Economic and Fragmentation Effects of Multiple Adjacencies in the Area Restriction Model

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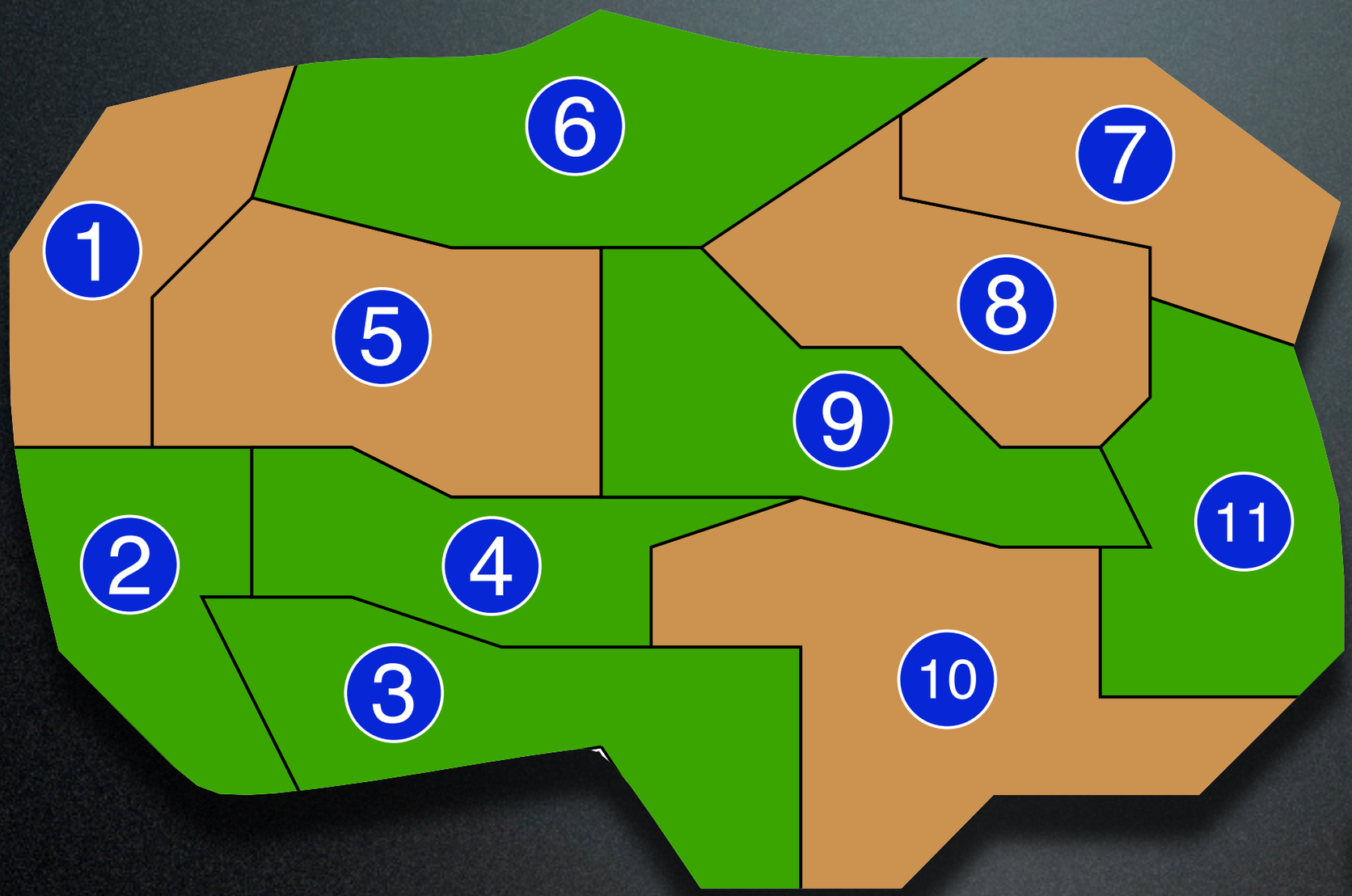
Overview

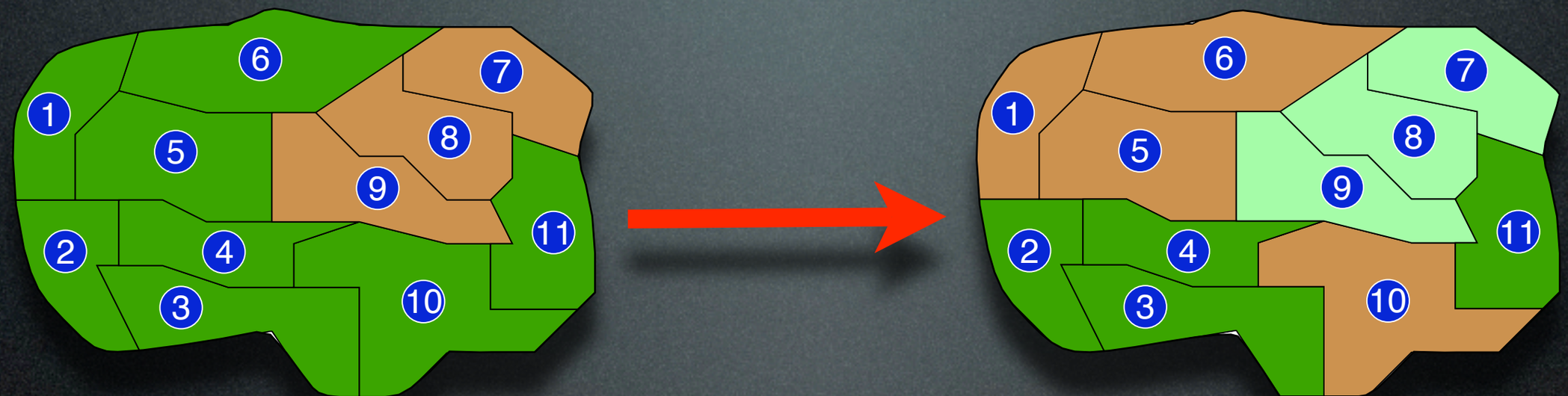
1. Introduction
2. Multiple Adjacency and Fragmentation
3. Idea on Enforcing Forest Characteristics
4. Conclusion

Area Restriction Model



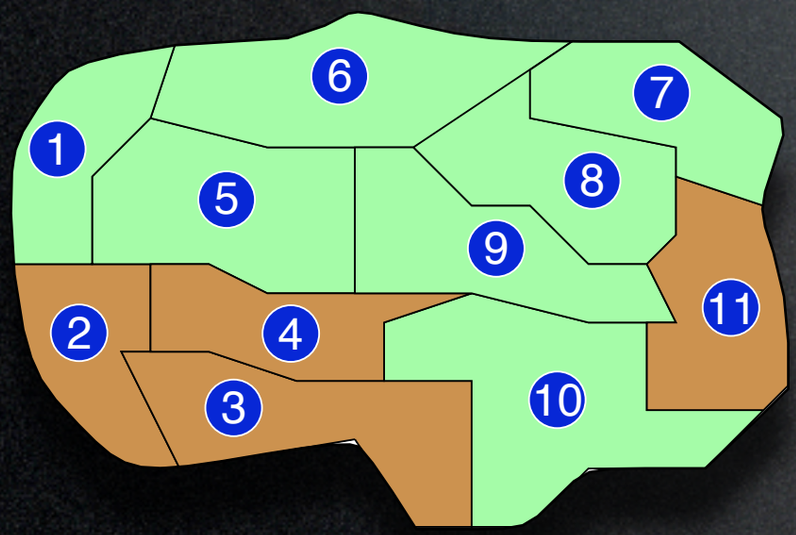
- Maximum clearcut area >> stand area

Stands Are Replanted (green-up 1)



