

# シダレカンバ非施業林における森林動態 ー構造、樹型、光環境に着目してー

Forest dynamics in unexploited birch (*Betula pendula*) stands in the Vosges(France): structure, architecture and light patterns

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造林学研究室4年 室木直樹

# Abstract

- 樹型や森林構造、光環境は遷移段階で異なっていた
- カンバの種内競争により、ギャップがたくさん
- 下層も光環境が良好で更新可能
- 将来的には、生物多様性を高めつつブナ林へ

# 1.Introduction

## 1.背景(background)

- 資源競争など森林環境に応じて、樹木の構造(例えば、樹型)は柔軟に変化する。
- It is known that tree architecture is flexible in a forest environment, depending on local competition for light and soil resources.
- Plasticity helps in situations of competition where resources availability is altered by neighbouring plants.

# 1.Introduction

## 1.背景(background)

- ブナ林の森林動態に関しては、小規模ギャップによる研究が多く、大規模攪乱後の長期的な研究はなされていない。
- Natural dynamics of beech (*Fagus sylvatica*) forests have been mainly studied in the context of small gaps.
- There are very few studies on spontaneous long-term development after a major disturbance, which killed hectares of beech forest.

# 1.Introduction

- ということで...

大規模攪乱跡地で、樹型や森林構造を絡めて、森林動態をみてみたい

# 1.Introduction

## 2.研究目的(objectives of the study)

- シダレカンバとヨーロッパブナに関して、樹木の構造(樹型)の発達過程を調べる。
- To study architectural developments of two tree species (*Betula pendula*, *Fagus sylvatica*).
- 樹型と森林構造の関係性、森林構造と光環境の関係性を調べる。
- Link changes in tree architecture to changes in forest structure, forest structure and light patterns.

# 1.Introduction

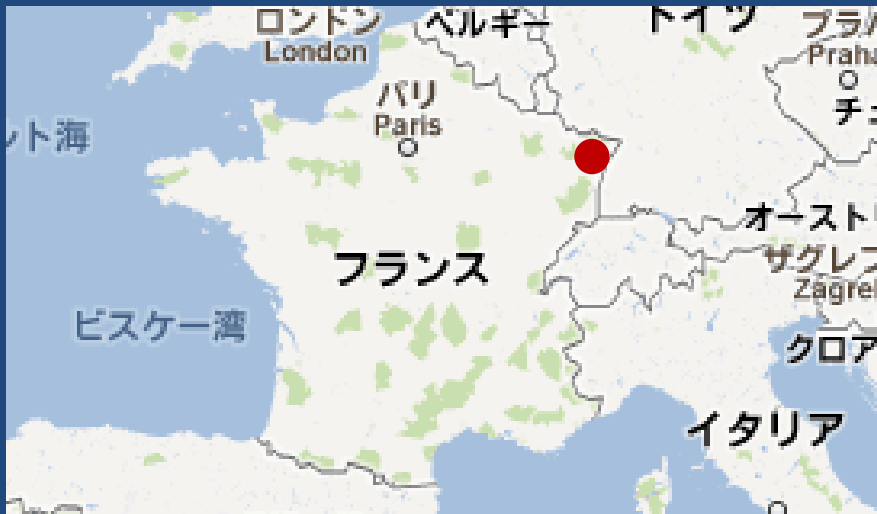
## 2.研究目的(objectives of the study)

- 遷移に関して、将来予測する。
- Draw conclusions about the future of the succession.

樹型、森林構造の変化に関するモデルを、  
大規模かつ長期的な研究に当てはめる

## 2. Study site

### 1. 概況



- 標高(altitude): 200m
- 土壌(soil): sandstone, acidic
- 降水量(rainfall): 800-900mm
- 優占種(dominant species): beech, oak



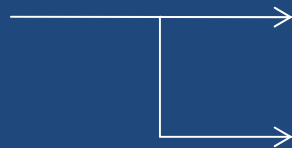
## 2.Study site

### 2.詳細

- 第二次世界大戦中、100haにおよぶ火災
- 100ha of the forest burnt down during World War.2
- 近年の台風や火災
- Recent disturbance (storm, local fire)



Oak,  
Beech



Birch (50 years of age)

Birch (15 years of age)

# 3.Methods

## 1.プロット(plots)

plot1 : 15-year-age 40m × 60m (0.24ha)

plot2 : 50-year-age 50m × 50m (0.25ha)

## 2.測定項目(measurement)

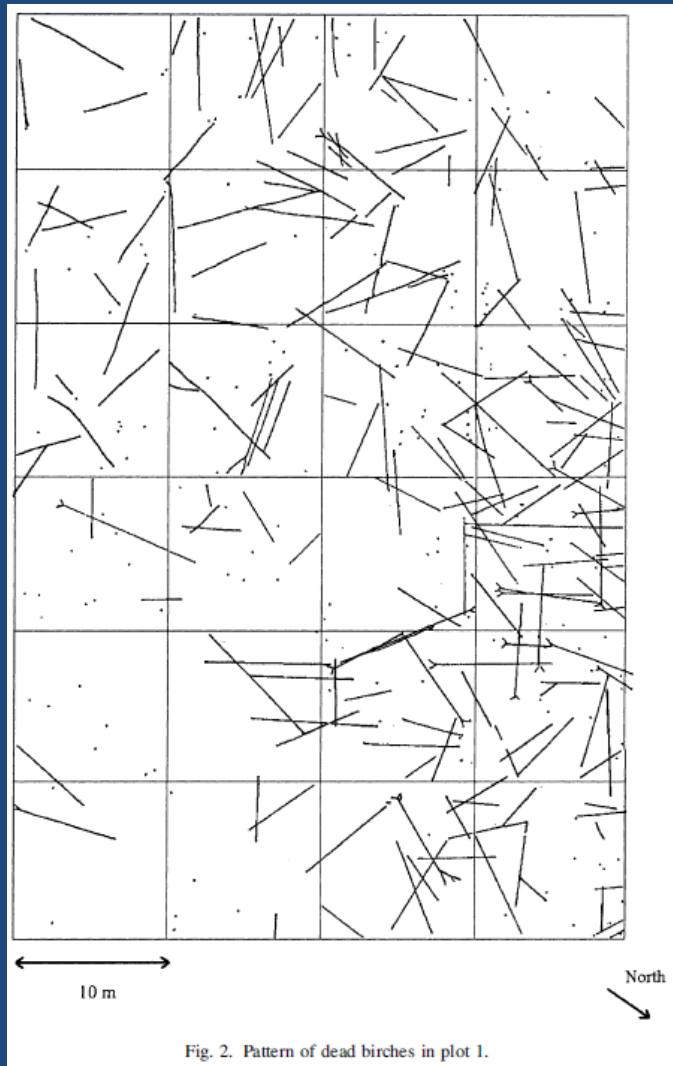
樹高(H)、胸高直径(d)、樹種(species)、樹型(観察スケッチ、observations and drawing)、光環境(PPFD、R:IR、LAI)

