# Multidecadal Response in Soil Carbon, Nitrogen, and Mercury to the Mt. Desert Island Fire of 1947 Using Paired Watersheds in Acadia National Park, Maine

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# Outline

- Background
  - Acadia National Park
  - PRIMENet
- My Work
  - Goals and Objectives
  - Hypotheses
  - Experimental Design and Methods
  - Preliminary results
  - Conclusion
- Future Directions

# Background, Acadia National Park (ANP)

- Higher N and Hg atmospheric deposition
  - Coastal fog
  - Steep slopes
  - Relatively high peaks
- Increased surface water sensitivity
  - Thin soils
- Acidification, N enrichment, and MeHg bioaccumulation

# Background, Acadia National Park (ANP)

- Great Fires of 1947
  - No significant history of fire
  - 1/3 of ANP burned
  - Hardwoods regeneration
- Paired Watershed Study

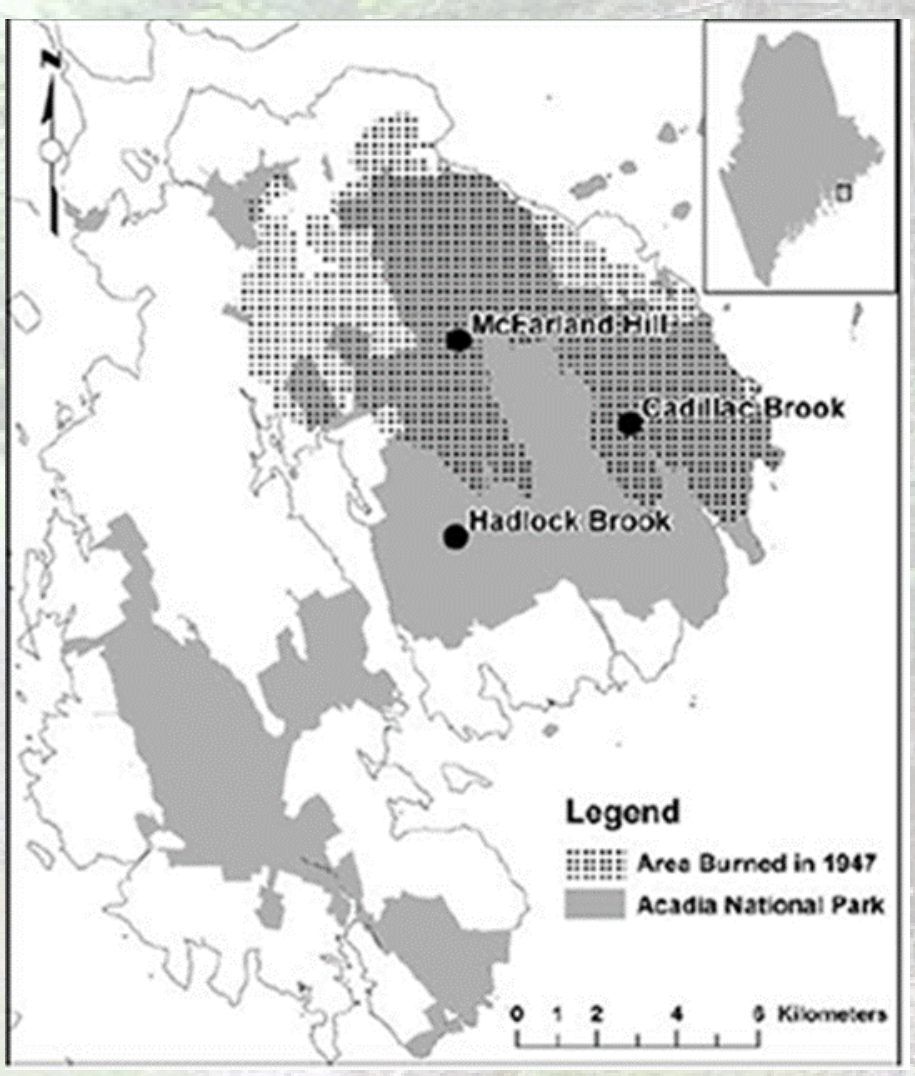



**Figure 1.** Location of study watersheds within ANP on Mount Desert Island, Maine, USA. The National Atmospheric Deposition Program sire is shown for reference (McFarland Hill). The patterned area was burned in wildfire in 1947. Park boundary and fire extent were provided by Acadia National Park, Resource Management Map projection is NAD83, Zone 19 N

# Background, PRIMENet

- Park Research and Intensive Monitoring of Ecosystems Network - 1996
  - Environmental Protection Agency (EPA) and the National Park Service (NPS)
- Hg, acid rain, and N saturation
  - Watershed characteristics

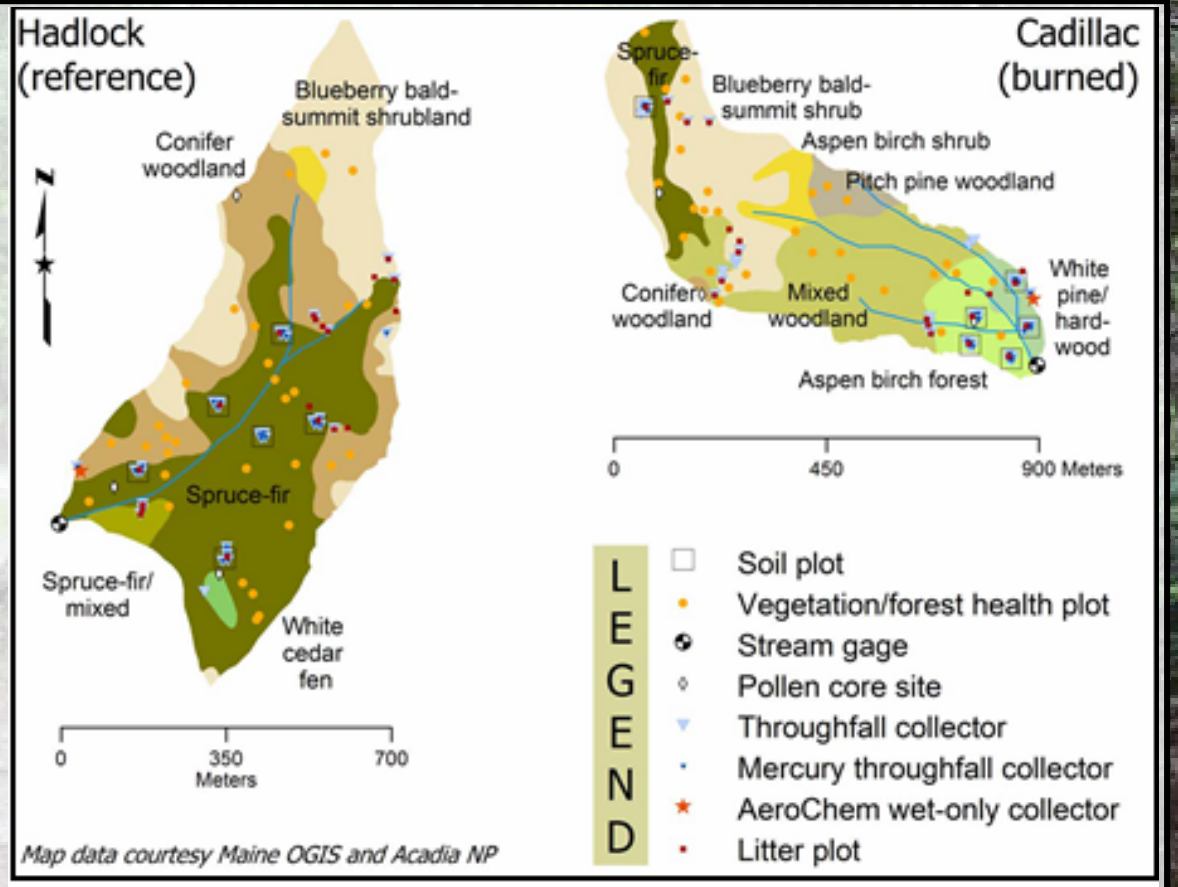



**Figure 2.** Study watersheds at ANP: Hadlock (unburned) and Cadillac (burned) with PRIMENET plot design for locations of various research elements. Soil plots used in this study are noted as boxes.

