Rapid Ecological Assessment of Forests and Associated Exotic Earthworms in the Laurentian Mixed Forest-Great Lakes Coastal Biological Network, Midwest Region, National Wildlife Refuge System, US Fish & Wildlife Service

SUMMARY TABLES & FIGURES: Seney NWR

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The following are summary tables and figures associated with the 2010 rapid ecological assessment of sampled forest stands and associated earthworms at Seney National Wildlife Refuge (NWR). Along with the training provided to the refuge, the field manual (with sampling procedures), and the forest database (including plot photos), these tables and figures will comprise “deliverables” and will be used to guide summary discussions with refuge staff. **Please note**: to be most useful, these data and statistics must be viewed within the context of existing literature, land use history, land capability (as constrained by multiple factors, including climate, soils, landforms, etc.), and specific refuge management goals and objectives.

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REFUGE SCALE

Table 1. Refuge-scale sampling effort and related findings.

Metric	Value	Metric	Value
Numbers stands sampled	11	Mean (±SD) basal area (ft^2/ac) / stand[b]	130.0±84.7
Number transects	11	Mean (±SD) live tree DBH (in) / stand	12.1±1.6
Number plots	112	Mean (±SD) snag DBH (in) / stand	11.3±4.1
Mean (±SD) number plots / stand	10.2±6.0	Mean (±SD) number snags / stand	4.3±4.3
Number overstory spp. identified [a]	20	Mean (±SD) number invasive plant spp. / stand	0±0
Mean (±SD) number identifiable overstory spp. / stand [a]	5.0±1.9		

[a]Does not include unknown species or general species groups when identifiable species in same genera present.
[b]Does not include dead trees (snags).

Table 2. Overstory tree species (by U.S. Forest Service species code) and invasive plant species encountered (no codes).

Code	**Common Name**	***Genus species***
12	balsam fir	*Abies balsamea*
95	black spruce	*Picea mariana*
105	jack pine	*Pinus banksiana*
125	red pine	*Pinus resinosa*
129	eastern white pine	*Pinus strobus*
241	northern white cedar	*Thuja occidentalis*
261	eastern hemlock	*Tsuga canadensis*
316	red maple	*Acer rubrum*
318	sugar maple	*Acer saccharum*
371	yellow birch	*Betula alleghaniensis*
375	paper birch	*Betula papyrifera*
531	American beech	*Fagus grandifolia*
541	white ash	*Fraxinus americana*
542	Oregon ash	*Fraxinus latifolia*
701	hop-hornbeam	*Ostrya virginiana*
743	bigtooth aspen	*Populus grandidentata*
762	black cherry	*Prunus serotina*
833	northern red oak	*Quercus rubra*
951	American basswood	*Tilia americana*
972	American elm	*Ulmus americana*

STAND SCALE

Table 3.Overstory composition summary.

Stand Name or Code	Number of Plots	Number of Identifiable Overstory Tree Species	Mean (±SD) Identifiable Overstory Species / Plot	Name of Dominant Species(s) (trees per acre)	Name of Dominant Species(s) (basal area, ft^2/ac)	Mean (±SD) Vigor Rating [a]	Percent (%) of Trees with >2 Damage Codes	Percent (%) of Ash Trees with EAB
HEM	4	5	2.8±1.5	eastern hemlock	eastern hemlock	1.2±0.4	0	
COF	6	3	1.0±0.6	sugar maple	sugar maple	1.0±0	0	
SH-R	9	5	1.9±0.6	sugar maple	sugar maple	1.1±0.1	0	
SH-N	9	4	1.7±0.7	sugar maple	sugar maple	1.6±1.0	12	
CHF-TA	9	5	1.7±0.7	sugar maple	sugar maple	1.1±0.3	4	
CHF-TB	9	6	2.0±0.5	sugar maple	sugar maple	1.0±0	0	
HARD	8	8	2.1±1.0	bigtooth aspen	bigtooth aspen	1.3±0.7	4	
WILD	13	5	1.9±0.9	sugar maple	sugar maple	1.2±0.2	13	
D-CUT	21	6	1.2±0.8	red pine	red pine	1.1±0.2	3	
D-PINE	21	7	1.8±0.7	red pine	red pine	1.0±0.1	3	
D-C2O	3	1	0.7±1.2	sugar maple	sugar maple	1.0±0	0	

[a]See field manual.