## 3.解析(analysis)

形状比(H/d ratio)→social status、樹型と構造(structure and architecture)、全天写真(hemispherical photographs)→樹冠配置(canopy geometry)

# 4. Results and discussion

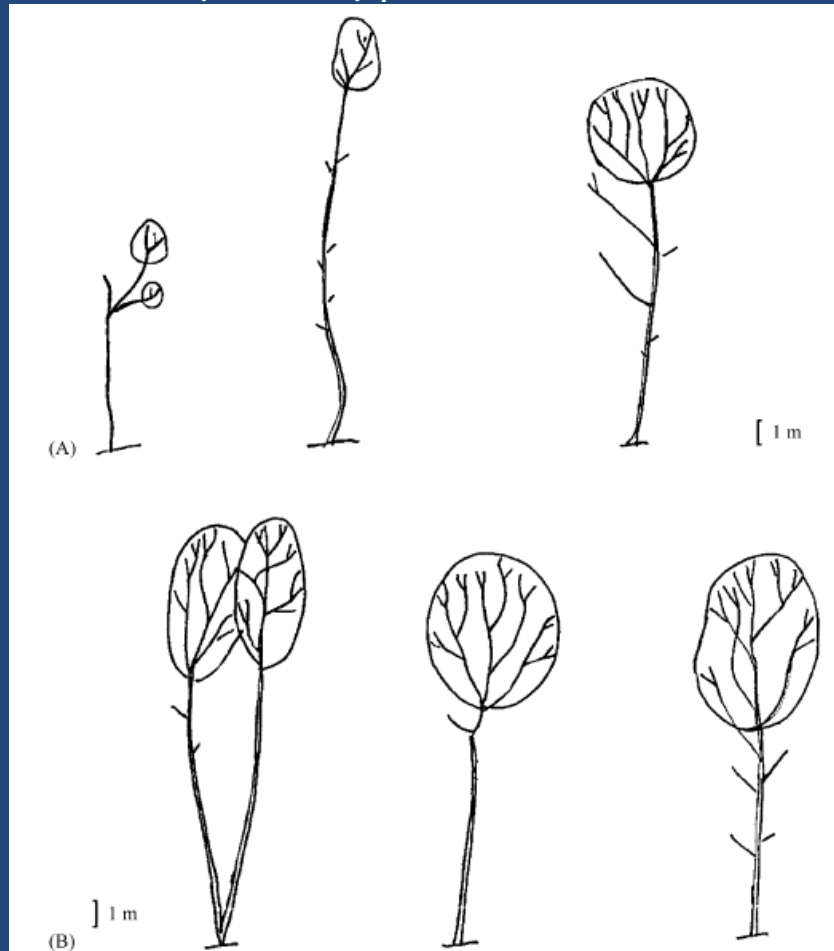
# Plot1(15year) Birch population



- Density 2672本/ha
- Height  $16 \pm 3.6\text{m}$
- DBH  $12 \pm 6\text{cm}$
- 立枯木(disd standing trunks) 696本/ha
- 高密度(high density)
- 高死亡率(high mortality)

# Plot1 Birch architecture

準優勢木(将来木) potential trees



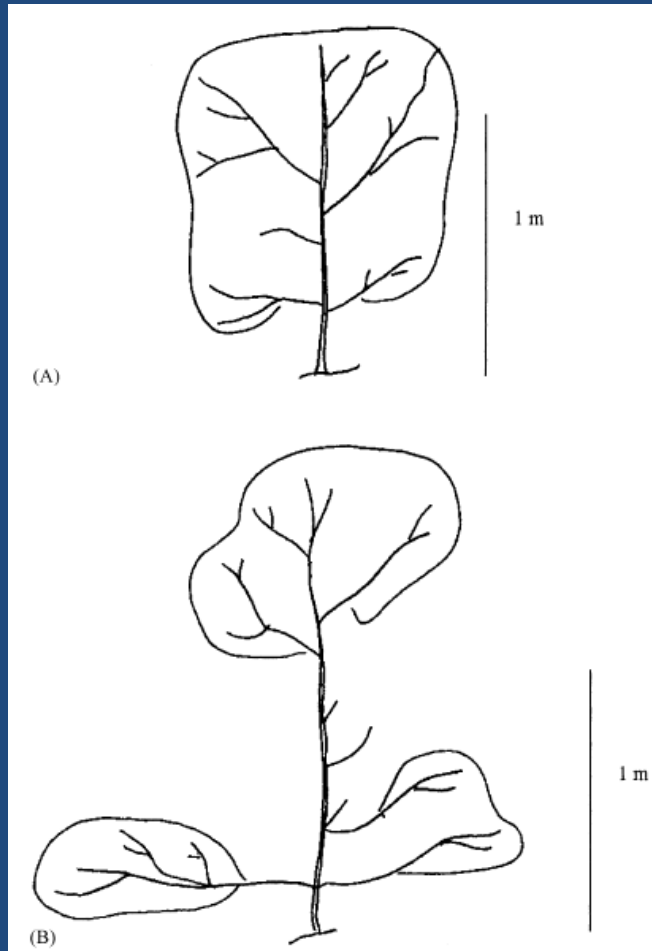
- 狭い樹冠、細い幹
- 樹高成長 > 分枝
- 多様な樹型
- 今後、競争により被圧

