

Developing the Visible Habitat Profile for New England Forests

A pilot reference-based structural assessment tool for land stewards

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Take-home: Simple field measurements, compared with existing New England forest data, gave consistent Low / Typical / High ratings. Two observers agreed in 22 of 24 checks.

1 Background

Soil microbes drive decomposition and nutrient cycling, and have historically been an important source of antibiotics. Yet they are invisible in routine assessments and costly to measure in a lab.

Visible forest structure is increasingly linked to belowground conditions (Lang et al. 2023), but land stewards lack a practical way to judge where their habitat features fall relative to established New England forest data.

Aim

- Develop the Visible Habitat Profile (VHP), a simple way for land stewards to rate three forest features as Low, Typical, or High against New England reference data.
- Test whether two observers using the VHP reach the same ratings.

2 Evidence base

A review of ≈245 peer-reviewed studies (93 annotated in detail, including null and contradictory results) tested whether candidate features matter below ground and how they have been measured.

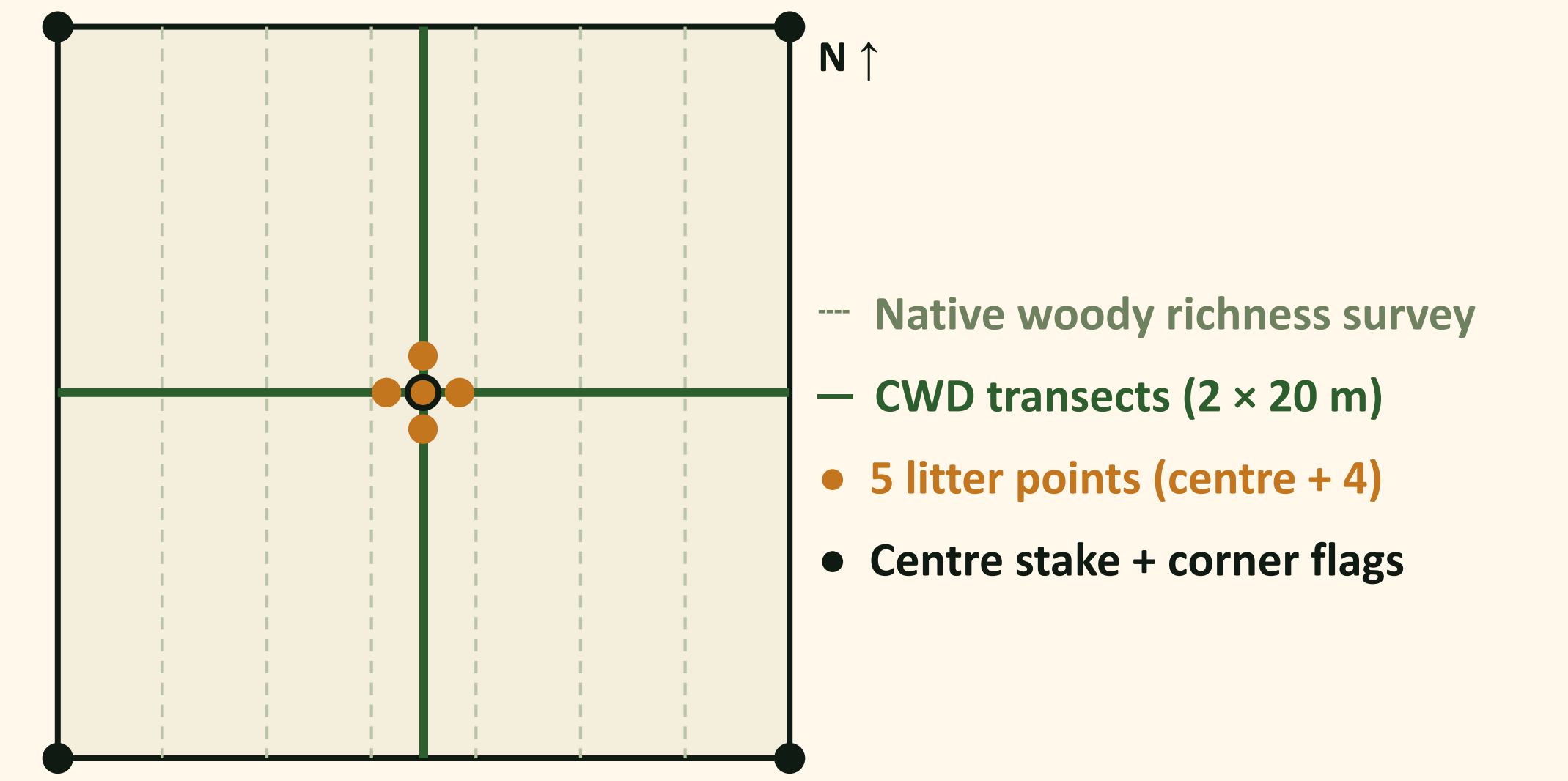
Native woody richness: across 106 studies, mixed plant communities held about 12.5% more soil microbial biomass than single-species stands (Chen et al. 2019).

