Mushroom production and diversity under experimental thinning and climate change

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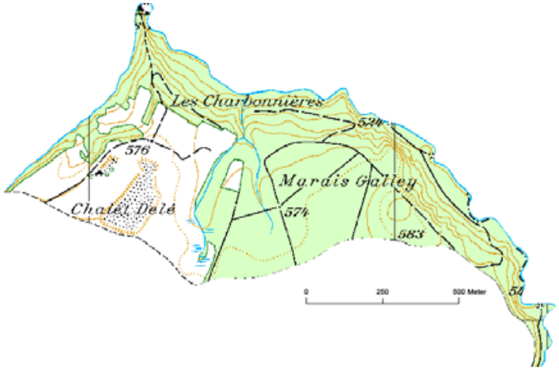
The fungus reserve La Chanéaz, FR

- established in 1975
- 74 ha
- mixed, multi-storied forest
- 575 m a.s.l.
- 845 mm/year



The long term mycological dataset: 1975-2006



- full inventory of all epigeous macromycetes
- weekly, from week 20-52
- total area: 1500 m^2 (5 plots à 300 m^2)
- spatial resolution: 1 m^2
- color marking to avoid double counting
- the plots were enclosed by fences of 2 m hight

- a total of 115‘415 fruit bodies
  450 species (273 mycorrhizal, 177 non-mycorrhizal)

Thinning experiment La Chanéaz (1987)

