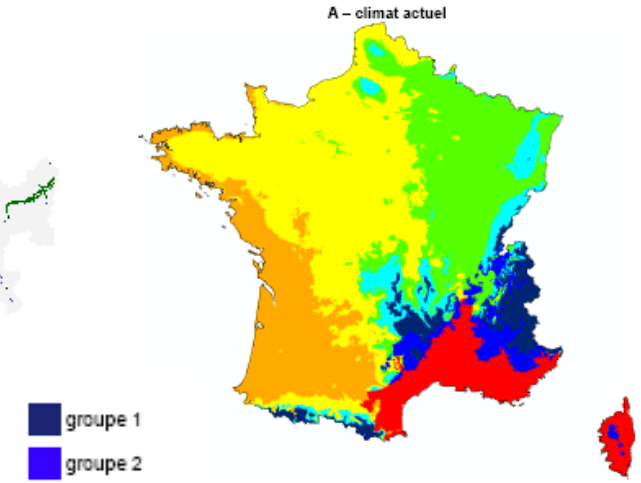


- 31.000 ha nelle Alpi W
- Dal piano basale al montano
- Elevata plasticità
- Settori oceanici (pioniera) e continentali (stabile)
- Ecotipi locali
- Multifunzionalità della foresta

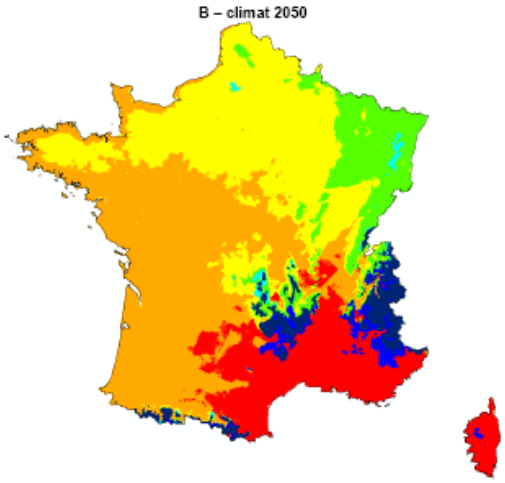
Scenari futuri (2000-2050)







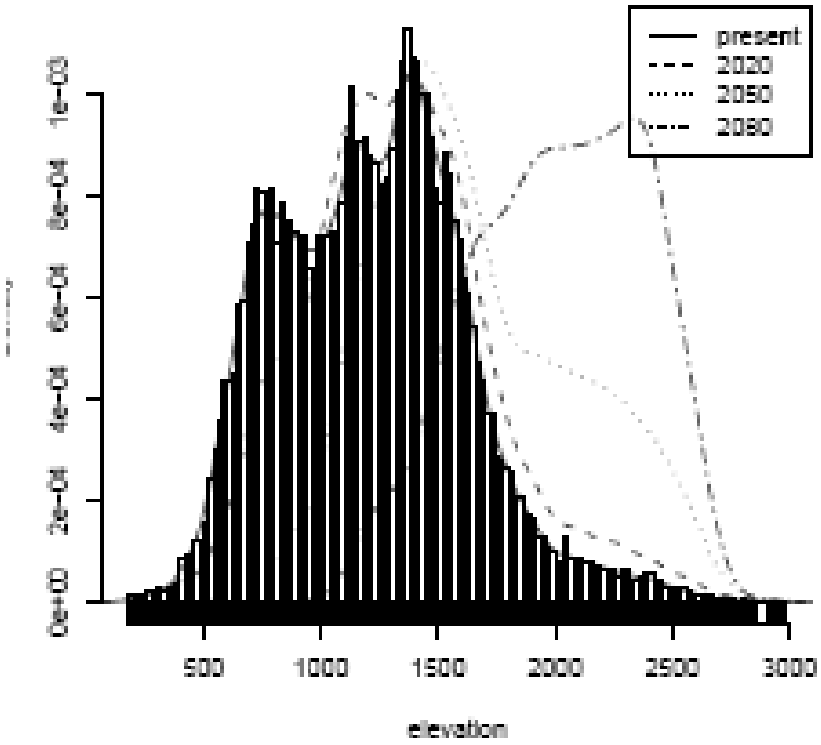
Pino silvestre e latifoglie termofile



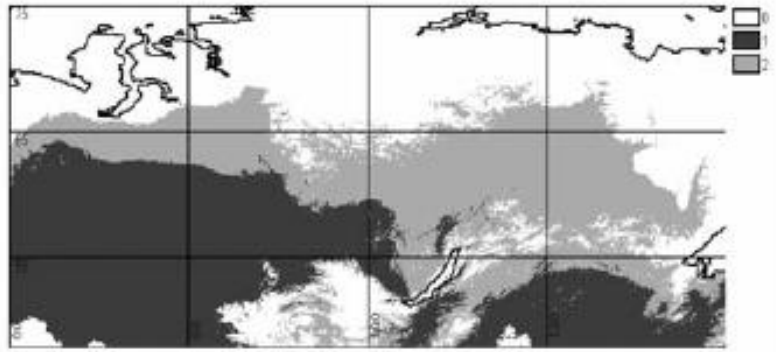
Sources: Kienast et al. 2007, UK Forestry Commission 2003, CARBOFOR France 2004

Scenari futuri

Benito Garzòn et al. 2008, Applied Vegetation Science (in press)

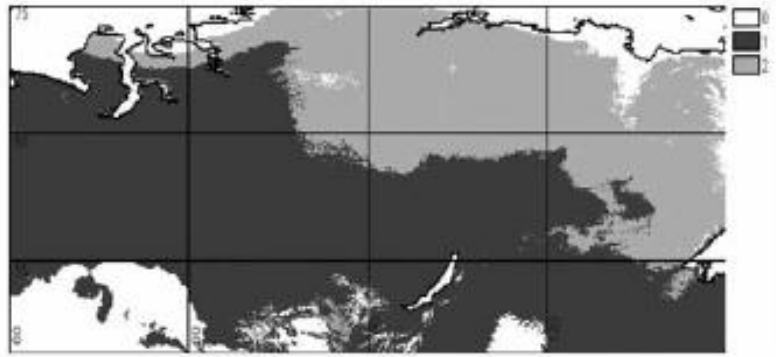


Spain (2000-2080): altitudinal shift of **800 to 1000 m**



b.

Tchebakova Nadezda et al. 2006, Mitigation and Adaptation Strategies for Global Change 11



c.

Russia (2000-2090): latitudinal shift of **500 to 1000 km**

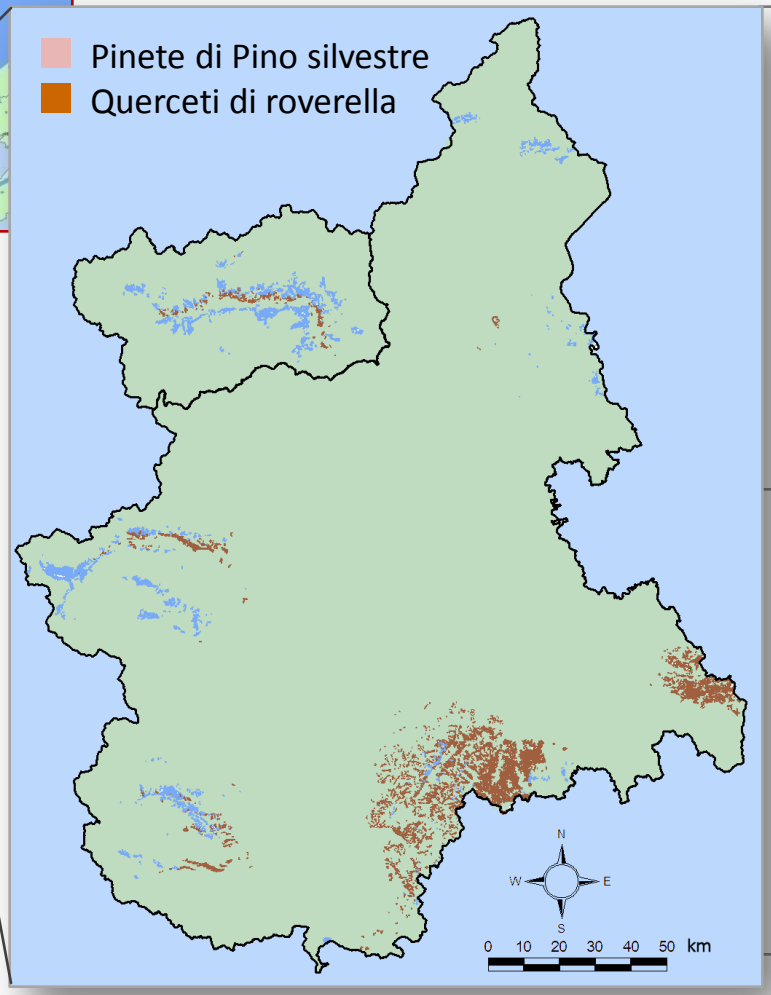
Il pino silvestre

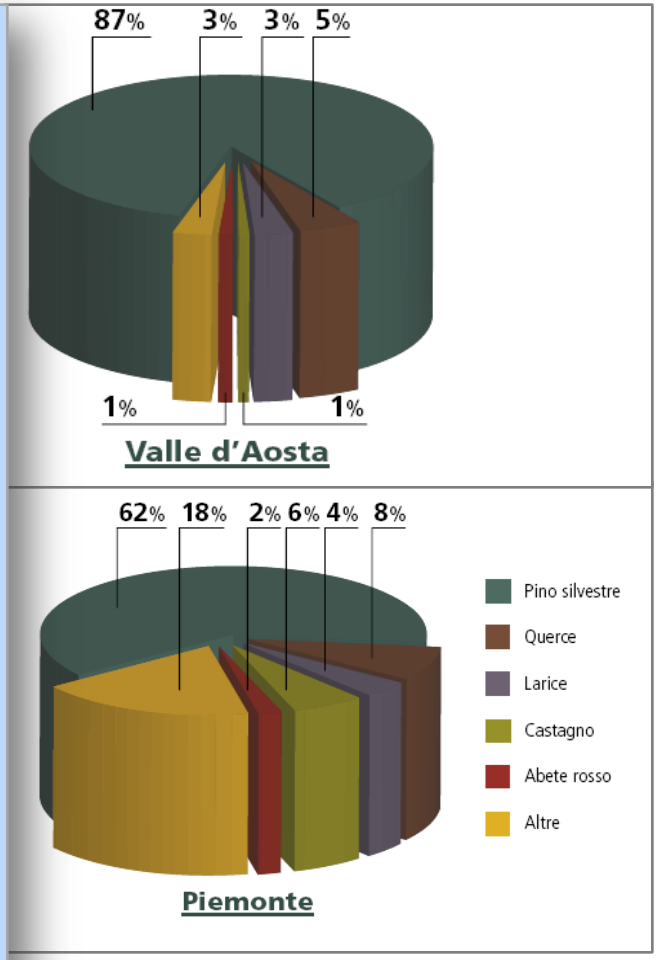
La specie esibisce una risposta rapida ai cambiamenti ambientali e di uso del suolo.

Ampie superfici sono in trasformazione (espansione o contrazione) in aree legate alle attività antropiche.

Risposta a land use e climate change?
Sostenibilità della risorsa
(protezione, produzione, paesaggio…)

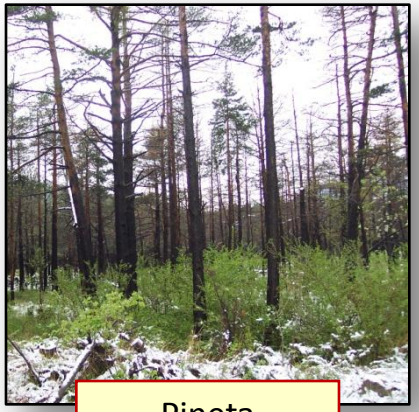
Area di studio (2004-08)



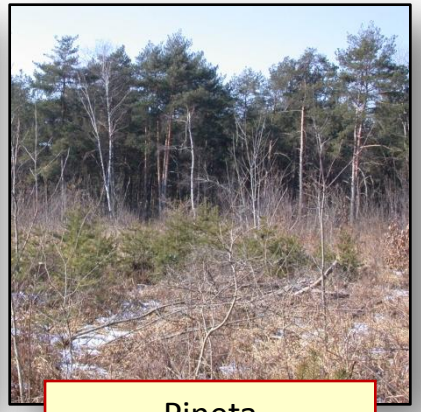


*Base map: www.ipgri.cgiar.org/Networks/euforgen/Distribution_Maps/Maps/Pinus%20sylvestris%20big.jpg

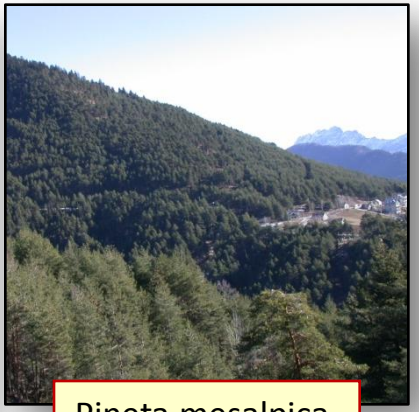
Stato e diffusione delle Pinete



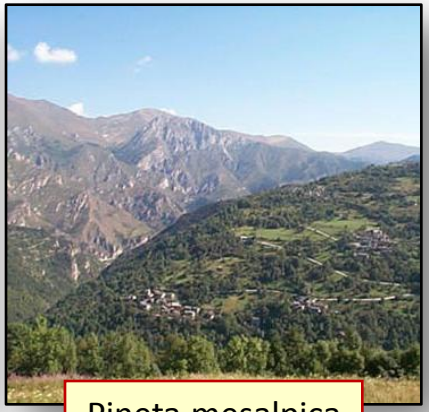
Pineta
di greto



Pineta
di brughiera



Pineta mesalpica
acidofila



Pineta mesalpica
basifila

Pineta endalpica
basifila

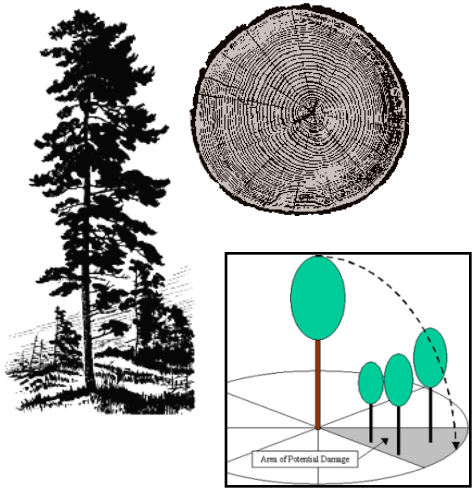
Pineta endalpica
acidofila

Pineta endalpica
mesoxerofila

Pineta dei
Rilievi collinari

Scala di analisi

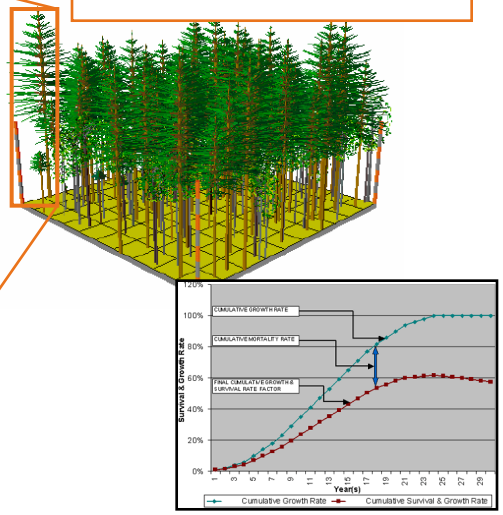
Individuo



5-10 anni

Aree di monitoraggio
Rilievo dendroauxometrico
Rilievo fitosanitario

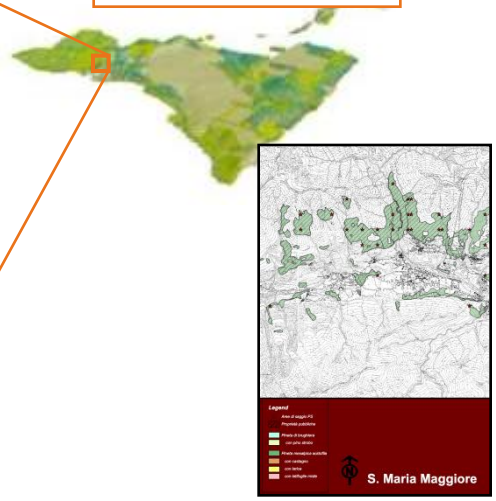
Popolamento



10-50 anni

Rilievo dendrocronologico
Rilievo fitosanitario
Rilievo climatico real-time
Inventari forestali

