Deadwood dynamics following clearcutting and partial harvesting



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Chaire en aménagement forestier durable
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Deadwood and the carbon cycle

- In boreal forests >80% of C is in soils

- Deadwood : - large C pool in snags, logs and buried wood (=17-64% of the organic matter returned to forest floor)

  - depend on succession and disturbances resulting in mortality of trees

  - slow decomposition

  → C sequestration

- Deadwood : - energy and nutrients for organisms

  - physicochemical properties of soil

  → importance of understanding deadwood dynamics

Deadwood and harvesting

- Clearcut harvesting changes deadwood dynamics and carbon distribution in forest.

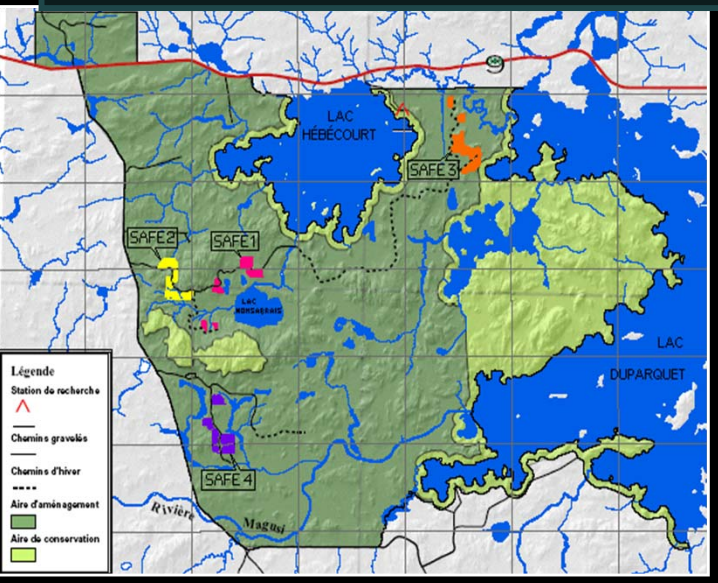
- Leads to a decrease in the quantity and quality of decaying logs and snags.

Does partial harvesting have the same effects?

Objectives

- Assess and compare the effects of clearcutting and partial harvesting on deadwood dynamics.
- H1 : Recruitment of deadwood is reduced following partial harvesting while decomposition increases.
- H2 : Partial harvesting decreases the diversity of deadwood (snags, large debris, well-decomposed debris)

Study area



- Lake Duparquet Research and Teaching Forest (northwestern Quebec).

  Continental climate
  Mean annual temperature : 0.7°C
  Precipitation : 890 mm, 50%
  between May and September

- Mixedwood zone of the boreal shield within the balsam fir-white birch bioclimatic domain..

- SAFE Project (Ecosystem Management and Silviculture).

- Aspen-dominated stands of fire origin dating from 1923.

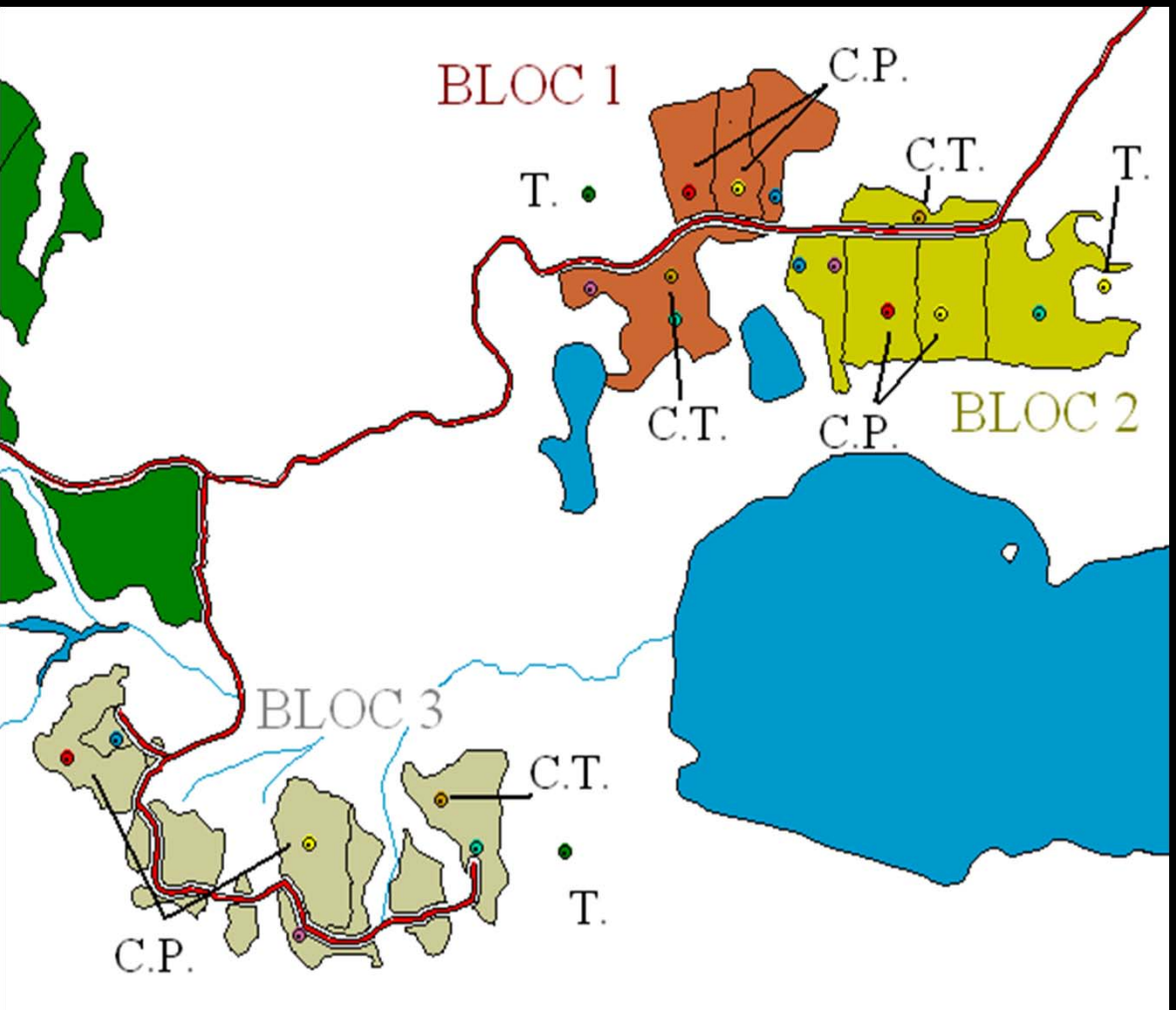
  Fresh clay soils
  Forest floor : Mor (8 cm)

Experimental design

• Complete block design with 3 replications of each treatment (1 to 2.5 ha/experimental unit) applied in the winter of 1998-1999 (75 year old stand)

• Four treatments : -1 control

- 1/3 partial harvesting
  =low thinned
- 2/3 partial harvesting
  =crown thinned
- 1 complete harvesting



Methods

Inventory of DBH and height

- 5 (400 m²) permanent circular sample plots/experimental unit;
- estimation of biomass using equations of Lambert *et al*. (2005)