before thinning

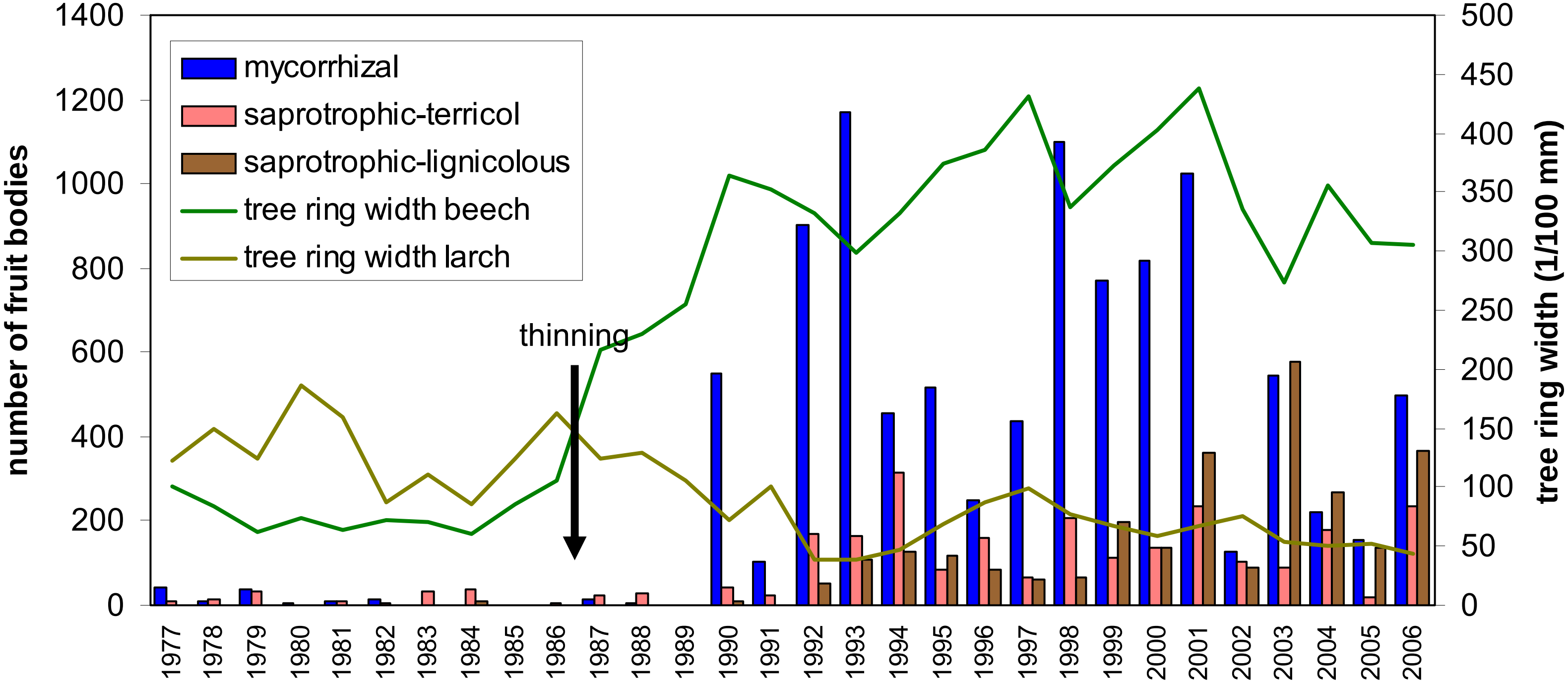
after thinning

Forest structure before and after thinning

	59 Before thinning	59 After thinning
Basal area per tree species ($m^2\ ha^{-1}$)	*Larix decidua*, 55.2	*Fagus sylvatica*, 34.7
	Fagus sylvatica, 34.7	*Larix decidua*, 25.5
	Pinus strobus, 14.7	*Quercus robur*, 3.2
	Picea abies, 13.7	*Acer pseudoplatanus**, 0.6
	Quercus robur, 5.3	*Fraxinus excelsior**, 0.2
	*Acer pseudoplatanus**, 0.6	*Picea abies*, < 0.1
	*Fraxinus excelsior**, 0.2	
Total basal area ($m^2\ ha^{-1}$)	124.4	64.2
Stand age (years)	150	170
Height of dominant trees (m)	44	44
Stand structure	Multi-storied	Multi-storied

(Egli et al. 2010)

Effect of a thinning



mean species number x 4 mycorrhizal: x 5

mean fruit body number x 10 mycorrhizal: x 17

Egli et al. (2010)

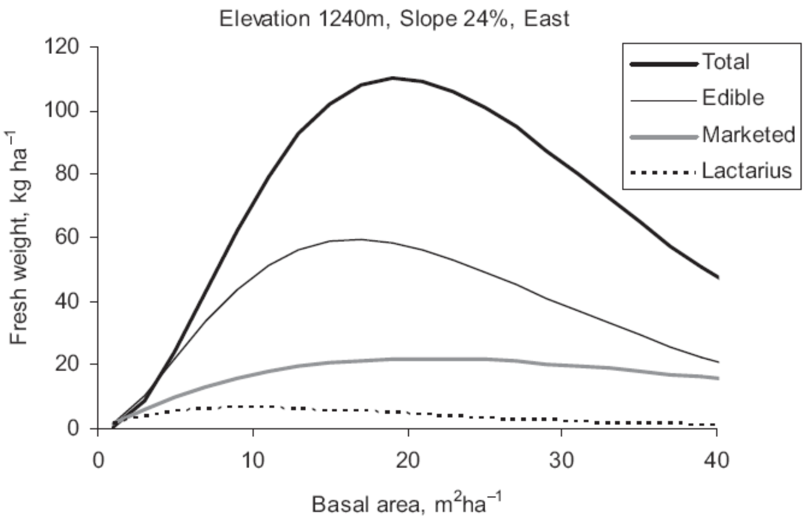
shift in mycorrhizal community structure towards beech-specific species

	59	58	54	51	47
mycorrhizal	44%◄63%	71%►57%	81%►66%	83%►57%	56%►38%
strictly beech-specific	19%◄70%	68%►52%	78%◄81%	91%◄92%	25%►21%
facultatively beech-specific	70%►15%	9%◄27%	8%◄11%	6%►5%	16%◄38%
non beech-specific	11%◄15%	23%►21%	14%►8%	3% 3%	59%►41%
non mycorrhizal	56%►37%	29%◄43%	19%◄34%	17%◄43%	44%◄62%
saprotrophic-terricol	95%►41%	79%►34%	68%►65%	96%►63%	40%◄47%
saprotrophic lignicolous	5%◄48%	10%◄26%	26%►23%	4%◄36%	21%►12%
parasitc, pathogenic	0%◄11%	11%◄40%	6%◄12%	0%◄1%	39%◄41%

Table 3
Shift in the relative fruit body abundance of mycorrhizal and non-mycorrhizal species and in the proportions per ecological category between the period before (1977-1986) and the period after thinning (1987-2006) in plot 59 and in the non-thinned plots 47, 51, 54, 58. ◄ = increasing trend ► = decreasing trend

Egli et al. (2010)

Influence of the host tree on ectomycorrhizal mushroom growth



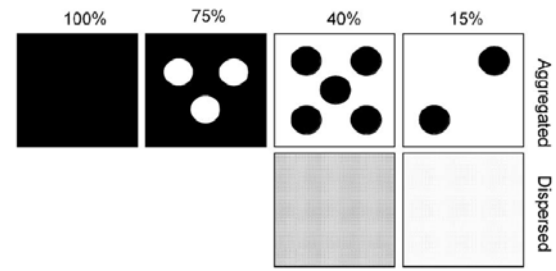
Bonet et al. (2008, 2010)