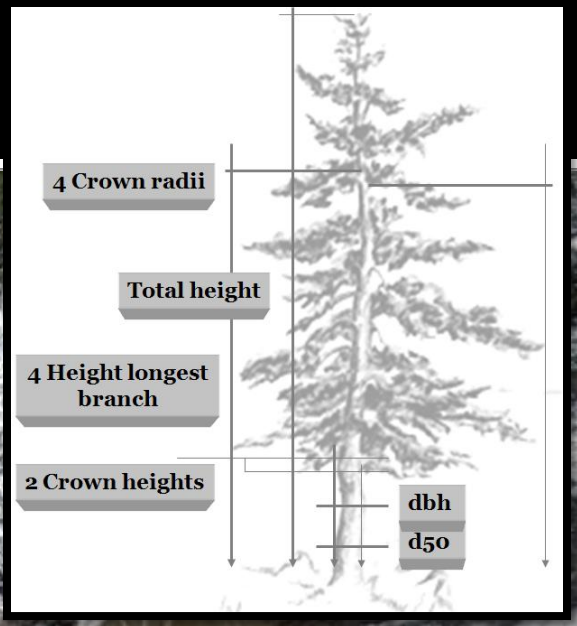
Paesaggio



50-100 anni

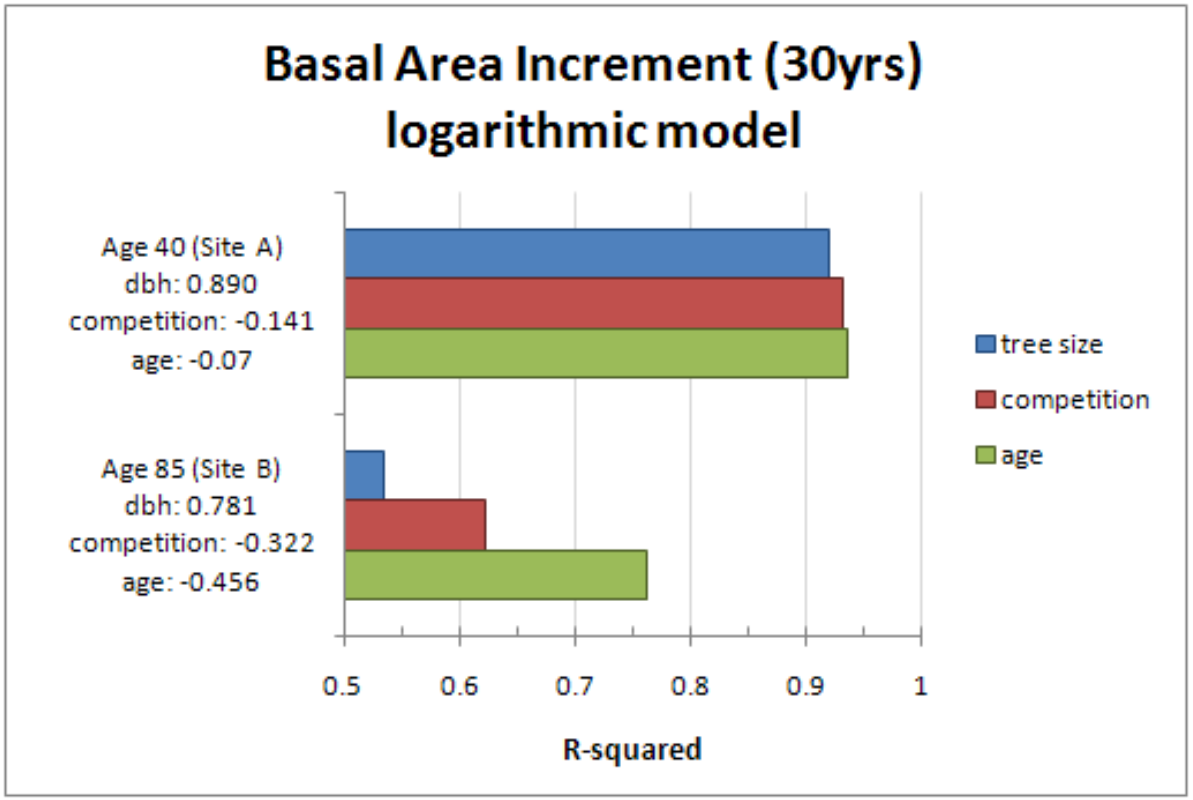
Aerofotogrammi storici
Serie climatiche
Dati telerilevati (sat)

I. Dinamiche endogene



	Location	*UTM*	*Elevation [m]*	*Slope.*	*Aspect*	*Age*
1	Challand St. Anselme (AO)	5062482 N 402270 E	1116	40%	W	90
2	St.Denis (AO)	5068071 N 387870 E	985	62%	SW	30
3	St.Denis (AO)	5068444 N 389978 E	1350	34%	SW	125
4	Morgex (AO)	5069859 N 344753 E	1091	77%	S	90
5	Borgo Ticino (NO)	5060489 N 467254 E	320	flat	-	100
6	S. Maria Maggiore (VB)	5110657 N 457763 E	1050	40%	E	45
7	Toceno (VB)	5110964 N 458567 E	1050	80%	W	90-130
8	Trasquera (VB)	5118744 N 439503 E	1247	30%	SE	100-300

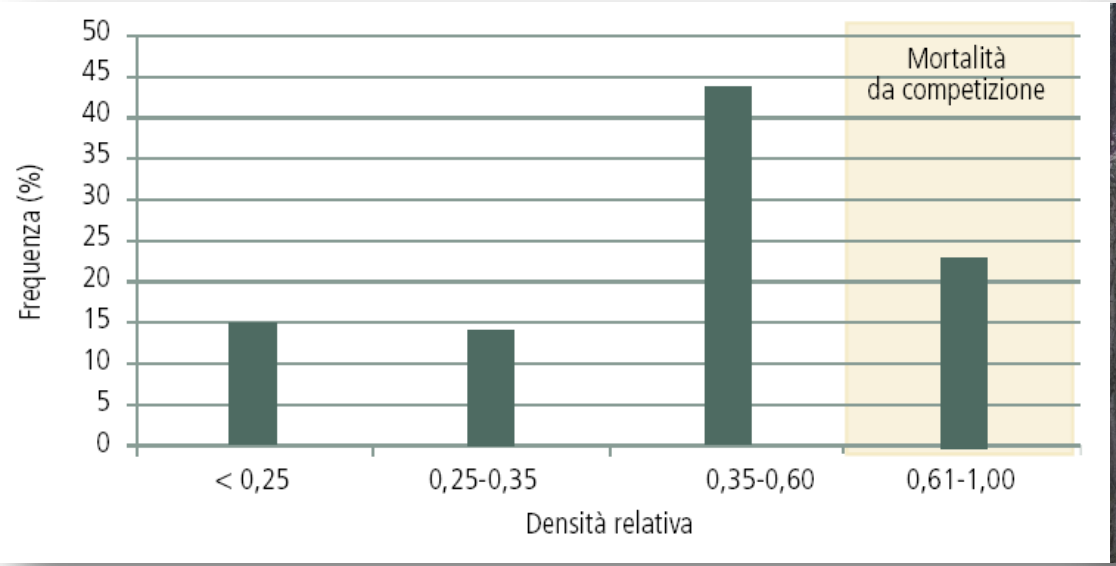
Competizione

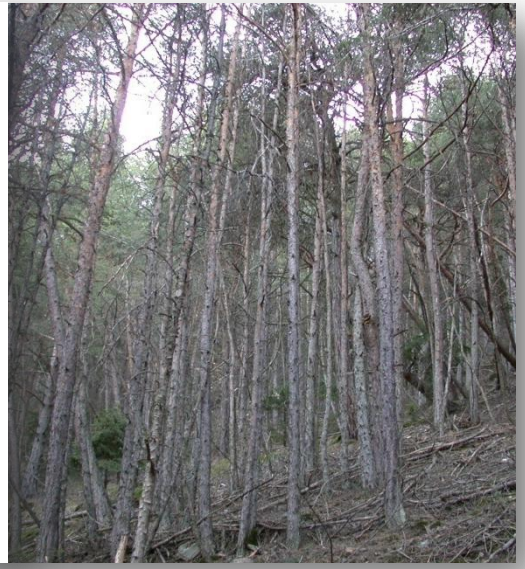


Radius: 10 m
Crown competition index

Radius: 5 m
Relative height index

Mortalità

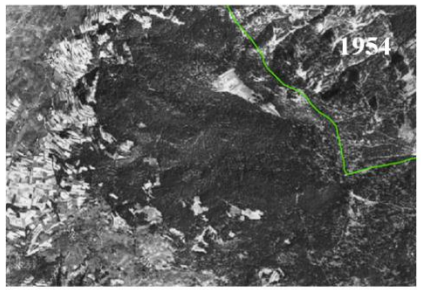




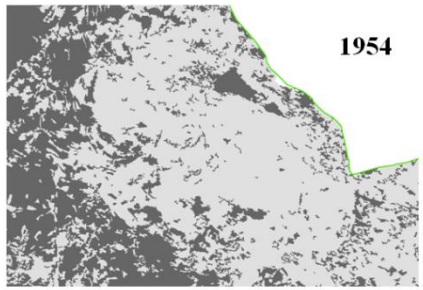
<u>Competizione per la luce</u>: motore delle dinamiche (accrescimento, mortalità, rinnovazione)