Triangular transects

- 90 m
- 1/experimental unit

Decomposition bags

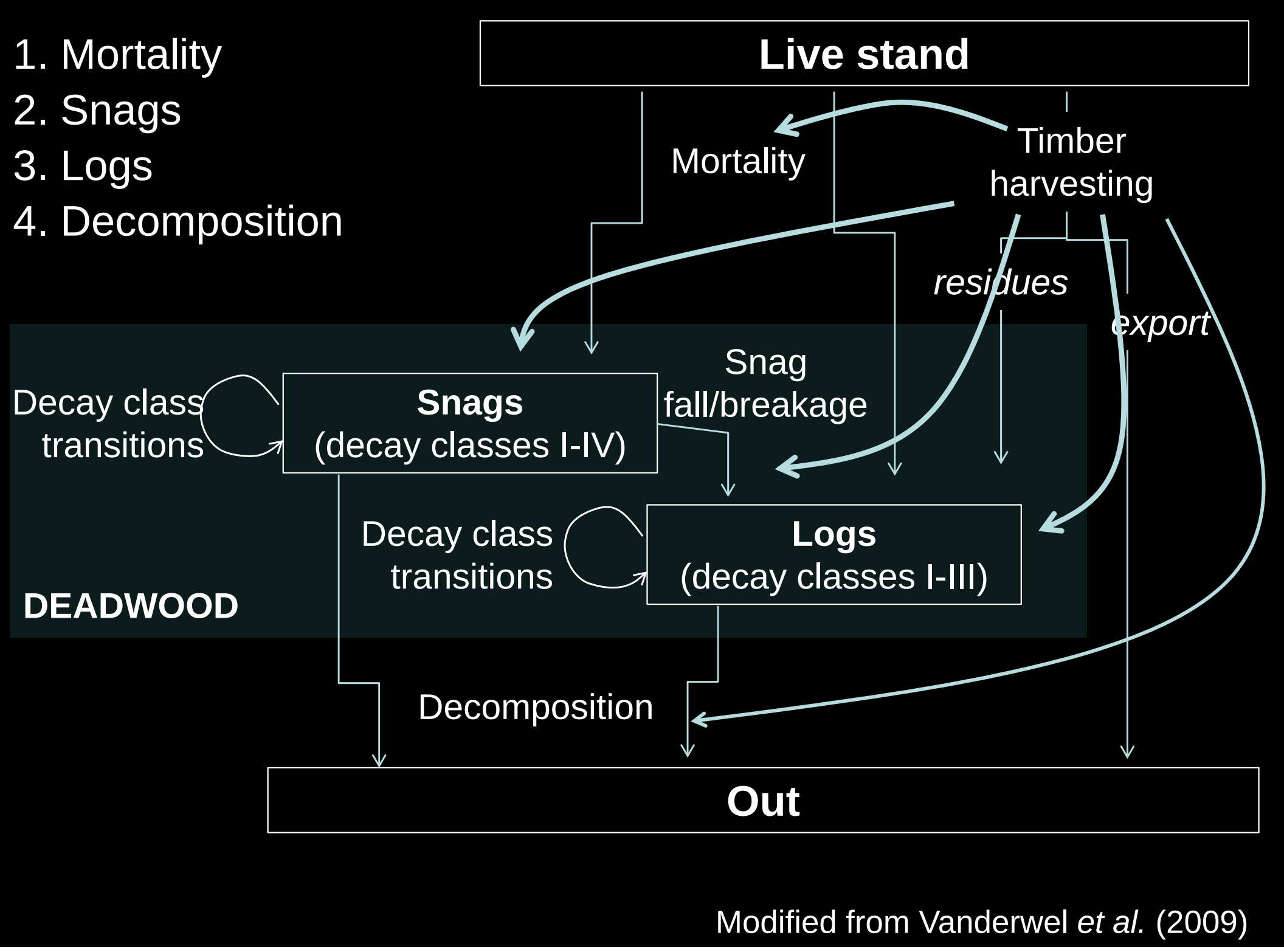
- aspen wood blocks
- 5/experimental unit

Statistical analyses

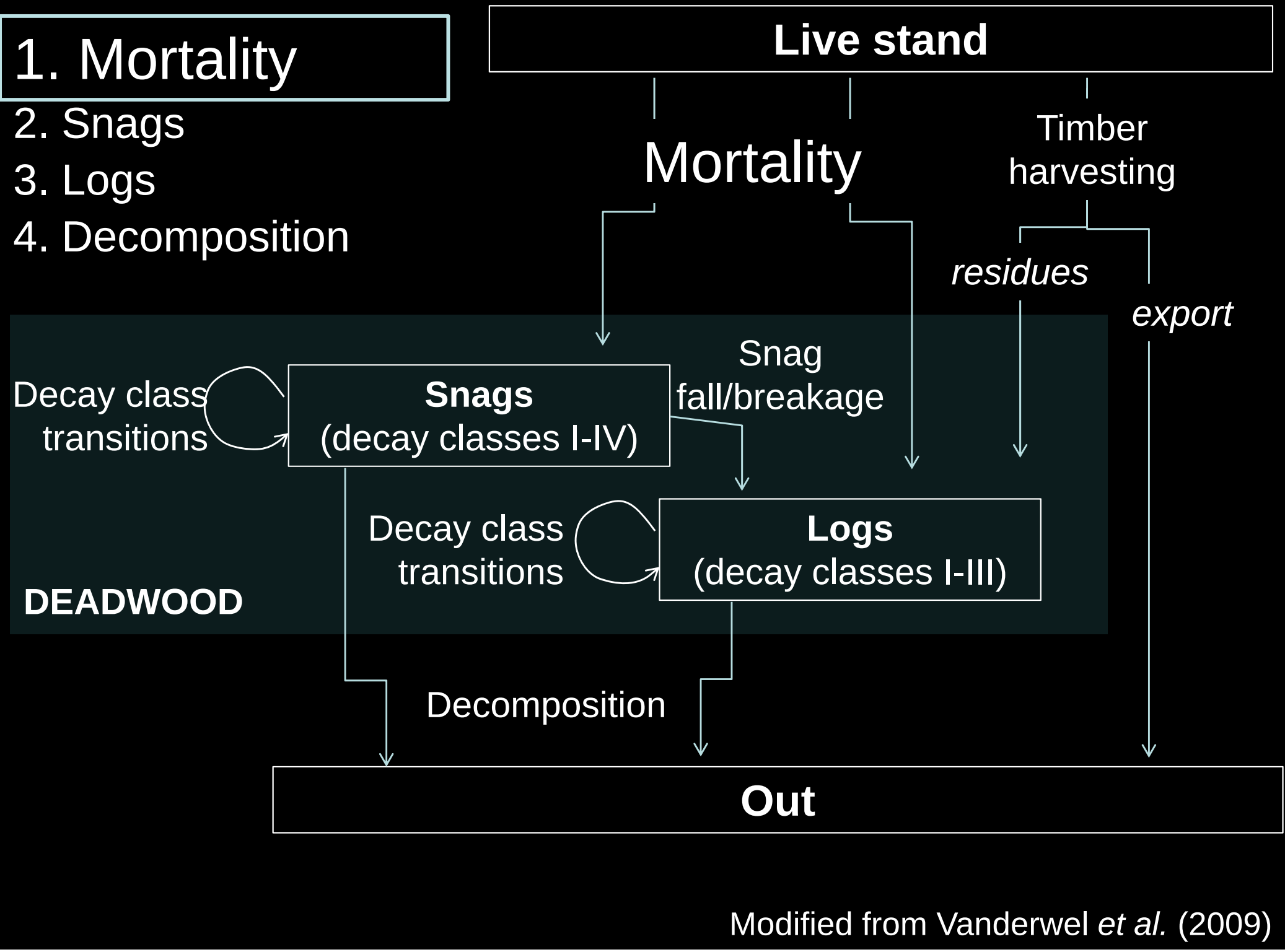
- Mixed models
- Linear regression

with contrasts of treatments

1. Mortality
2. Snags
3. Logs
4. Decomposition



Modified from Vanderwel *et al.* (2009)