優勢木(健全木) trees of the present

# Plot1 Beech population

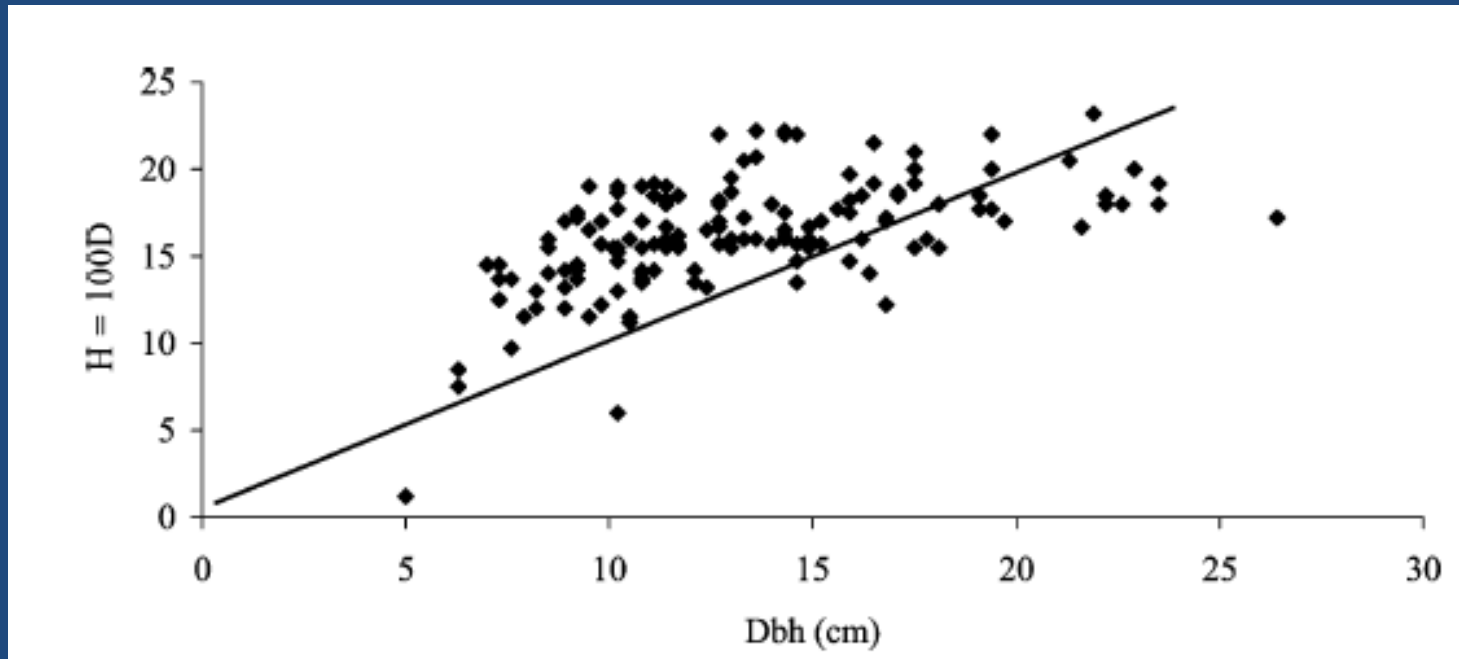
- Density 268本/ha(h=1-2m), 1232/ha(seedlings)
- Height  $1.2 \pm 0.3\text{m}$
- **ブナはかなり疎**(beech population is very sparse.)
- 他樹種は少し(*Q.petraea*, *Sorbus.aria*, *S.aucuparia*)
- カンバ実生はない(Birch seedlings are absent.)