II. Land abandonment

Orthophoto

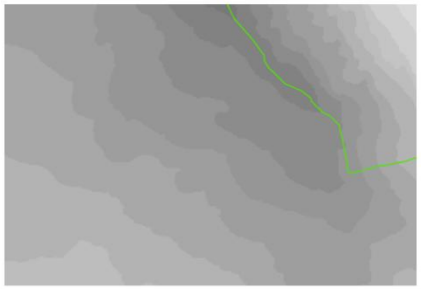


Land Use

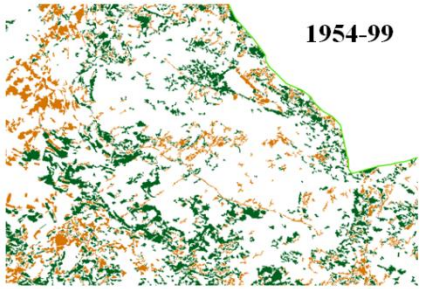


Landscape metrics

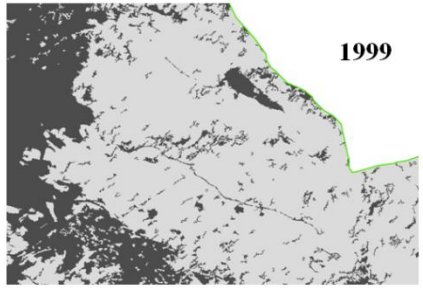
Elevation



Land Use Changes

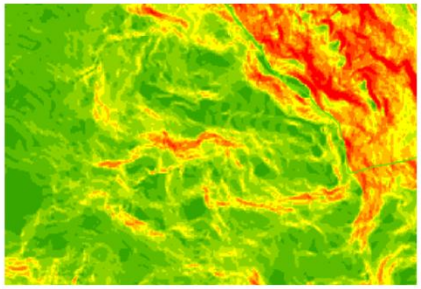


Topographic features Analysis

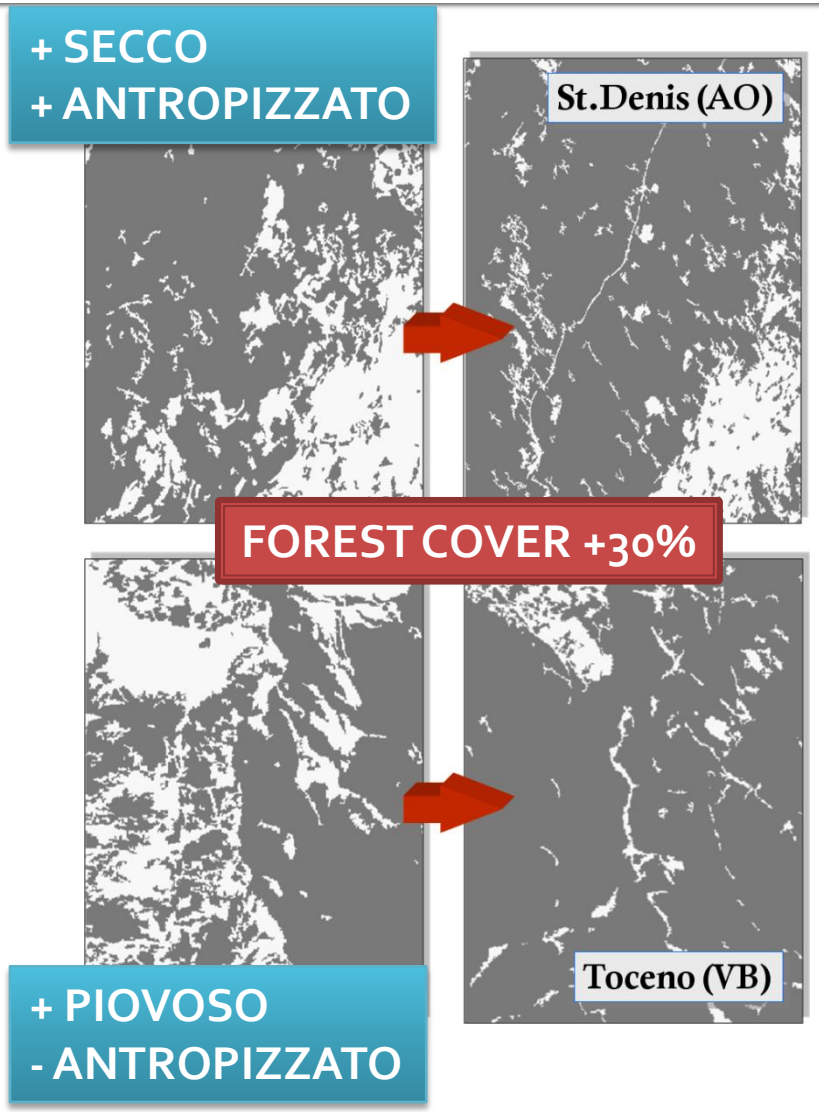


Landscape metrics

Slope



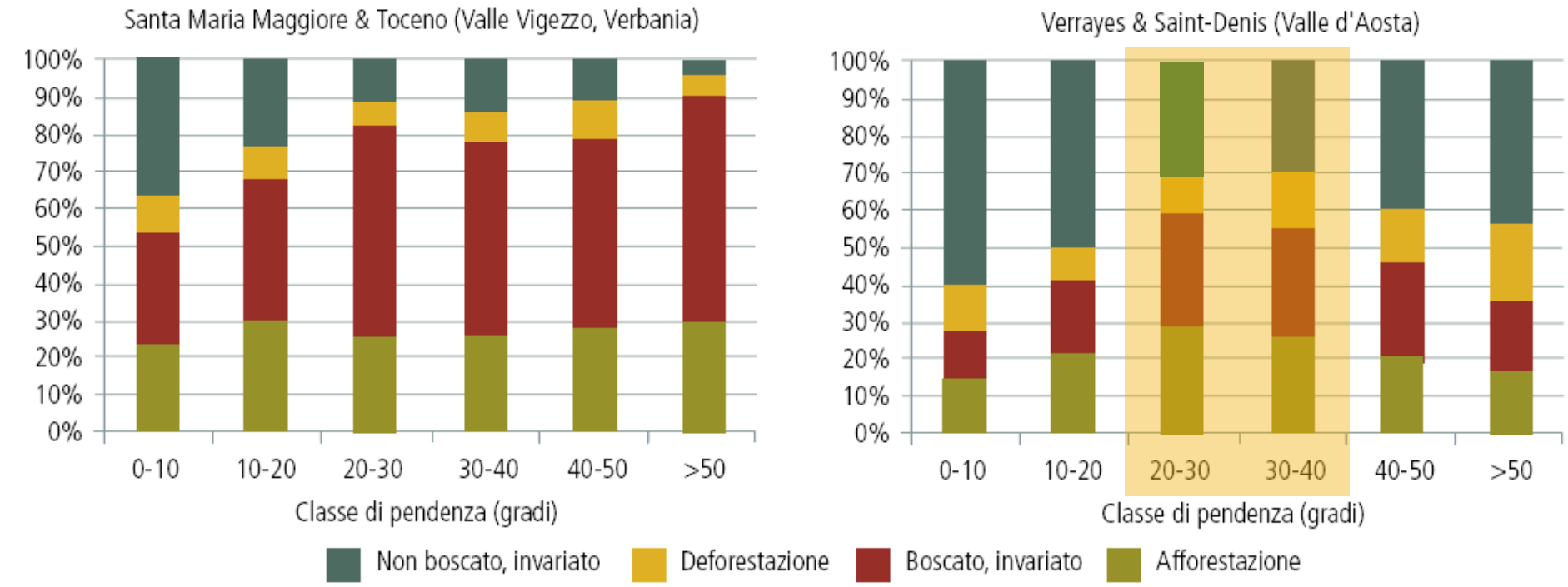
II. Land abandonment



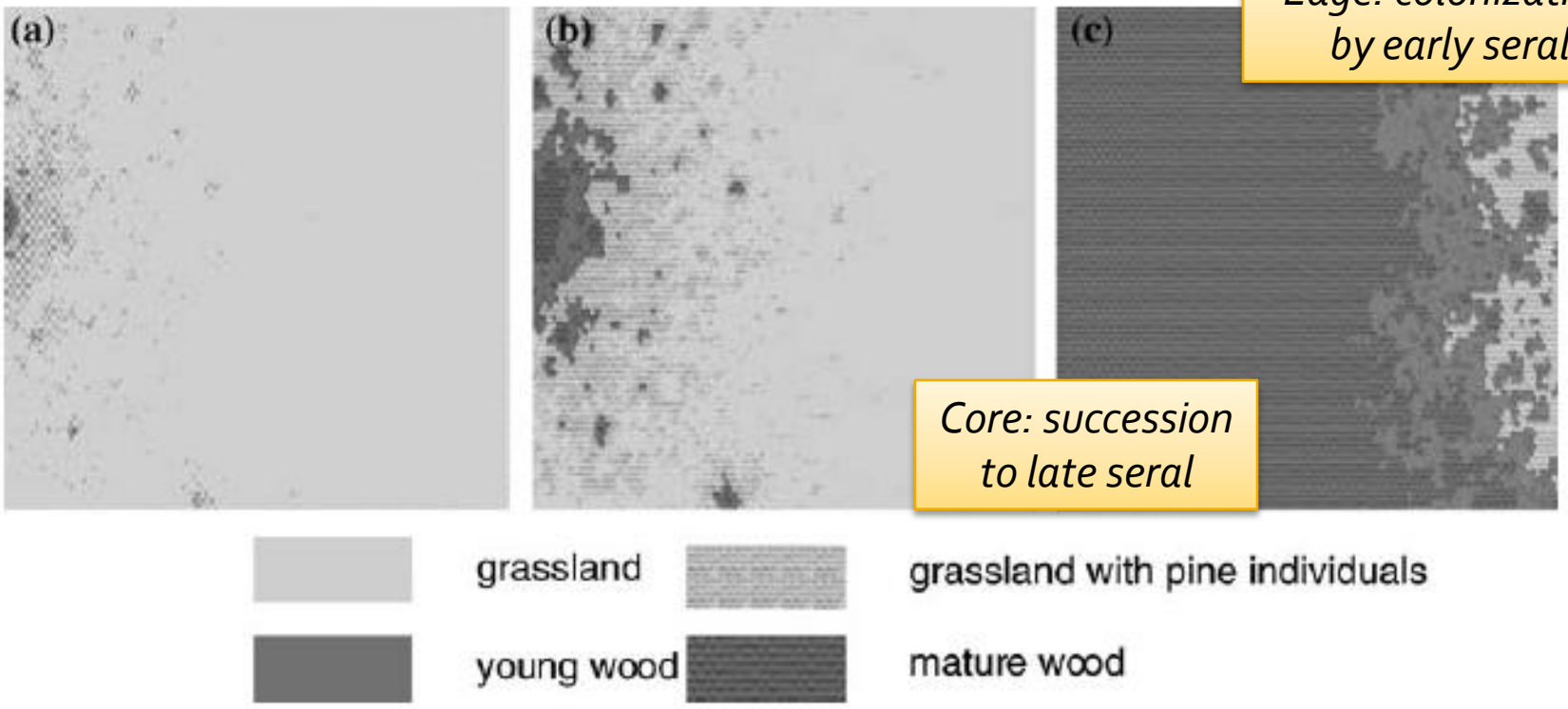
Successione a "macchia di leopardo": *patch* piccole e numerose, infittimento del mosaico forestale.
Conservazione dell'irregolarità nel mosaico bosco – non-bosco.
Nuovi elementi in aree non boscate.

Successione " a macchia d'olio": aumento della dimensione media delle *patch* boscate e scomparsa di quelle mantenute dall'uomo.
Aumento della complessità a tutti i livelli. **Ingrandimento e aggregazione di tessere boscate preesistenti.**

II. Land abandonment



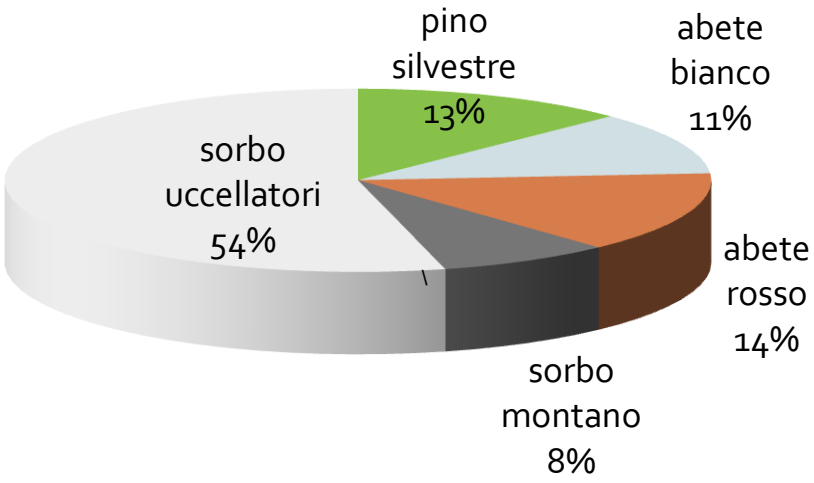
II. Land abandonment

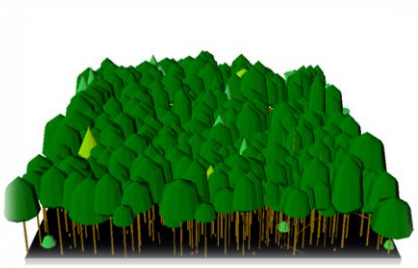


Year +50 **Year +75** **Year +150**

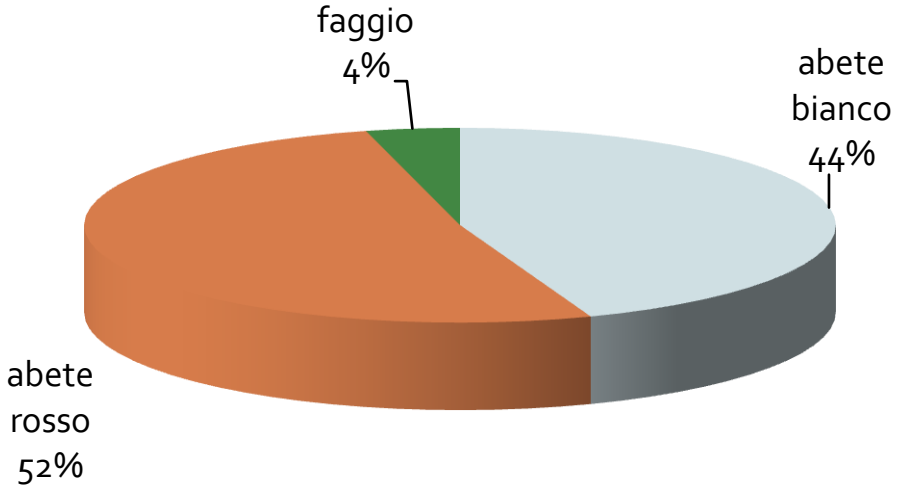
Caplat et al. 2006, Landscape Ecology 21

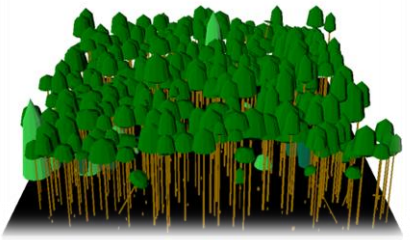
Pinete mesalpiche





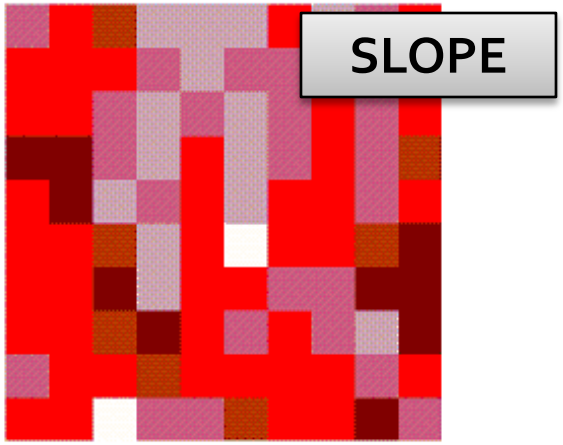
Santa Maria Maggiore – 40 years

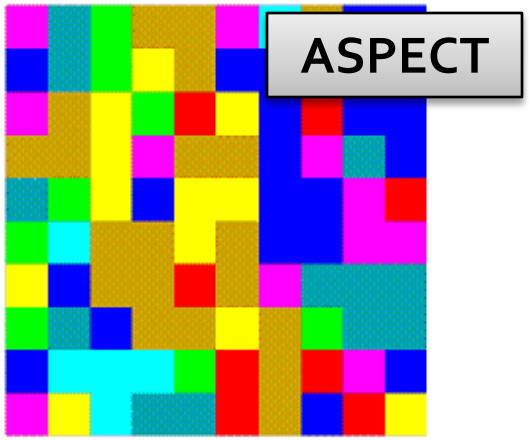


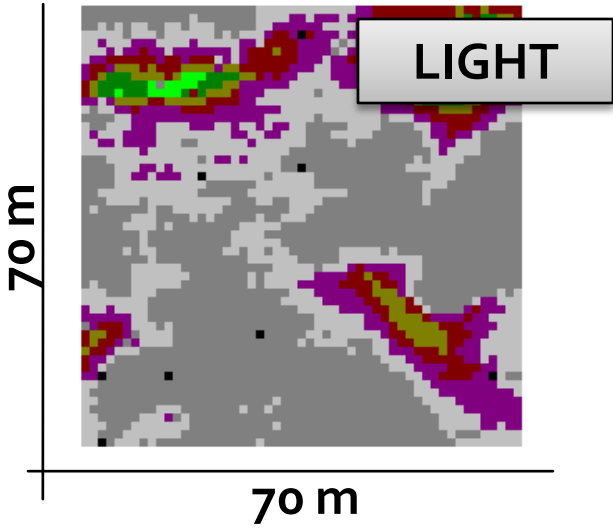


Toceno – 90 years

Pinete mesalpiche





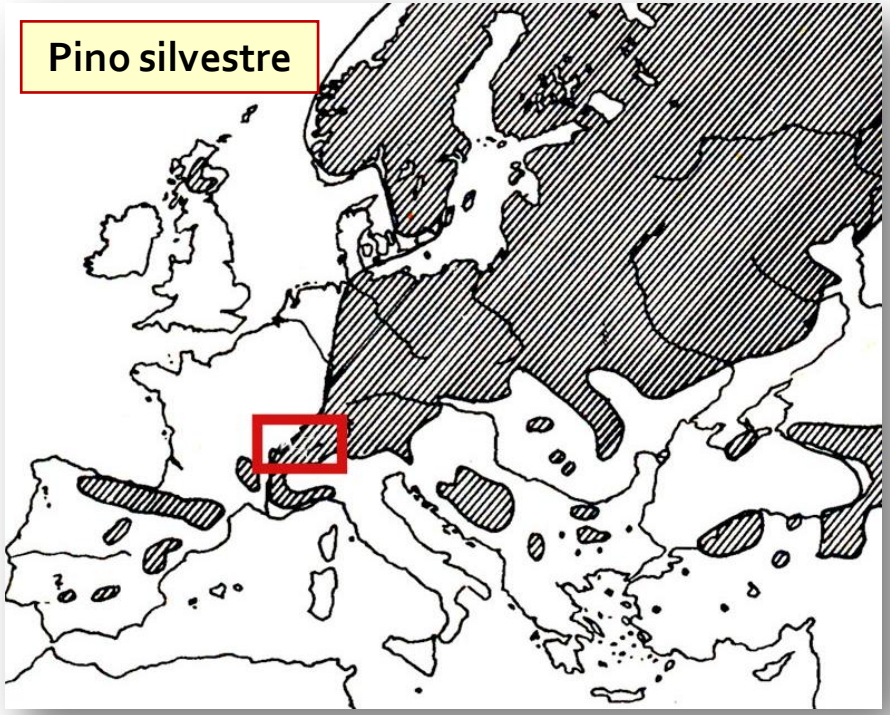


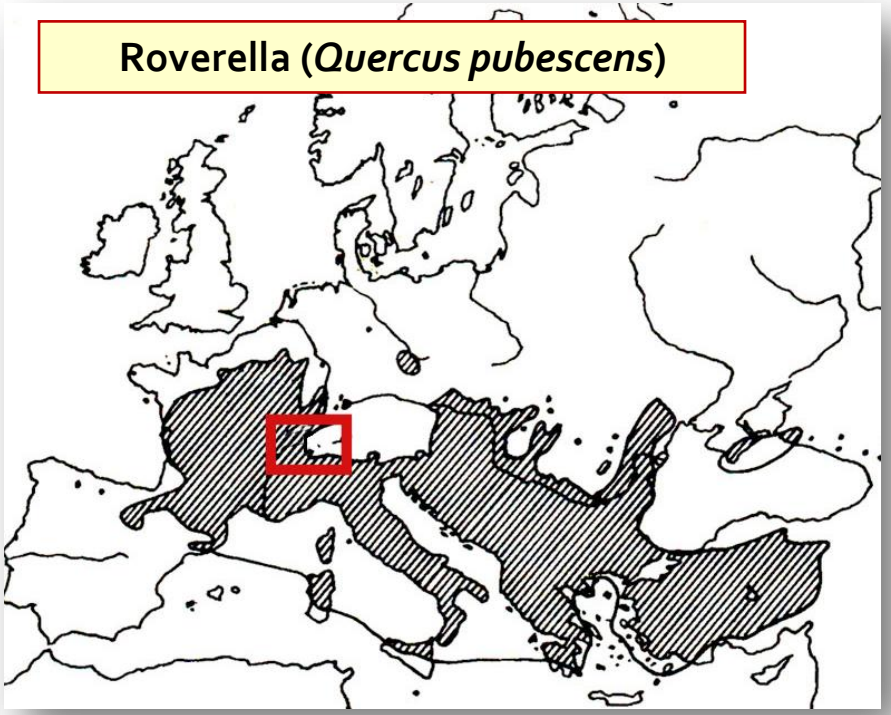
Parametro	coefficiente	Errore std.	p
Esposizione	327.60	408.45	0.4225
Pendenza	-288.40	162.21	0.0754
Luce incidente trasmessa	1.43	0.57	0.0118
Erba	22.70	36.53	0.5343
Felci	16.23	37.90	0.6686
Lettiera latif.	31.26	39.06	0.4235
Lettiera aghif.	19.68	36.51	0.5899