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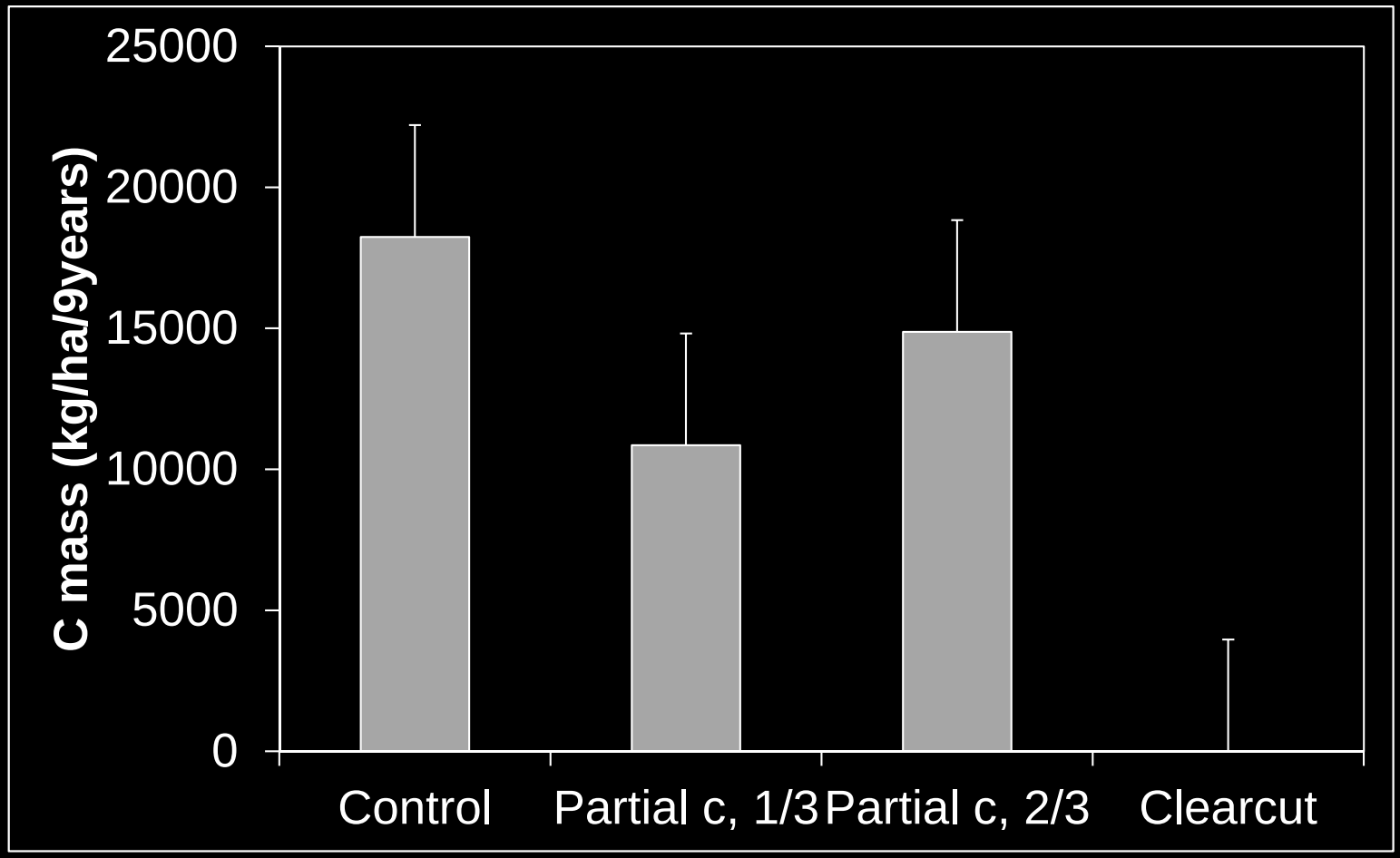
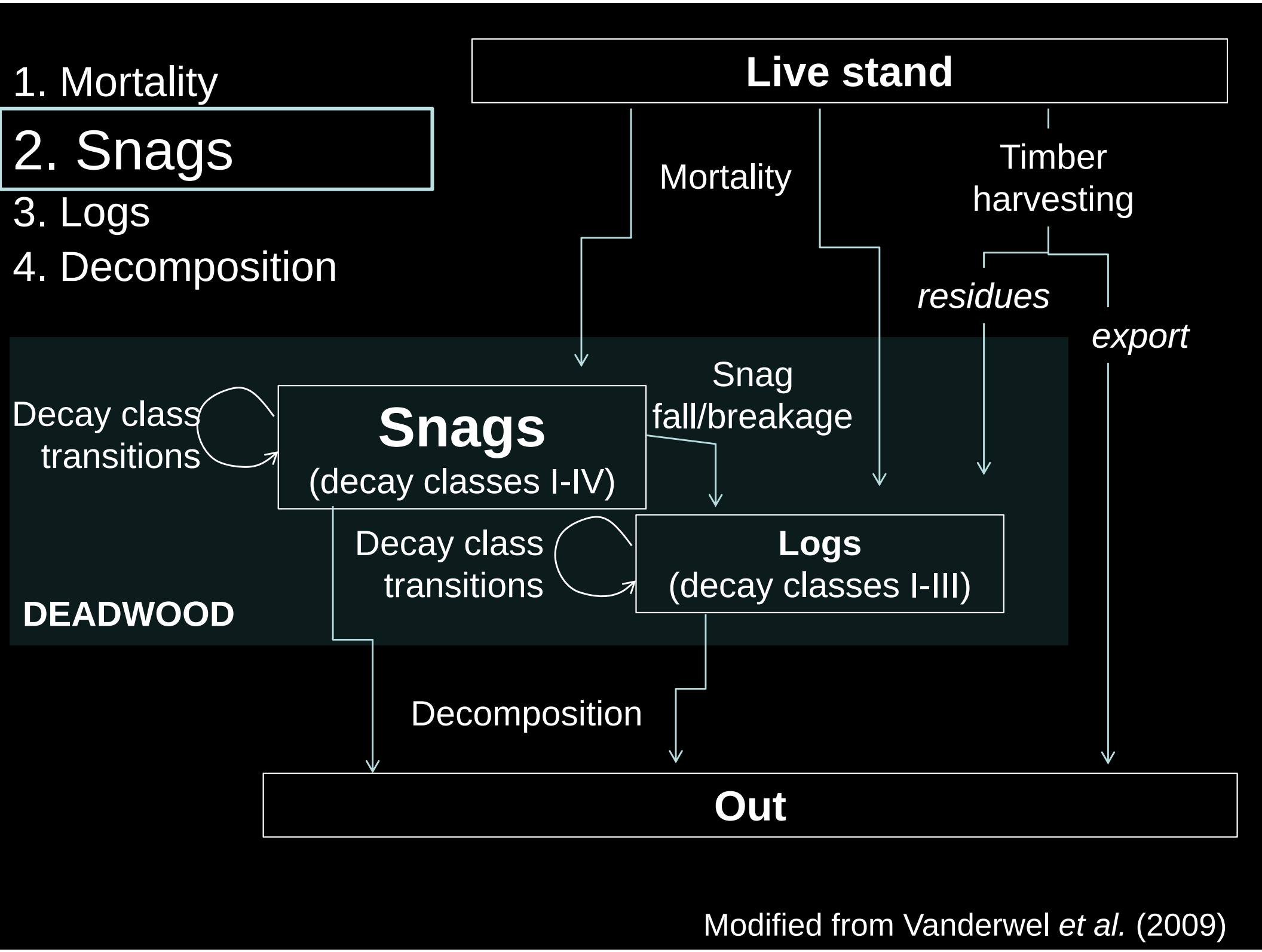
1. Mortality over a 9 year period



34% of aspen stems died in the 2/3 partial harvesting;
24% in the control;
16% in the 1/3 partial harvesting.