Table 1 *Boletus edulis* and *Lactarius deliciosus* autumnal sporocarps mean fresh weight production (kg/ha) between 1995 and 2008 in Pinar Grande by stand age class (extracted from Martínez-Peña 2009)

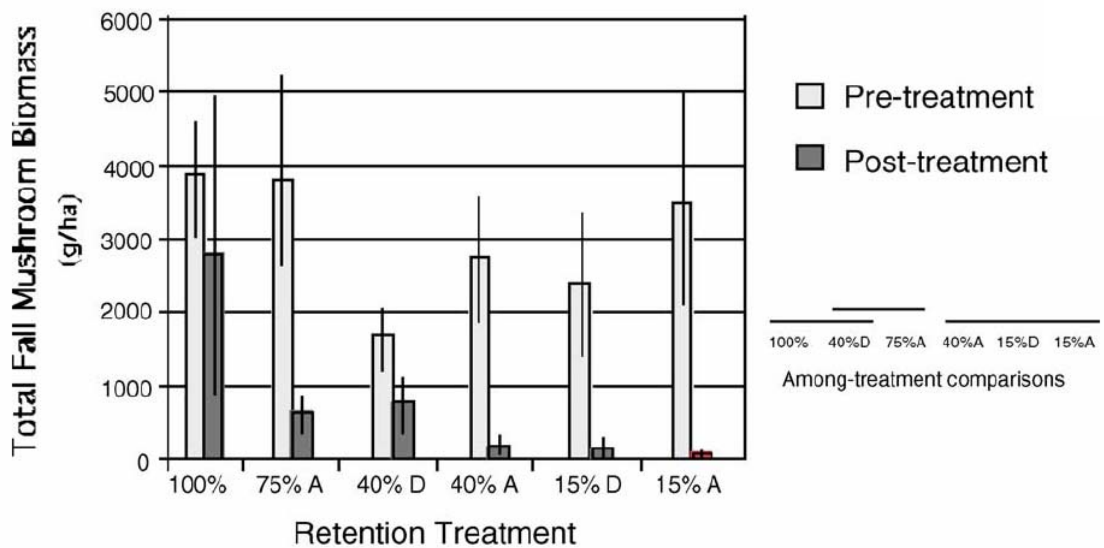
	Pinus sylvestris age class stand (years)			Mean
	Under 30	31–70	Over 71	
Boletus edulis	16.2	84.9	21.9	30.3
Lactarius deliciosus	17.9	3.1	14.9	9.1

Ortega-Martinez et al. (2011)

Effect of thinning



D.L. Luoma et al. / Forest Ecology and Management 202 (2004) 337–354



Luoma et al. (2004)

Fig. 5. Mean total ectomycorrhizal mushroom standing-crop biomass for the fall samples from three DEMO blocks. Standard errors are indicated by vertical bars. Among-treatment comparisons were derived from MANOVA repeated measures contrasts of the time × treatment interaction using transformed data. Treatments without a shared horizontal bar above them are significantly different at $P \leq 0.1$ (see Table 5 for specific P-values).

- thinning caused a clear decline in fruit body production in a Douglas fir forest, with great variation according to the pattern and level of thinning

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THE EFFECTS OF SILVICULTURAL TREATMENTS ON OCCURRENCE OF MYCORRHIZAL SPOROCARPS IN A *Pinus contorta* FOREST: A PRELIMINARY STUDY

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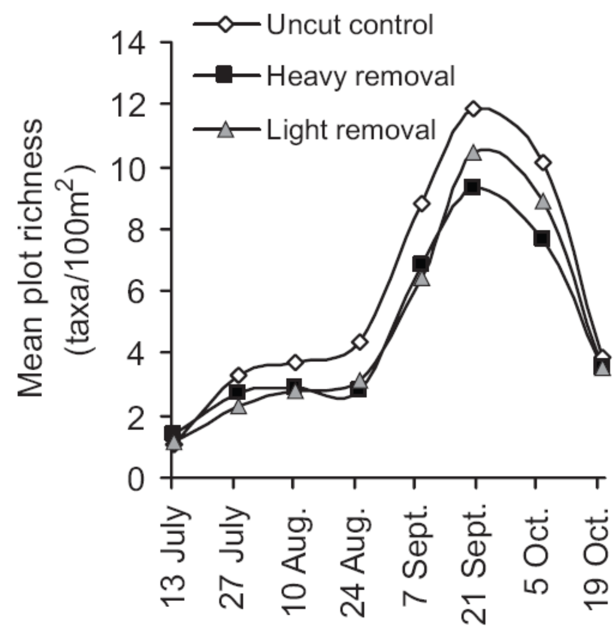
(Received 19 June 1995; accepted 1 September 1995)