Frequenza % di semenzali di abete bianco

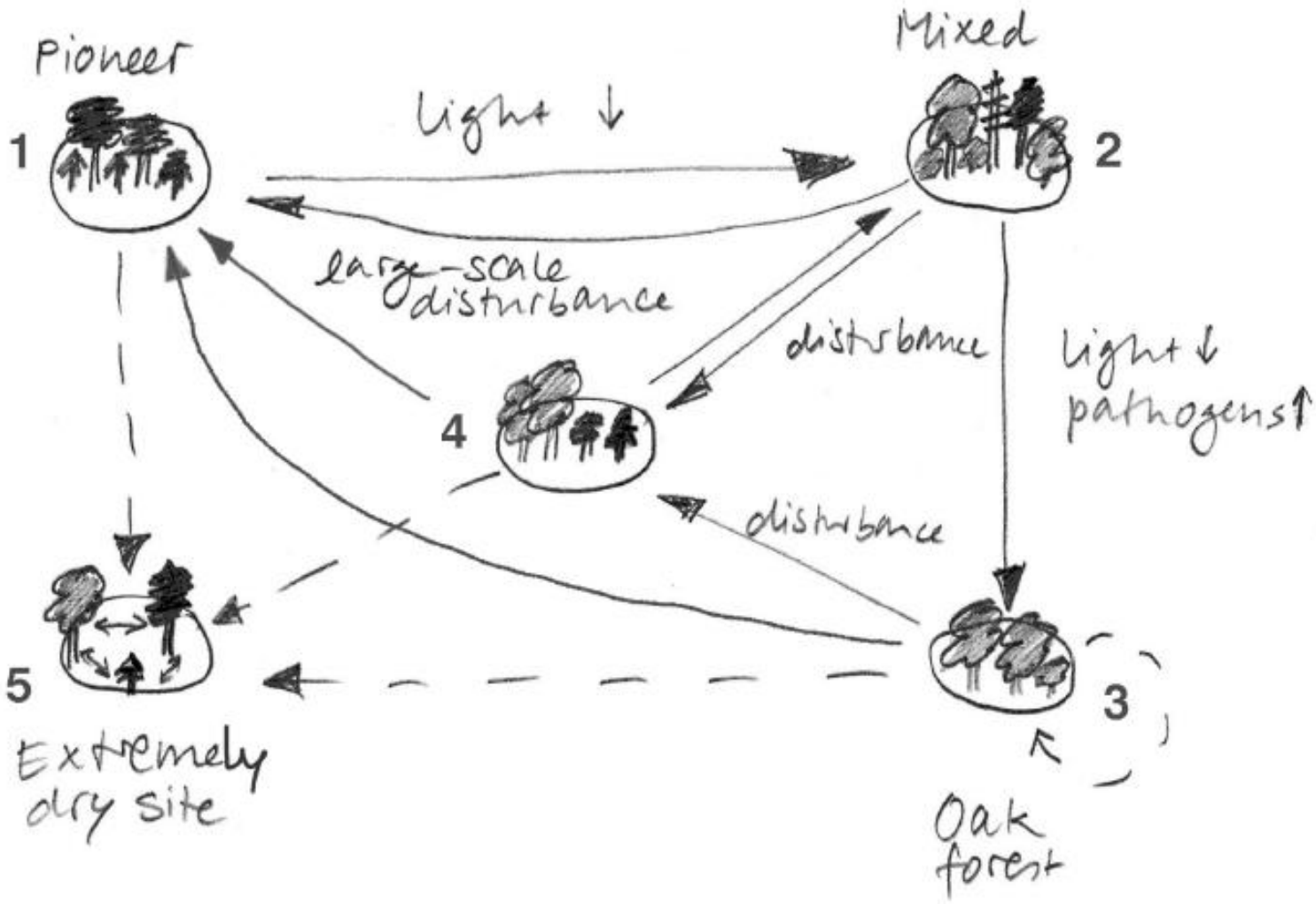
Ronelli 2006, BS thesis Univ. Turin

Pinete endalpiche





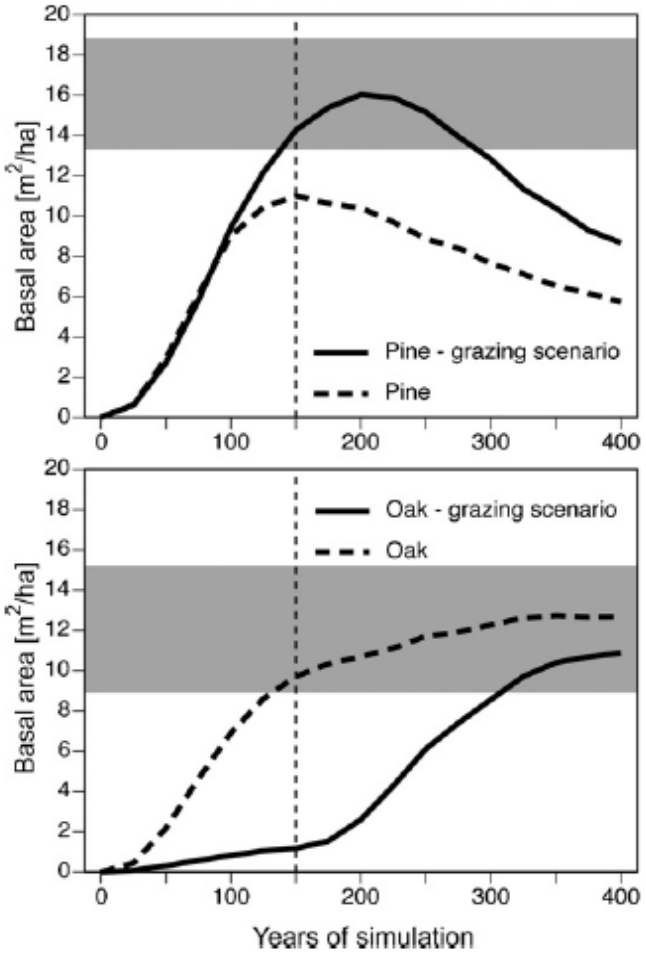
Pinete endalpiche



Weber 2005, PhD dissertation ETH Zurich

Pinete endalpiche

Grazing scenarios



Weber et al. 2008, Ecological Modeling 210

Previous land use

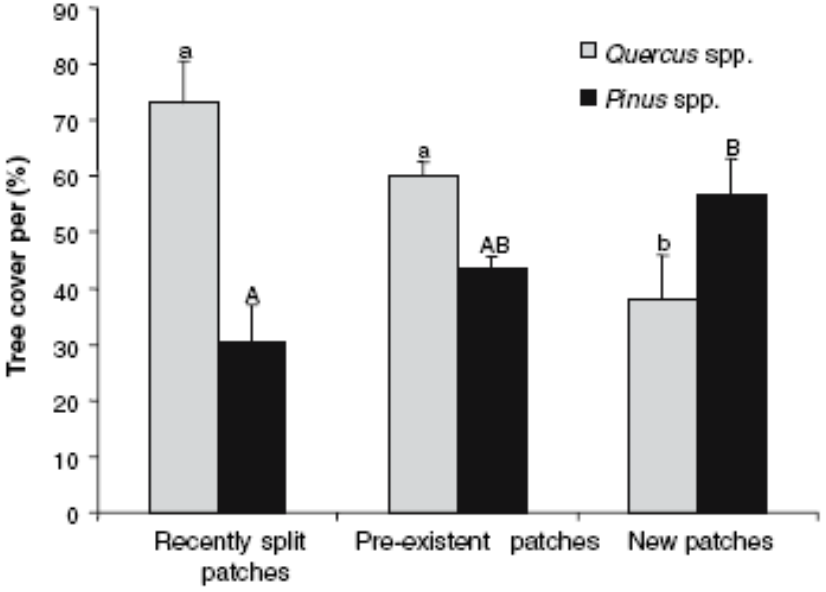
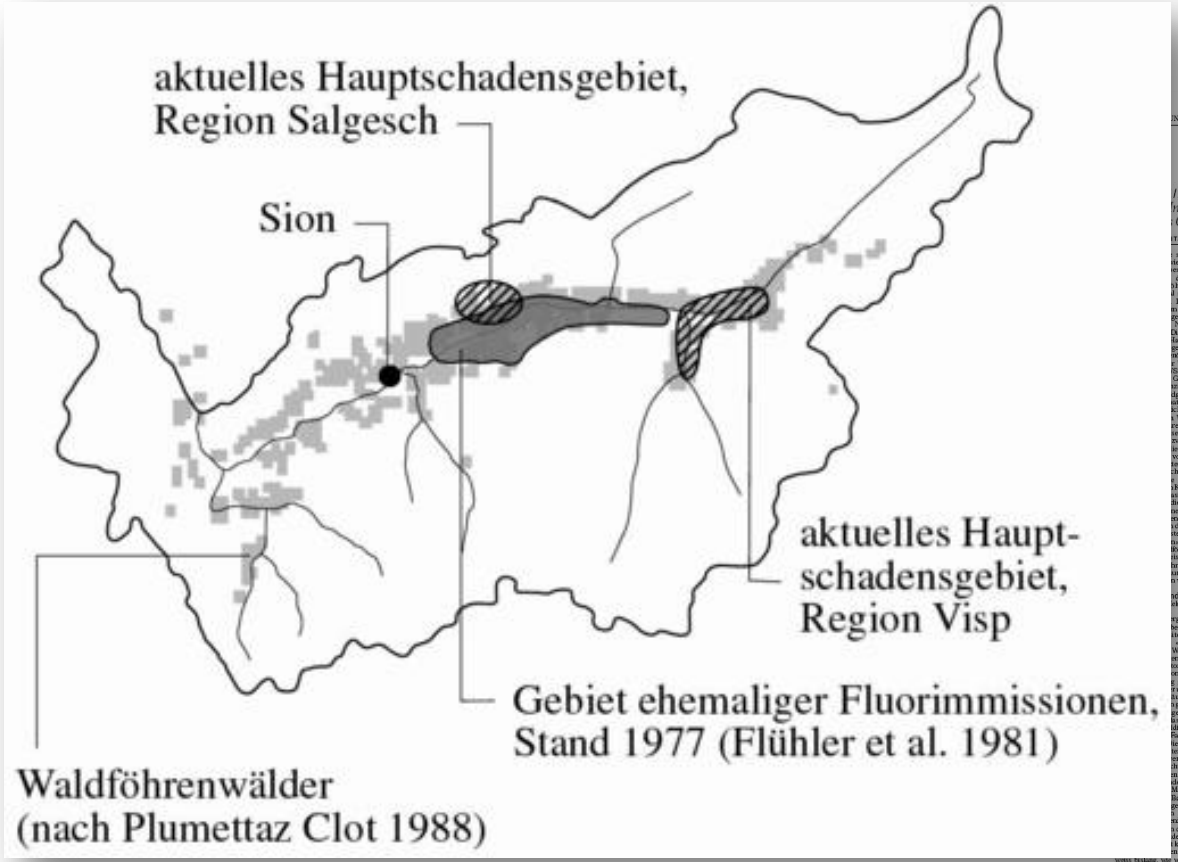


Fig. 2 Mean *Quercus* and *Pinus* crown tree cover in sampling plots as a function of recent patch history. Error bars are one standard error of the mean. Different capital letters indicate statistically significant differences for *Pinus* spp. (one-way ANOVA and Tukey test); different small letters indicate significant differences for *Quercus* spp.

Guirado et al. 2007, Plant Ecology 194

III. Climate change e deperimento



A.Rigling, WSL (2001)

WISSEN

Rätselhaftes Waldföhrensterben im Wallis

In der Region Visp sterben Waldföhrenwälder grossinnert weniger Wochen wird aus einem grünen Baum Gerüst. Über die Ursachen rätseln die Wissenschaftler.

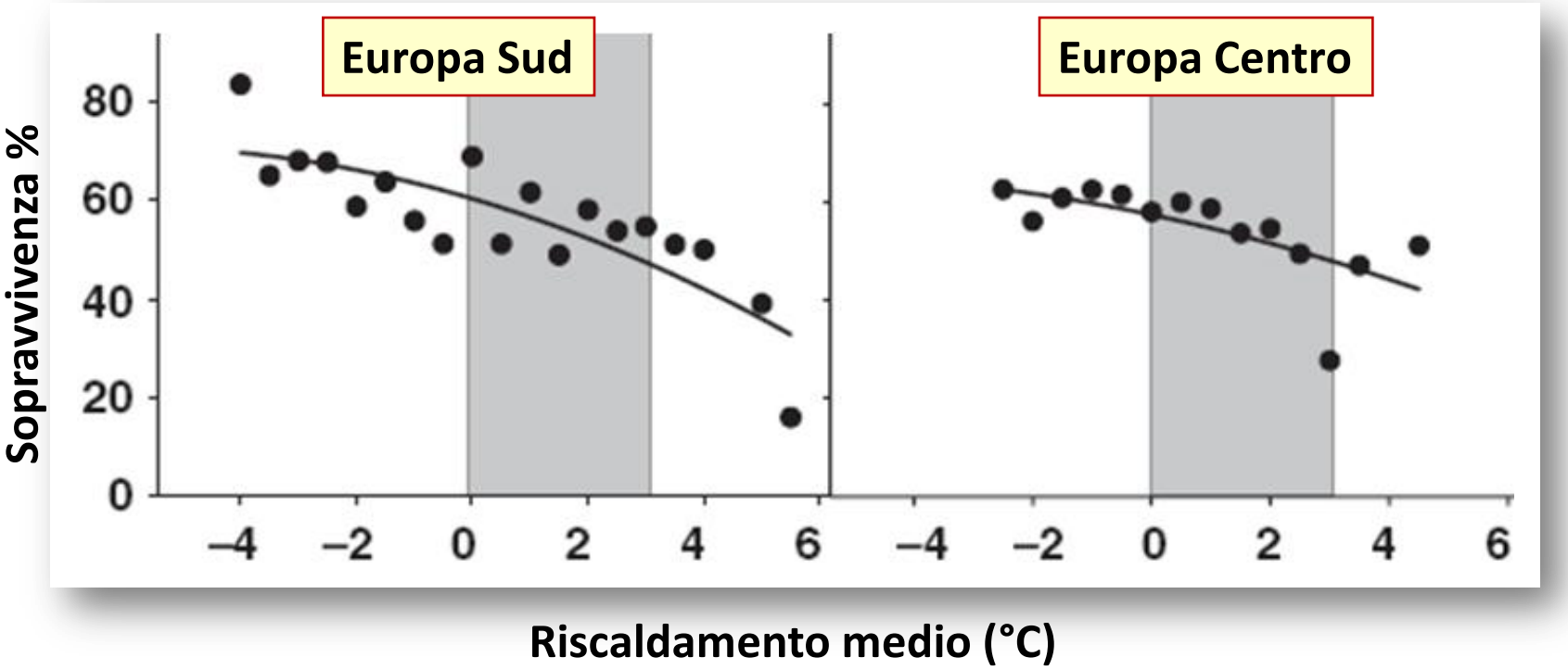
Das bis in die 80er-Jahre durch Aluminium-Werke ausgestossene Fluor kann nicht allein am Tod der Bäume schuld sein. Denn vom Föhrensterben betroffen sind auch andere Alpenregionen.

Waldföhren im Tehwald bei Stalden, Wallis: Die Borke fällt vom Stamm (links), der Baum stirbt (im rechten Bild eine abgestorbene neben einer gesunden Föhre).