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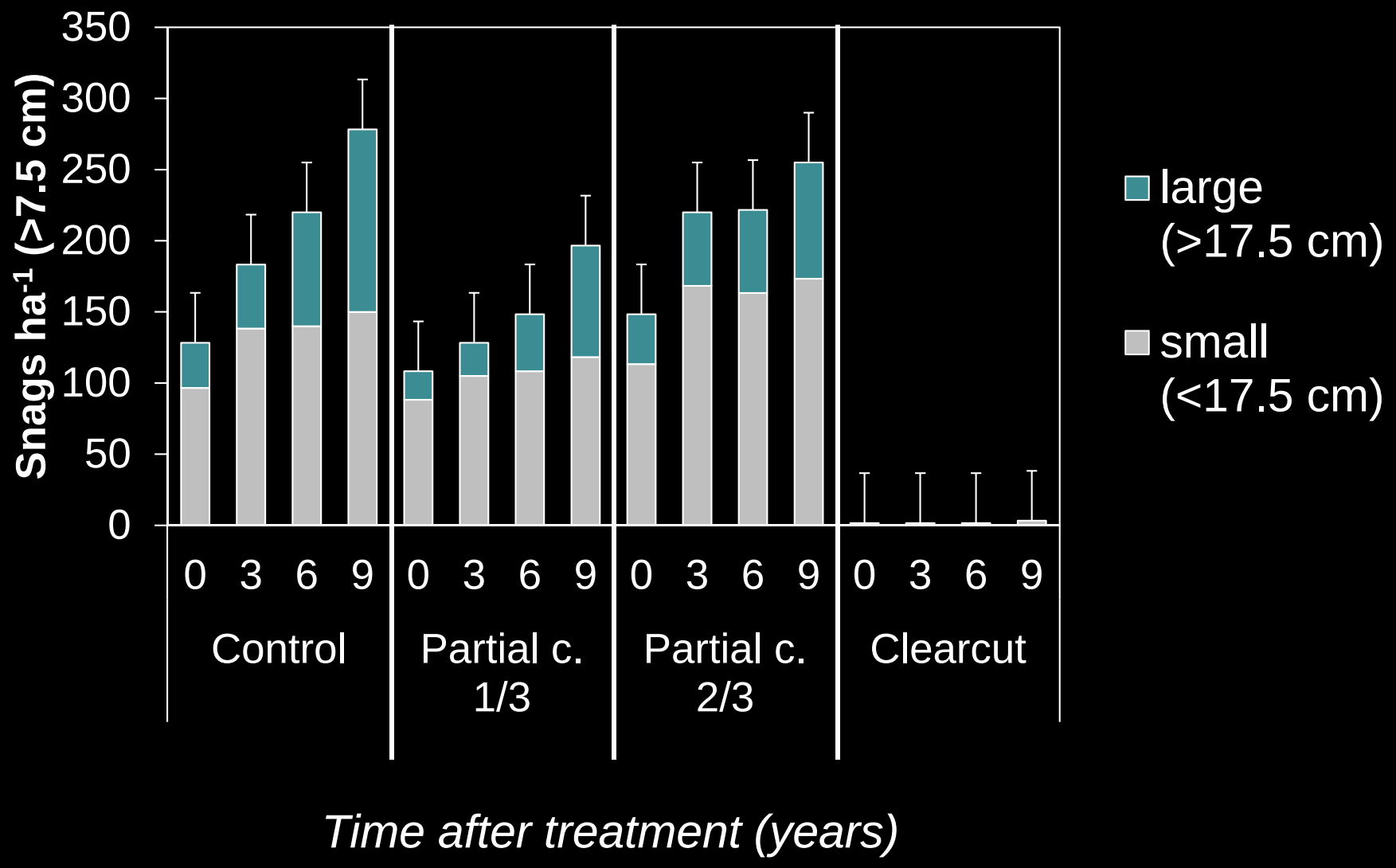
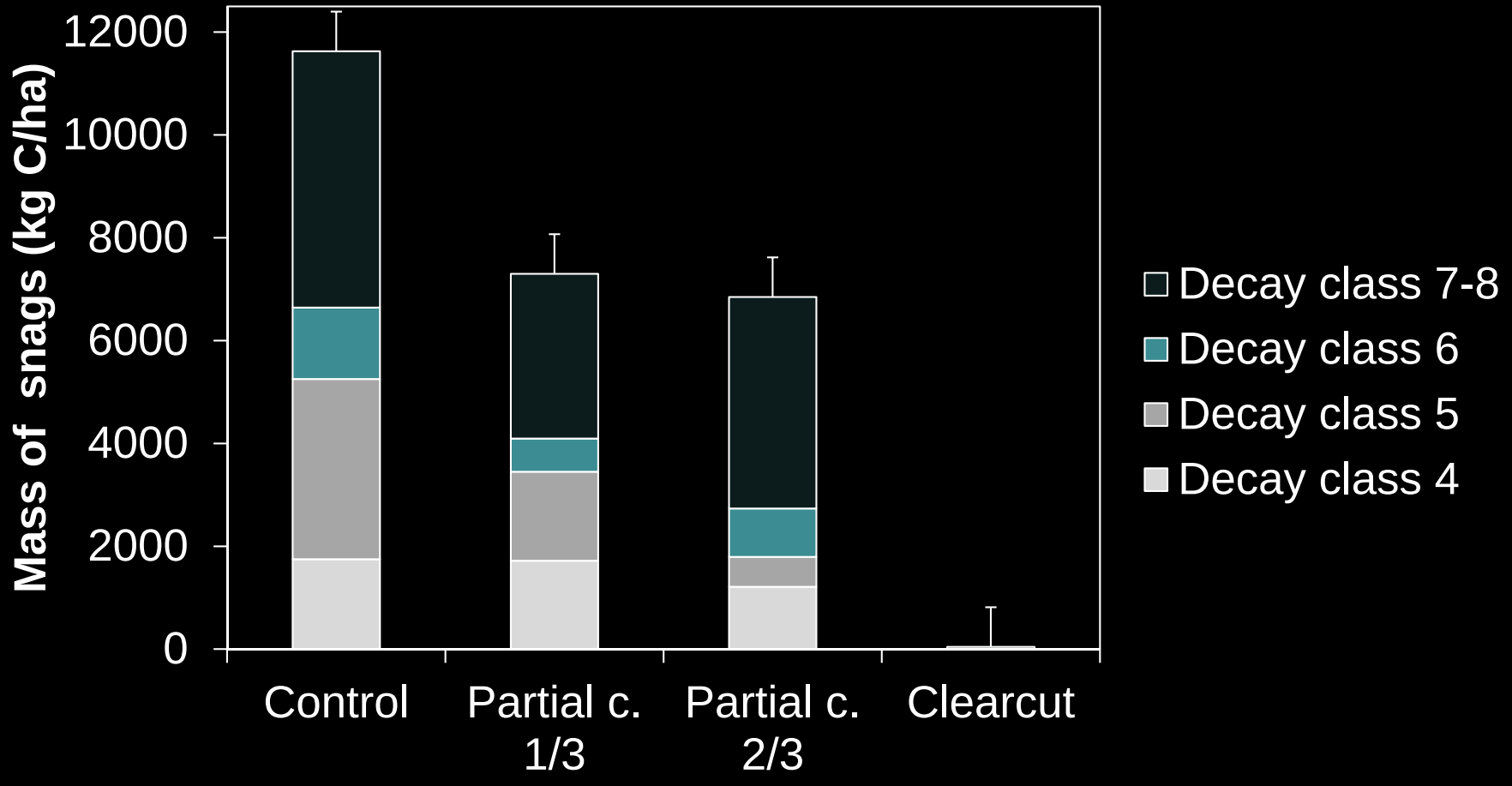
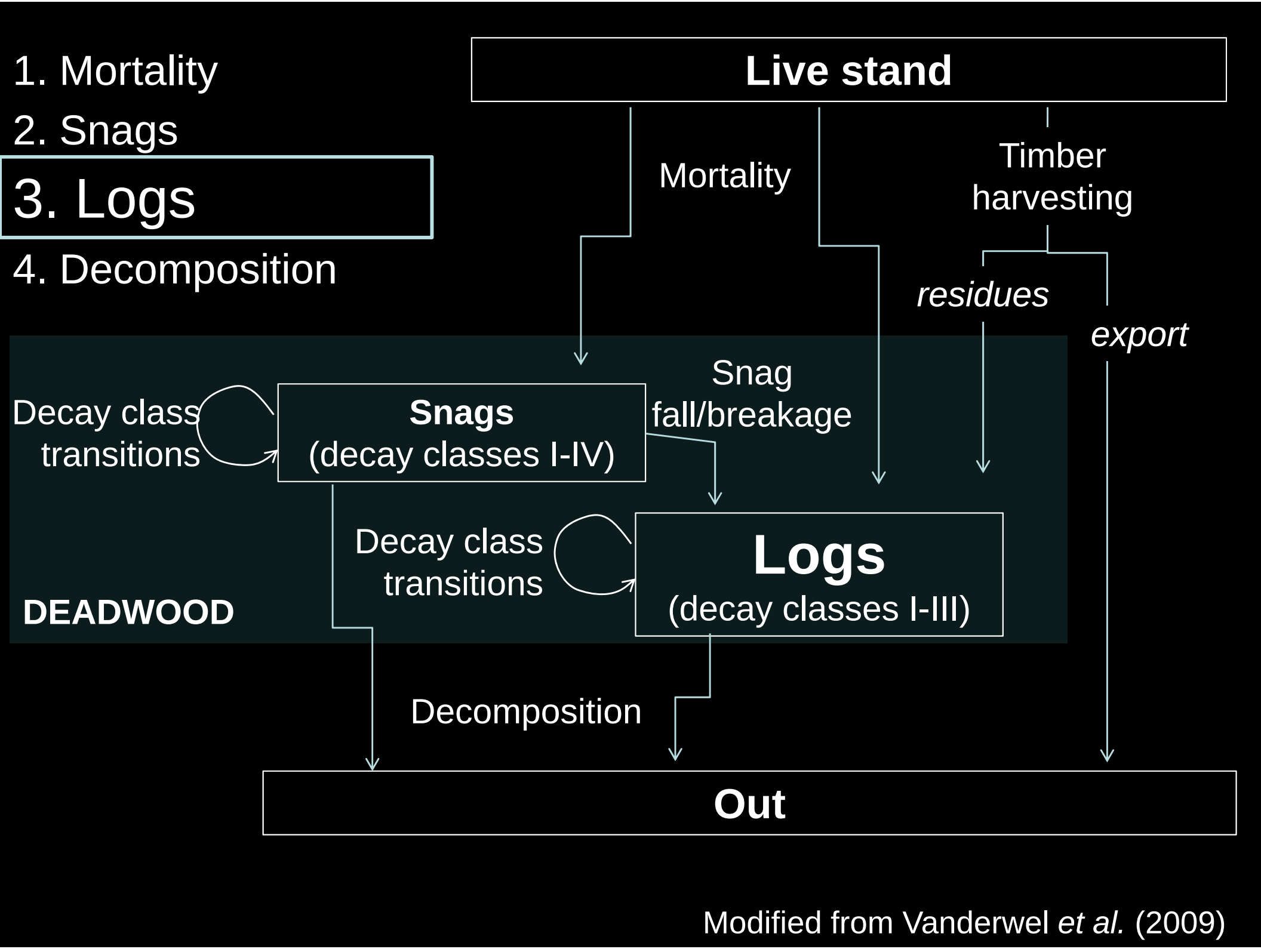
2. Snags – changes with time