# Background, PRIMENet Findings

- Deposition differences
  - Scavenging efficiency, species and age
- Disturbance history
  - Forest cover patterns, soil, runoff chemistry
- Disturbance effects
  - Decades or centuries, watershed influences

# Background, PRIMENet Results

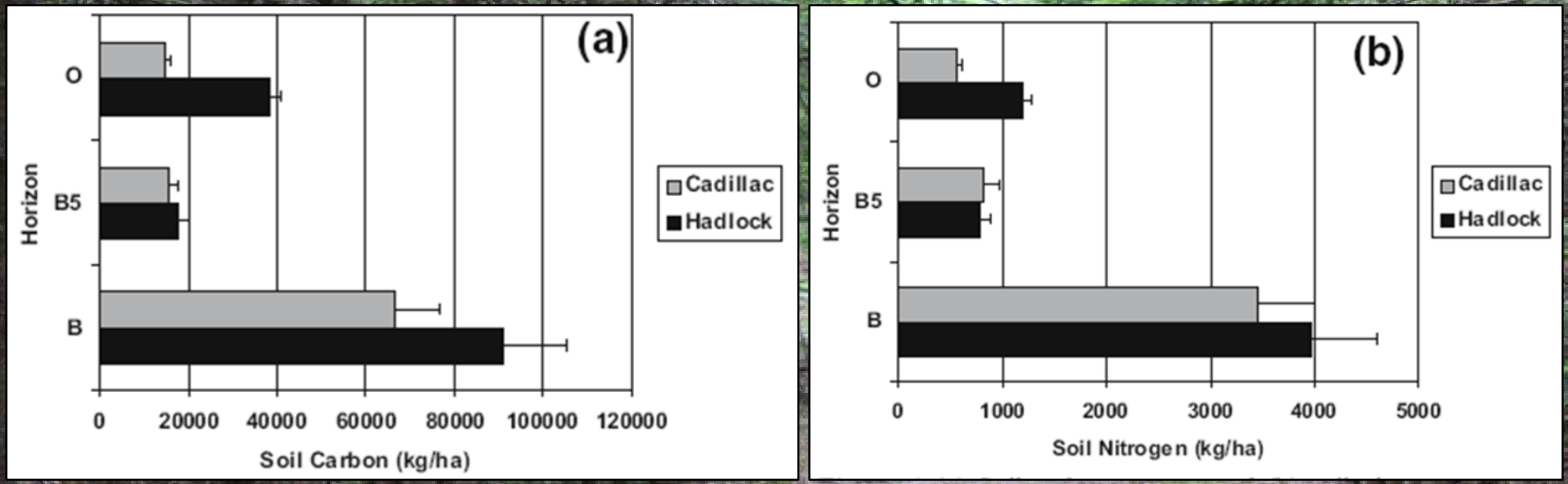



**Figure 3. (a) Soil C content and (b) soil N content in three soil horizons at Cadillac and Hadlock watersheds**

# Background, PRIMENet Results

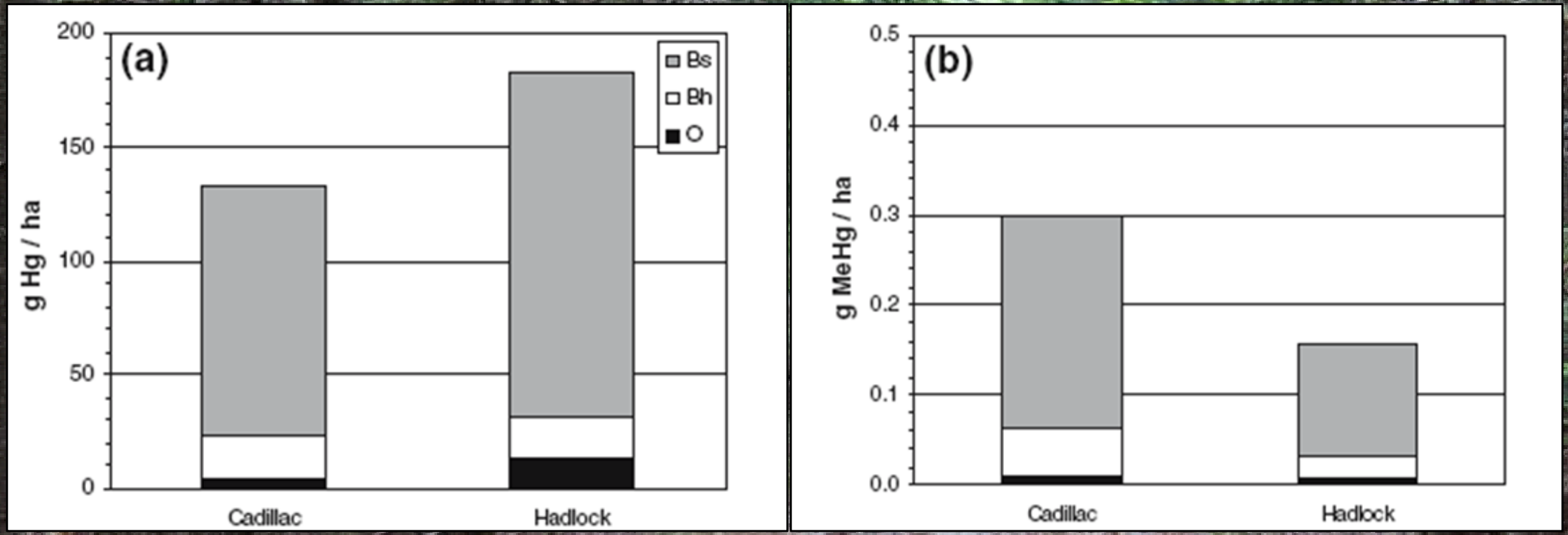



**Figure 4. (a) Total Hg and (b) MeHg contents in the soils of Cadillac and Hadlock watersheds**

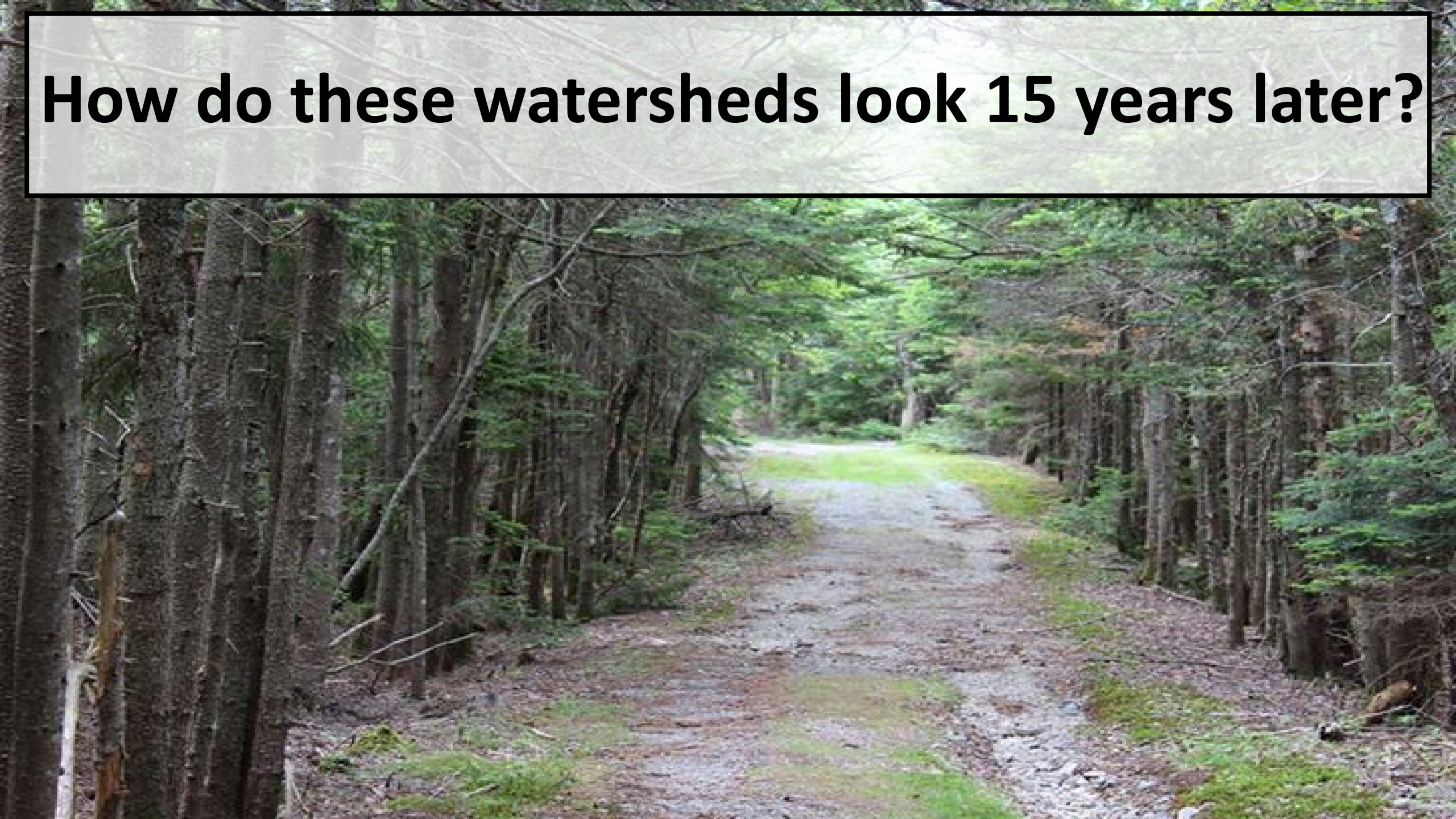
# Background, PRIMENet Findings

| | | *n* | Mean | Minimum | Maximum |
|---|---|---|---|---|---|
| Cadillac | TotHg (ng/l) | 104 | 0.6 | <DL | 3.14 |
| | MeHg (ng/l) | 12 | 0.05 | <DL | 0.12 |
| | $NO_3^-$ (μeq/l) | 93 | 0.7 | <DL | 7.4 |
| | $NH_4^+$ (μeq/l) | 93 | <DL | <DL | <DL |
| | DOC (mg/l) | 96 | 1.6 | 0.6 | 3.8 |
| Hadlock | TotHg (ng/l) | 139 | 1.5 | <DL | 5.7 |
| | MeHg (ng/l) | 17 | 0.07 | <DL | 0.15 |
| | $NO_3^-$ (μeq/l) | 126 | 7.4 | 0.3 | 19.8 |
| | $NH_4^+$ (μeq/l) | 125 | <DL | <DL | 3.3 |
| | DOC (mg/l) | 130 | 2.7 | 1.3 | 6.7 |

One-half the detection limit was used for samples below detect for computing means for N species.