# Plot1 Beech architecture



- 枝を良く伸ばす
- 直交、平行な枝
- 樹高成長<分枝
- 光のある方に伸びる

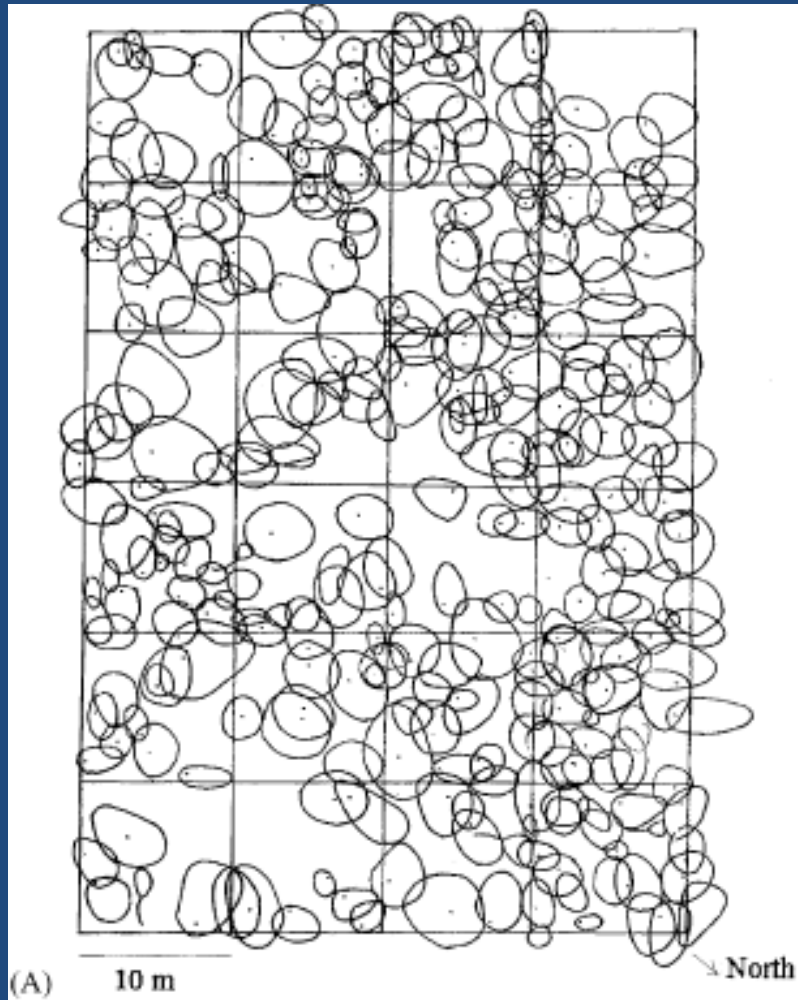
# Plot1 forest architecture



準優勢木(Potential tree) 63%  
優勢木(tree of the present) 37%



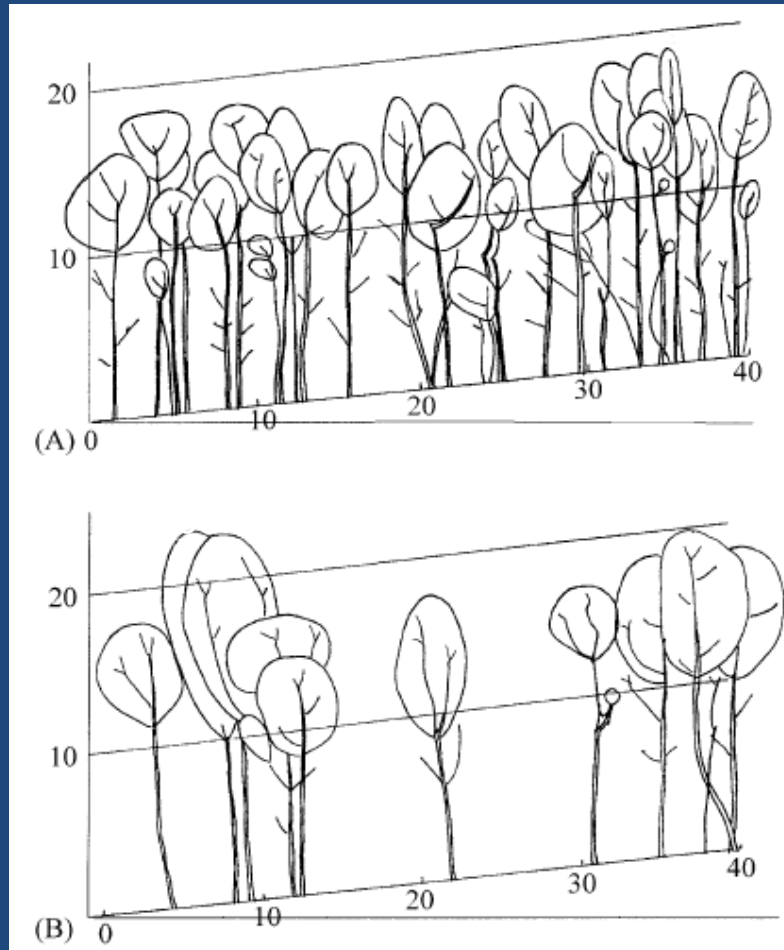
# Plot1 forest architecture



- 混みこみ (high crowding)
- ギャップ小さい、少ない (gaps are rare and small.)
- ギャップは倒木 (被圧木) (from the falling of small suppressed trees)



# Plot1 forest architecture

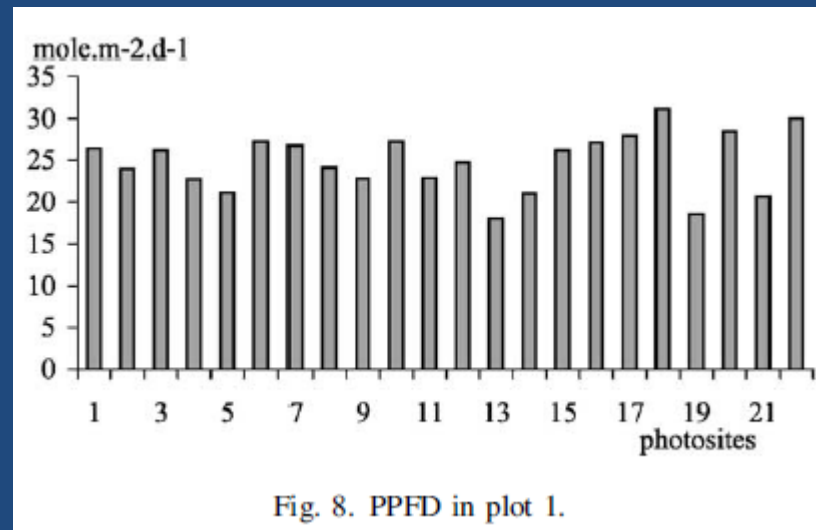


- 準優勢木は多様な形
- 優勢木は似た形
- 優勢木は大きい

まとめ: 成熟期へ向かって急成長中

# Plot1 light pattern

- Canopy openness 17.4%-28.9%
- LAI 1.2-2.01
- PPFD 9(understory)、18.2(gaps)  $\mu \text{mol}/\text{m}^2 \text{S}$
- %PPFD 19.5%-42%
- R:IR ratio 0.67-1.05



# Plot1 light pattern

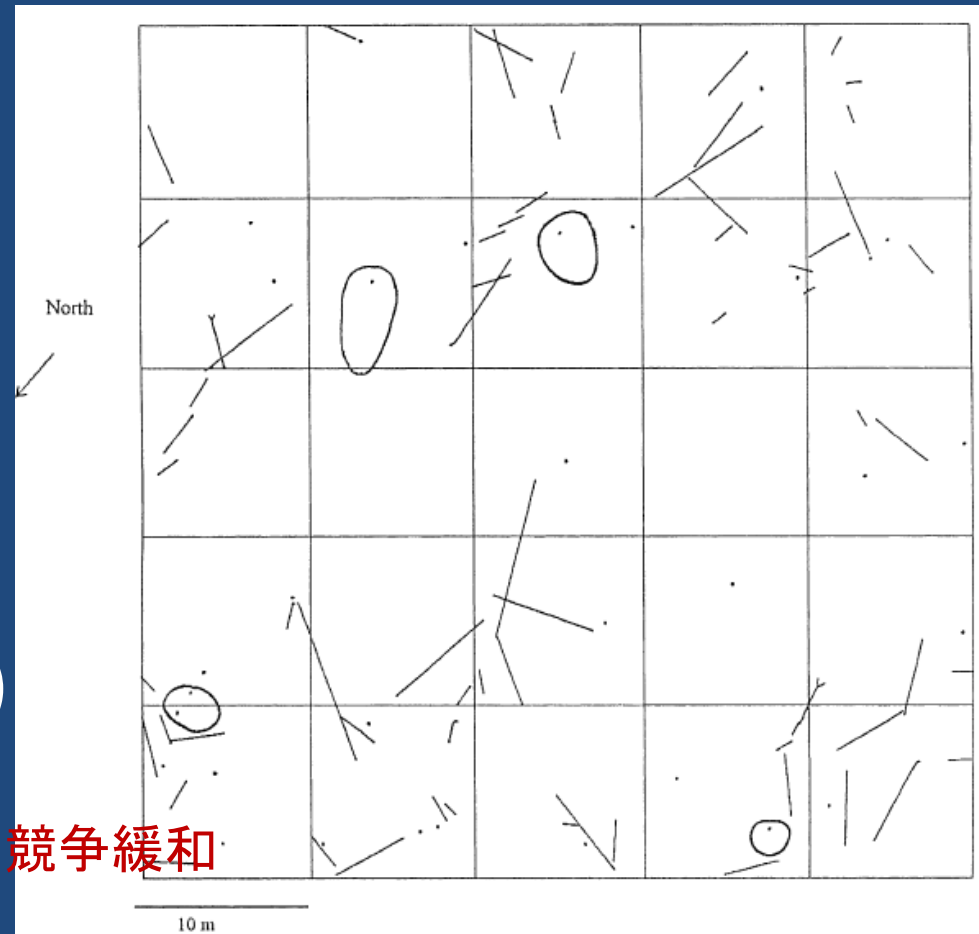
- 場所によって光環境はバラバラ(irregular light pattern)
- 有効な赤色光域がある(good availability for red radiation)