Coarse woody debris (CWD): soil stays moister beneath CWD (Kim et al. 2017), and CWD can shift soil temperature and bacterial communities (Perreault et al. 2021).

Identifiable surface-litter depth: removing litter cut microbial biomass by 4.9% in a global forest synthesis (Jing et al. 2021); 23 years of litter changes at Harvard Forest caused large shifts in fungal biomass (Rousk & Frey 2015).

What came from it: evidence supports all three features, but the literature gave no values at which soil conditions clearly shift, so the VHP's Low / Typical / High ranges come from reference forest data instead.

3 The three measurements



One 20 × 20 m (400 m²) plot, the area at which the native woody richness reference is defined. Definitions matter: counting species of any stem size roughly doubled the count.

Native woody richness
Number of native tree, shrub and woody-vine species with a living stem ≥1 cm across at breast height (1.37 m).

CWD volume
Downed logs and branches crossing two 20 m transects: pieces ≥7.6 cm in diameter where they cross and ≥1 m long (snags and stumps excluded). Volume is calculated from those diameters.

Identifiable surface-litter depth
Depth of loose, recognisable leaves and plant material above the decomposed layer, averaged over five points.

4 Pilot field study

4 sites: two actively managed (Fox Forest, Newbury Logged) and two preserved (Newbury Preserved, Sheldrick Preserve).

8 plots: two per site, randomly placed using GIS, ≥50 m apart.

2 observers: the second repeated every measurement without seeing the first observer's results.

Pass mark: both give the same Low / Typical / High rating on at least 6 of 8 plots.

5 Reference ranges

Low = bottom quarter of the reference plots, High = top quarter, Typical = the middle half (25th–75th percentiles). Each reference dataset was chosen to match its field measurement as closely as possible.

Measurement	Low	Typical	High	Reference data
Native woody richness (species / 400 m ²)	< 6	6 – 11	> 11	Harvard Forest ForestGEO census: 875 squares (each 20 × 20 m) in one 35-ha forest
CWD volume (m ³ /ha)	< 8.4	8.4 – 46.7	> 46.7	USDA Forest Inventory & Analysis (FIA): 185 plots in VT, NH, MA, CT, RI
Identifiable surface-litter depth (cm)	< 2.2	2.2 – 3.5	> 3.5	Same 185 FIA plots

Ranges held up under checking. Removing Harvard Forest's 87 beaver-swamp quadrats, or using different subsets of FIA plots, changed the boundaries little or not at all. Recalculating CWD volume from 999 individual pieces recorded by FIA gave nearly identical boundaries.