Forschungsprojekt gestartet

Der Tehwald ist am Ende

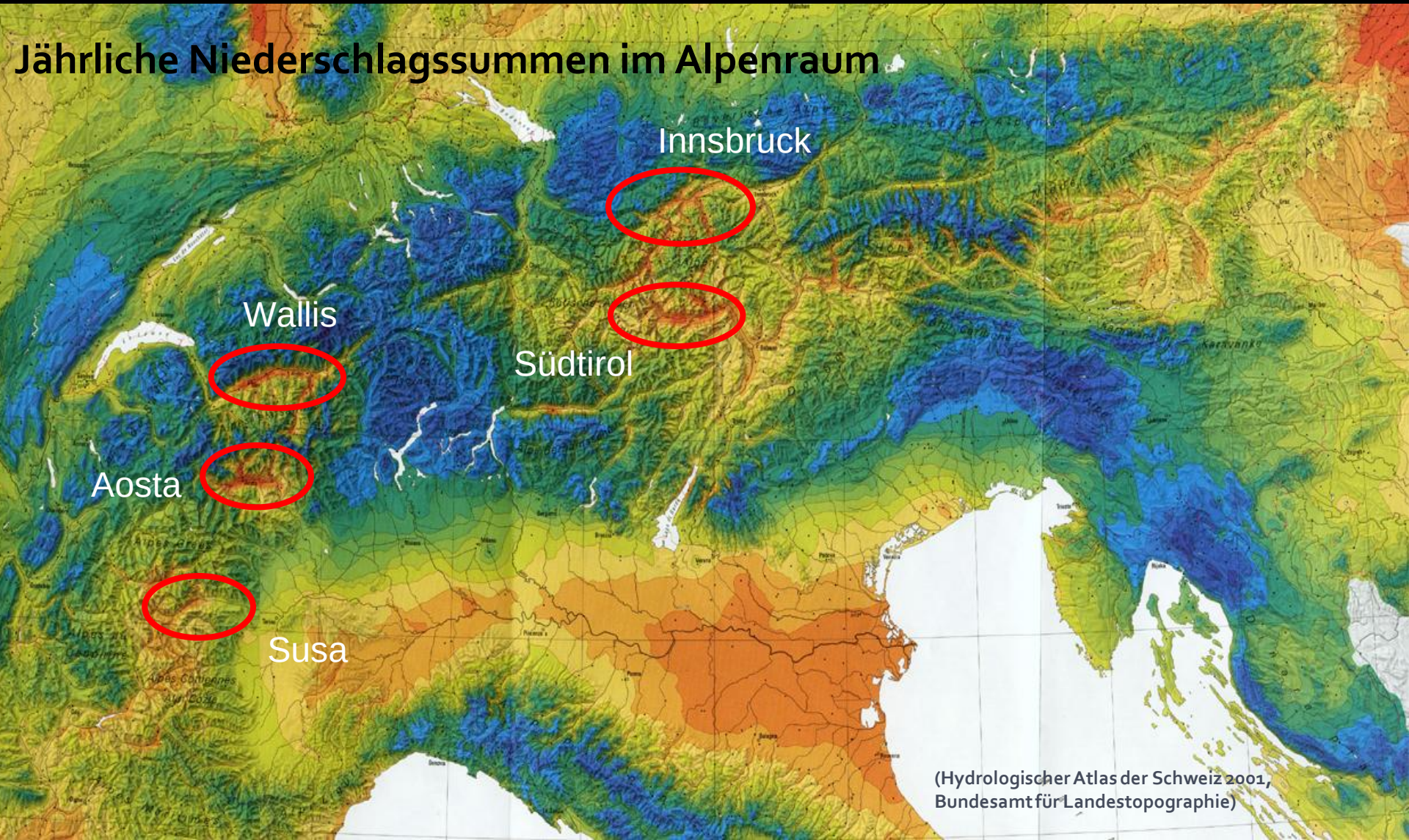
III. Climate change e deperimento



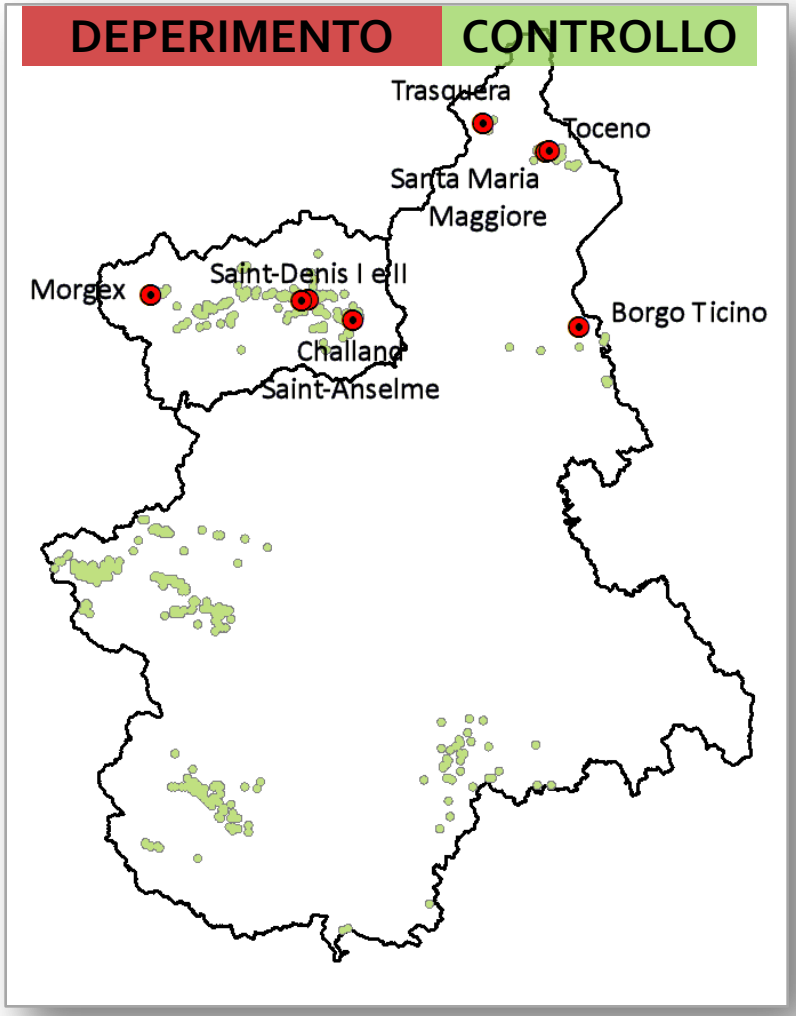
"Expected climate change will first affect the populations at the southern fringes of the distributional range."

Reich, P.B., Oleksyn, **J.** 2008.. Ecology Letters 11

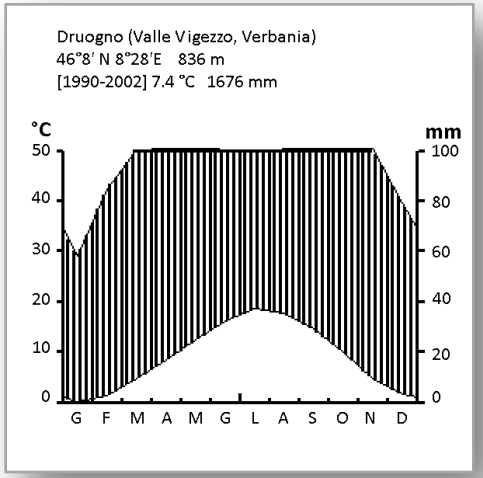
III. Climate change e deperimento

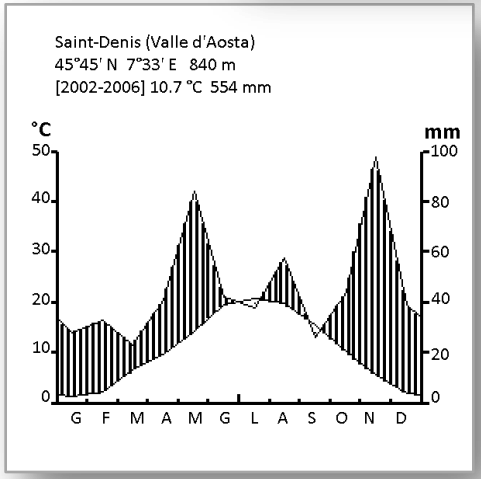


III. Climate change e deperimento



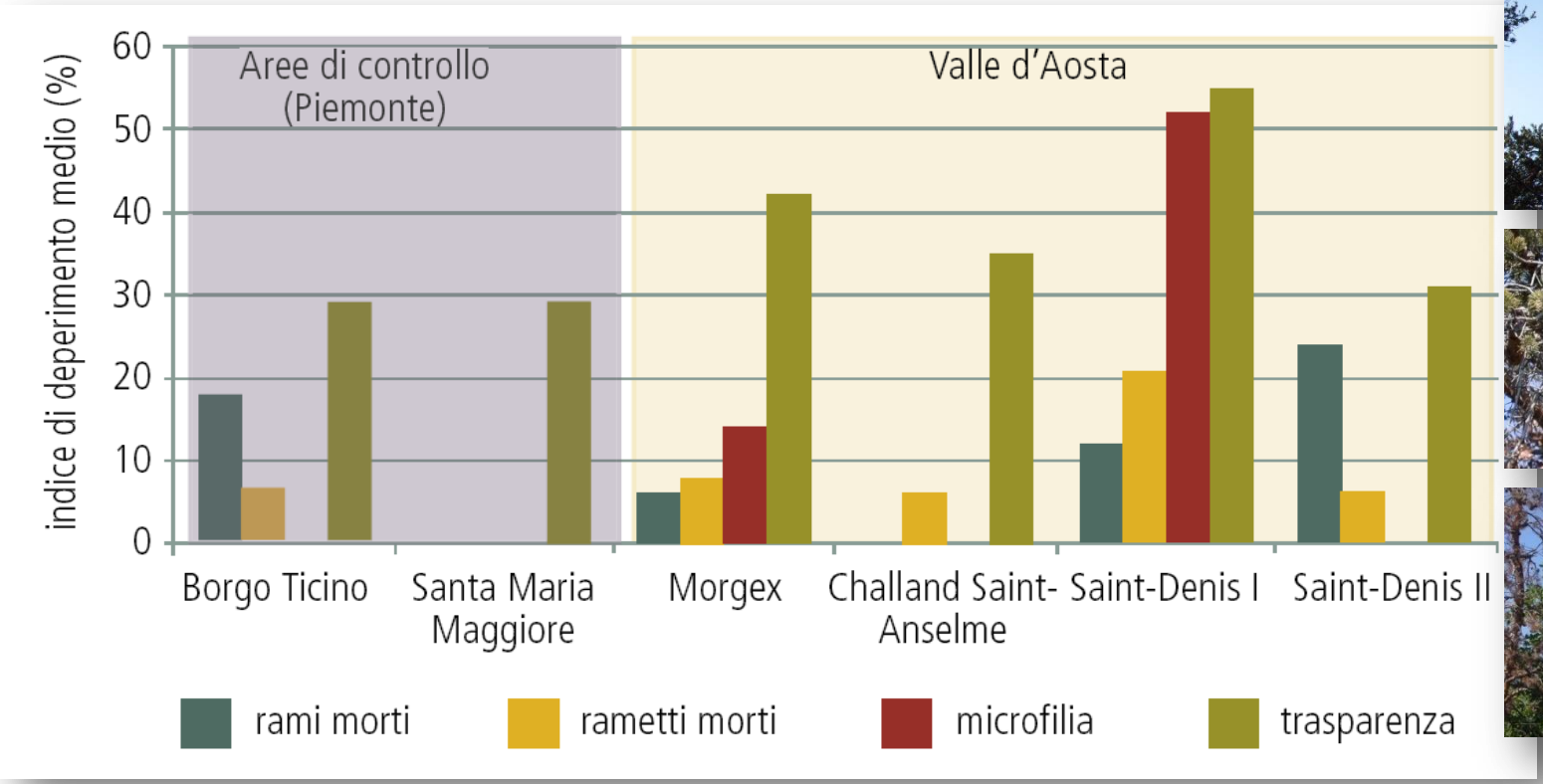
Pinete mesalpiche



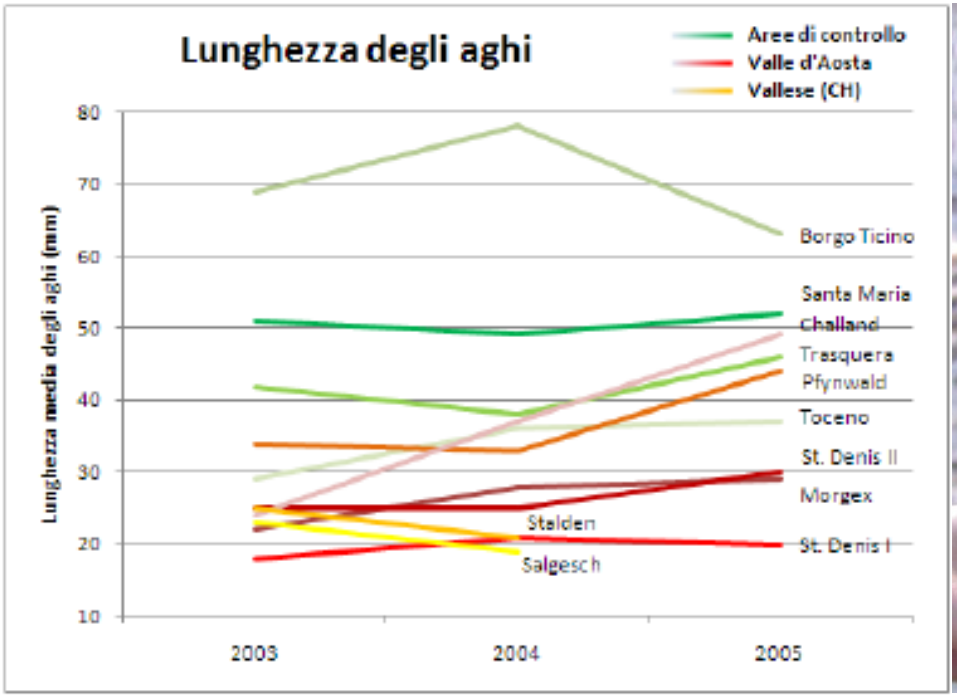


Pinete continentali

Sintomatologia

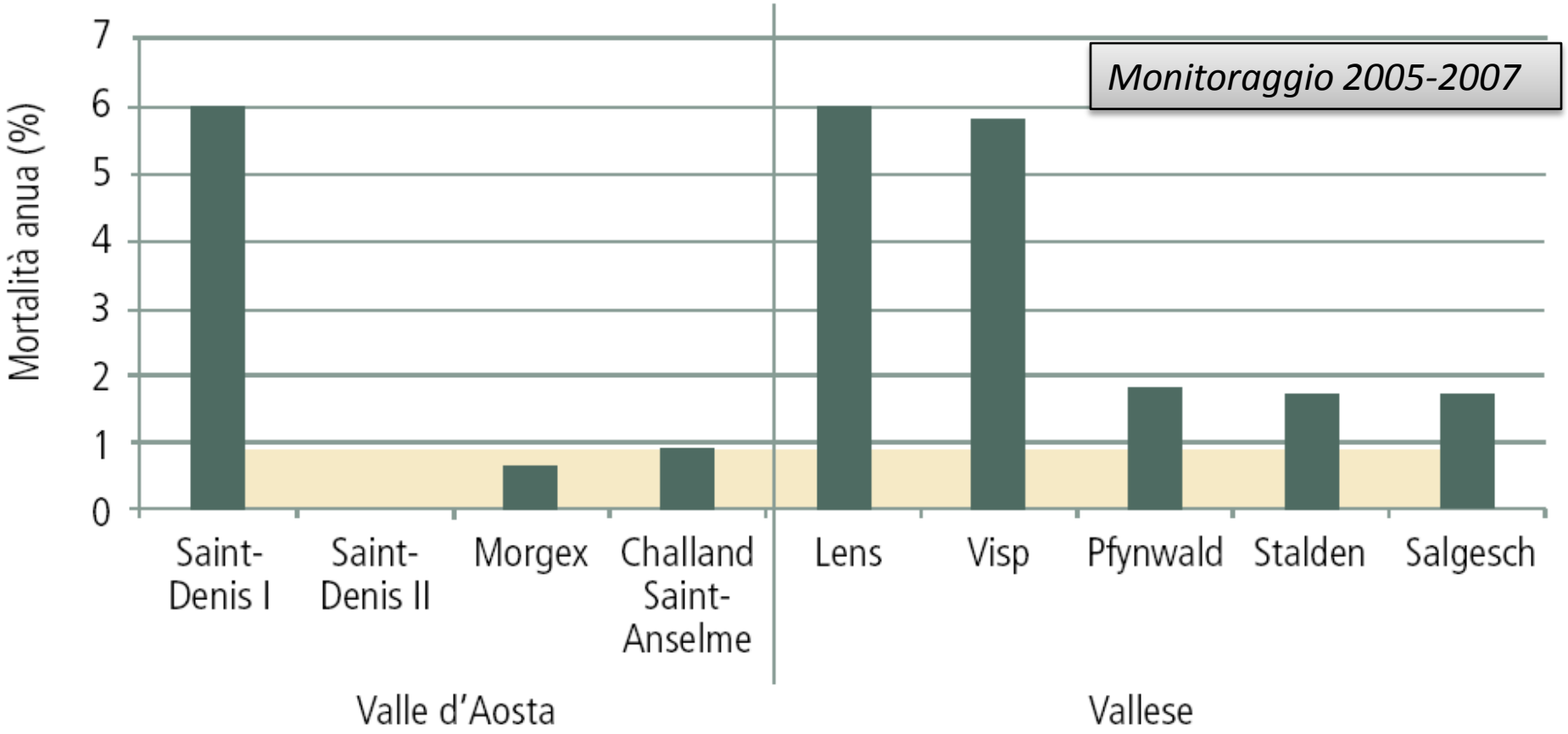


Sintomatologia



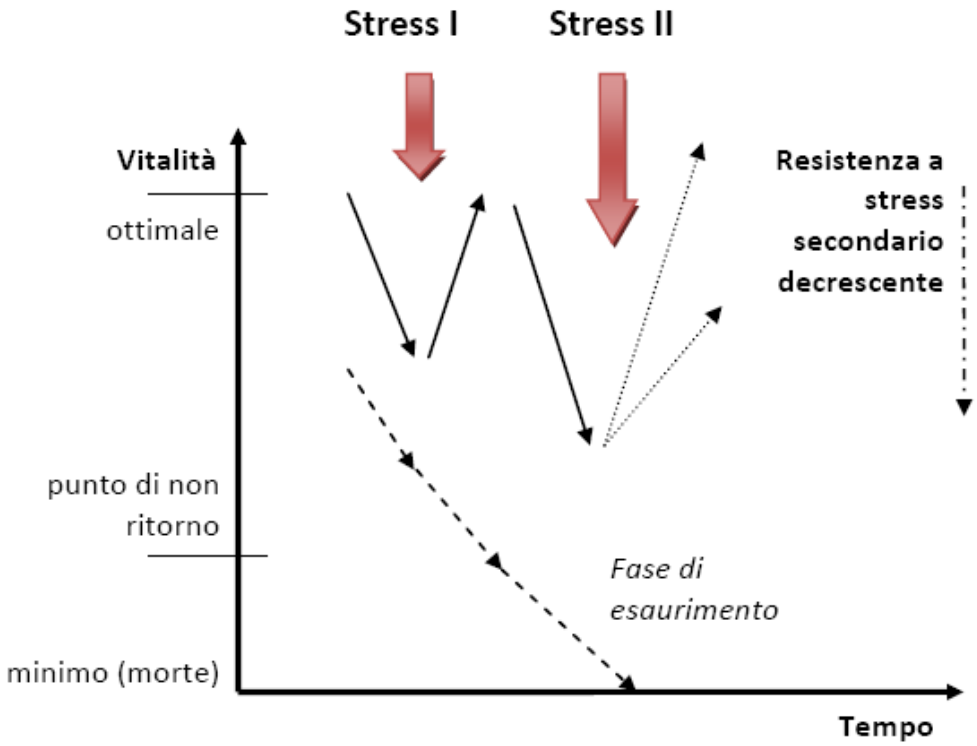
Source: Dobbertin 2006 (unpublished data)