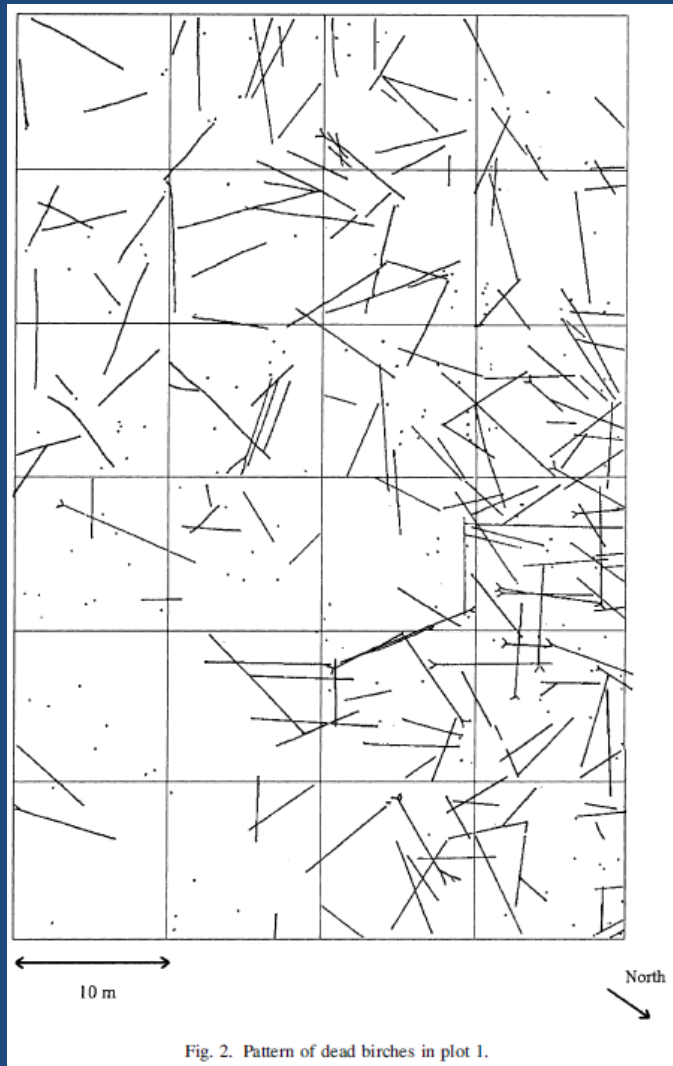
更新が場所によっては可能

# Plot2 (50 year) **Birch** population

- Density 532本/ha
- ほとんど50年生くらい  
(all about 50 years of age)
- Height  $21.8 \pm 6\text{m}$
- DBH  $26 \pm 14\text{cm}$
- 枯死木(dying and dead tree) 230本/ha (26cm)
- **成熟**(maturity)
- **低密度**(low density)

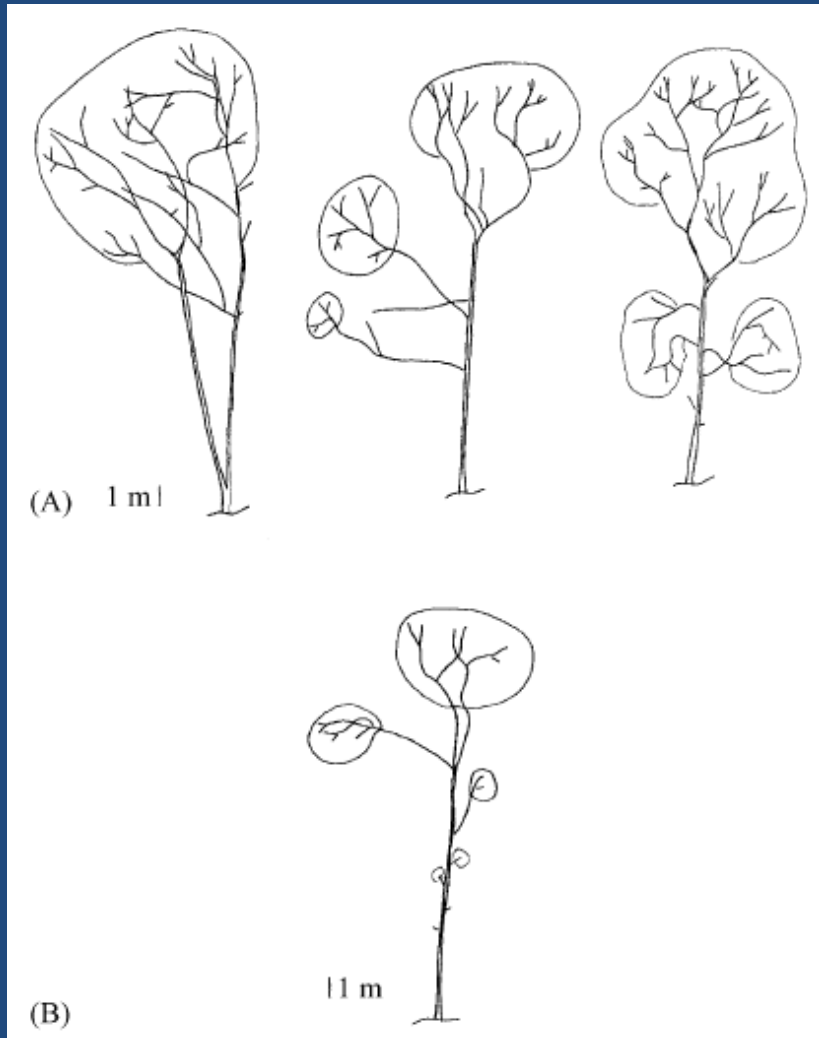


# Plot1(15year) Birch population



- Density 2672本/ha
- Height  $16 \pm 3.6\text{m}$
- DBH  $12 \pm 6\text{cm}$
- 立枯木(dese standing trunks) 696本/ha
- 高密度(high density)
- 高死亡率(high mortality)