**Table 1. Stream water concentrations for mercury (Hg in ng/l), methylmercury (MeHg in ng/l), dissolved organic carbon (DOC, in mg/l) and nitrogen ($NO_3^-$ and $NH_4^+$, in μeq/l) in Cadillac and Hadlock Brooks, for even and regular grab samples taken between November 17, 1999 and November 16, 2000**

# How do these watersheds look 15 years later?



# Goal and Objective

- Goal
  - Evaluate the recovery trajectory of these two differing watersheds to atmospheric deposition and fire disturbance
- Objective
  - Measure original PRIMENet site soil C, N, Hg, MeHg, and watershed export as streamwater for spatial and temporal comparison between burned (Cadillac) and unburned (Hadlock) watersheds

# Hypotheses

- Soil C, N, and Hg concentrations and content in the burned watershed (Cadillac) have increased but are still significantly lower than the unburned watershed (Hadlock)
- MeHg concentration and proportion in the burned watershed (Cadillac) have increased and are still significantly higher than the unburned watershed (Hadlock)
- Watershed export as streamwater $NO_3^-$, DOC, and Total Hg remain higher in the unburned watershed with MeHg content being equal between both watersheds with higher proportionality in the burned watershed (Cadillac)

# Experimental Design

- Replicate PRIMENet design
- 6 20 x 20 m pseudoreplicate plots
- 4 corners and center