- species diversity was reduced 10 y after thinning and 17 y after clearcut
- the effects on fruit body production are species-specific: from positive to negative
- clearcutting reduced fruit body production of ectomycorrhizal species (except *Suillus brevipes,* which increased)

Ectomycorrhizal mushroom response to partial cutting in a western hemlock – western redcedar forest

J.M. Kranabetter and P. Kroeger

Fig. 8. Mean taxon richness from 1997 to 1999 over the fruiting season, summarized by treatment.



- no clear effects on species richness and productivity (positive, neutral, negative), 5-7 y after thinning

Mycol. Res. **107** (3): 317–328 (March 2003). © The British Mycological Society 317
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Effects of thinning treatment on an ectomycorrhizal succession

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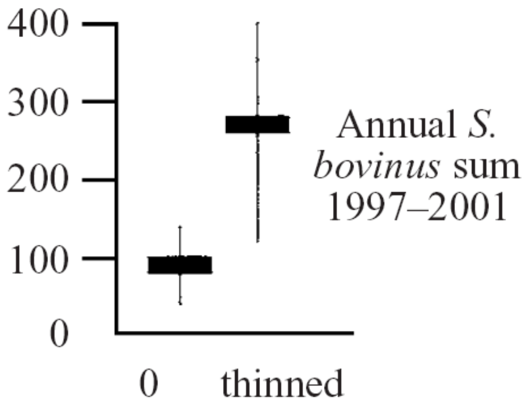
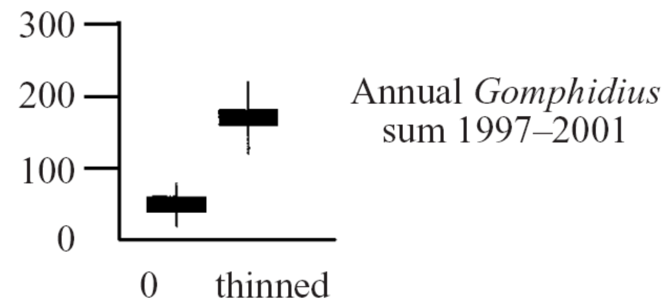




- 12 years after a 50%-thinning in a Scots pine forest:
  out of 19 species only 3 significantly responded to thinning (*Suillus bovinus, Gomphidius roseus, Cortinarius semisanguineus*)

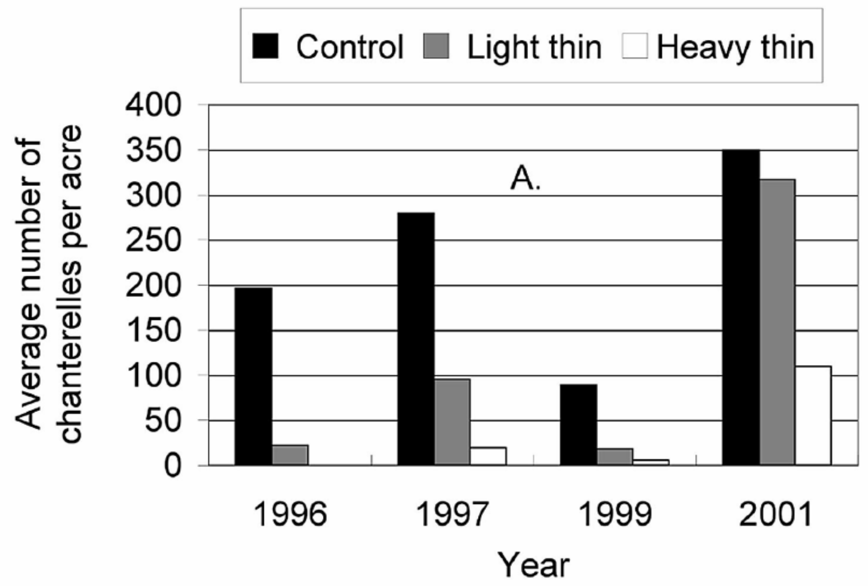
Effects of Thinning Young Forests on Chanterelle Mushroom Production