T=1

T=2



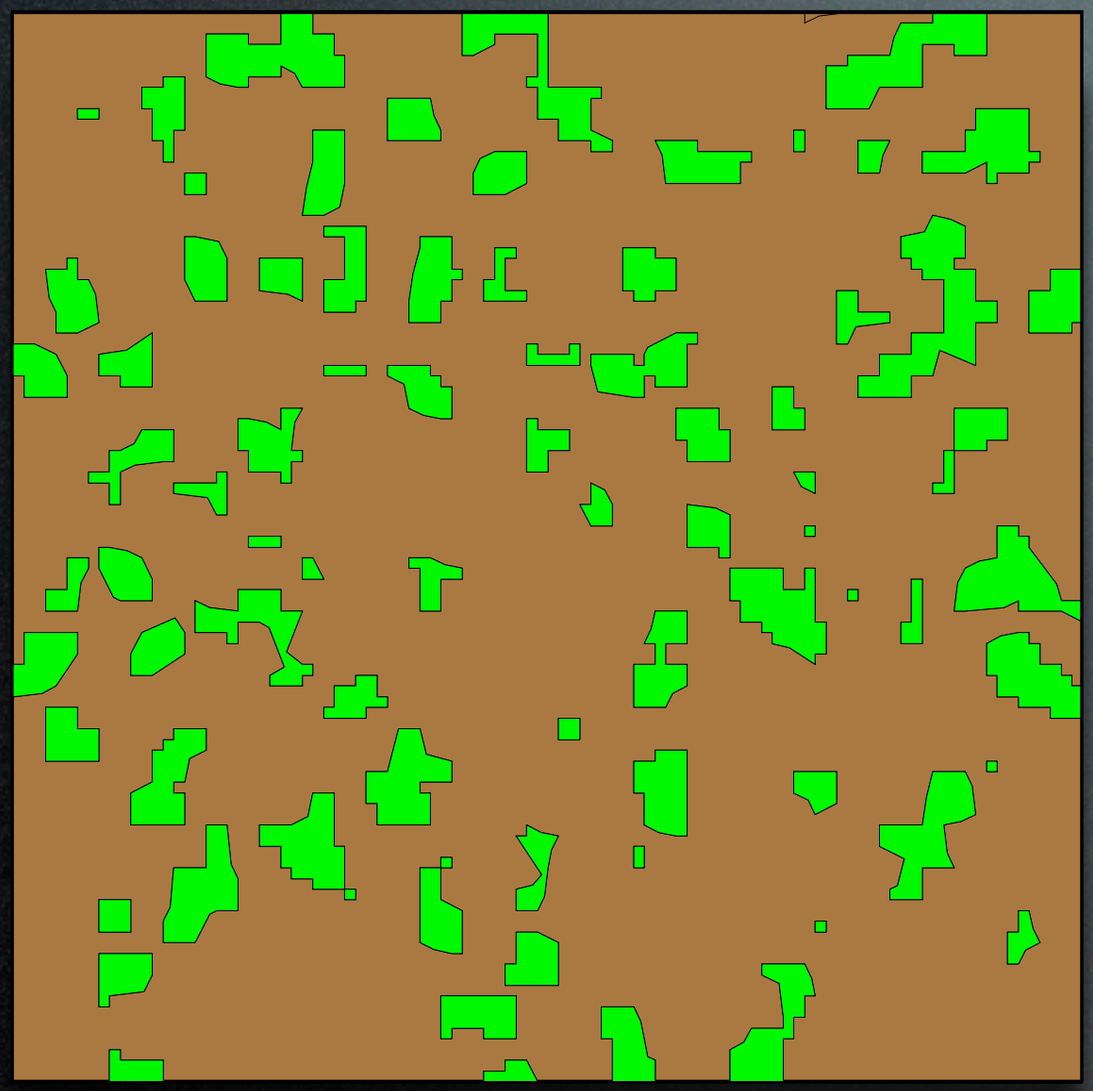
T=3

Untreated

Clearcut

Recently replanted

ARM and Fragmentation



Stands > 60 years

Stands < 60 years

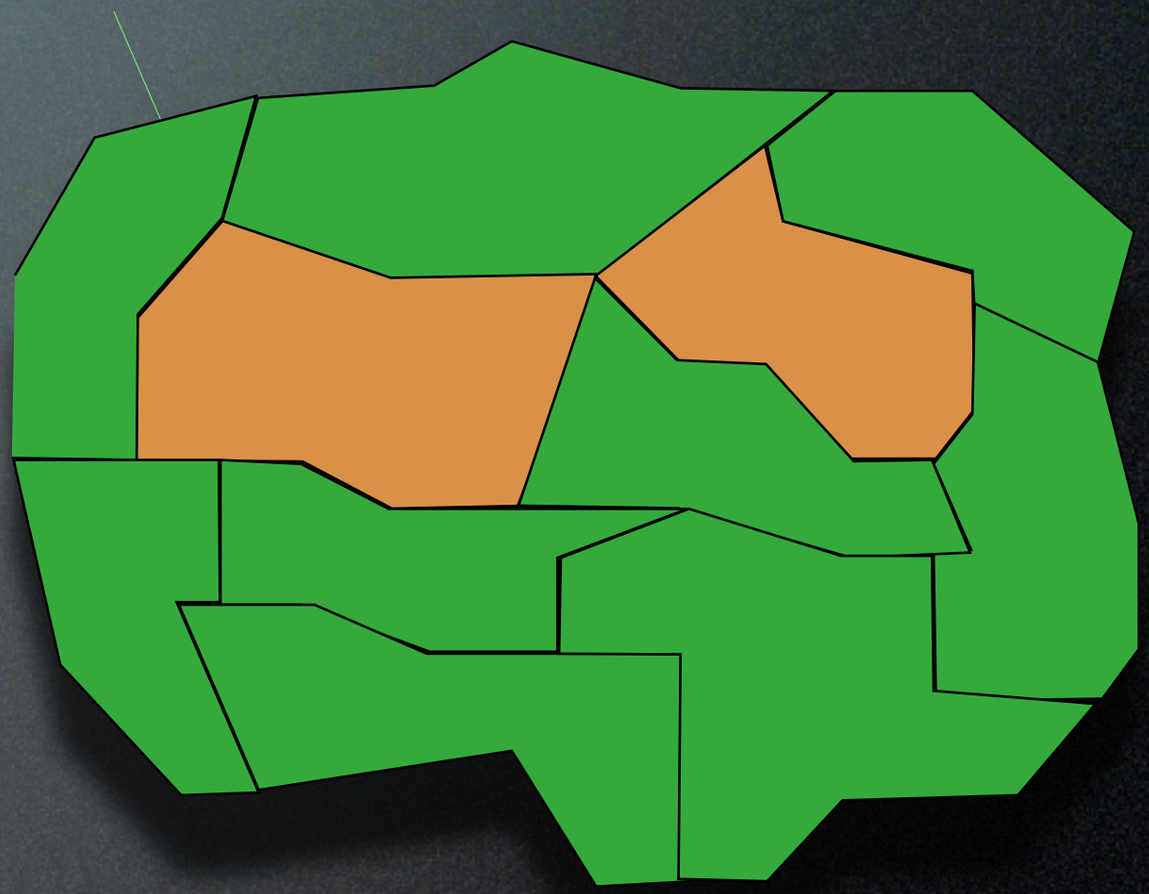
- FLG9_1.0 from FMOS
- 3 periods:
  - Volume Flow +/- 15%
  - Average ending age >40 years
- Maximum area of 40 hectares
- Cells adjacent if they intersect
- Well known deficiency of ARM