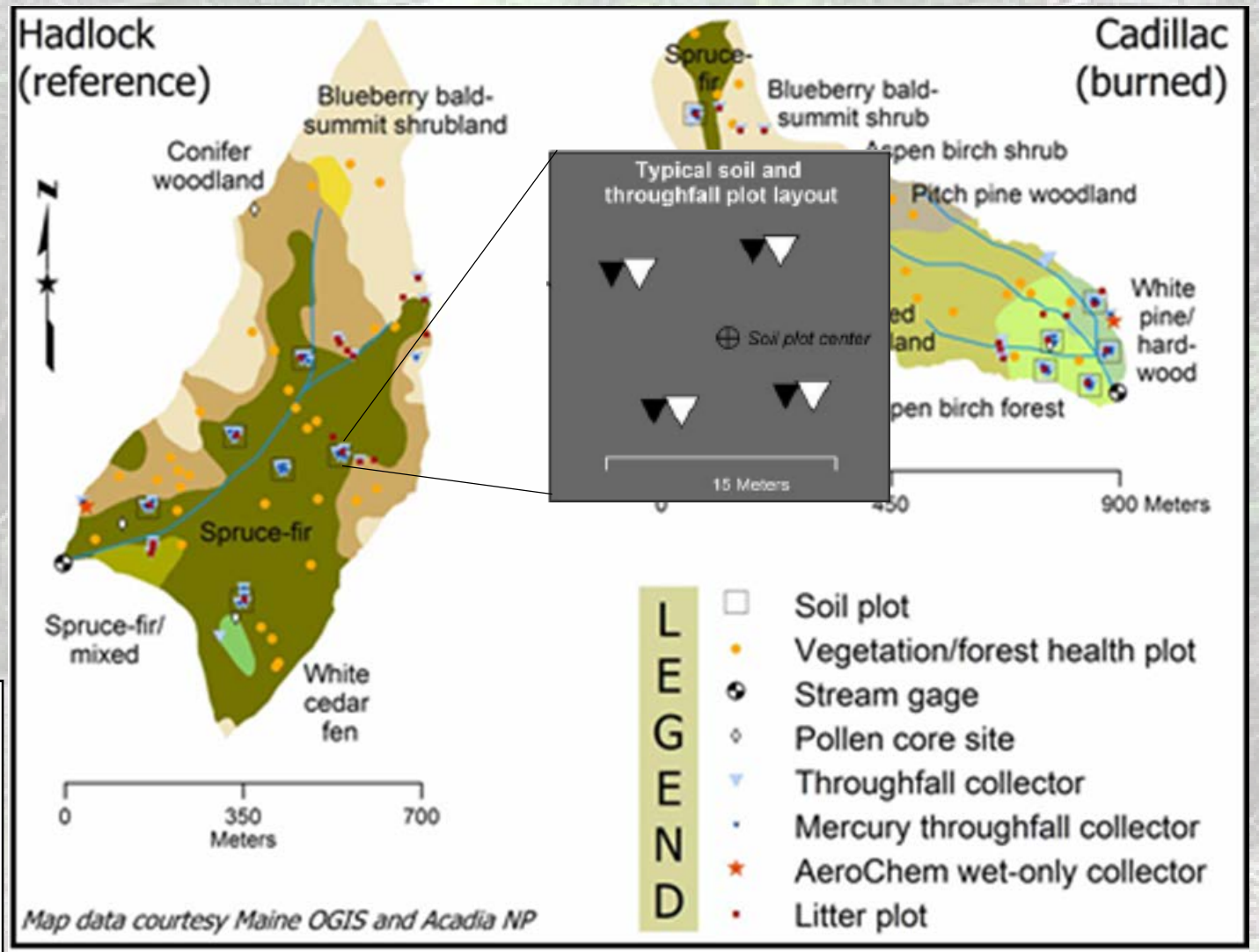


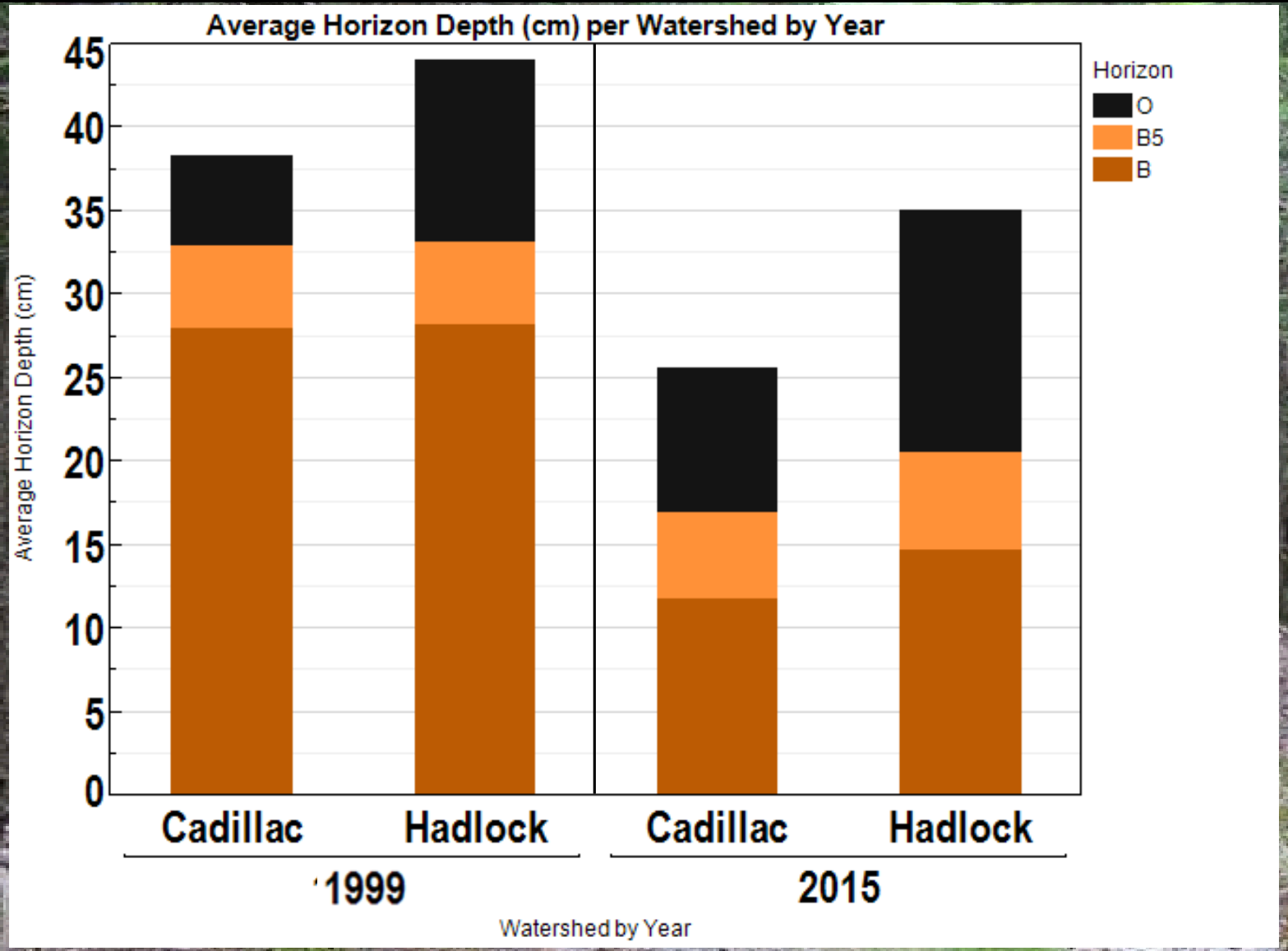

**Figure 2. Study watersheds at ANP: Hadlock (unburned) and Cadillac (burned) with PRIMENet plot design for locations of various research elements. Soil plots used in this study are noted as boxes.**

# Methods

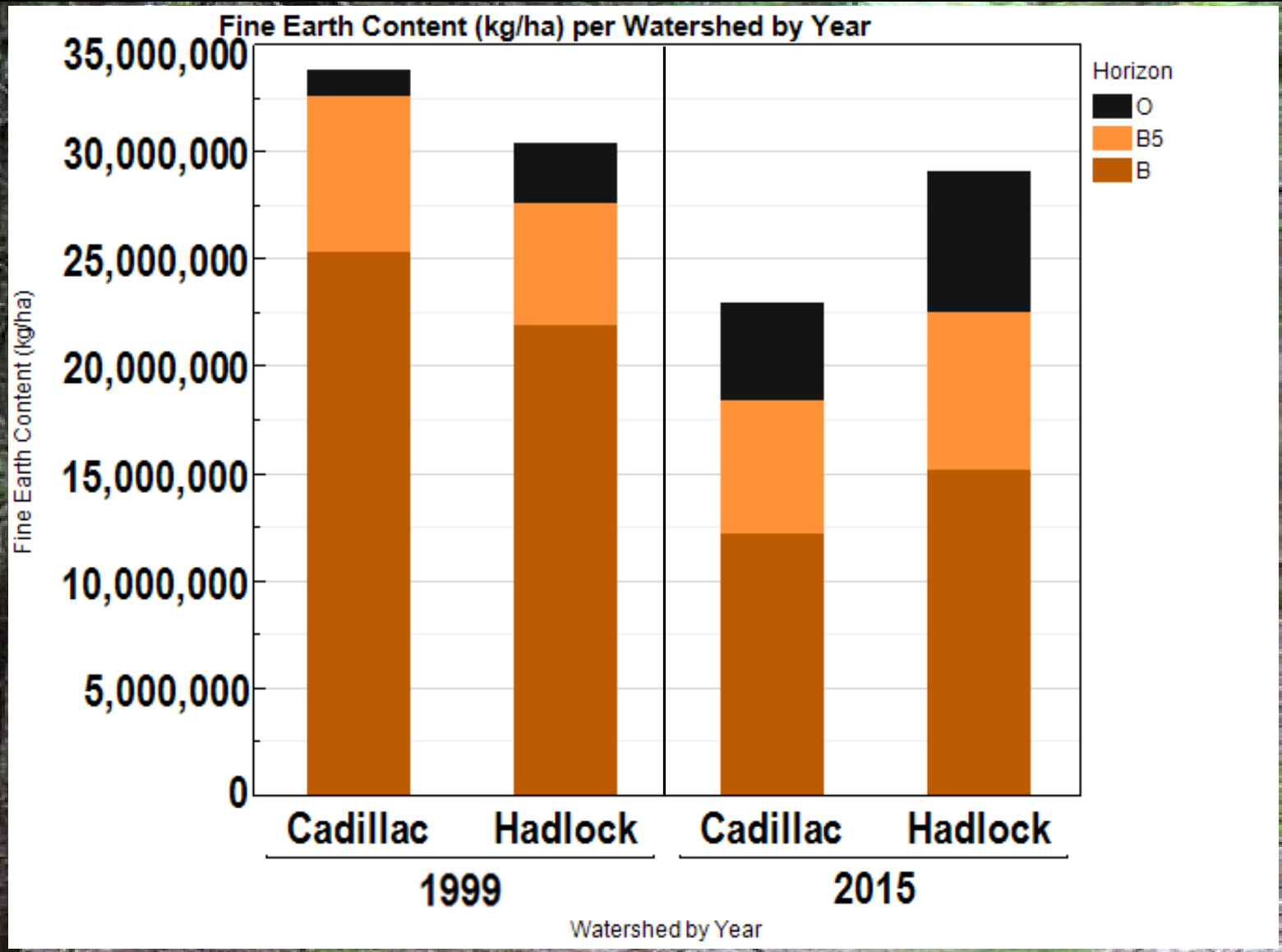
- 11.3 cm diameter template
  - O, E, 0-5 cm and 5-25 cm B
- Hg contamination
- 2 mm and 6 mm Nalgene
- C + N
- Hg + Archival