Sintomatologia

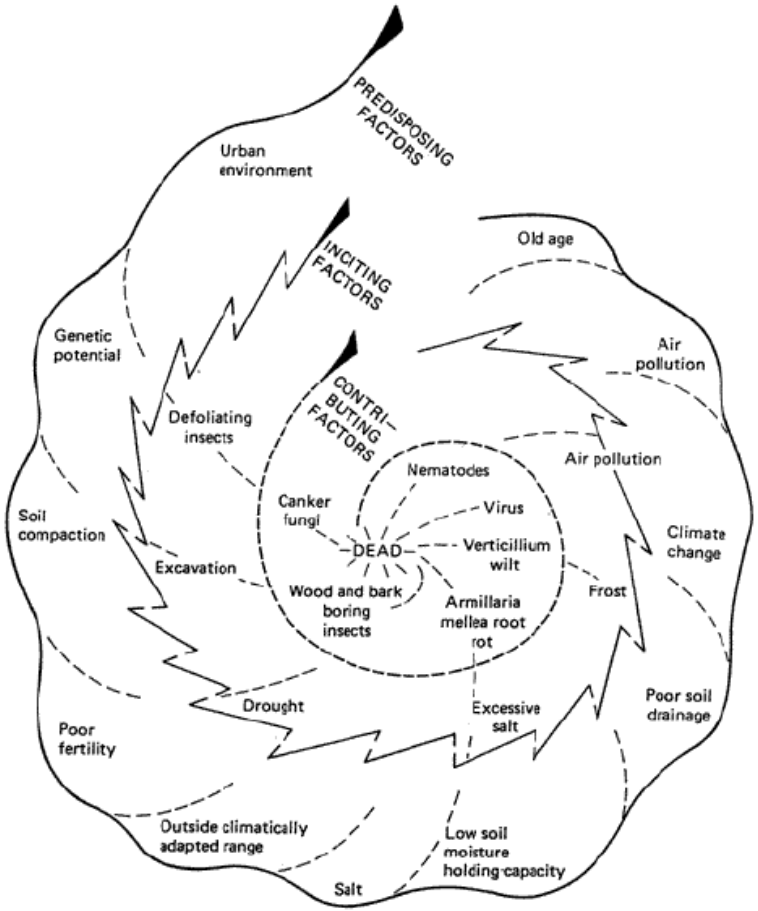


Mortalità media annua in Piemonte e Valle d'Aosta (dati di inventario)

Agenti causali



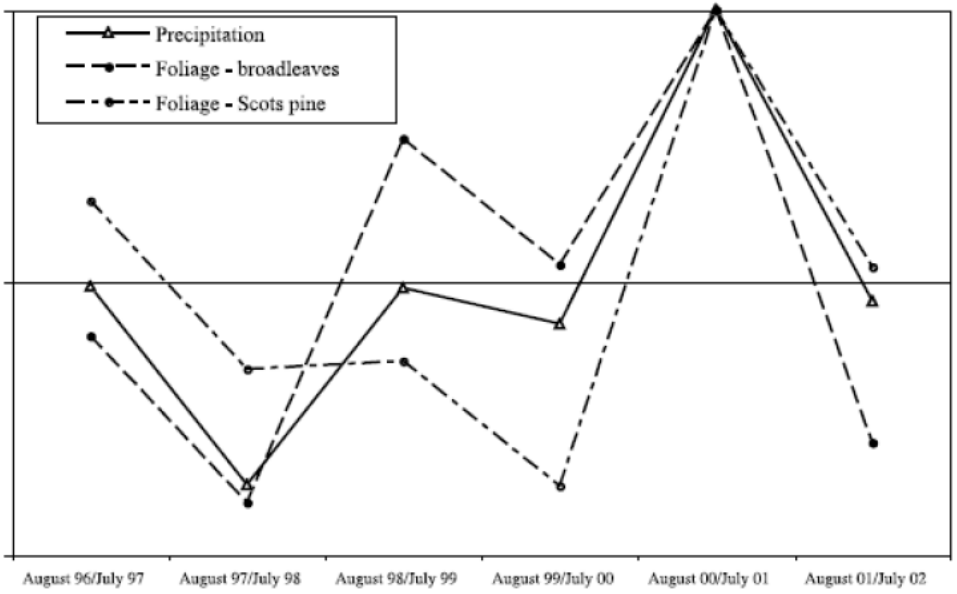
Manion's spiral (decline disease)



Dobbertin 2005, Tree Physiology 22

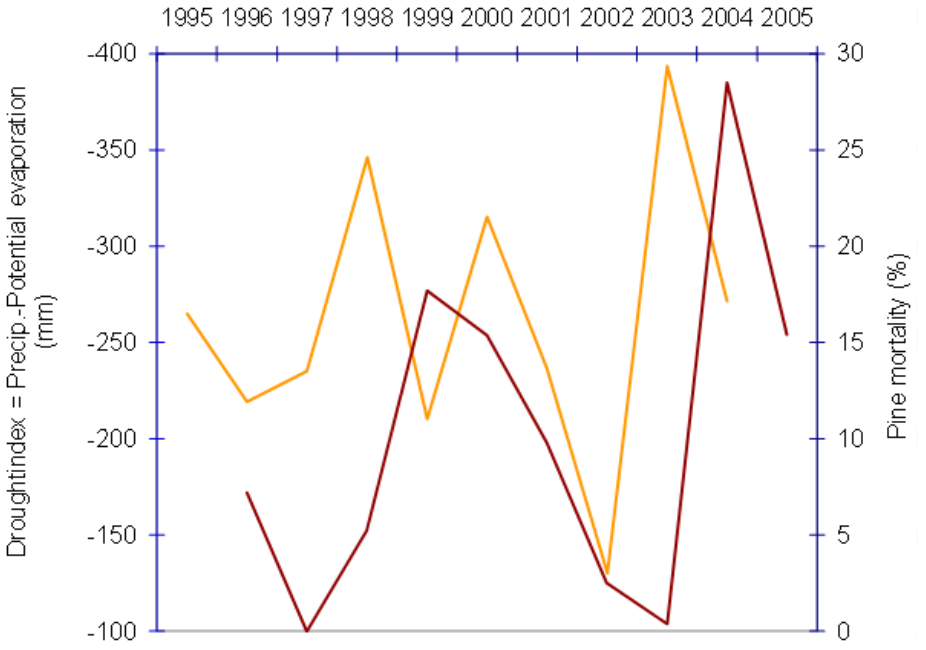
Agenti causali

Precipitation / drought



DEFOLIATION

Rebetez & Dobbertin 2004, Theoretical and Applied Climatology 79

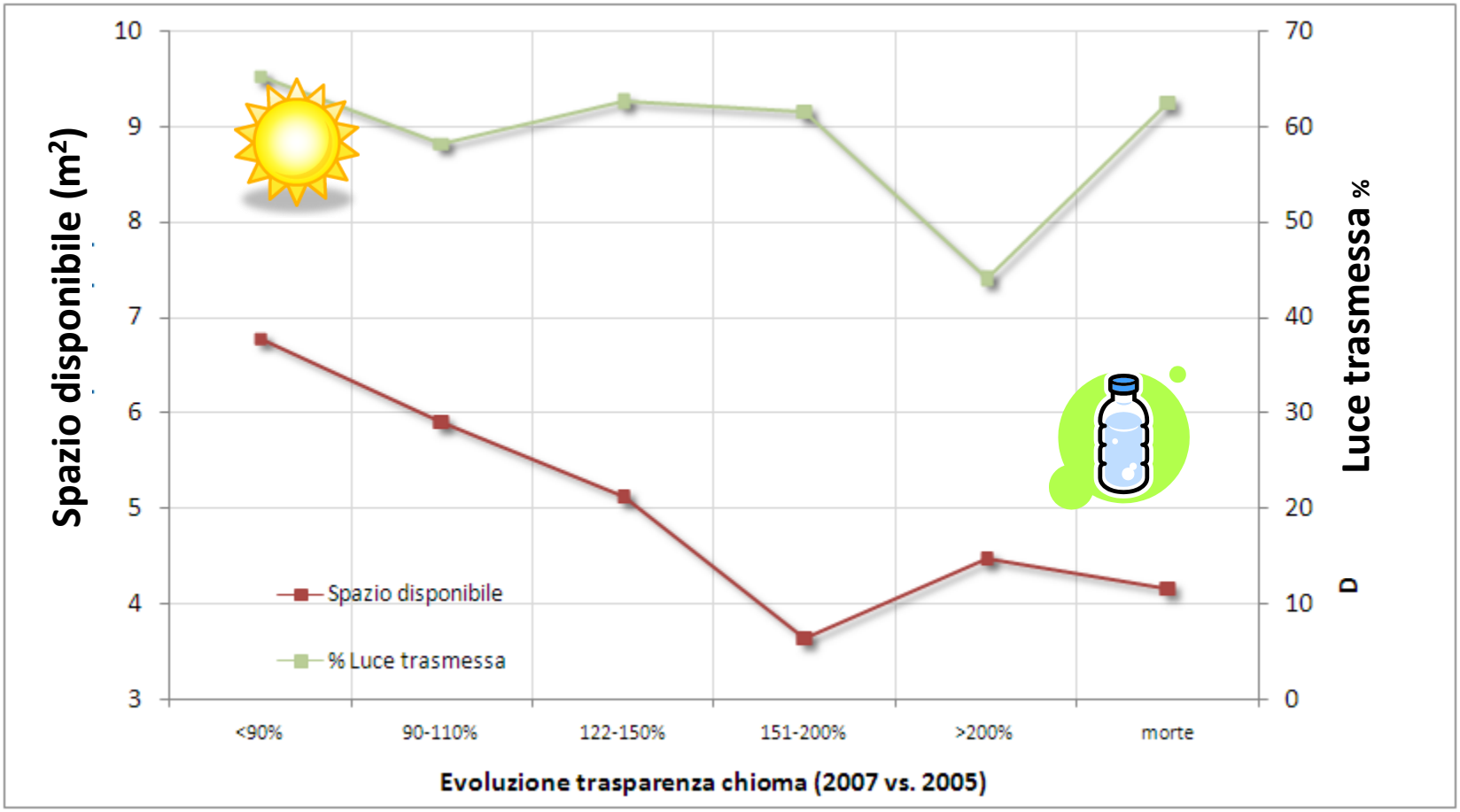


MORTALITY

Bigler et al. 2006, Ecosystems 9

Agenti causali

Competition for water – available growing space



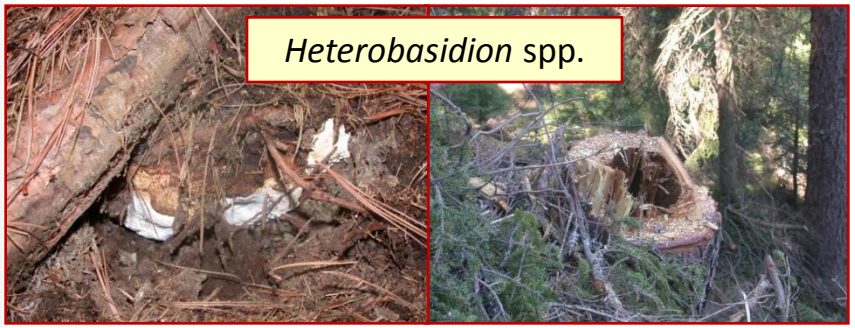
Saint-Denis I

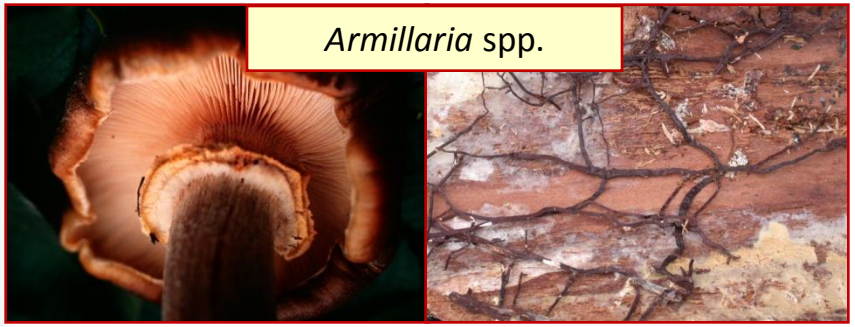
Agenti causali

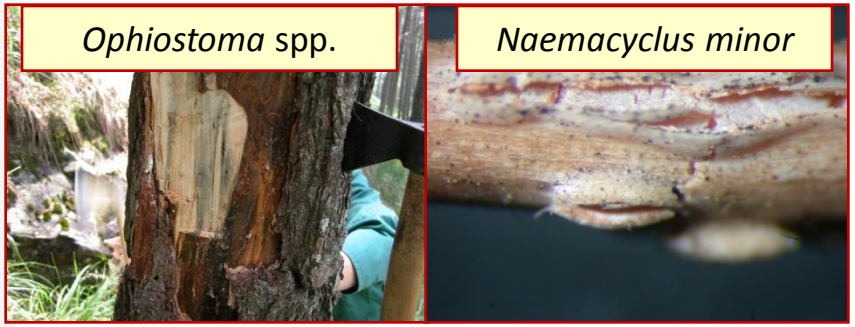
Principali patogeni del pino silvestre, organi colpiti e sintomi ad essi associati