Fragmentation Control with Multiple Adjacency

- Fragmentation:
  - Average Patch Size (> 60 years)
- Economic:
  - Economic/Fragmentation Tradeoff
- Model: EARM (Goycoolea et. al 2005)
  - Formulation: Cluster/GMU

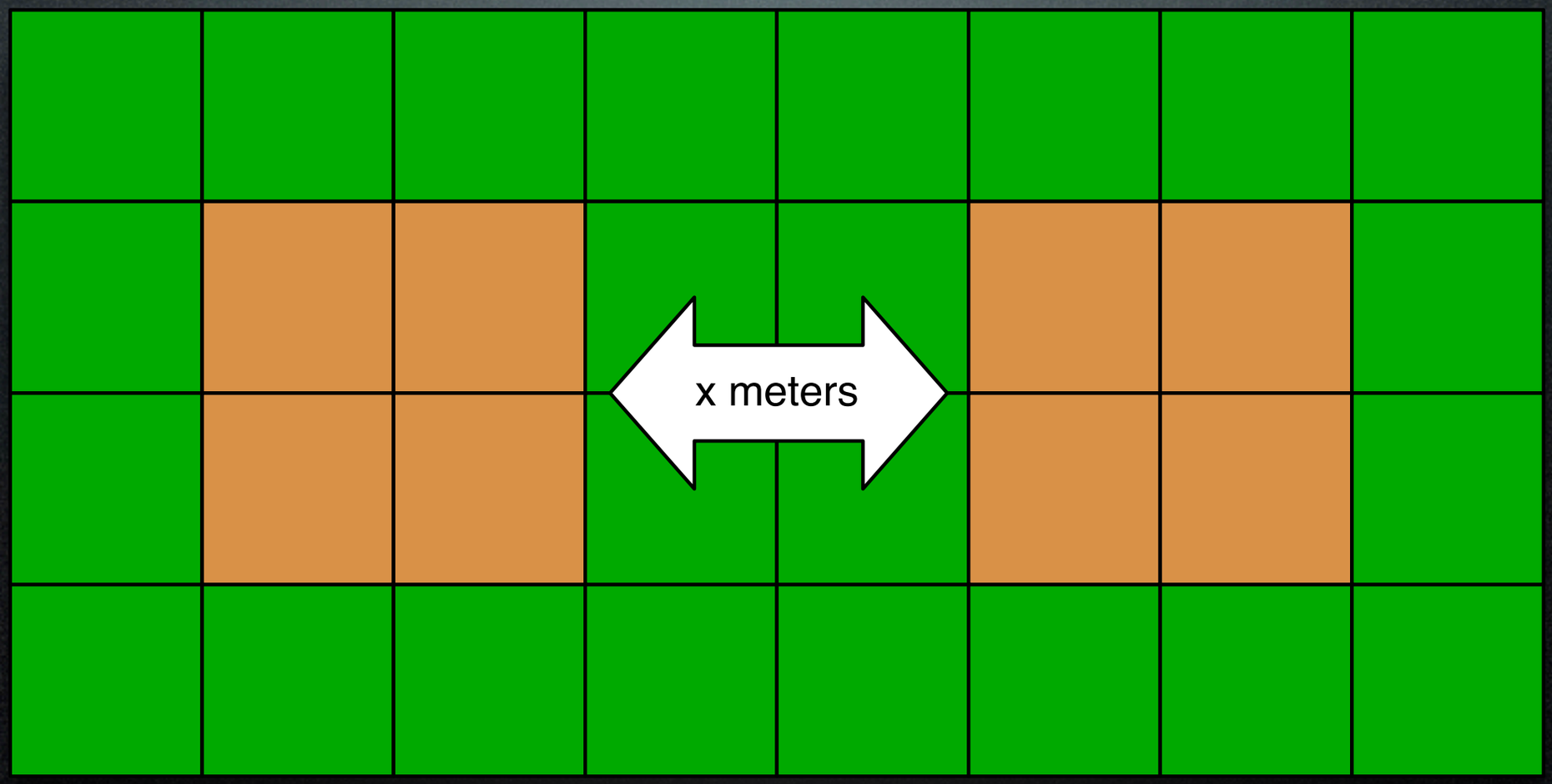