Figure 5. Soil pit at ANP: Hadlock (unburned) horizons

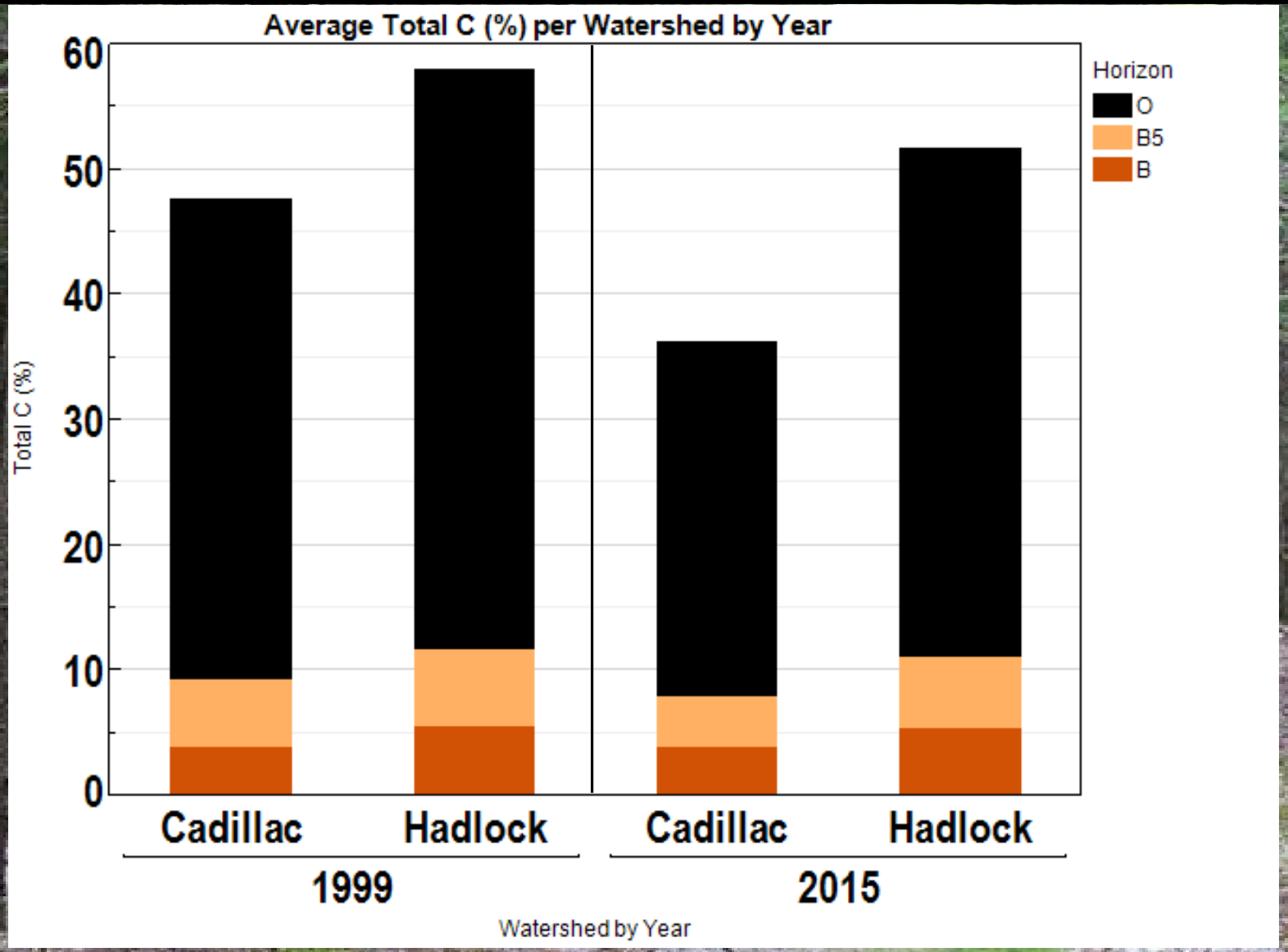
# Preliminary Results – Average Horizon Depth



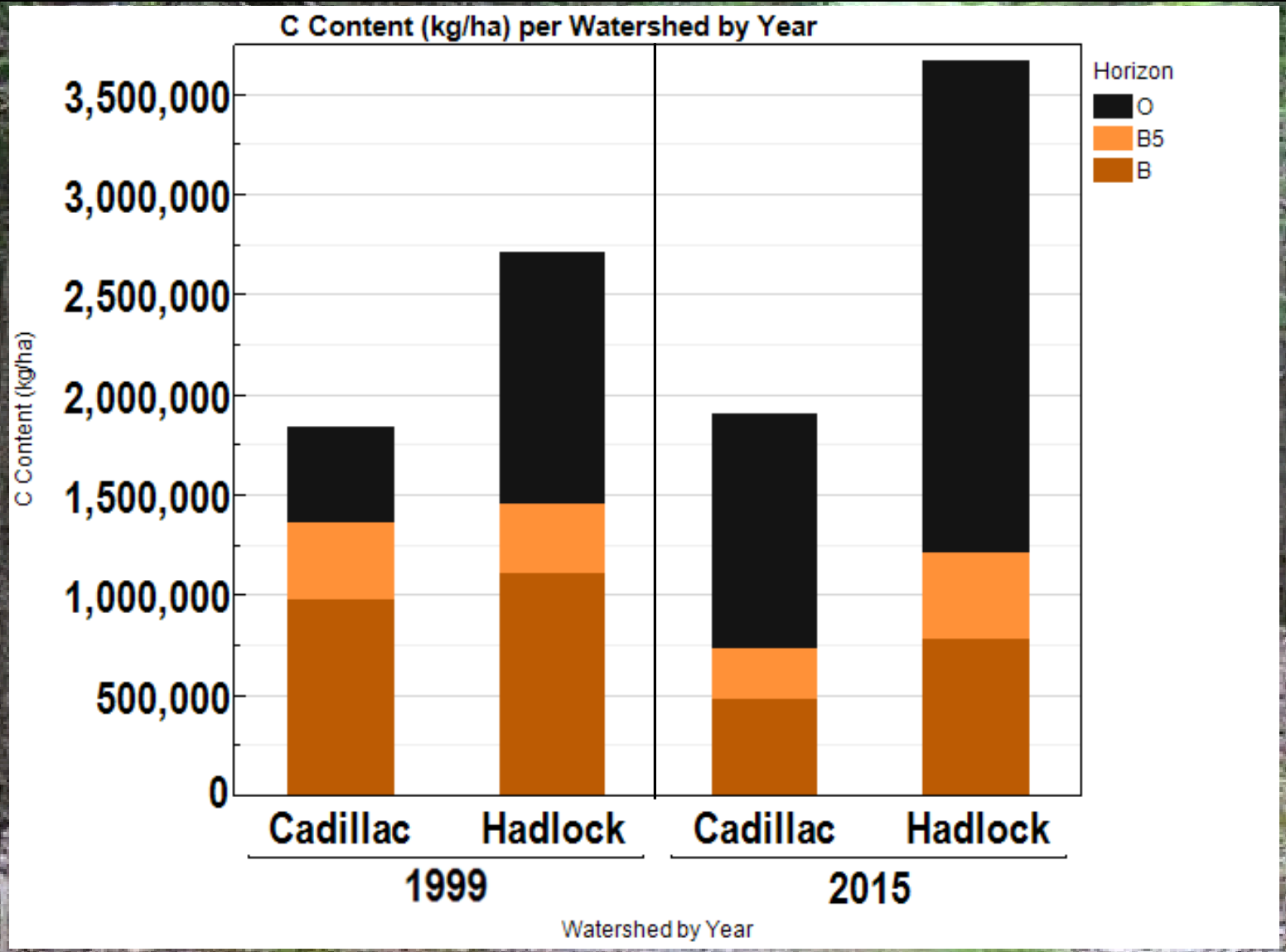
# Preliminary Results – Fine Earth Content