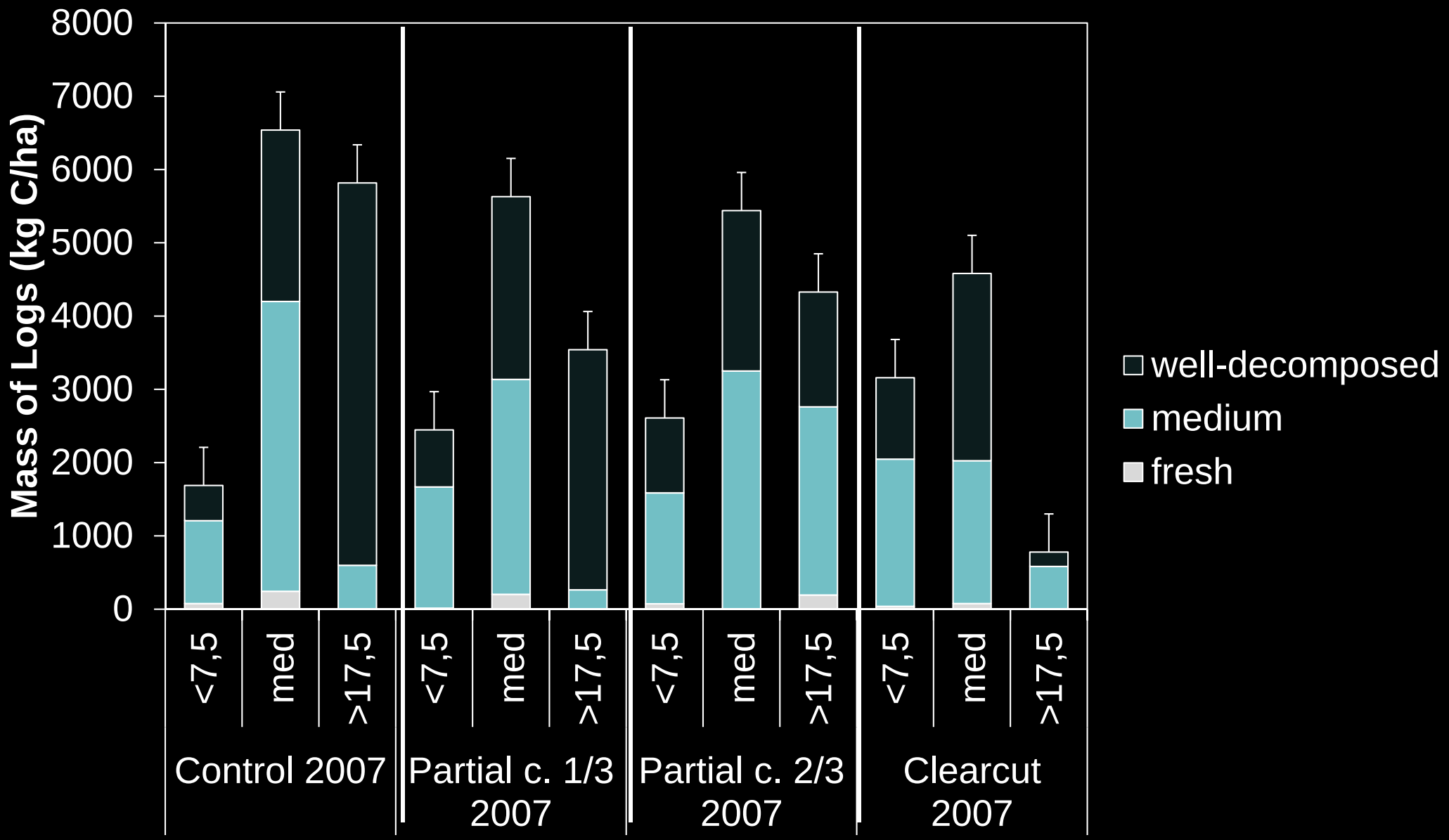
2. Snags – 9 years after treatment



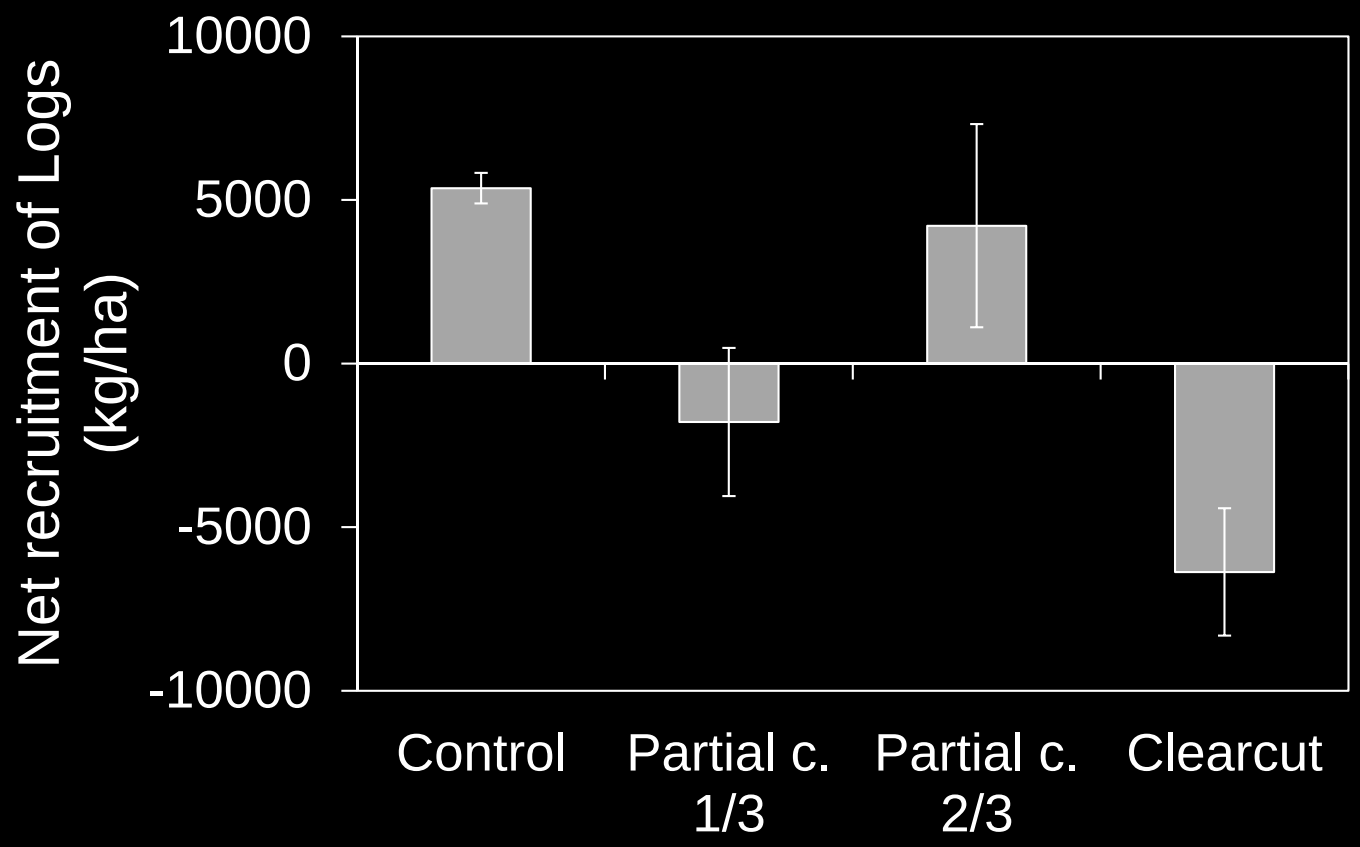


Modified from Vanderwel *et al.* (2009)