# Plot2 Birch architecture



- 樹冠が拡大
- 立派な幹
- 斜面にそって成長

- 樹冠が衰退
- Present より小さい(11-13m)

presse

# Plot2 Beech population

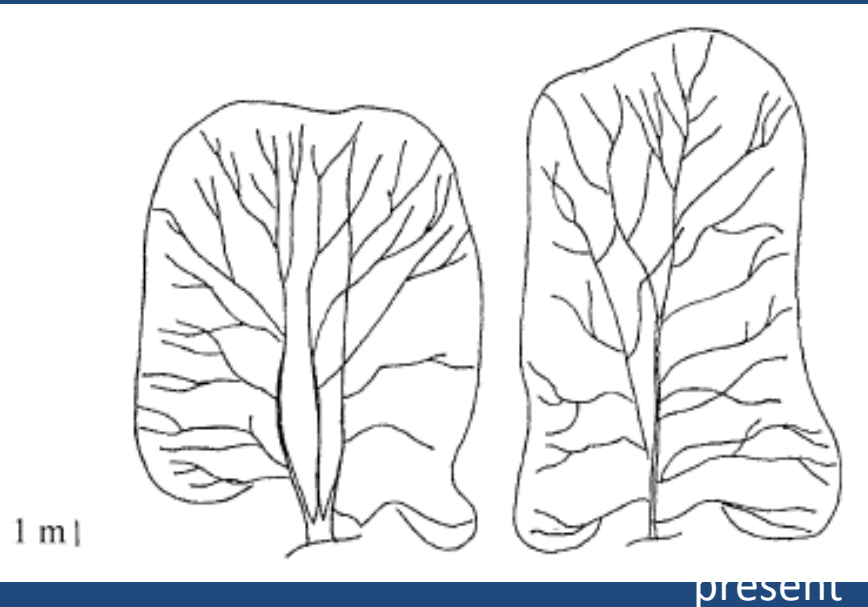
- Density 592本/ha 高密度
- Height 1-22m (95%は5m以下)
- *S.aria*はブナ並に存在(*S.aria* are almost as numerous as *F.sylvatica*.)
- 他にもいろいろ(*Q.petraea*, *Pinus sylvestris*, *S.aucuparia*)



# Plot1 Beech population

- Density 268本/ha(h=1-2m), 1232/ha(seedlings)
- Height  $1.2 \pm 0.3$ m
- **ブナはかなり疎**(beech population is very sparse.)
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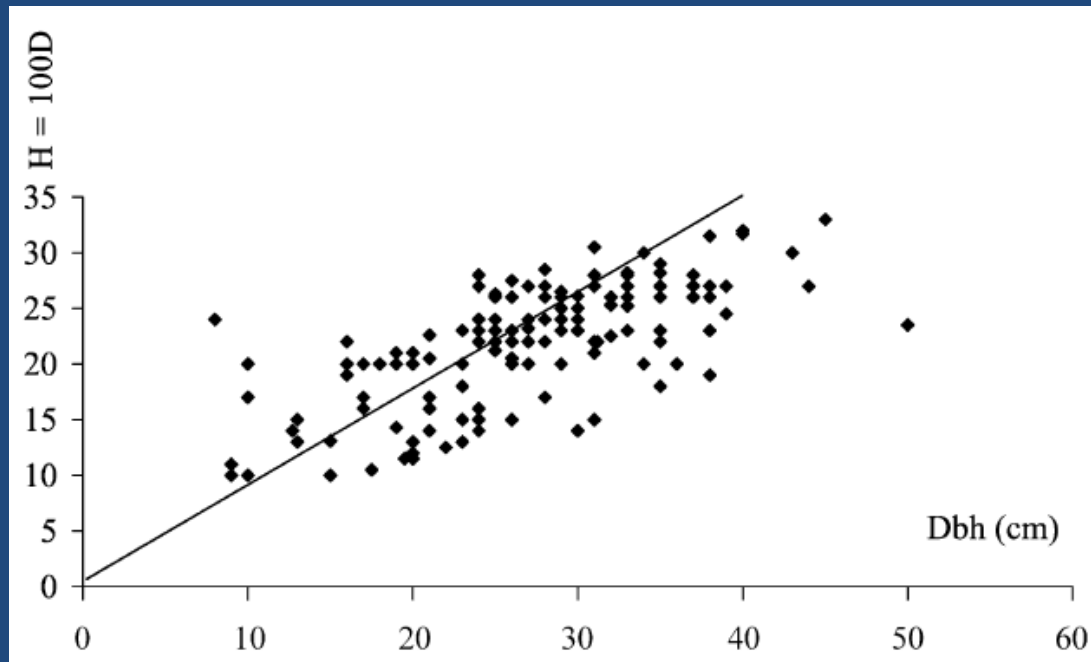
# Plot2 Beech architecture



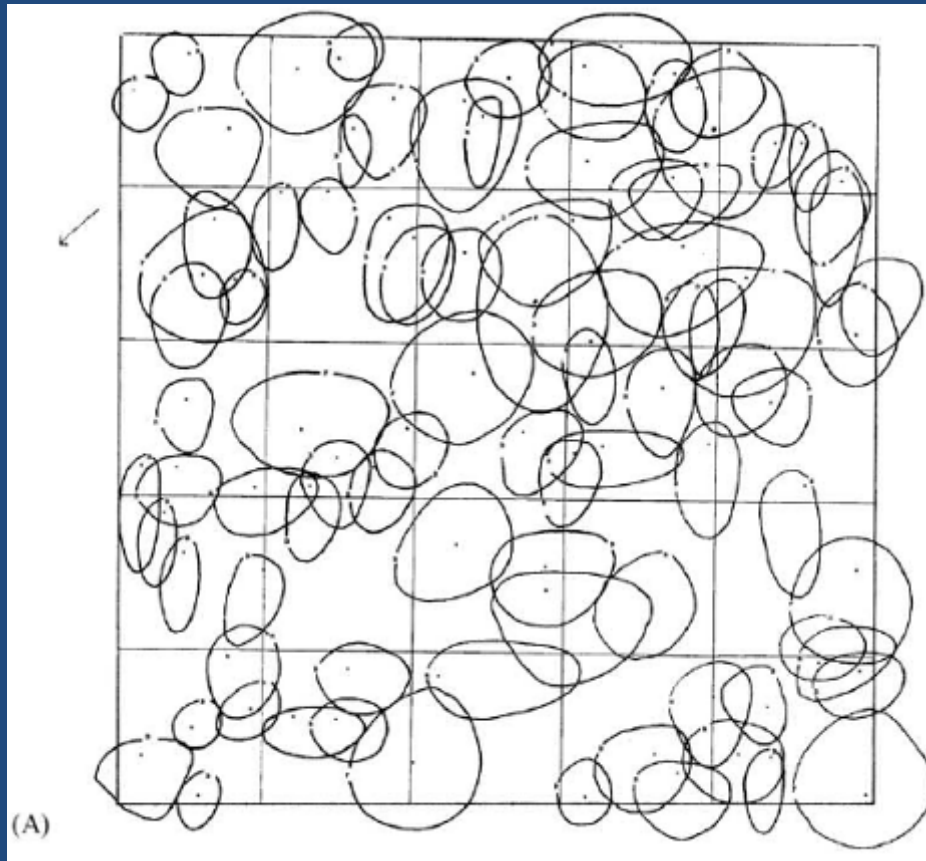
- Present, potentialともに樹冠が発達(8-12m)
- ギャップでは、株立ち、枝を長く張る
- 小さいやつ(1-3m)はplot1と同じ