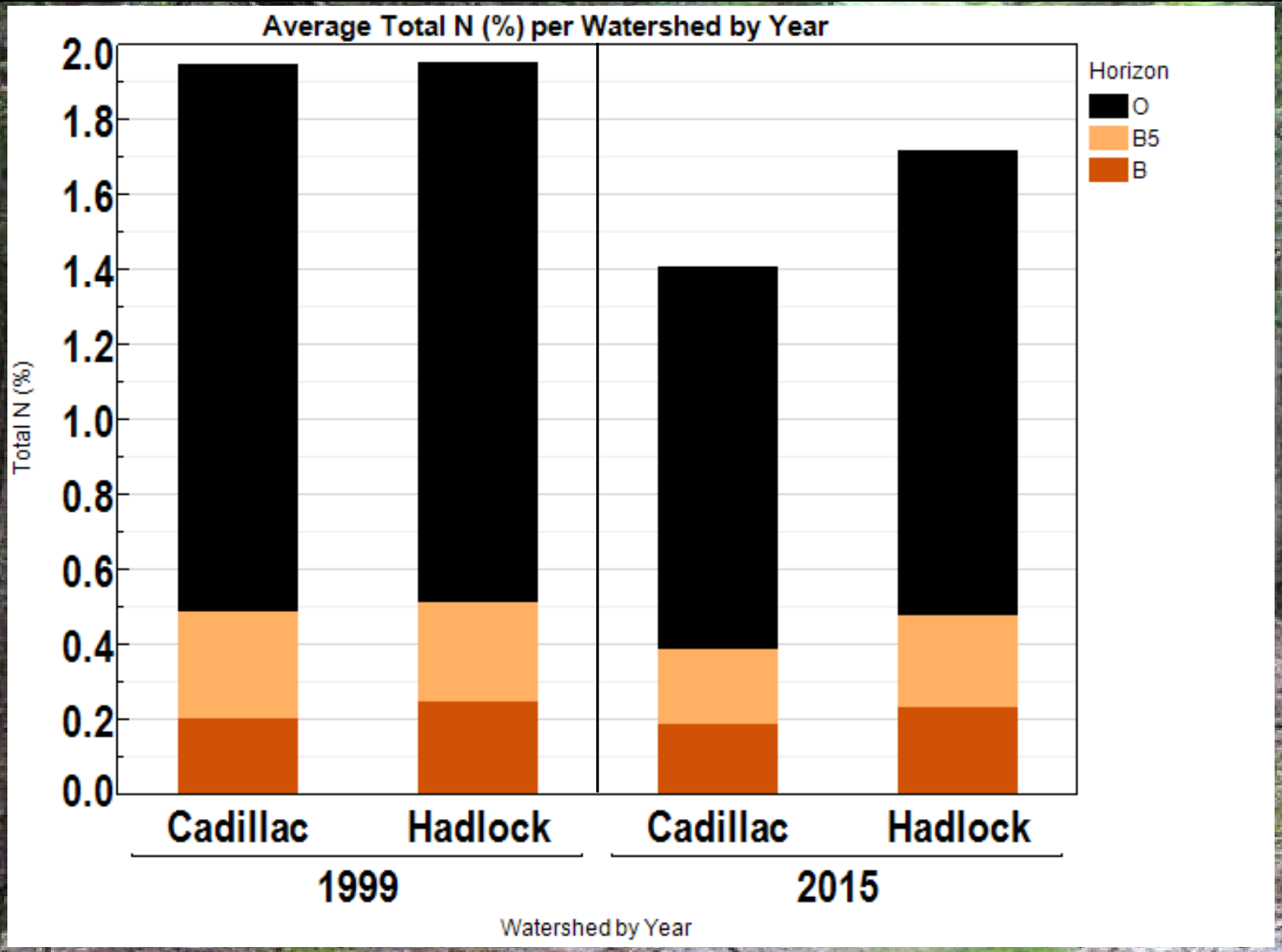
# Preliminary Results – Average C (%)



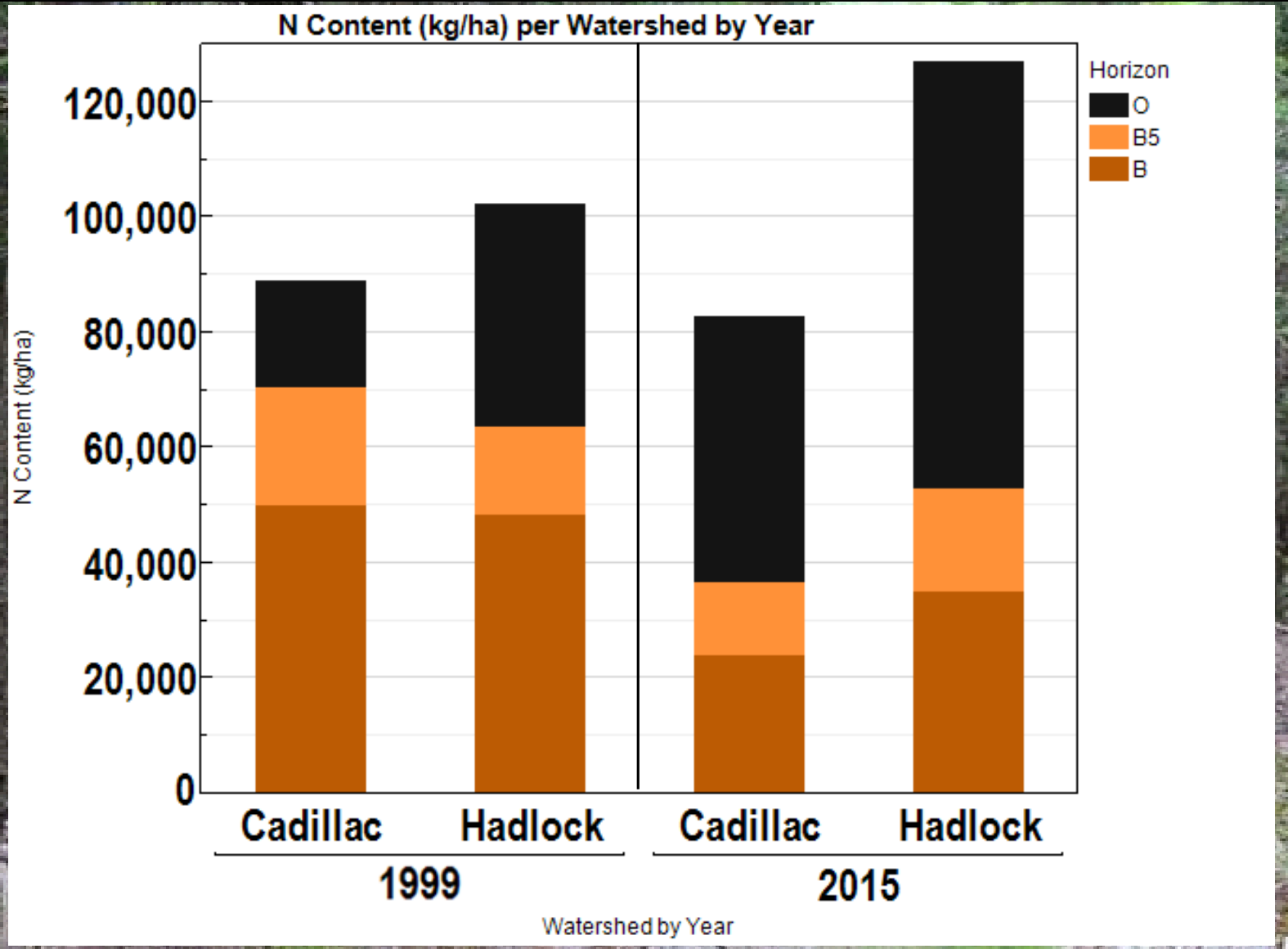
# Preliminary Results – C Content (kg/ha)



