The Dynamics of In-Stream Large Woody Debris

Mohammad Bataineh, Lori Daniels, Trevor Jones, Sonya Powell, Evan Henderson, and Dave Andison
Research Goals

I) Understand LWD dynamics
II) Links between riparian forests and LWD

Questions

1) Time since death of LWD?
2) Rates of decay?
3) Processes determining recruitment?
- small, headwater streams
- width <3.5m, no transport
- mature riparian forests
- 5 pine-dominated sites
- 5 spruce-dominated sites
LWD Time Since Death:

- 2 to 143 years (n = 186 logs)
- pine ≤ 86 years (n = 113)
- spruce ≤ 143 years (n = 73)
The graph shows the relationship between time since death (in years) and decay class, with significant differences indicated by P<0.001. The decay classes are labeled as DC I - 1997, DC II - 1968, DC III - 1951, and DC IV - 1943.
Position class

- Bridge
- Partial bridge
- Loose
- Buried

Time since death (years)

- Bridge: a
- Partial bridge: b
- Loose: c
- Buried: c

P < 0.001

bridge

partial bridge

buried
Young LWD
bridge
decay I & II
perpendicular

Old LWD
loose & buried
decay III & IV
angled & parallel

Time since death (years)

Decay class

Position class

P<0.001
30 years

Position class

Mean frequency (per 50 m reach)

Decay class I
Decay class II
Decay class III
Decay class IV

BR PB L B

P<0.001
White & Black Spruce

uneven-aged, variable rates of initial growth, tree death relatively continuous in 20th C
Lodgepole Pine post-fire, even-aged, fast initial growth, tree deaths after crown closure, no LWD predated the fire

What happens during the first 50 years after fire?
2001 Dogrib Fire
- 5 headwater streams
- white-spruce dominated
- not salvaged
- regenerating to pine
Frequency distribution of LWD

Mature spruce LWD vs Pre-fire spruce LWD

Similar frequency distributions
Frequency distribution of LWD

Mature LWD vs Pre-fire LWD + Post-fire recruits

Large pulse in recruitment following fire
LWD Depletion Rates:
Mature spruce LWD vs Pre-fire spruce LWD

![Graph showing depletion rates of LWD in mature spruce vs pre-fire spruce over time.](image)
50% reduction of LWD in 50 years
50% reduction of LWD in 39 years

If no additional LWD input:

50% reduction of LWD in 50 years
50% reduction of LWD in 39 years
LWD Depletion Rates:
Mature spruce LWD vs Pre-fire LWD

If no additional LWD input:
80% reduction of LWD in 83 years
80% reduction of LWD in 79 years
Future LWD Dynamics

• Mature forests have ~continual long term supply of LWD due to stand dynamics

• Burned forests have pulse of LWD from fire
  – Size of and duration of pulse?
  – Lag before LWD affects stream function?
  – Lag before new forest contributes new LWD?
Snag fall rates?

5 years post fire
Lag between fall and function?

5 years post fire
Young LWD nominal function → LWD increasing function → Old LWD multi-functional

- Time since death (years)
  - 0
  - 20
  - 40
  - 60
  - 80

- Decay class
  - I
  - II
  - III
  - IV
  - P<0.001

- Position class
  - Bridge
  - Partial bridge
  - Loose
  - Buried
  - P<0.001

- 30 years
How long before new forest will contribute new LWD?
Lodgepole Pine

post-fire, even-aged, fast initial growth, tree deaths after crown closure
Implications of the Dogrib Study

• 70-80-yr lag: fire to new functional LWD
• snags surrounding headwater streams provide a source for LWD recruitment
• retain post-fire buffer zones of snags especially in riparian forests that
  – are susceptible to seasonal floods and erosion
  – provide habitat for threatened, rare or endangered species
Chronosequence Study

• Comparison of LWD in riparian forests of different ages and composition
  – ~50 year-old pine (n = 4)
  – ~50 year-old mixed species (n = 3)
  – ~100 year-old pine (n = 3)
  – >150 year-old spruce (n = 3)
Chronosequence Study

- LWD time since death and depletion rates
- Does LWD in young forests decay at the same rate as LWD in mature forests?
Conclusions

• LWD persists decades to centuries
• LWD position relates to decay and determines in-stream function with time
• LWD recruitment depends on disturbance and stand dynamics
• Changes to LWD abundance have long-term implications for stream function
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