Production capacity in oak high forests

Tradeoffs between wood production, biodiversity preservation and attractiveness for recreation

Nicolas Robert (IFN-LEF)
PhD supervisor: Anne Stenger (LEF)

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Context

Multiple stakes of forests

Harvest more wood and preserve the environment

Store carbon in forest and in wood products

Reduce carbon releases using wood

+ 12 Mm$^3$/year in 2012

+ 21 Mm$^3$/year in 2020

(assises de la Forêt et du bois)
**Context**

A multiple scale question

- **Country**: Forest resources, Biodiversity, Recreation
- **Landscape**: Biodiversity
- **Stand**: Tree growth, Wood production, Biodiversity, Attractiveness
- **Owner**: Forest management, Wood harvesting, Preserve biodiversity, Acceptance
Multi-functionality at the stand level
Material and methods

A production possibility Frontier approach

- Biodiversity indicator
- Harvested wood value
- Observations
- Production possibility frontier

Graph showing the relationship between biodiversity indicator and harvested wood value.
Material and methods

Choosing indicators

\[ \text{Bio}(t) = \text{Bio}_{\text{cavity nesters}}(h_{\text{dom}}(t)) + \text{Bio}_{\text{migrant}}(h_{\text{dom}}(t)) \]

Biodiversity

- Diversity of bird species
- Migrant bird species
- Cavity nester bird species

Graph showing changes in biodiversity over time.
Material and methods

Choosing indicators

\[ B(t) = V_{\text{timber sold at } t} \times f\left( d_{\text{timber sold at } t} \right) \]
Material and methods
Choosing indicators

\[ A(t) = f\left(\text{Age}_{\text{Stand}_t}, \text{nb}_{\text{stems}_t}, \text{d}_{g_t}\right) \]

Recreation

![Graph showing attractiveness for recreation over time](image-url)
Material and methods

Output from rotations

Net present value of an infinite series of rotations

\[ NPVIS = \frac{\sum_{t=0}^{T} (B_t \cdot (1 + r)^{T-t}) - C_0}{((1 + r)^T - 1)} \]

Average value

\[ \mu_A = \frac{\int_{t=0}^{T} f_A(t) \, dt}{T} \]
Material and methods

Biological simulation of the rotations

• Growth and yield simulator
  – At the stand scale
  – With cutting planning

• Simulations parameters
  – For all simulations
    • area : 1 ha
    • fertility : 32.5 m at 100 years
  – variable
    • Number and intensity of cuttings
    • Target diameter
Results

3 dimensions frontier analysis

Attractiveness for recreation

Biodiversity index (ecosystem quality)

- Production of the simulated scenarios
- Projection of the values on the PPF

Net present value of wood resulting from an infinite series of revolutions

0.5

7

4000

0.1

3000
Results

Reduce NPVIS to protect bird species

- NPVIS in Euros
- discount rate 3%

Bird species biodiversity index
Results

Protection of cavity nester bird species

Cavity nester bird species biodiversity index

NPVIS in Euros
discount rate 3%
Results

Preserve places for migrant bird species
Results

Attractiveness v.s. NPVIS

NPVIS in Euros

discount rate 3%
Results

To protect bird species and to propose attractive forests: two compatible services
Conclusions

• DEA analysis of simulated data
  → no values of the products required
  → compatibility of products

• Simulation
  → oak high forest stand management

• Further work:
  → other species and forest types
  → other indicators
  → change scale
Thank you for your attention

Nicolas Robert
nicolas.robert@ifn.fr