3. Logs – 9 years after treatment

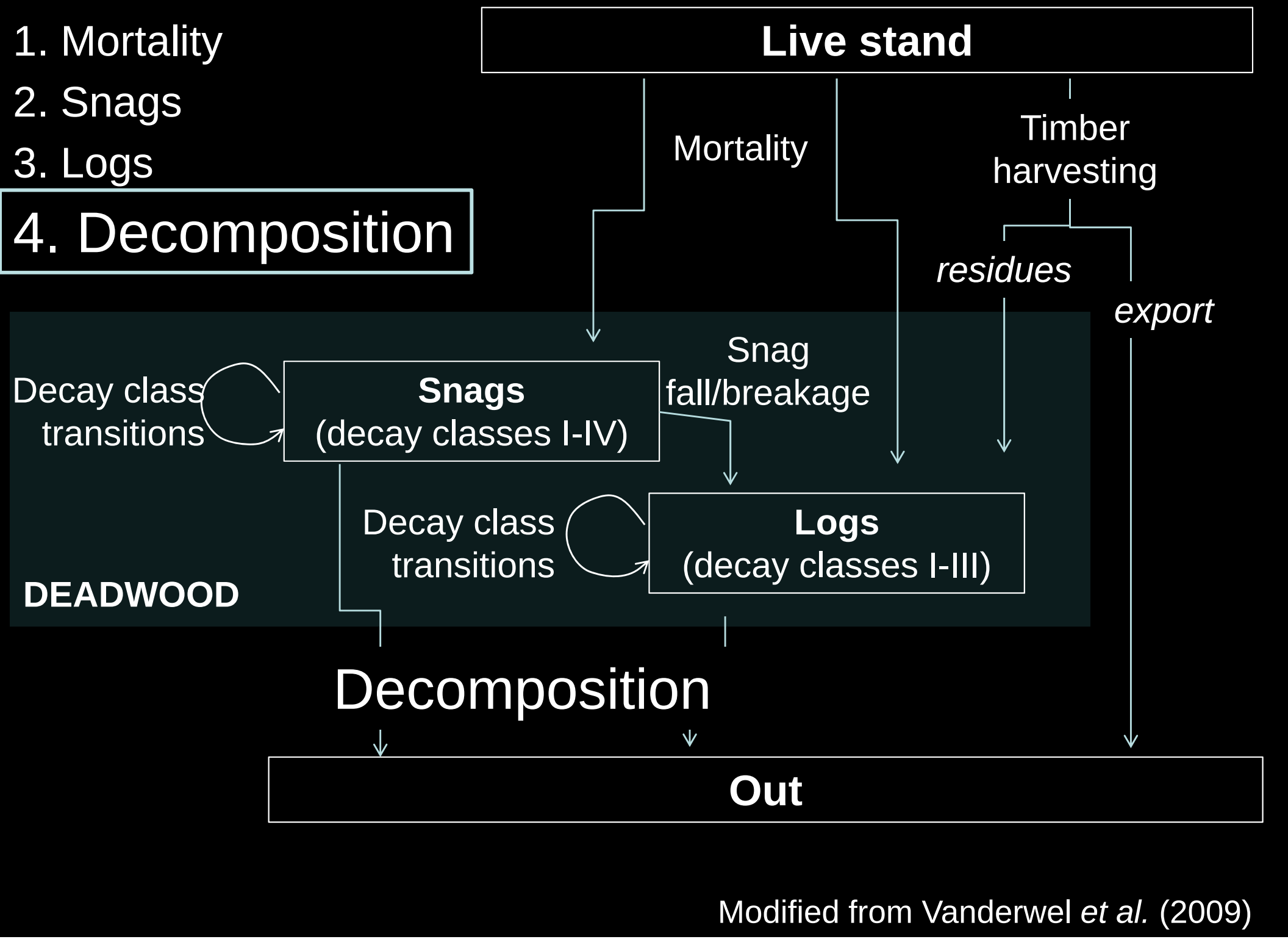


3. Logs – Net recruitment over a 9 year period



1. Mortality
2. Snags
3. Logs