Limit Clearcut Shape with Adjacency

Acceptable Clearcut



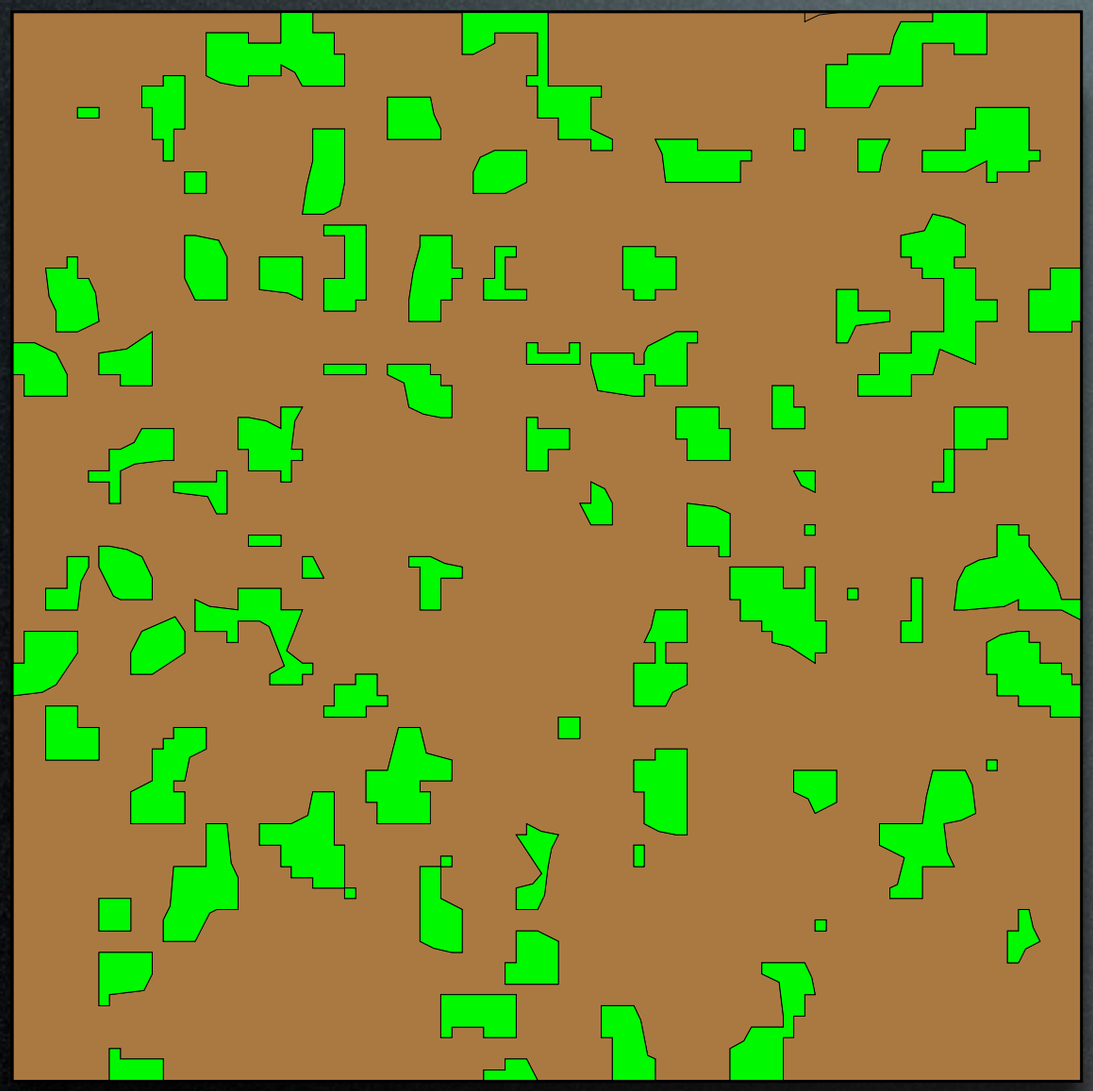
Unacceptable Clearcut

Limiting Distance Between Clearcut and Connectivity

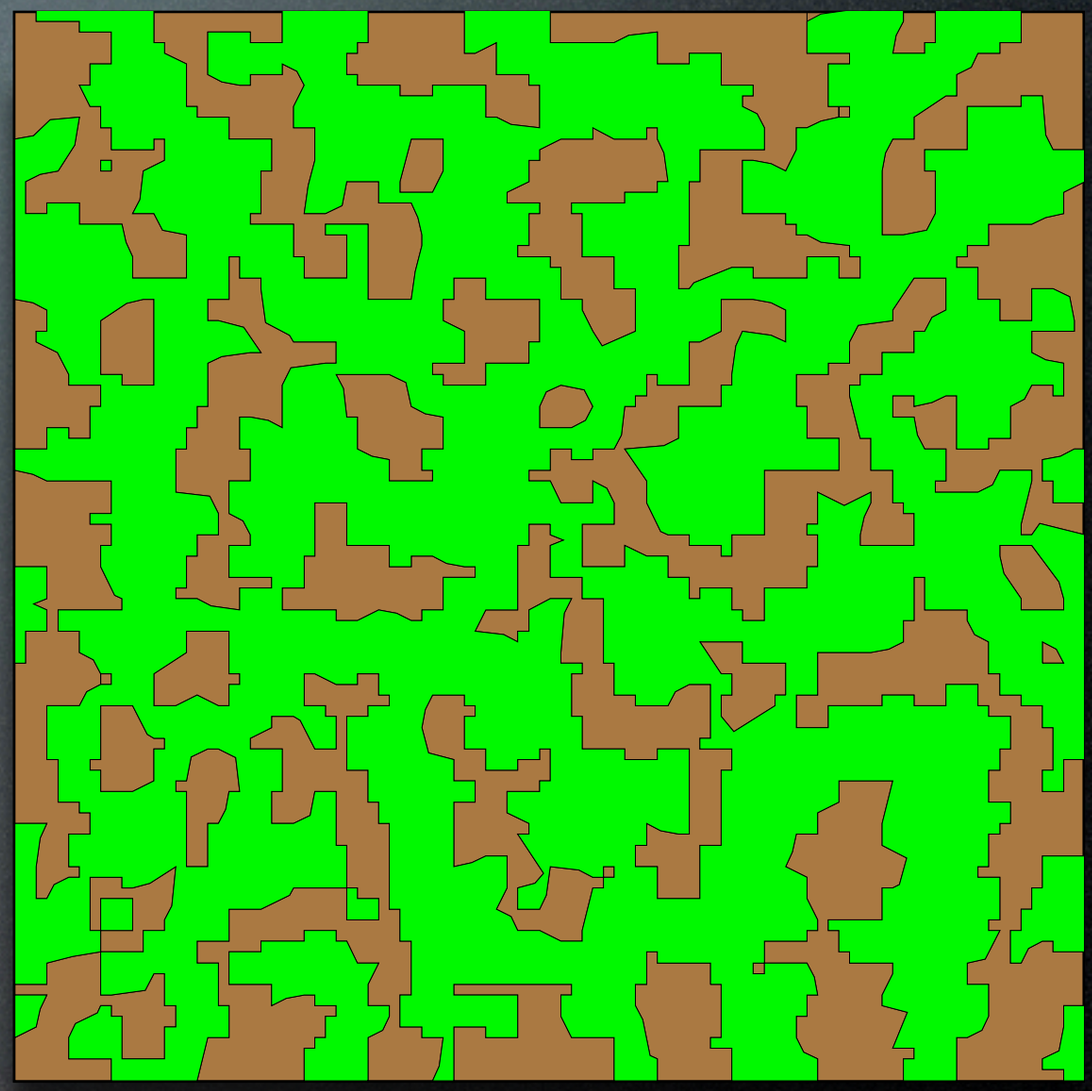


- For 1 period it “can” force connectivity of unharvested area