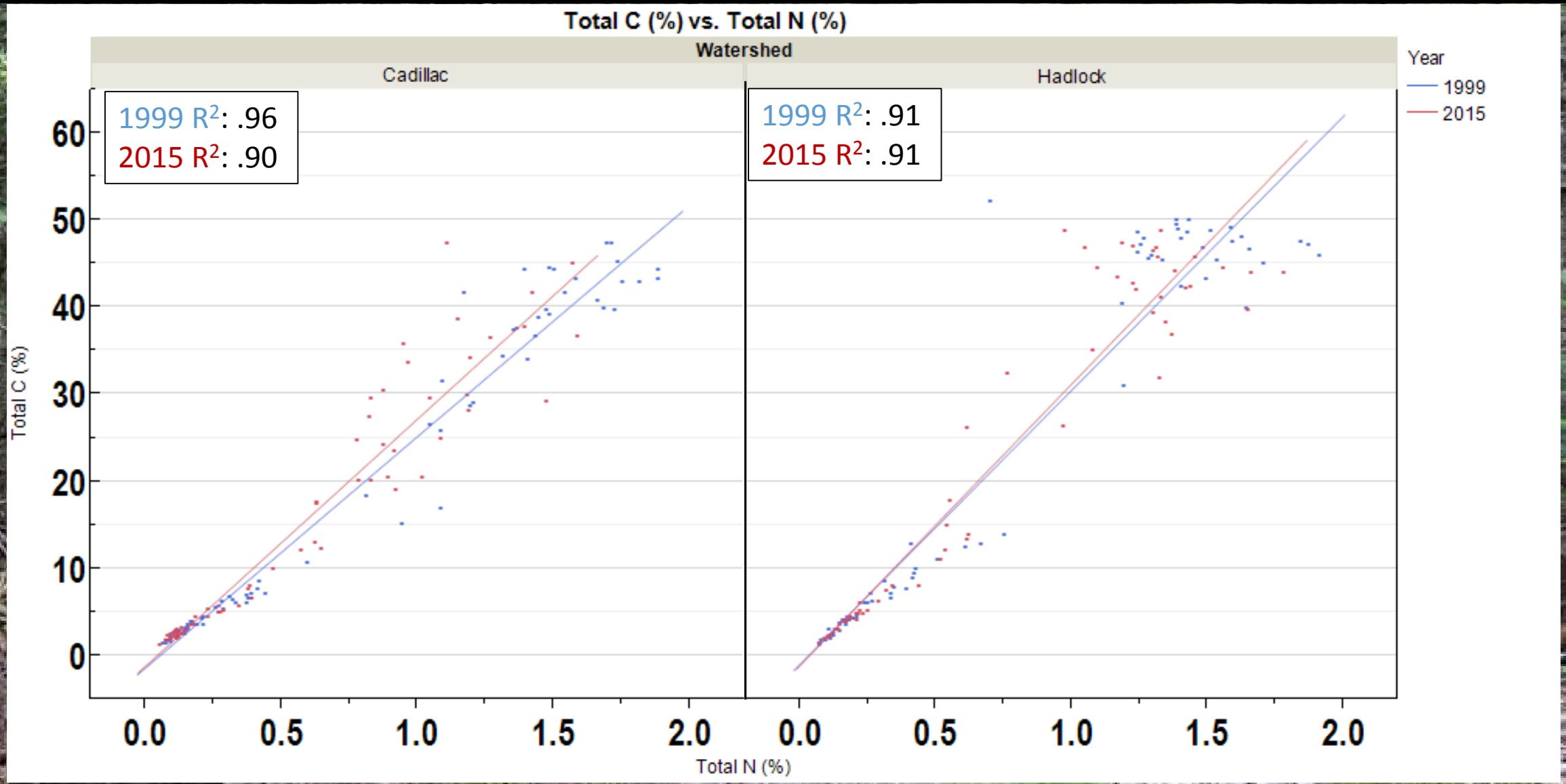
# Preliminary Results – Average N (%)



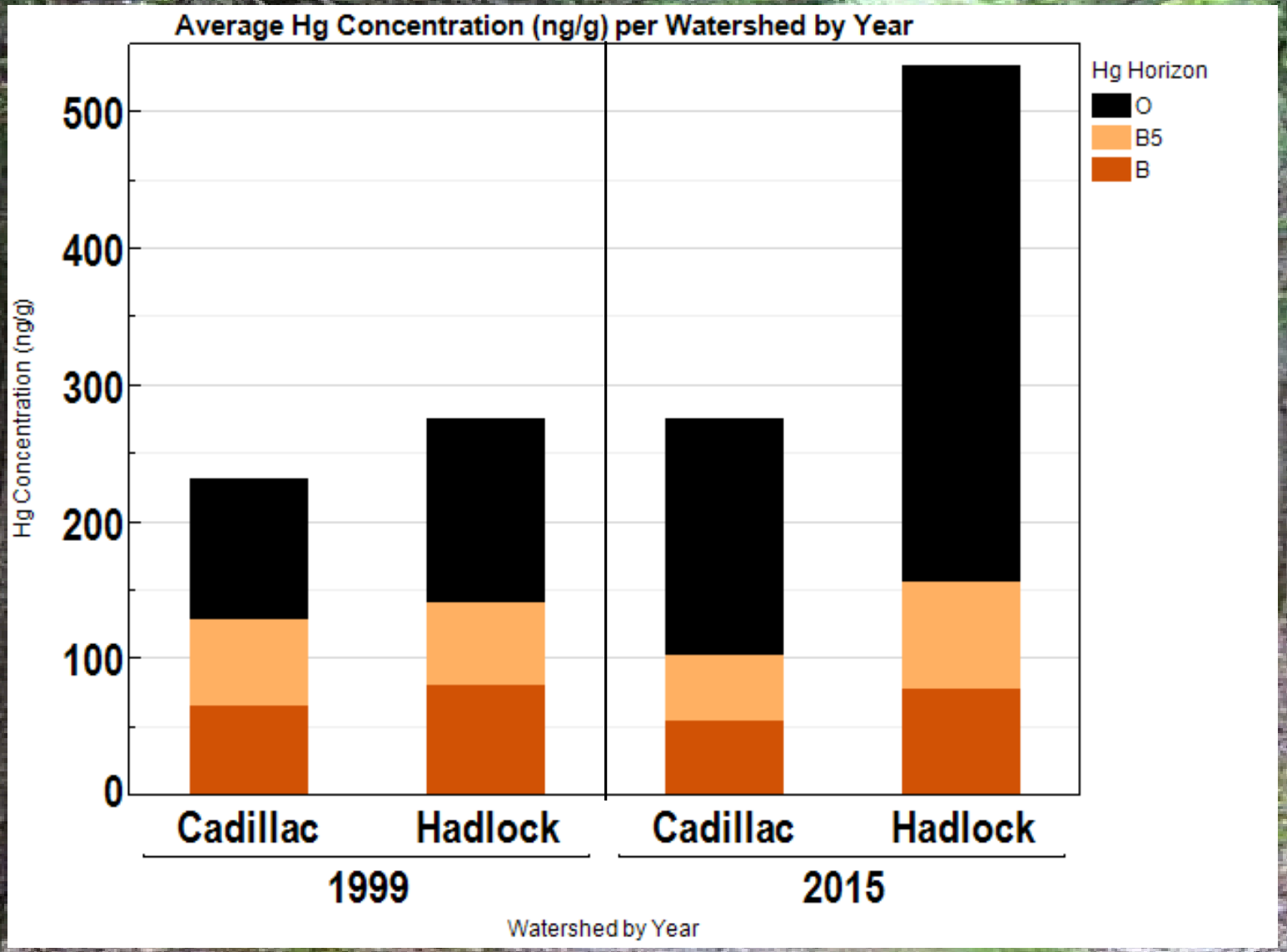
# Preliminary Results – N Content (kg/ha)