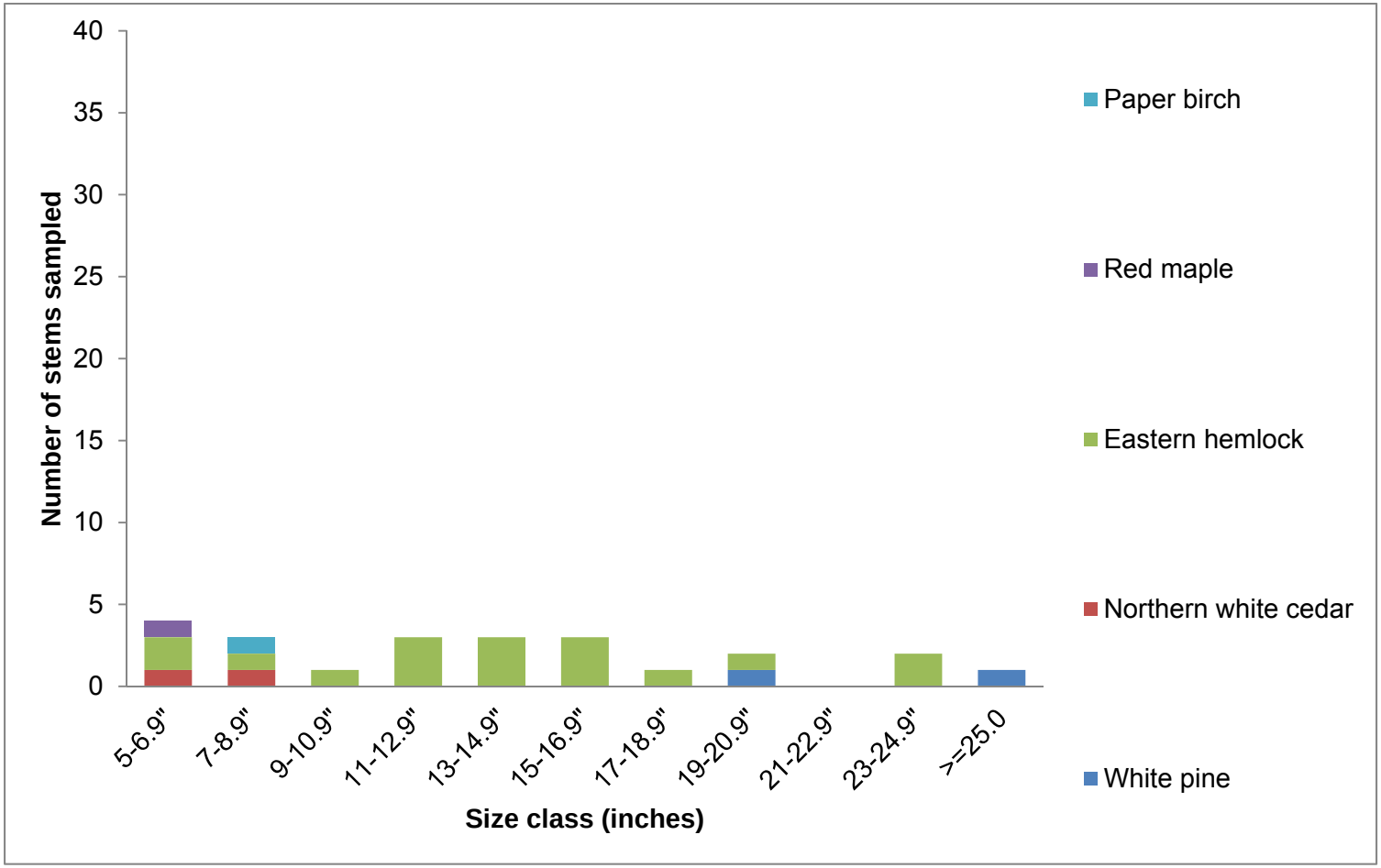
Table 4. Structure summary (mean (±SD) across plots within a stand).