4. Decomposition



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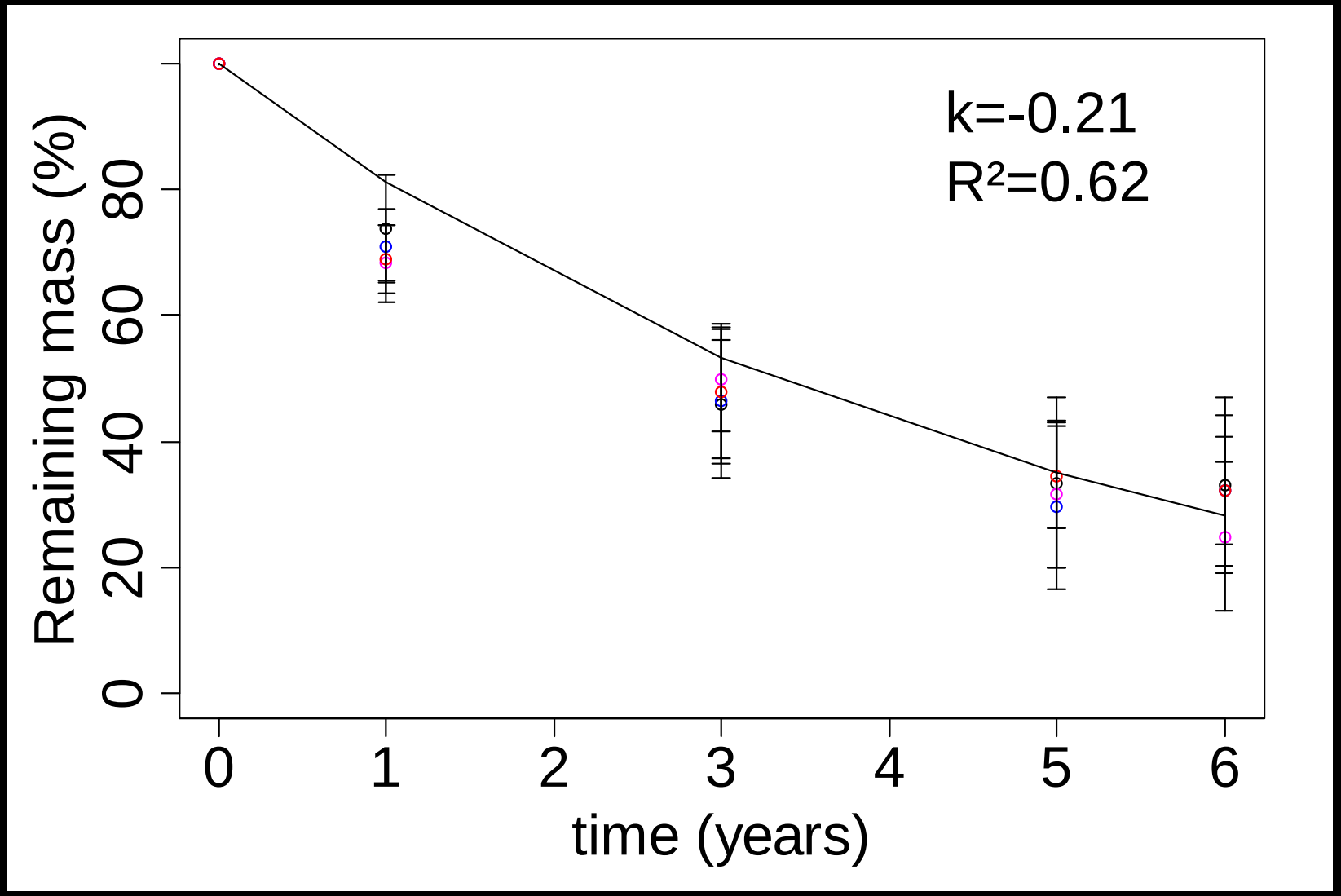
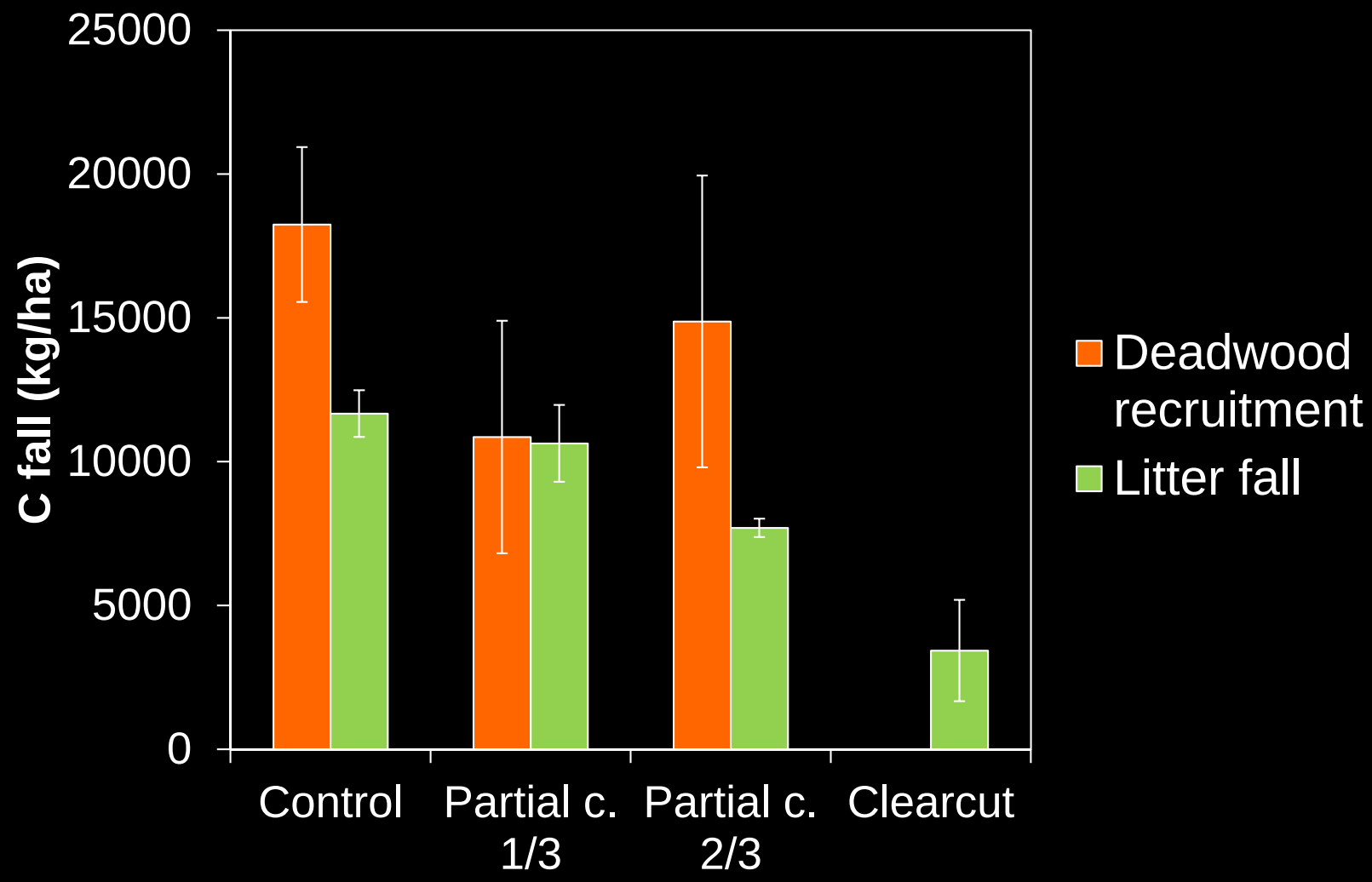
4. Decomposition