Stands over 60 years



0 meters

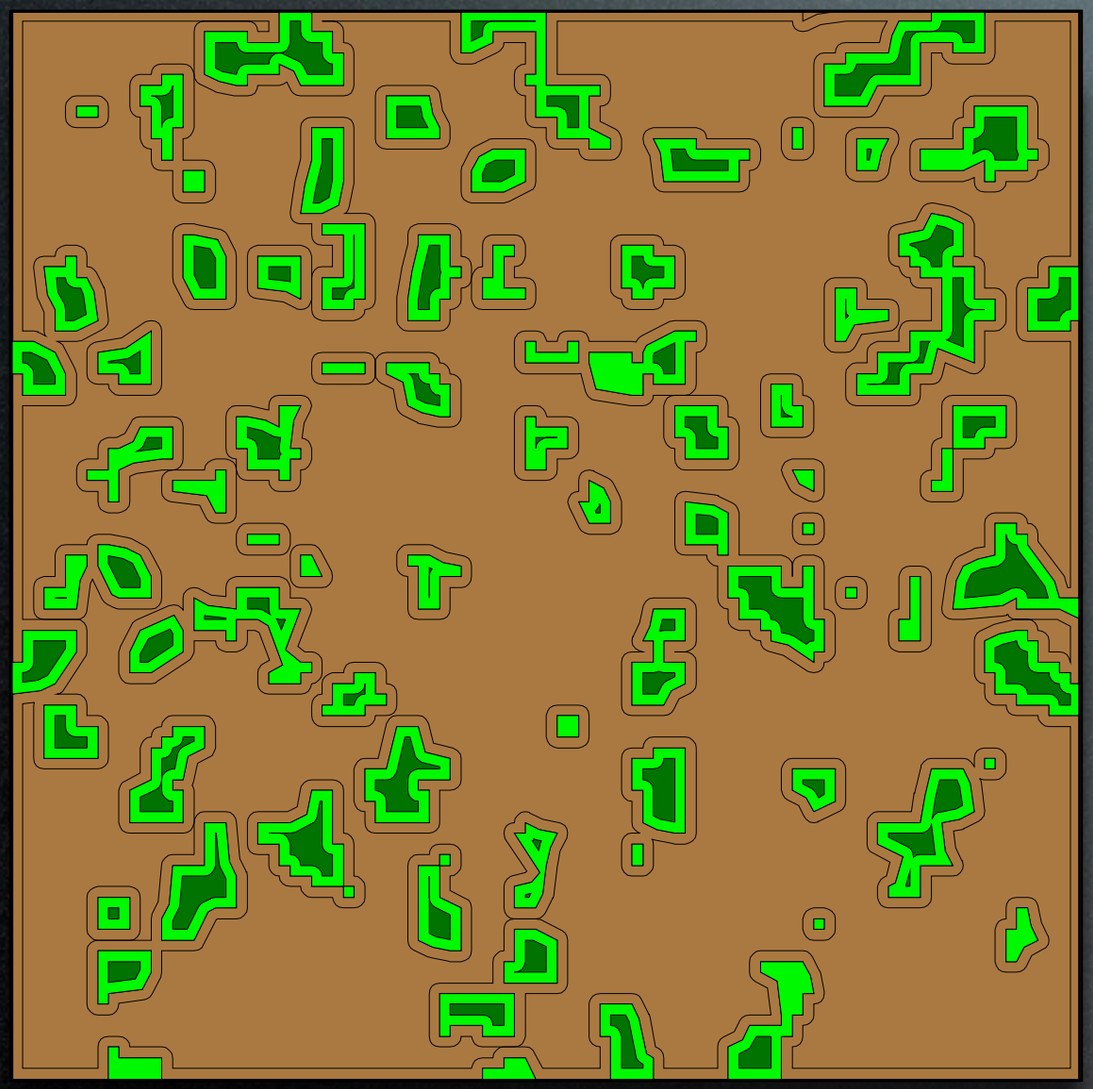


800 meters

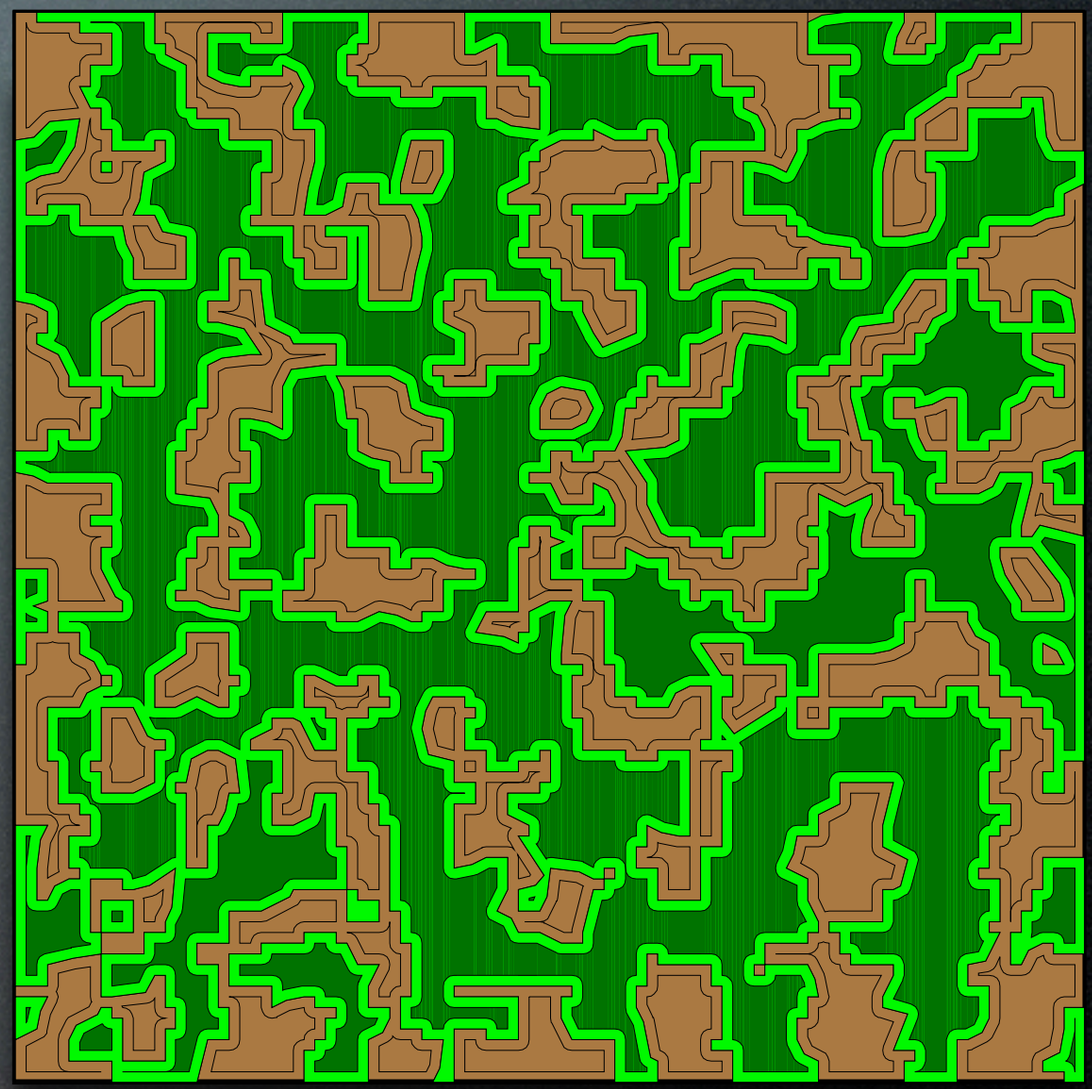
> 60 years

< 60 years

Stands over 60 years



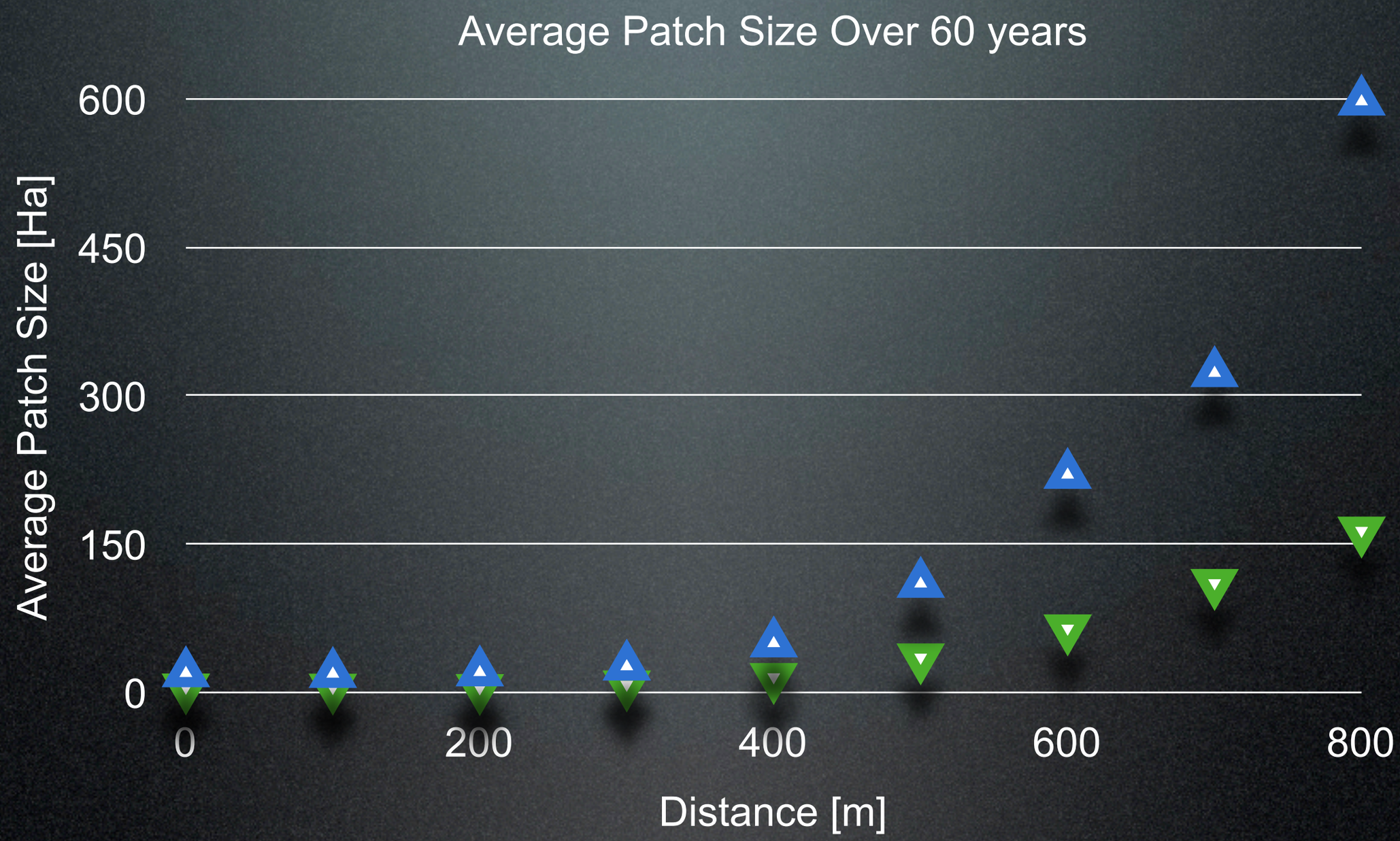
0 meters



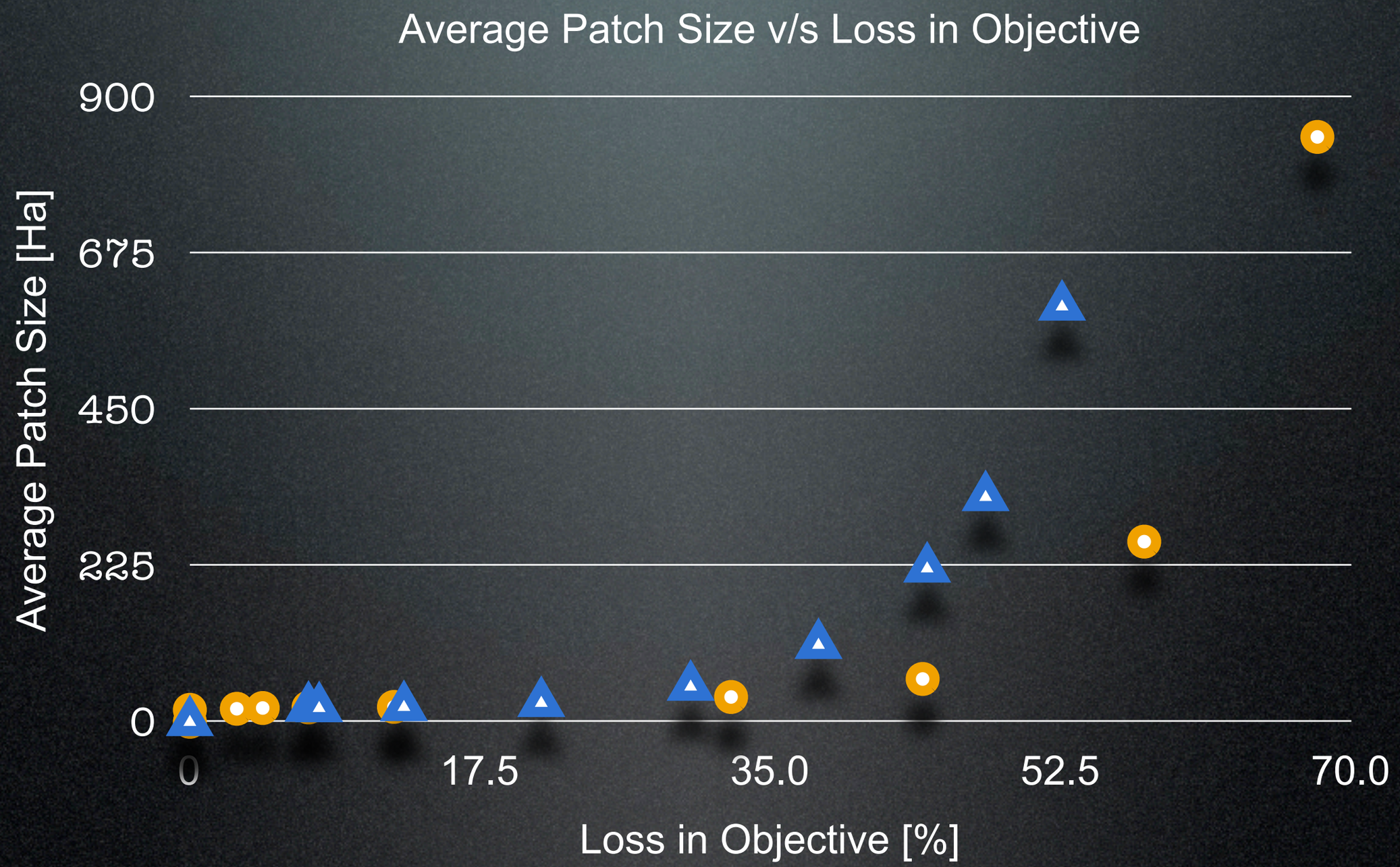