Stand Name or Code	Trees per Acre	Tree Basal Area (ft^2/ac)	Tree DBH (in)	Tree Crown Class[a]	Percent (%) Closed Canopy	Snags per Acre	Snag DBH (in)	Percent (%) of Plots with Coarse Woody Debris
HEM	250.0±38.3	358.4±64.7	14.7±1.7	2.8±0.3	86.9±3.6	0±0	0±0	75
COF	60.0±33.5	75.4±56.5	14.5±6.8	2.4±0.2	93.7±1.6	13.3±20.7	18.4±6.4	67
SH-R	177.8±75.1	127.0±79.2	10.7±3.8	2.4±0.4	91.4±2.7	22.2±21.1	15.5±7.5	67
SH-N	151.1±79.4	120.4±75.7	12.1±3.1	2.7±0.6	91.5±2.6	13.3±40.0	13.3±0	44
CHF-TA	106.7±40.0	117.2±48.2	13.9±4.1	2.2±0.2	95.5±0.9	8.9±17.6	13.2±9.6	56
CHF-TB	200.0±109.5	163.8±88.8	11.9±3.9	2.3±0.4	94.4±1.4	8.9±17.6	8.9±1.1	67
HARD	235.0±189.4	137.9±63.9	12.0±6.4	2.5±0.4	88.9±4.2	40.0±42.8	7.1±0.9	88
WILD	163.1±90.1	104.9±50.2	10.7±3.2	2.4±0.2	93.3±2.9	12.3±19.2	7.6±4.4	54
D-CUT	133.3±107.6	85.5±90.1	9.9±3.0	2.3±0.3	67.3±14.9	11.4±22.4	11.0±5.0	48
D-PINE	194.3±94.9	120.8±86.2	10.8±4.8	1.9±0.4	83.5±5.8	28.6±49.2	6.8±1.8	19
D-C2O	26.7±46.2	18.7±32.5	11.4±0.4	1.0±0	32.3±37.4	0±0	0±0	0

[a]Crown class codes (numeric value): 1= dominant, 2= co-dominant, 3= intermediate, 4= suppressed.

Figure 1-11. Size class distribution of sampled overstory stems.