# Plot2 forest architecture

- 優勢木(trees of the present) 81.8%
- 潜在優勢木(potential tree) 15.7%
- 劣勢木(trees of the past) 2.4%



# Plot2 forest architecture

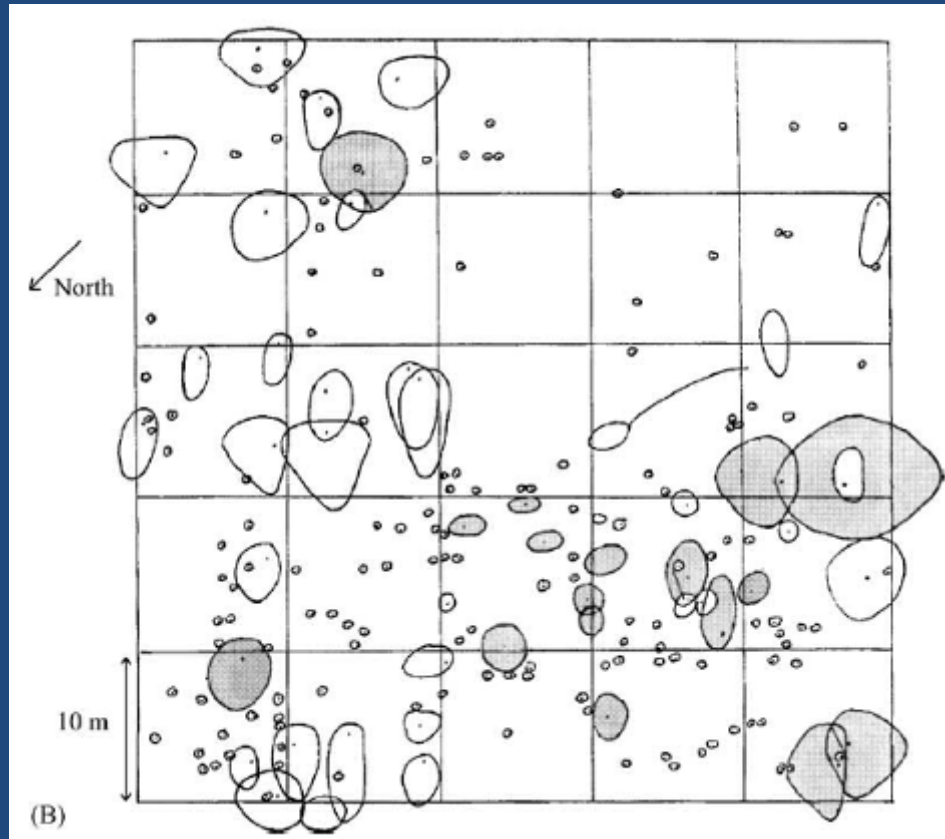


(A)

present

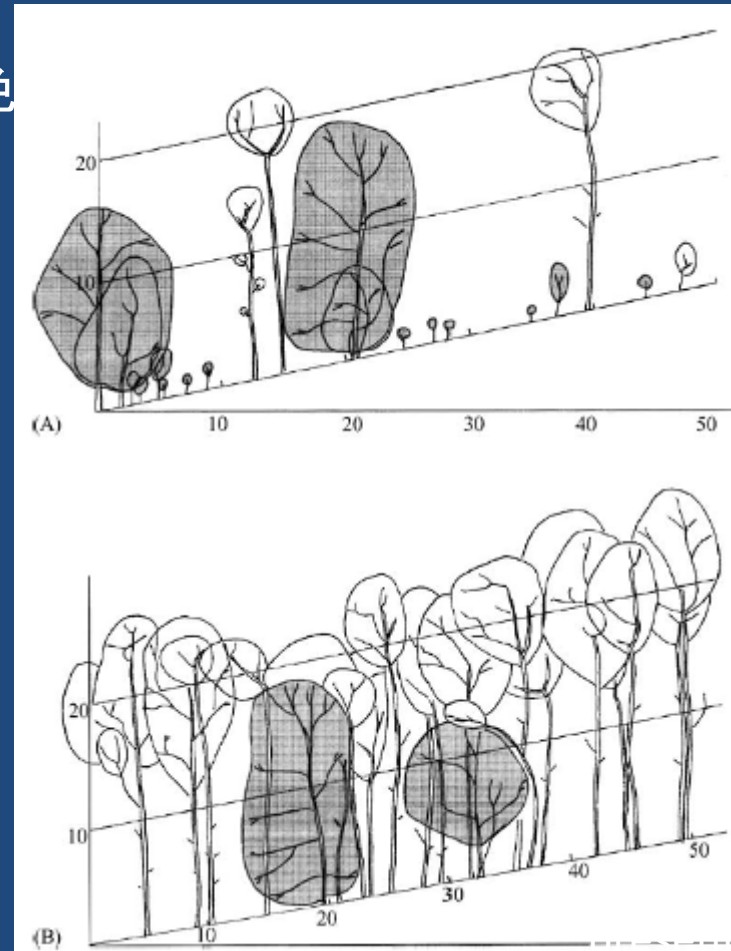
- 階層構造は3段  
21-25m(both)  
30-32m(birch)  
15-18m
- ギャップが大きい(枯死木も大きいから)
- 樹冠配置はより複雑に