800 meters

> 60 years Core 100m < 60 years

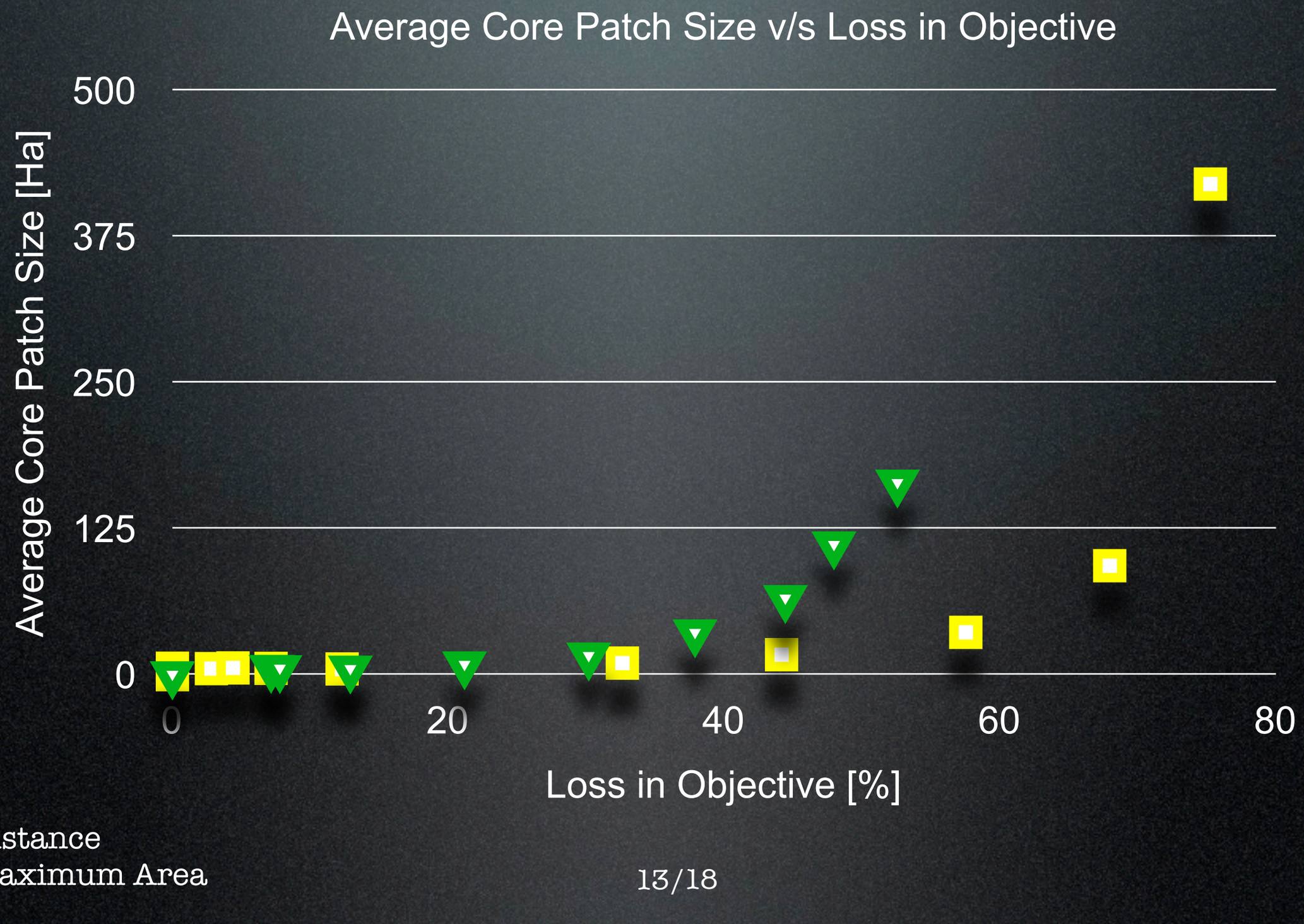
Fragmentation Effects



Econ./Frag. Tradeoff: Distance v/s Area



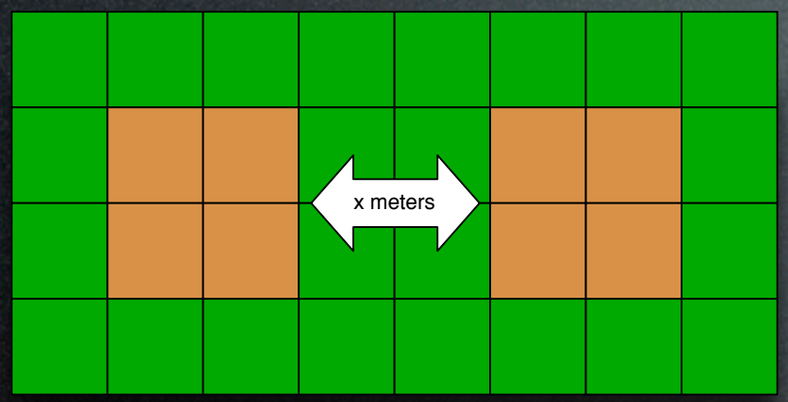
Econ./Frag. Tradeoff: Distance v/s Area (Core)

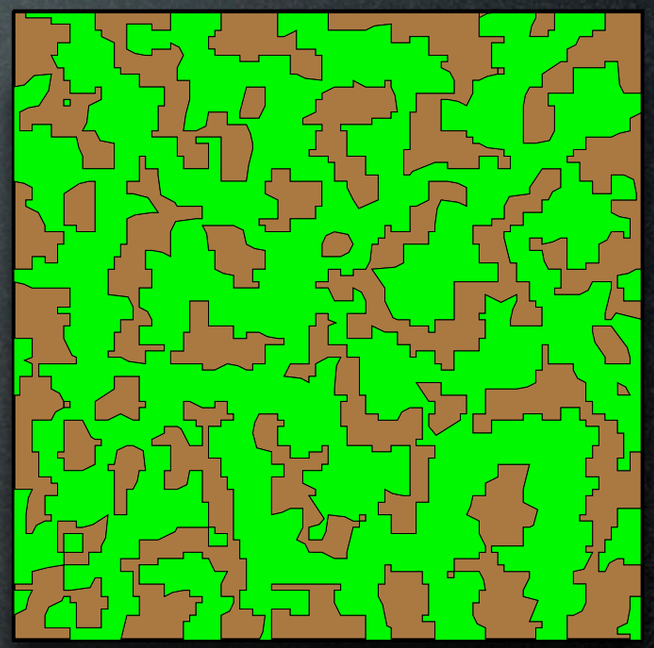


Effects of Adjacency

- Good News: Better econ./frag. tradeoff than decreasing max clearcut area
- Bad News: Valid for only ONE forest tested and only ONE feasible solution
- Solution? Test more forests, use CPLEX 11 solution pool
- Can we get better guarantees?