Agente patogeno	Organo colpito	Malattia indotta e sintomi
Lophodermium seditiosum Minter, Stanley et Miller	Aghi	Macchie irregolari bruno violacee disposte a bande trasversali. Gli aghi colpiti cadono nella primavera o all'inizio dell'estate del secondo anno
Coleosporium tussilaginis (Pers.) Lév.	Aghi	Agente della ruggine vescicolosa degli aghi. Provoca macchie isolate arrotondate rossastro-violacee di circa 1/2 mm di diametro. Nella primavera che segue appaiono gli spermogoni, poco visibili, e gli ecidi caratteristici. Le vescicole prodotte, di 2-3 mm di altezza lasciano fuoriuscire, a maturità, ecidioconidi giallo-arancioni. A fine stagione gli aghi si ricoprono di resina
Gremmeniella abietina (Lagerb.) M. Morelet	Aghi	Agente del disseccamento dei getti. Durante l'inverno alla base degli aghi di un anno compaiono tipici arrossamenti con successiva morte del getto
Sclerophoma pithyophila (Corda) Hohn.	Aghi	Parassita secondario, favorito da stati di crisi delle piante. Provoca ingiallimento e caduta precoce degli aghi
Cydaneusma minus (Butin) DiCosmo, Peredo, Minter	Aghi	Caduta precoce degli aghi
Cronartium flaccidum (Alb. et Schw) Wint	Rami	Disseccamento dei rami che assumono una colorazione rosso-bruna e comparsa in corrispondenza degli stessi di cancri fusiformi rigonfiati e fessurati
Melampsora pinitorqua Rostrup	Rami	Agente della ruggine curvatrice dei getti di pino. I getti colpiti assumono una caratteristica conformazione ad S
Phellinus pini (Brot.: Fr) Ames	Tronco	Carie bianca del legno.
Stereum sanguinolentum (Alb., Schwein.: Fr.)	Tronco	Carie bianca del legno
Funghi Ophiostomatoidi	Tronco	Disseccamento della chioma e alterazione cromatica del legno (azzurramento)
Heterobasidion annosum sensu stricto	Radici	Marciume radicale
Armillaria spp.	Radici	Marciume radicale

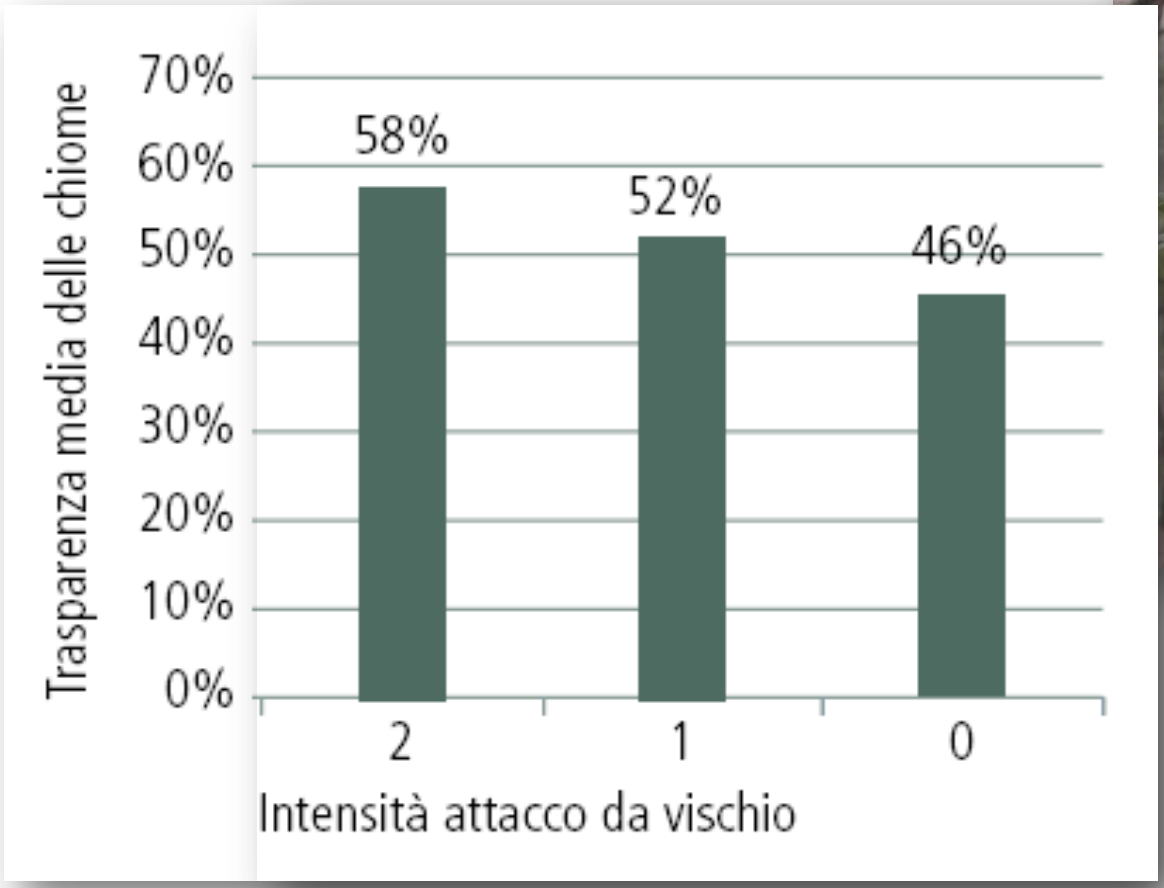
Agenti scatenanti (biotici)



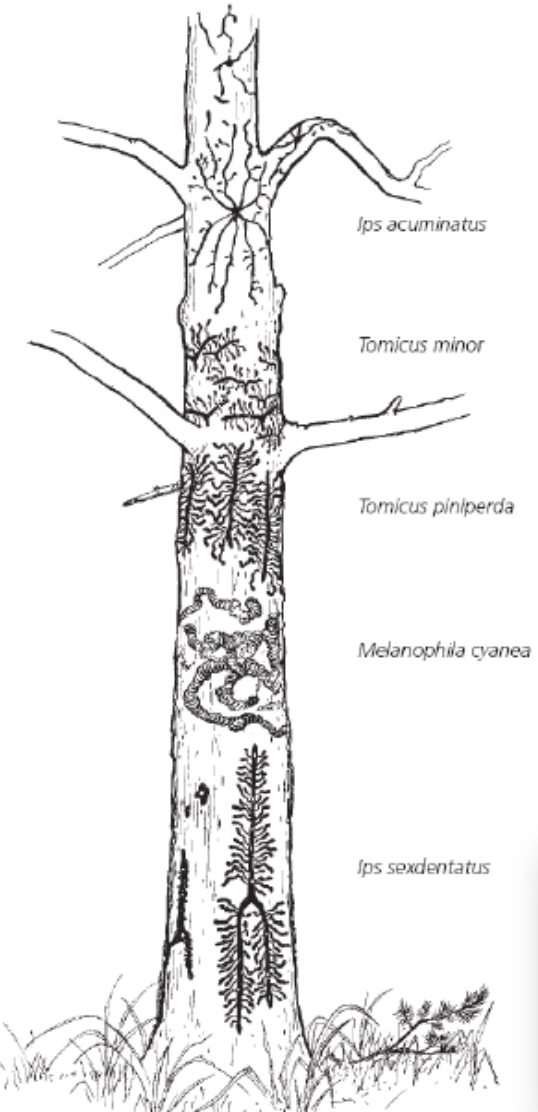


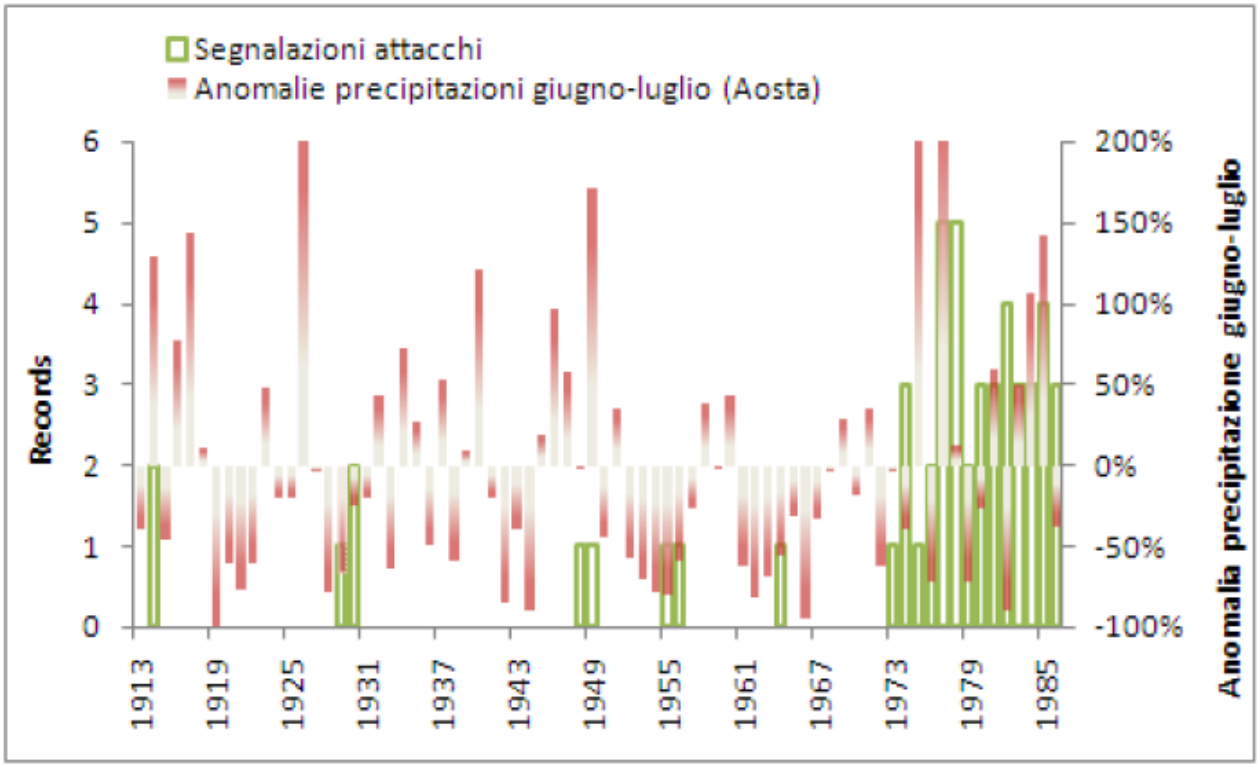


Agenti causali



Agenti causali

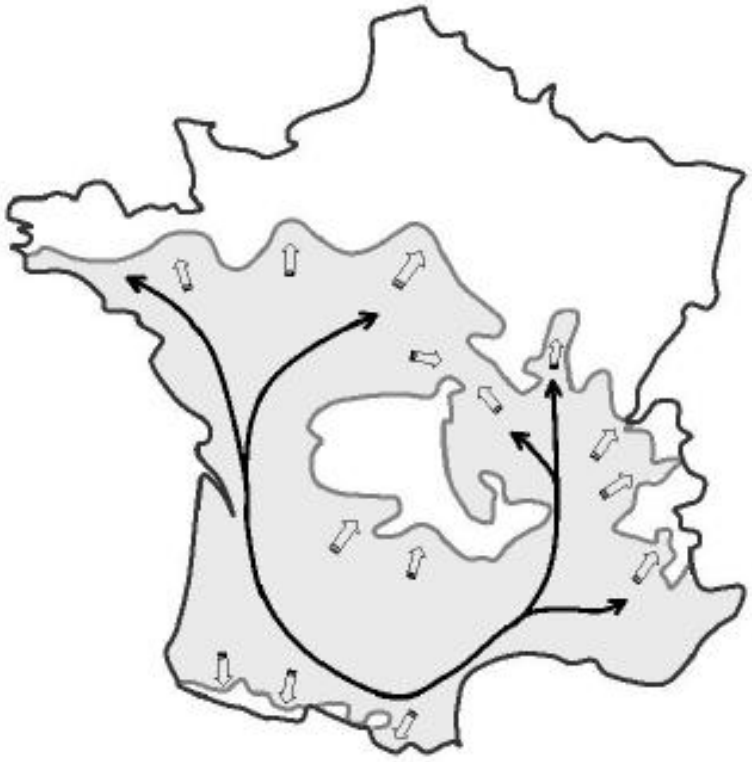


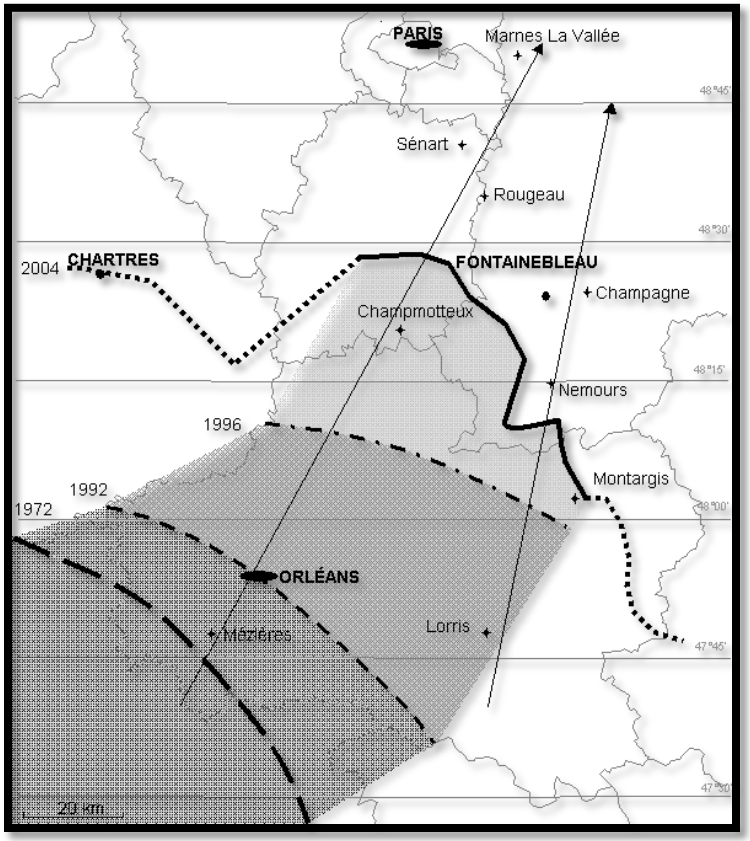


Source: Mazzoglio (2006), unpublished data

Agenti causali

La processionaria del pino risale verso nord ad una velocità di 55 km ogni 10 anni





Battisti et al. 2005, Ecological Applications 15

Conclusioni

1. **Pine decline as a result of the direct (drought) and indirect effects (pests) of climate change.**

Viscum album
- Stress idrico
- Defogliazione
- Alberi dominanti
- Persistente

Tomicus spp.
- Perdita di vigore
- Alberi isolati, maturi
- Chiome vitali
- Non persistente