# Plot2 forest architecture



potential

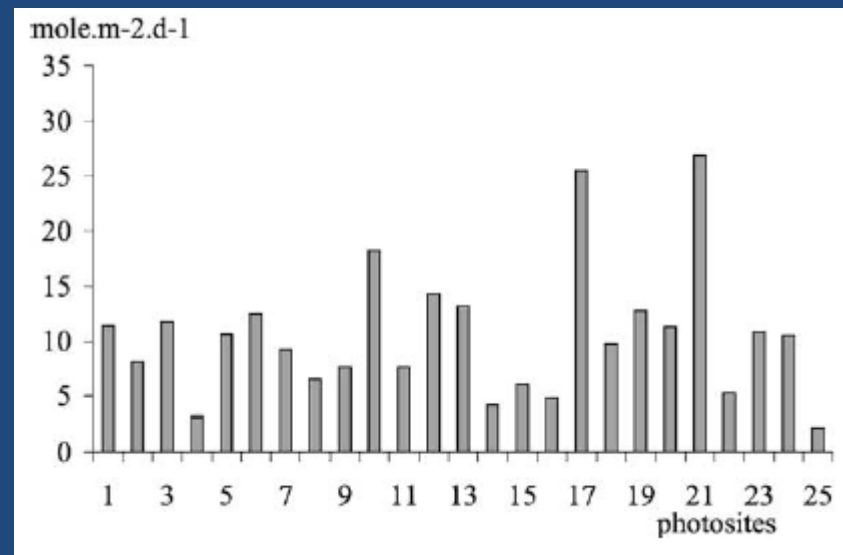
灰色



potential

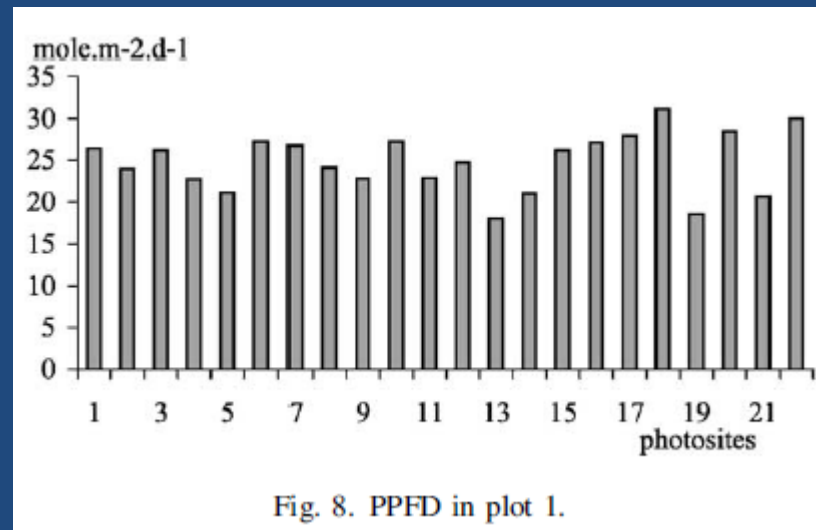
# Plot2 light pattern

- Canopy openness 9.9%-46.7%
- LAI 1.1-1.59
- PPFD  $11.9 \pm 55.2 \mu \text{ mol/m}^2\text{s}$
- R:IR ratio 0.45-0.86



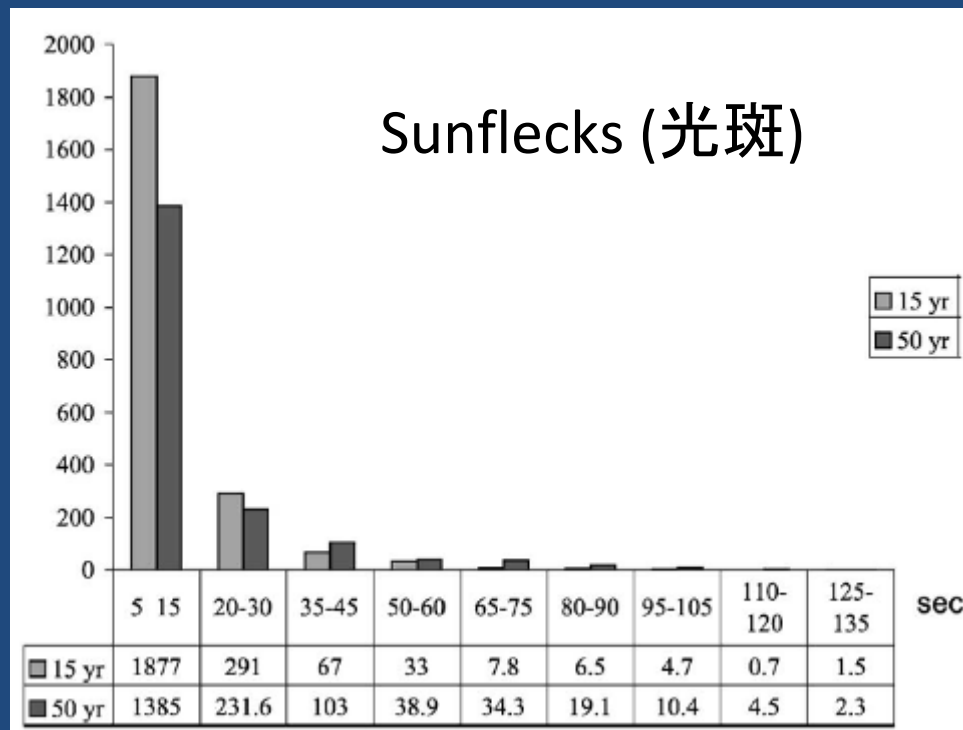
# Plot1 light pattern

- Canopy openness 17.4%-28.9%
- LAI 1.2-2.01
- PPFD 9(understory)、18.2(gaps)  $\mu \text{mol}/\text{m}^2 \text{S}$
- %PPFD 19.5%-42%
- R:IR ratio 0.67-1.05



# Light pattern

- Plot2の方が長い光斑が多い
- R:IRのみ有意差あり (P>0.05)



↓

密度、樹冠構造、種構成の変化が生じている



# 5.conclusions

## 1.Birch

- 種内競争により、多様な構造が発達した(There are a remarkable variety of architectural development, in relation with the high infraspecific competition.)

## 2.Beech

- 光環境が良いため、ブナは被圧されなかった (Beech growth does not pass through altering periods of suppression.)

# 5.conclusions

## 3.Forest

- 光環境が良好で、生物多様性が高く、土壌も厚い(Birch forests favour biodiversity and the soil is densely covered with various herbaceous species.)
- 耐陰性が高くない、肥沃なところを好む樹種にも有利(Birch forest also favours less shade-tolerant tree species, which greatly appreciate the nutrient rich litter.)

# 5.conclusions

## 4.prediction of the future

- **カンバ林が過熟となり、ギャップはブナが占める**(Gaps will be rapidly closed by underlying beech trees.)
- **ギャップが増え、生物多様性が高まる**(It will make biotically rich that sapace will be increasingly liverated.)
- **ブナ、ナラの混交で多様な森林構造に**(The forest stand will transform into a very different patter, composed patches of beech and oak.)