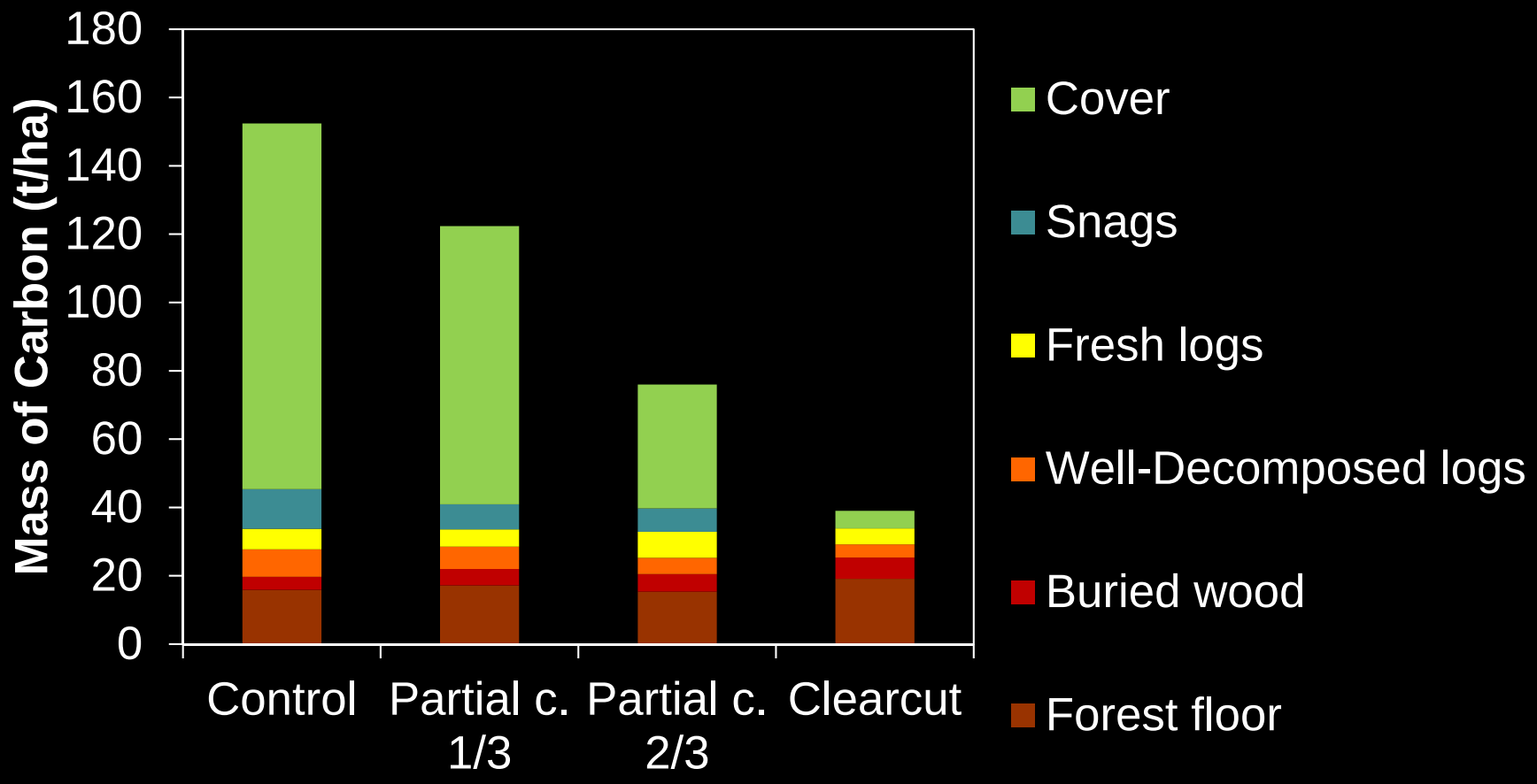


• Decomposition did not differ between treatments *per se*, but reduction in the size of coarse woody debris after harvesting could increase the decay rate.

5. Cumulative Deposition of Deadwood and Leaf litter over a 9 year period



6. Aboveground C pools – 9 years after treatment



Conclusion

• Partial harvested stands differ from clearcut stands. They conserve several characteristics of control : presence of snags and logs, deadwood recruitment, and rate of decomposition.

• Partial harvesting differs from control in terms of the amount of snags and logs, and in terms of the distribution within decay and diameter classes.

• The two different partial harvesting retentions have strong implications for deadwood dynamics. It should be possible to control the parameters of harvesting (% basal area removed, and DBH of removed tree) to manage deadwood.

• Harvesting also changes the ratio Deadwood/Leaf litter inputs, thus influencing the quality and mass of forest floor, which has an impact on Carbon sequestration.

Thank you

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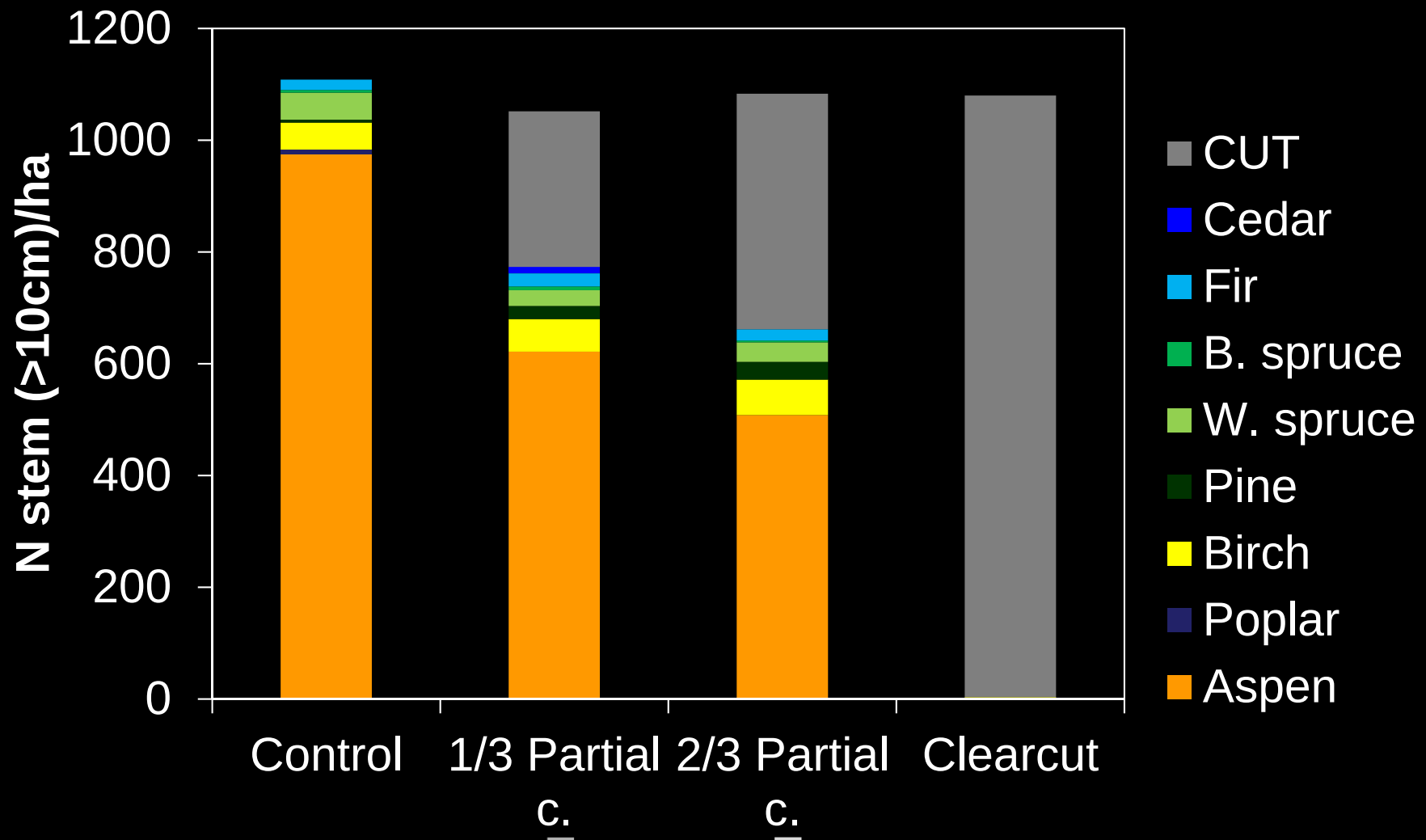
1. Live stand

- Stand description – after harvesting



Low thinned : with nonvigorous stems

Crown thinned : with vigorous stems