David Pilz, Randy Molina, and Jim Mayo

ABSTRACT

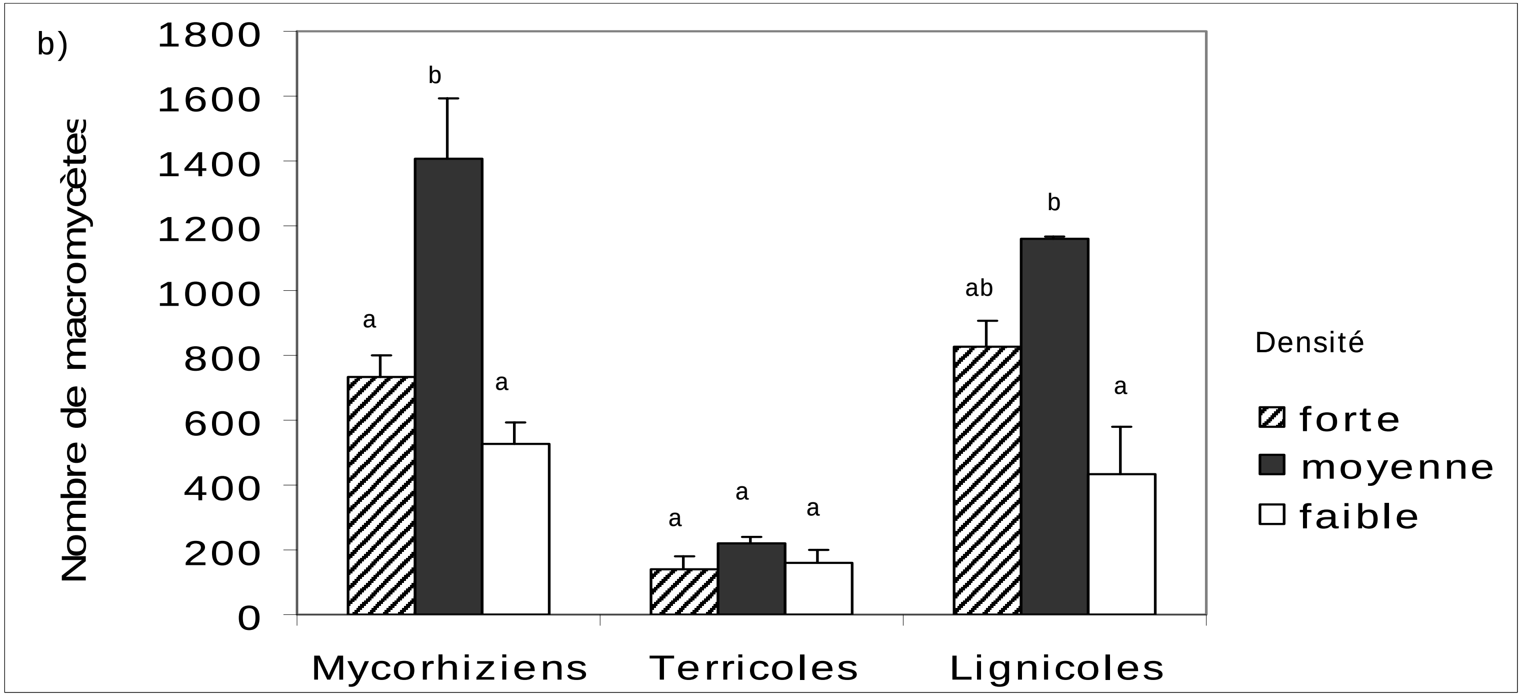
Chanterelle productivity responses were investigated in a replicated, landscape-scale thinning experiment in 50-year-old Douglas-fir stands in the Cascade Range of Oregon. Chanterelle numbers and weight were significantly decreased by thinning the first year after logging, more so in heavily thinned stands than lightly thinned stands for chanterelle numbers. Nearly all evidence of differences in chanterelle productivity among thinning treatment means disappeared within 6 years. Management implications and mitigation measures are discussed.

Keywords: chanterelle productivity, *Cantharellus*, young stand thinning, nontimber forest products



- significant decrease in number and weight in the first year after thinning of a 50-year-old Douglas-fir stand.
- Tendency of a recovery