General Idea

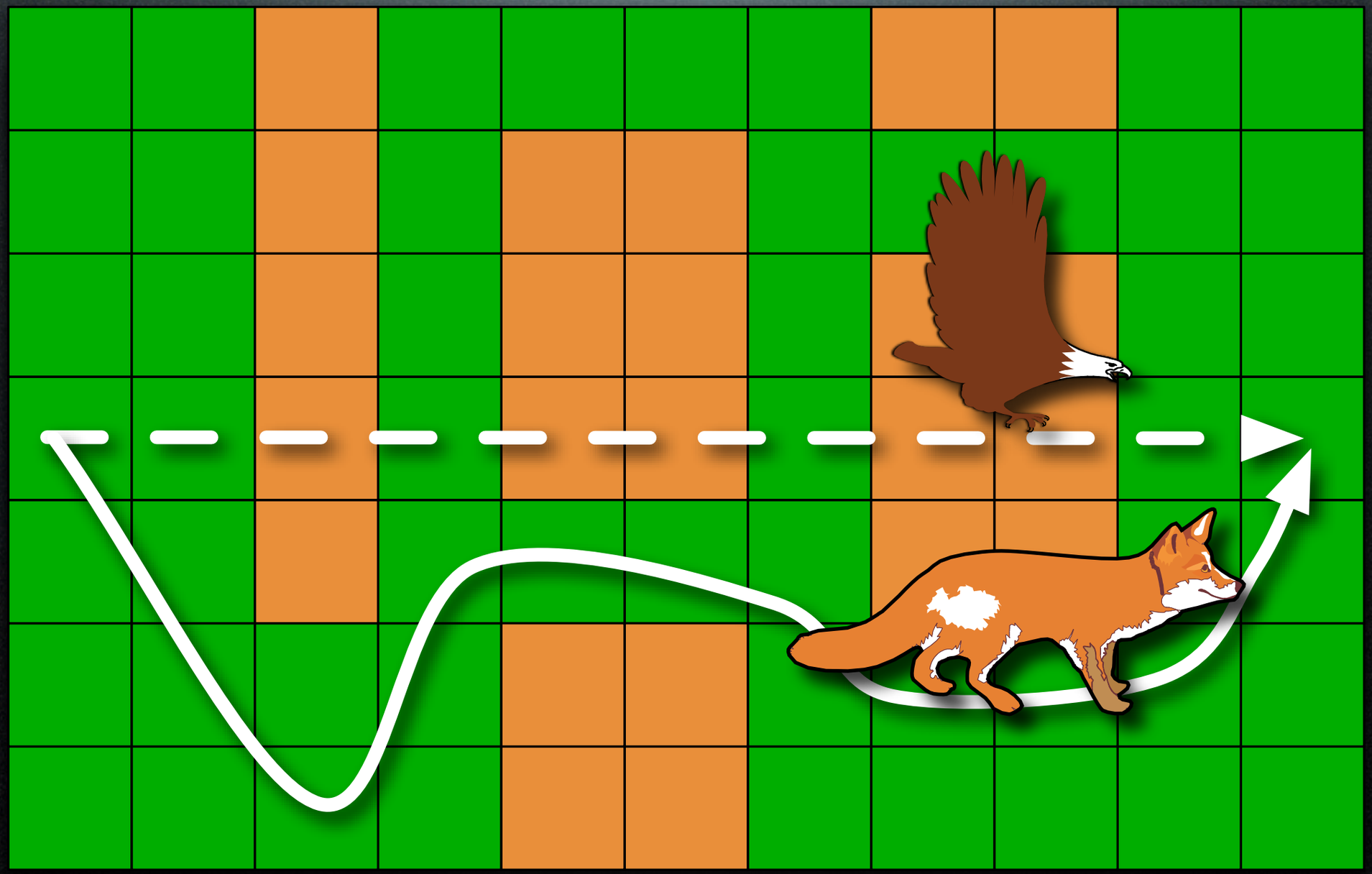




- Local and simple requirement:
  - Clearcut Adjacency
  - Clearcut Shape

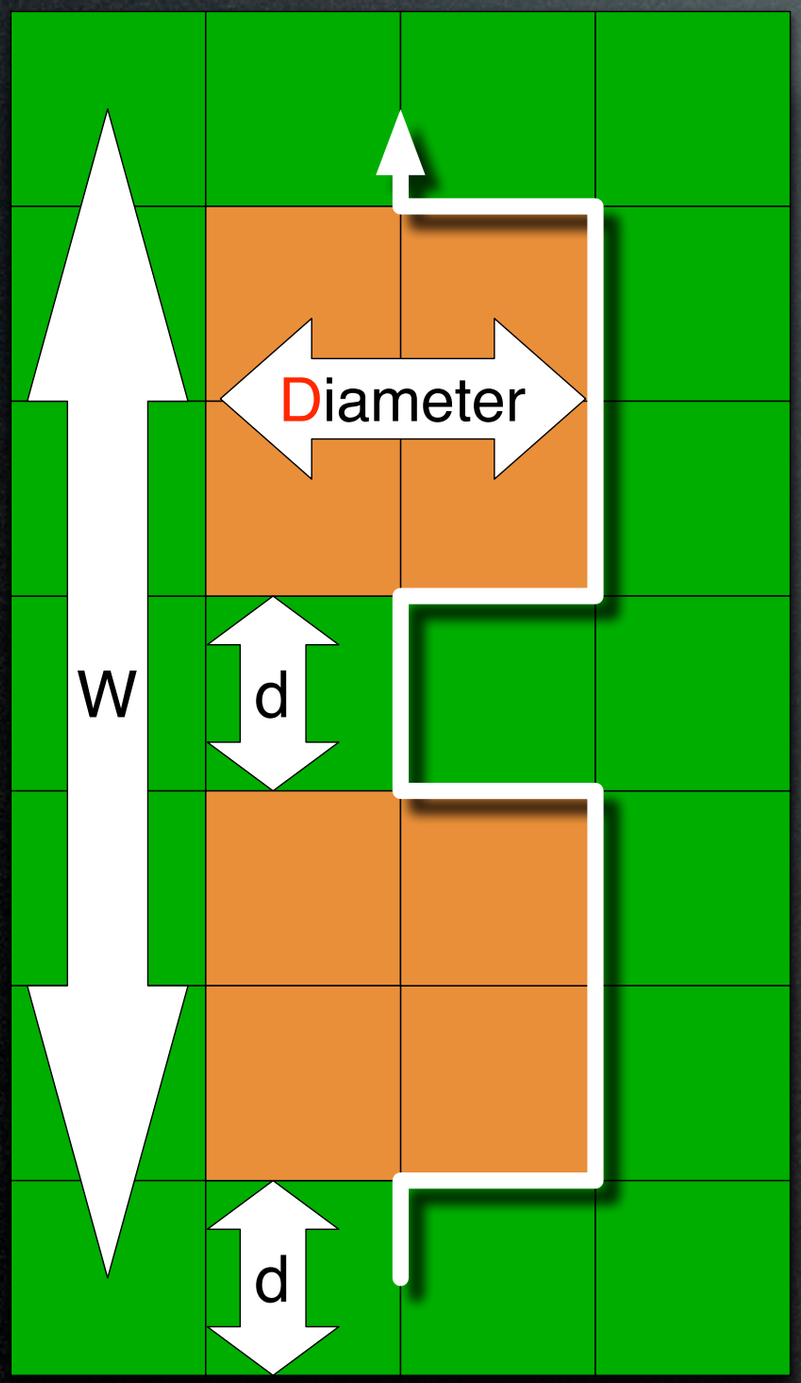
- Global Property:
  - Average patch size

Eagle-Fox Metric?



- EF Metric $= \dfrac{\text{Distance Traveled by Eagle}}{\text{Distance Traveled by Fox}} \in (0, 1]$

Simple Argument can Give a Guarantee on Metric



$$Eagle = W$$

$$Fox \leq \left(1 + \frac{D}{2d}\right) W$$

$$\Downarrow$$

$$EF \geq 1/\left(1 + \frac{D}{2d}\right)$$

Conclusions

- Multiple adjacency with distanca can provide a better econ./frag. tradeoff than decreasing max clearcut area
  - Test more instances/solutions/metrics
- Simple local rules can impose (approximate) global properties?