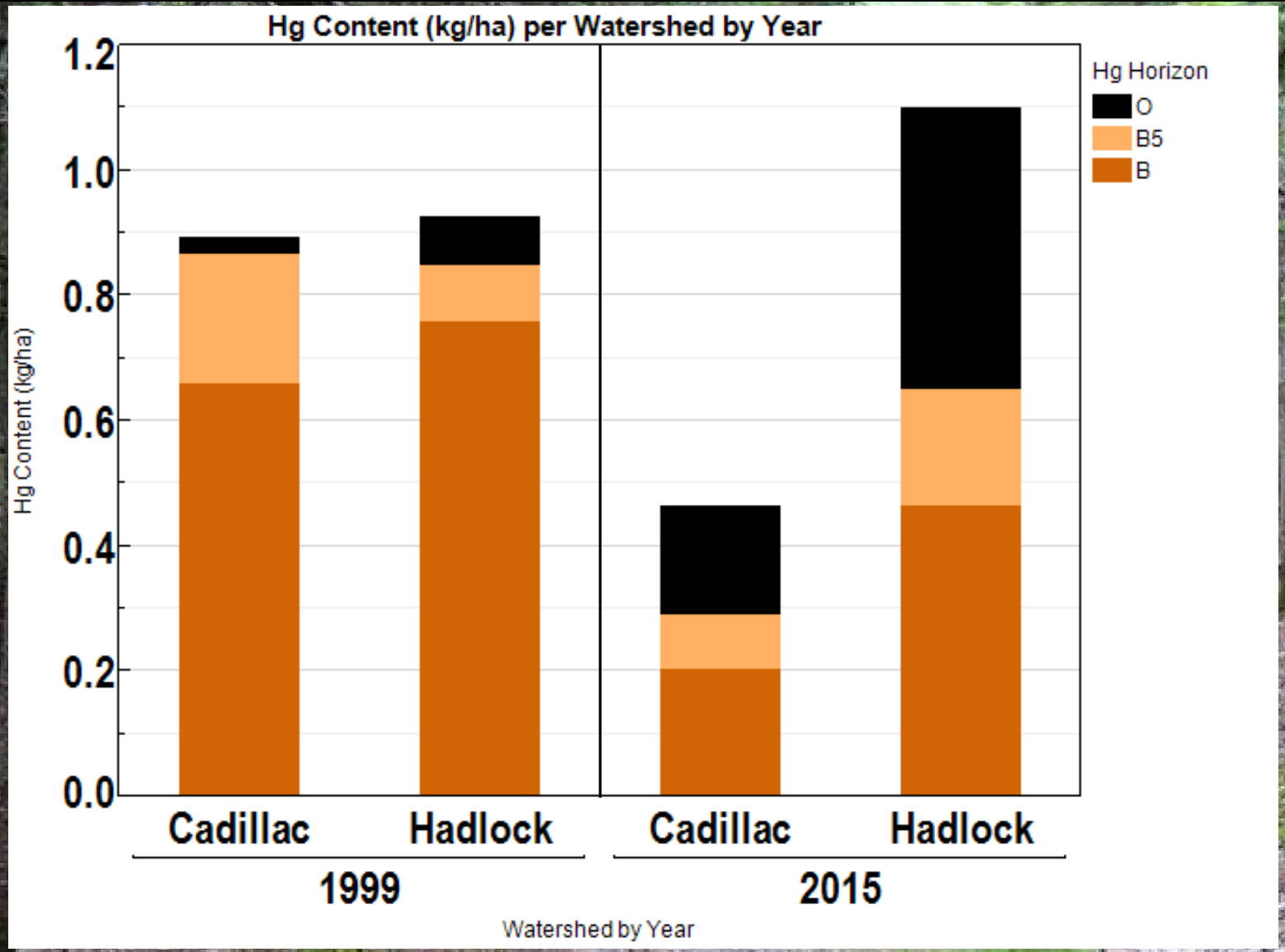
# Preliminary Results – Total C (%) vs. Total N (%)



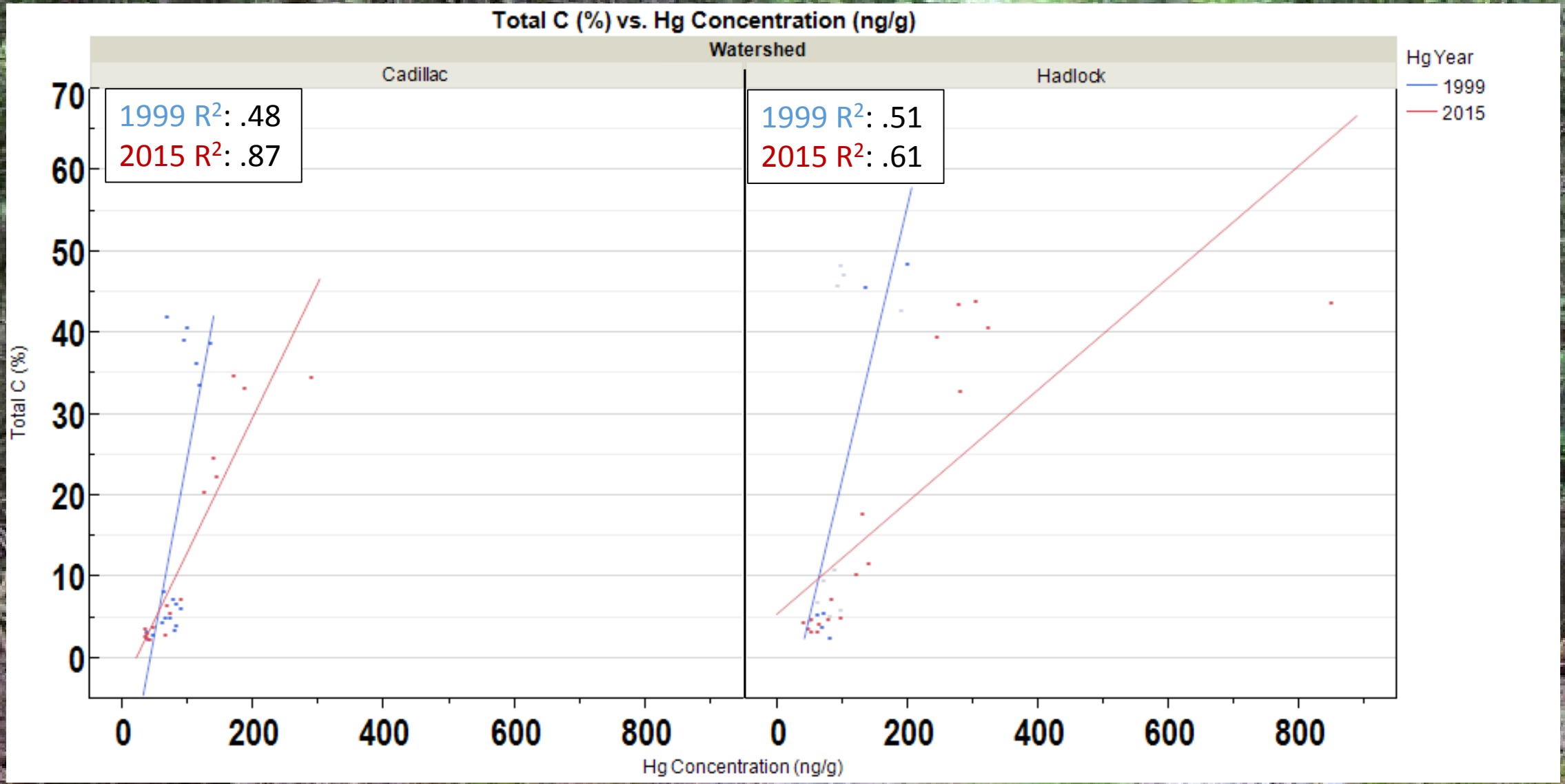
# Preliminary results – Average Hg Concentration (ng/g)



# Preliminary results – Hg Content (kg/ha)



# Preliminary results – Hg



# Conclusion

- Total soil C, N, and Hg concentrations and content in the burned watershed (Cadillac) have increased but are still significantly lower than the unburned watershed (Hadlock) due to the fire of 1947
  - Increase
    - C Content
    - N Content
    - Hg Concentration
    - Hg Content
  - Decrease
    - C Concentration
    - N Concentration

# Future directions

- MeHg and Hg proportionality
- Watershed export data as streamwater
- Introduction of new plots
  - Underrepresented landscape positions
    - Drainage
      - Hydropedology
      - Soil Moisture Active Passive satellite
    - Hg Hotspots

# Support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