Effect of stem density on diversity of forest mushrooms



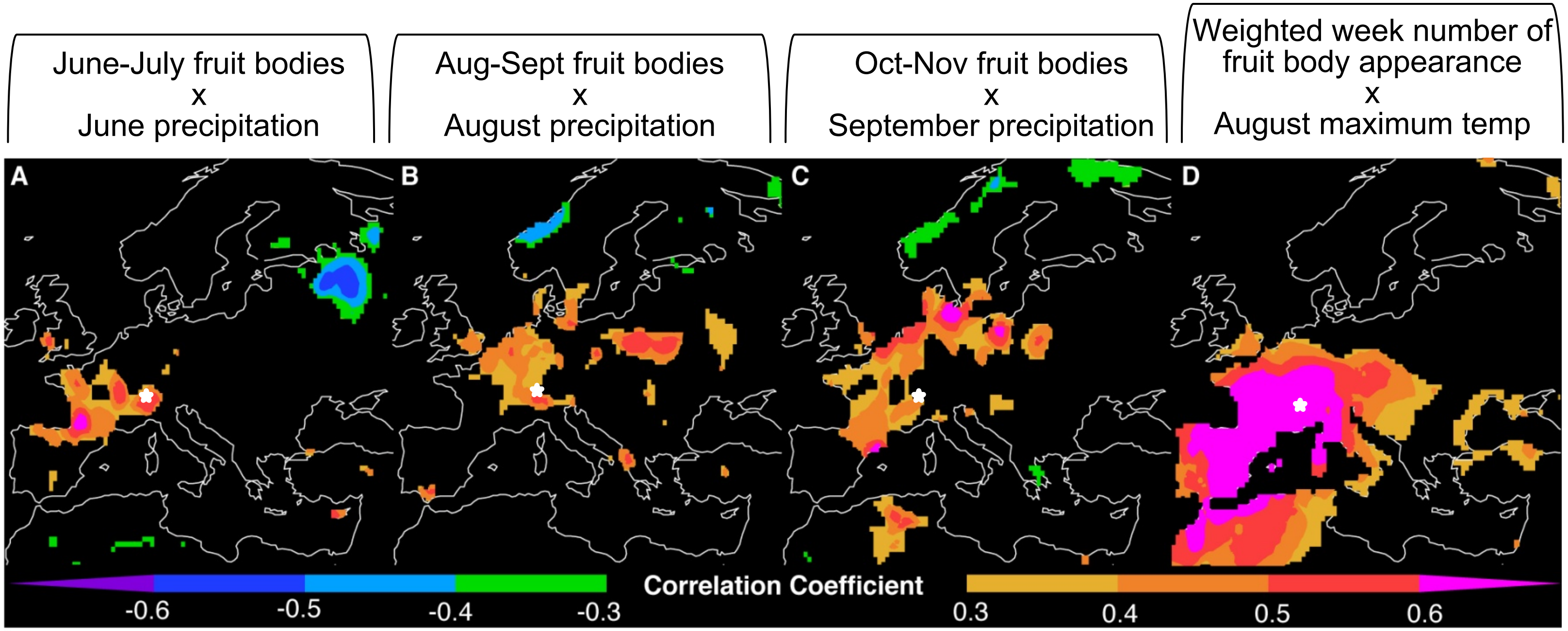
(Ayer et al., 2006)

➢ highest mushroom production in a medium dense Norway spruce plantation (1’300, <u>800</u>, 600 stems/ha, 35 years old)

Conclusions from the thinning results

- the available results of thinning experiments are inconsistent
- mushroom reactions are very species-specific
- medium dense forests seem to be most favourable for mushroom growth
- thinning treatments alone do not fully explain mushroom reactions

Influence of meteorological factors: case study Switzerland

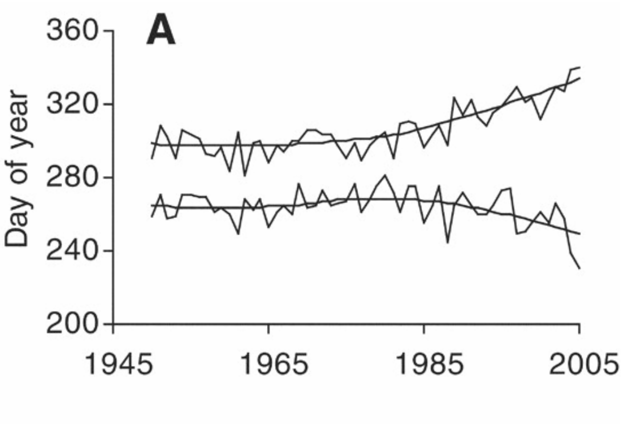


Spatial field correlations of (A) spring (June-July), (B) summer (August-September), (C) autumn (October-November) fruit body counts and (D) mushroom phenology (weighted week of appearance) against June, August and September precipitation totals and August maximum temperature, respectively (gridded high-resolution climate data, European Climate assessment dataset (ECA)).