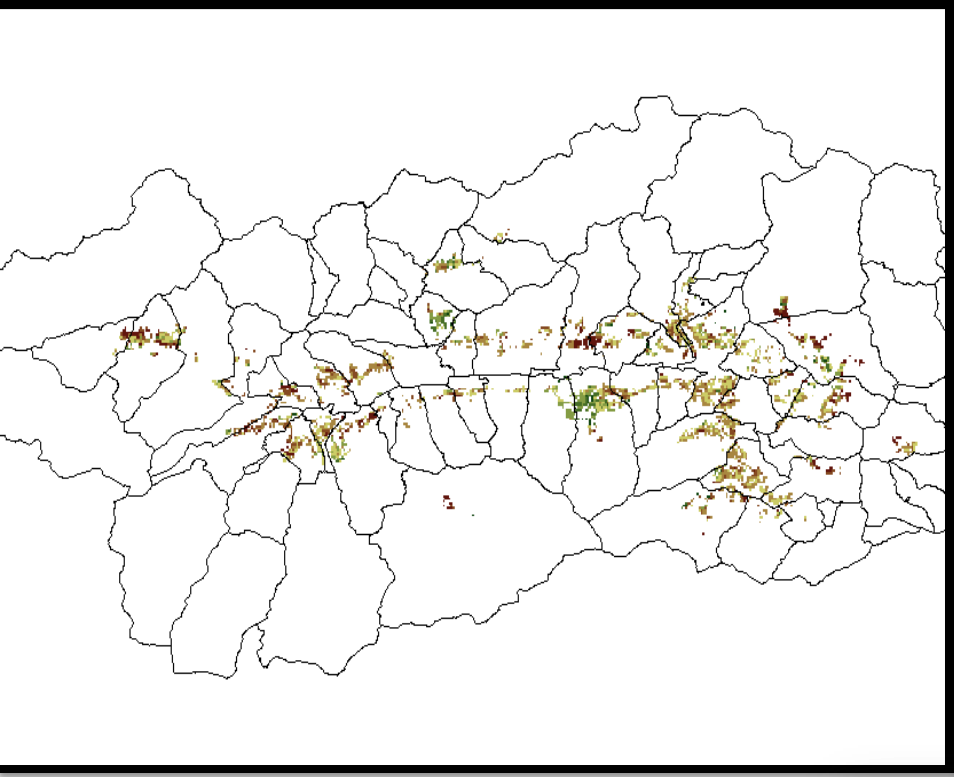
Ophiostoma spp.
- Perdita di vigore

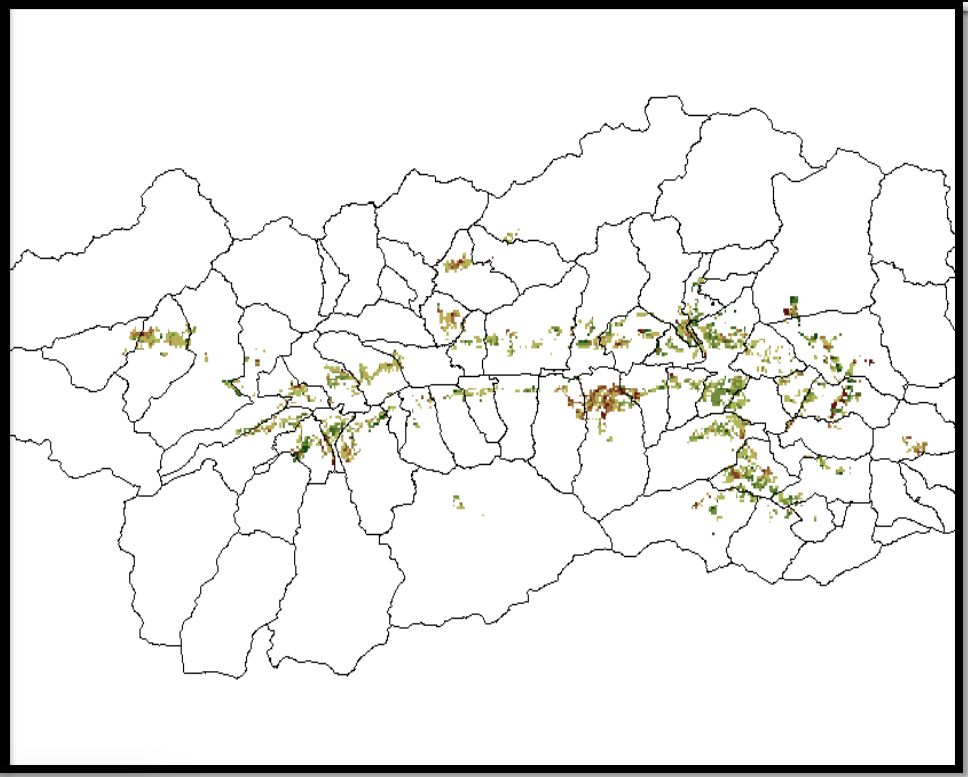
? Alberi stressati

? Persistente

? Ruolo dei vettori

Conclusioni



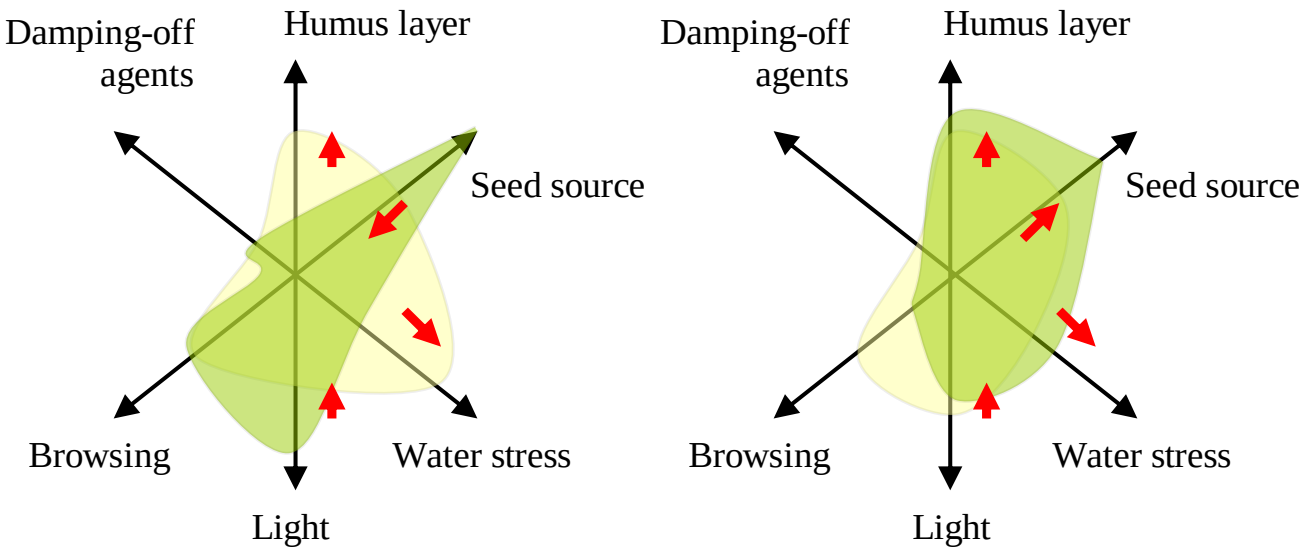


NDVI 2000-2007
Intensità fotosintesi
Disponibilità idrica
Deperimento delle pinete

EVI 2000-2007
Struttura forestale
Indice di area fogliare
Successione a latifoglie

Conclusioni

2. **Shift in tree species composition** (from pine to oak) **as a result of land use change** (former grazing, litter racking, & locally selective cuttings, plantations).



Rigling et al. 2006, WSL Merkblatt 41

Conclusioni

- The projected global climate change will influence growth and productivity of natural and managed forests.
- Decision making should consider the new risks and uncertainties arising from climatic change, especially if the rotation periods are long.

Conclusioni

a. Do nothing (business as usual)

No climate change, the same management as in the past will be applied.
Depending on local site conditions in the year 2050 species composition of large areas of forests may be poorly adapted to the prevailing climatic conditions *if our climate is changing according to the projections of climate modellers.*

b. Prepare for worst case

The scenario which has the strongest effect is selected. Favors species which are best adapted to this extreme climate scenario. Since e.g. drought tolerant species often are less productive than other species under good site conditions, this could lead to avoidable production losses *if the climate is changing less drastically as projected in the extreme scenario.*

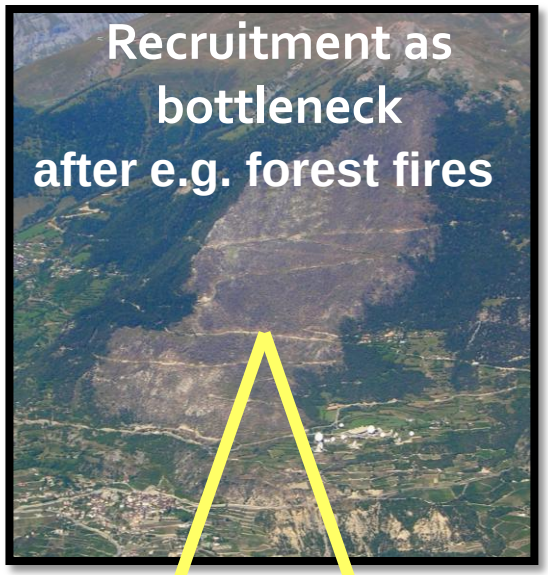
c. Risk reduction strategy

Capture the uncertainties about our future climate. Increase the species diversity both in individual forest stands and at the regional scale, thus improving flexibility and adaptive potential of forest management.

Conclusioni

Hot spell 2003 as future average?

Too dry for native forest vegetation ?



Forest ?

Steppe ?

Il deperimento del pino silvestre

natura e indirizzi di gestione

Tabella 4.5

Funghi agenti dell'azzurramento del legno e relativi insetti vettori.

Teleomorfo	Anamorfo	Ospiti	Insetti vettori
	Leptographium serpens (Gold.) Siem.	*Pinus sylvestris*	*Tomicus destruens*
Ophiostoma picea (Munch.) H. Sydow, P. Sydow	*Graphium* sp. *Sporothrix* sp.	*Picea abies* *Pinus sylvestris*	*Ips typographus*
	Leptographium wingfieldii Morelet	*Pinus sylvestris* *Picea abies*	*Tomicus piniperda* *Tomicus minor*
Ophiostoma minus (Hedgc.) Syd., P. Syd.		*Pinus sylvestris*	*Tomicus piniperda* *Dendroctonus frontalis* *Dendroctonus brevicomis*
Graphium fragrans Math. – Kaarik		*Pinus sylvestris*	*Ips typographus* *Ips sexdentatus*
?	*Sporothrix* sp.	*Pinus sylvestris*	?

In grassetto sono indicati i funghi riscontrati nelle aree oggetto di studio (Langstrom et al., 1993; Wingfield et al., 1993; Paine et al., 1997; Rioung et al., 1999; Solheim et al., 2001; Jacobs, Wingfield, 2001; Fernandez et al., 2004; Jacobs, Steimel, 2004; Sallenave Pedebos et al., 2005; Jankowiak, 2005; Rioung et al., 2006)

Figura 4.47 – Apoteci di Cyclaneusma minus su aghi di pino silvestre.

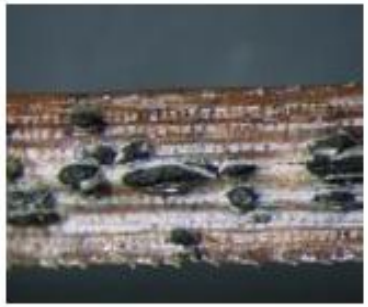
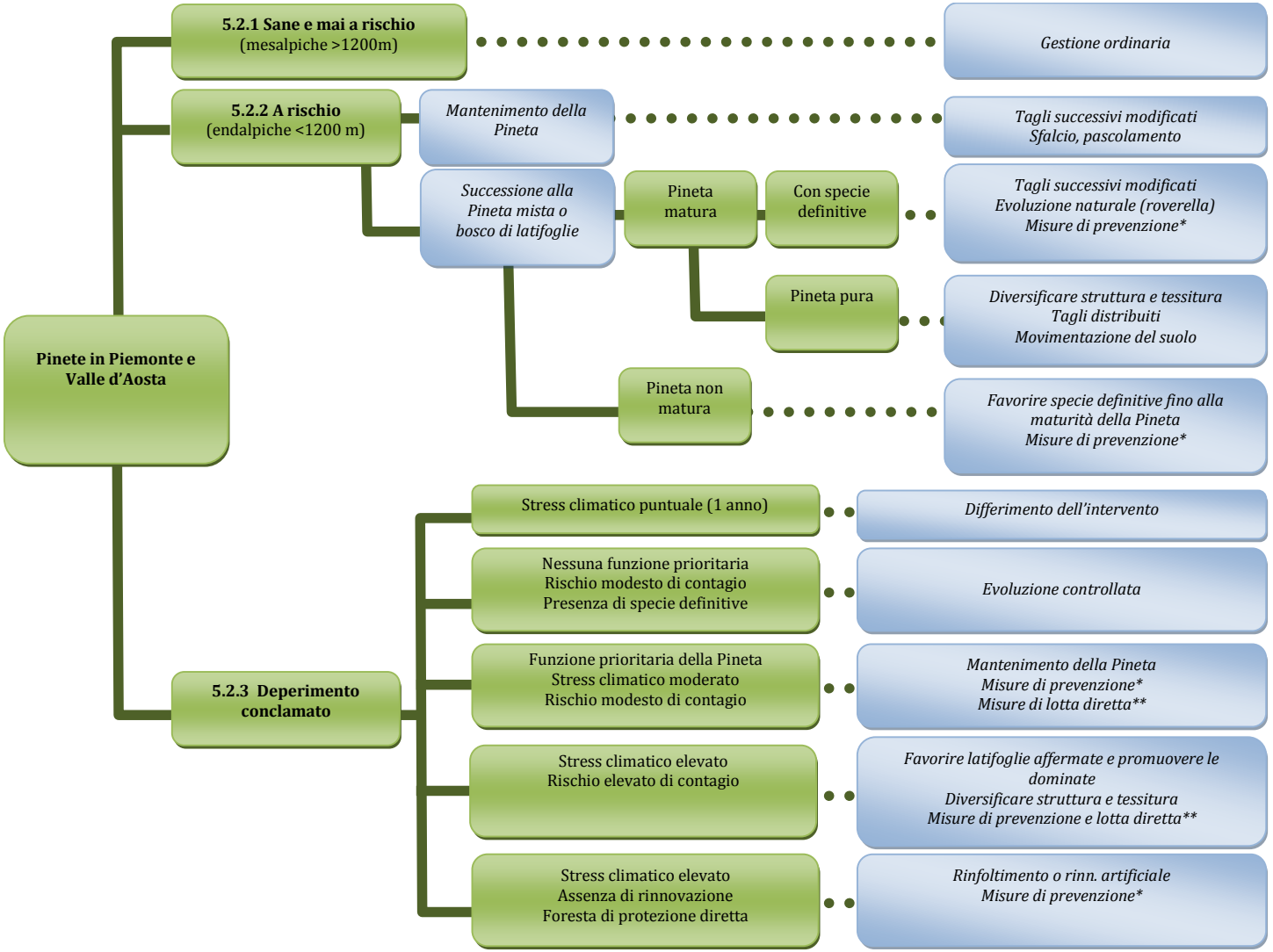


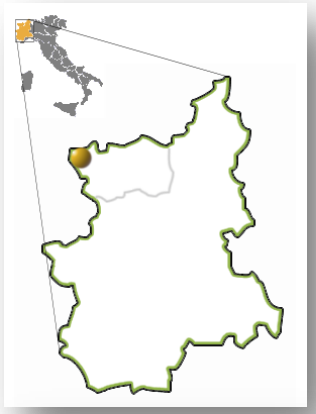
Figura 4.48 – Picnidi di Sclerophoma pithyophila su aghi di pino silvestre.

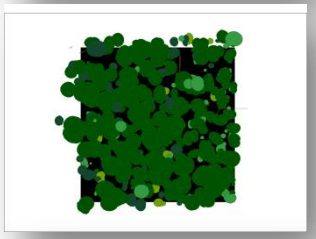
Indirizzi selvicolturali



Conclusioni

Casi di studio



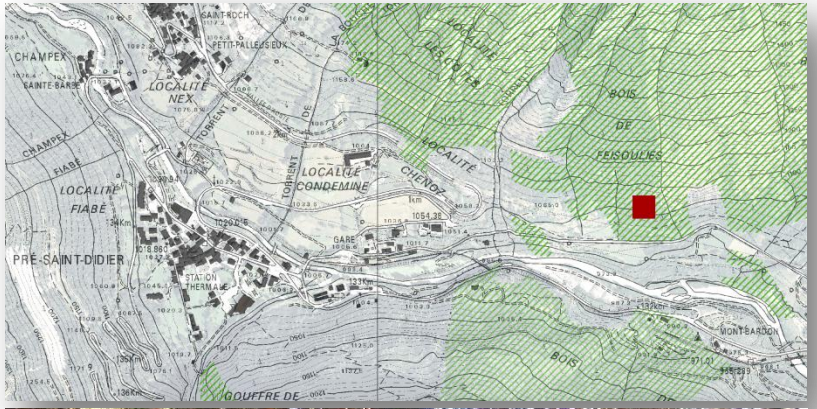


INQUADRAMENTO GENERALE

Comune: Morgex (AO)
Località: Dailley - Bois de Feisouilles
UTM: 5069859 N 344753 E
Quota: 1091 m
Pendenza: 77%
Esposizione: Sud
T media annua: 7,9 °C
P medie annue 8416 mm

POPOLAMENTO FORESTALE

Tipo forestale: Pineta endalpica basifila
N. piante/ha: 824
pino silvestre: 610
N. ceppaie/ha: 67
Area basim.: 36,8 m^2/ha
pino silvestre: 34,1 m^2/ha
necromassa: 7,1 m^2/ha
Copertura: 81%
Dmedio: 23,8 cm
pino silvestre: 26,7 cm
H dominante: 16,7 m
Età media: 90 anni



Tagli successivi adattati
Stadio evolutivo e fitosanitario transitori

Destinazione: Pineta pura o successione
Favorire latifoglie nobili
Lotta *Heterobasidion* (epoca, trattam.)

agroselviter
Dipartimento di Agronomia,
Selvicoltura e Gestione del territorio

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Dinamiche forestali nelle pinete di pino silvestre delle Alpi occidentali

Paesaggio forestale, "land use change" e "climate change"
Strumenti di analisi, modelli ed applicazioni in foreste europee e dell'America Settentrionale

29 Settembre 2008. Facoltà di Agraria – Università degli Studi di Torino, Grugliasco (TO)