6 Results: do two observers agree?

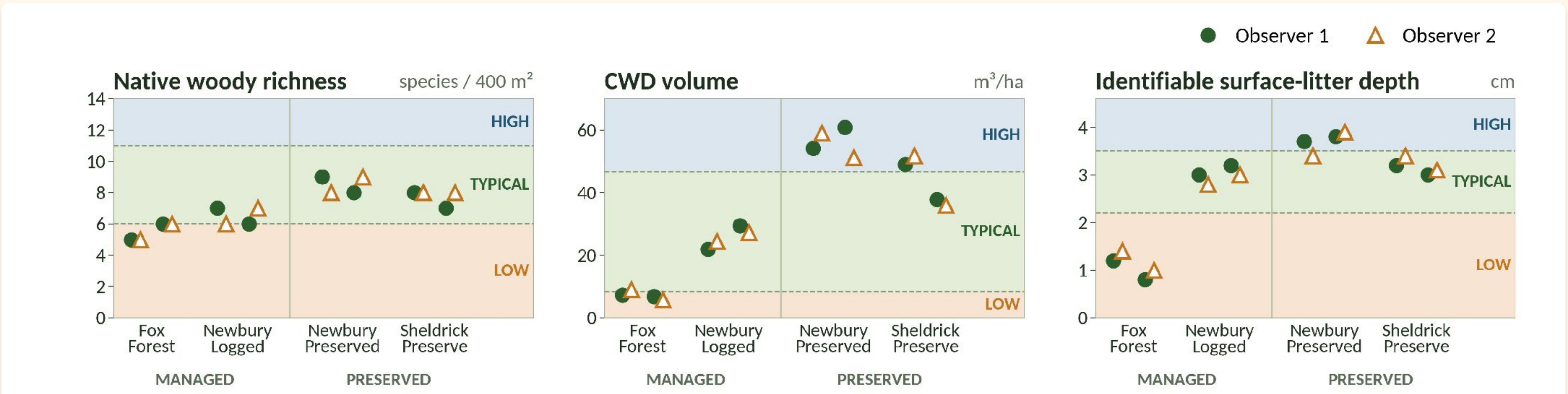


Figure 1. Both observers' measurements at each of the eight plots, grouped by site. Background colours match the ranges table; a value exactly on a boundary line counts as Typical.

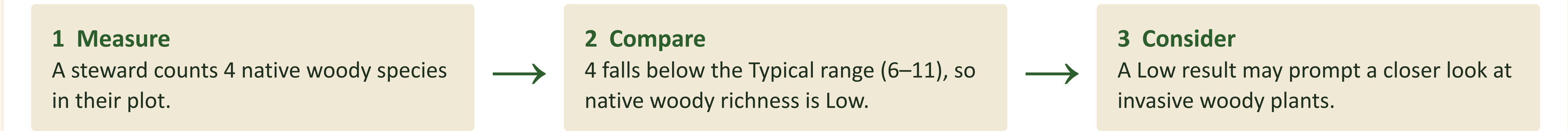
8 / 8
Native woody richness
plots given the same rating

7 / 8
CWD volume
plots given the same rating

7 / 8
Identifiable surface-litter depth
plots given the same rating

All three measurements passed. Both disagreements were plots sitting right at a range boundary. Values also differed between preserved and managed sites in the direction you might expect: preserved plots generally scored higher on all three measurements, most clearly for CWD volume.

In practice: a native woody richness example



Practitioner toolkit: field instructions · datasheet · Field Tracker app · plot workbook · interpretation guide

Limitations & next steps

- Link to soil microbes not yet shown: an exploratory check of 18 NEON plots found no consistent pattern
- Reference datasets and range boundaries are design choices still to be tested
- Native woody richness reference comes from a single forest
- Small pilot: 8 paired plots across 4 sites
- Measuring three visible features gives a partial picture of habitat condition

Next steps: test across more sites and forest types, and sample soil and habitat at the same plots

Project website & materials
naturespharmacyproject.com/vhp