(Büntgen, Kauserud & Egli, in press)

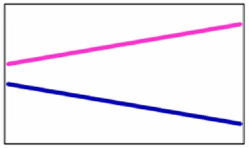
- fruit body production is driven by pre-rainfall of the current year
- mushroom phenology (weighted week of fruit body appearance) is driven by summer temperature

Phenological trends in the mushroom fruiting: first and last fruiting dates



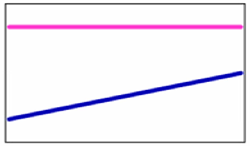
Great Britain (Gange et al., 2007):

Mushroom season has expanded in both directions since beginning of the 80's



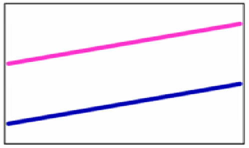
Norway (Kauserud et al., 2008):

Mushroom season starts later, with no clear tendency of ending later.

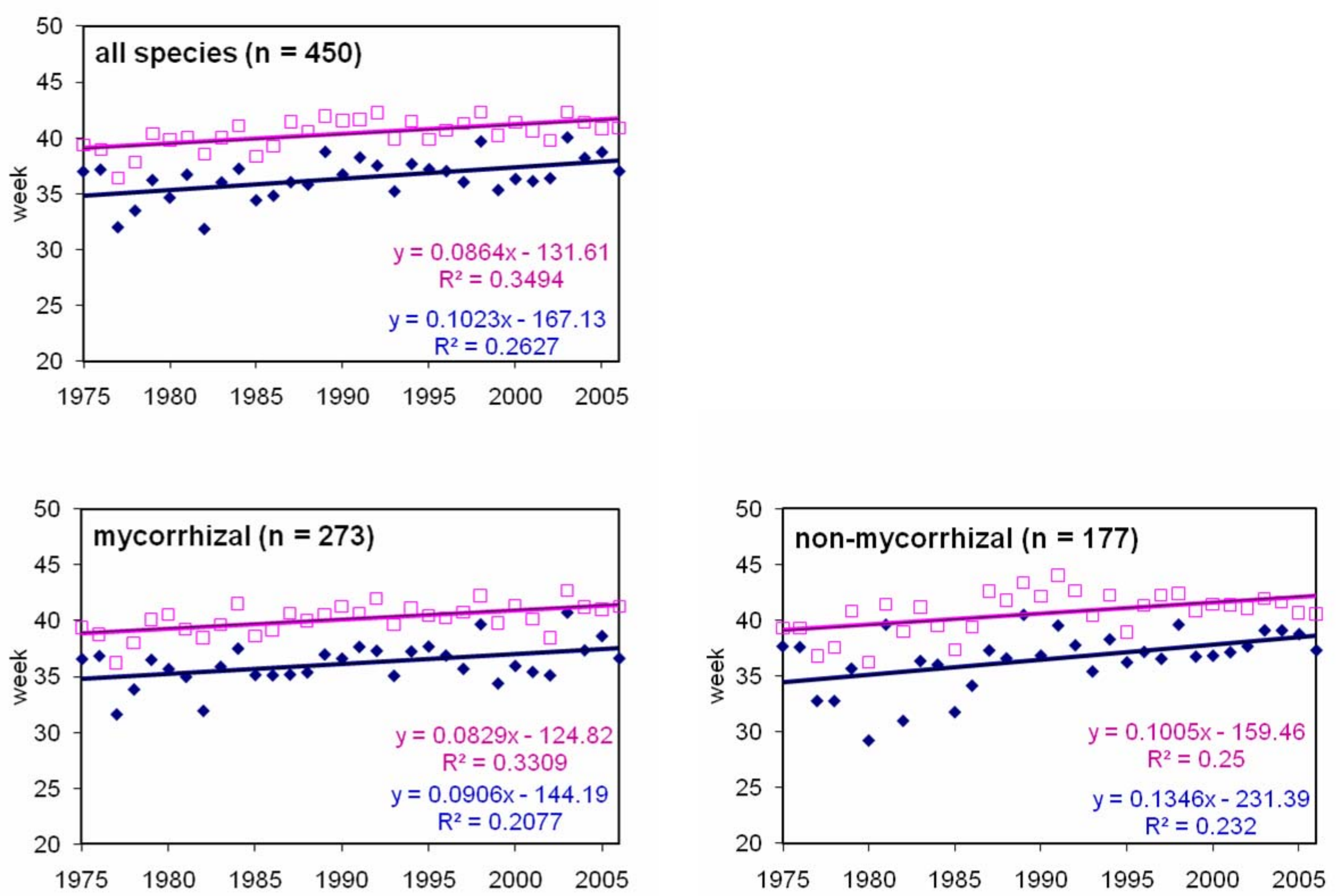


CH:

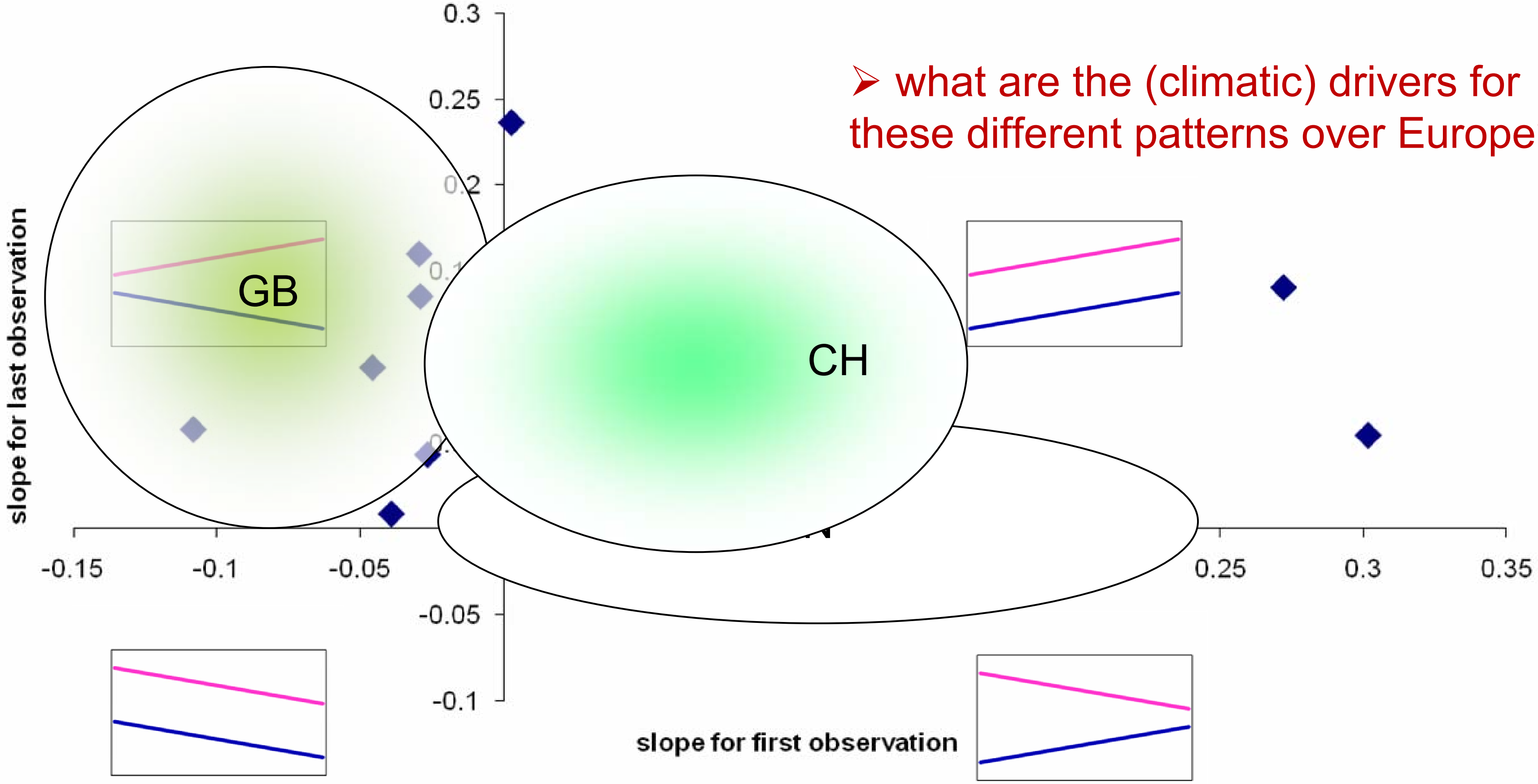
Mushroom season starts later, and ends later



First and last fruiting dates: fungus reserve La Chanéaz



First and last fruiting dates: fungus reserve La Chanéaz (25 most frequent species)



- what are the patterns in Spain, Finland?
- what are the (climatic) drivers for these different patterns over Europe?

Conclusions from the Swiss forest mushrooms observations (1975-2006)

- Good and poor mushroom years seem to be driven mainly by meteorological factors:
  - productivity by pre-rainfall in the current year
  - phenology by summer temperature
- Mean mushroom fruiting date has delayed by ~10 days between 1975-2006
- Both first and last fruiting dates have shifted forward, the mean duration of the fruiting period remains ± unchanged
- Mushrooms seem to be sensitive indicators for climate variation

Thank you for your attention