HEM



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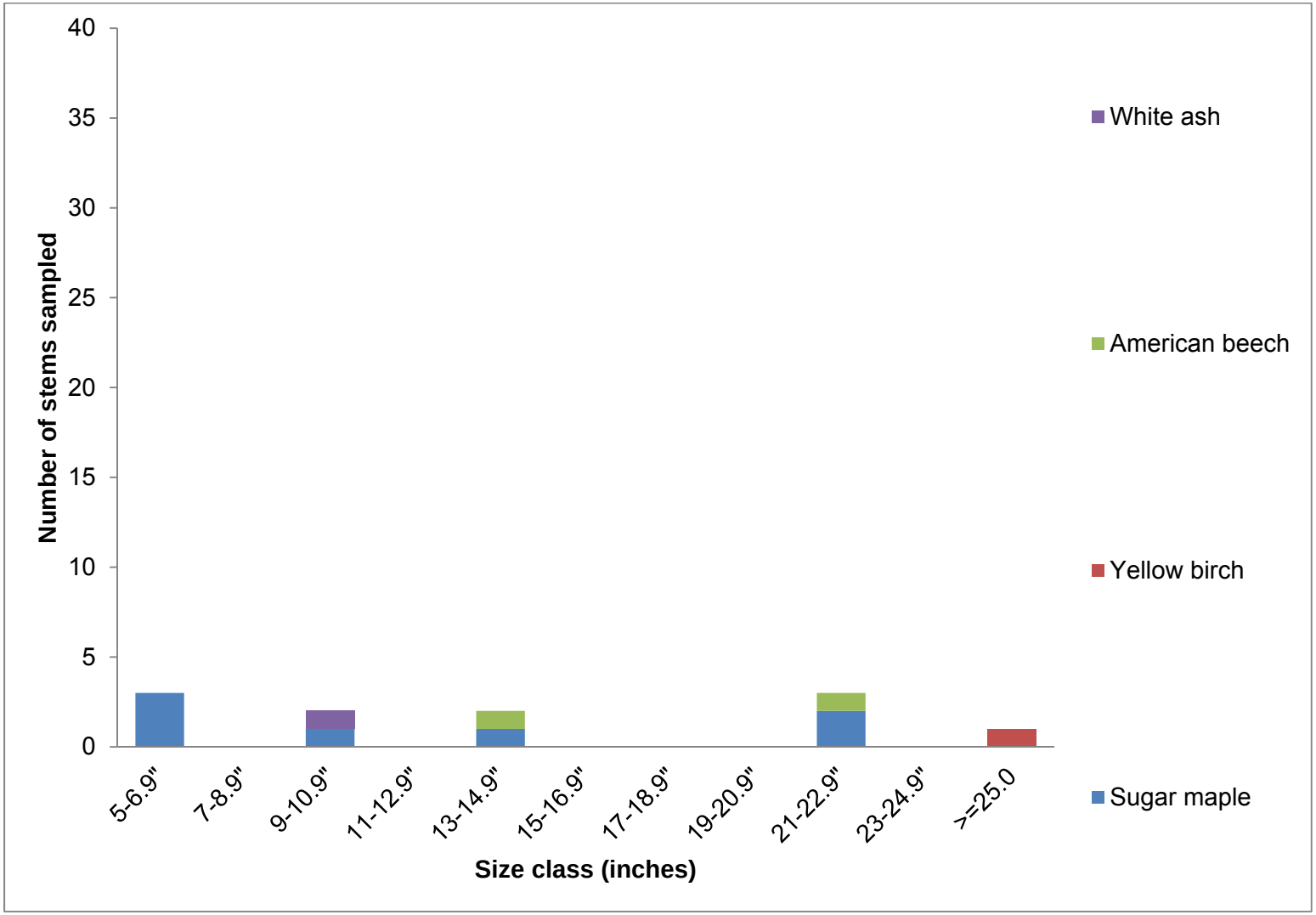
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13-14.9"
15-16.9"
17-18.9"
19-20.9"
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23-24.9"
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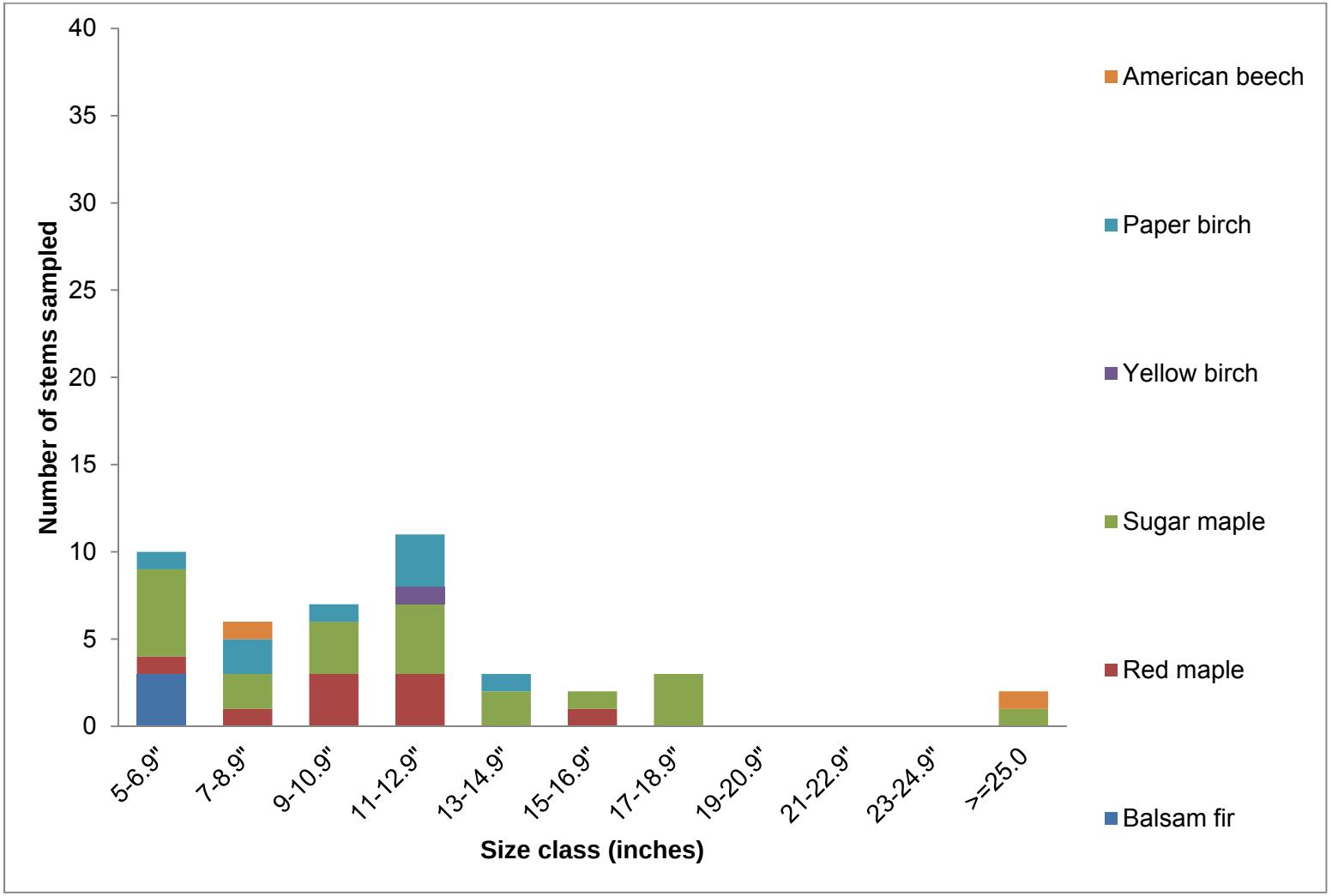
Size class (inches)
White ash
American beech
Yellow birch
Sugar maple

SH-R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17-18.9"
19-20.9"
21-22.9"
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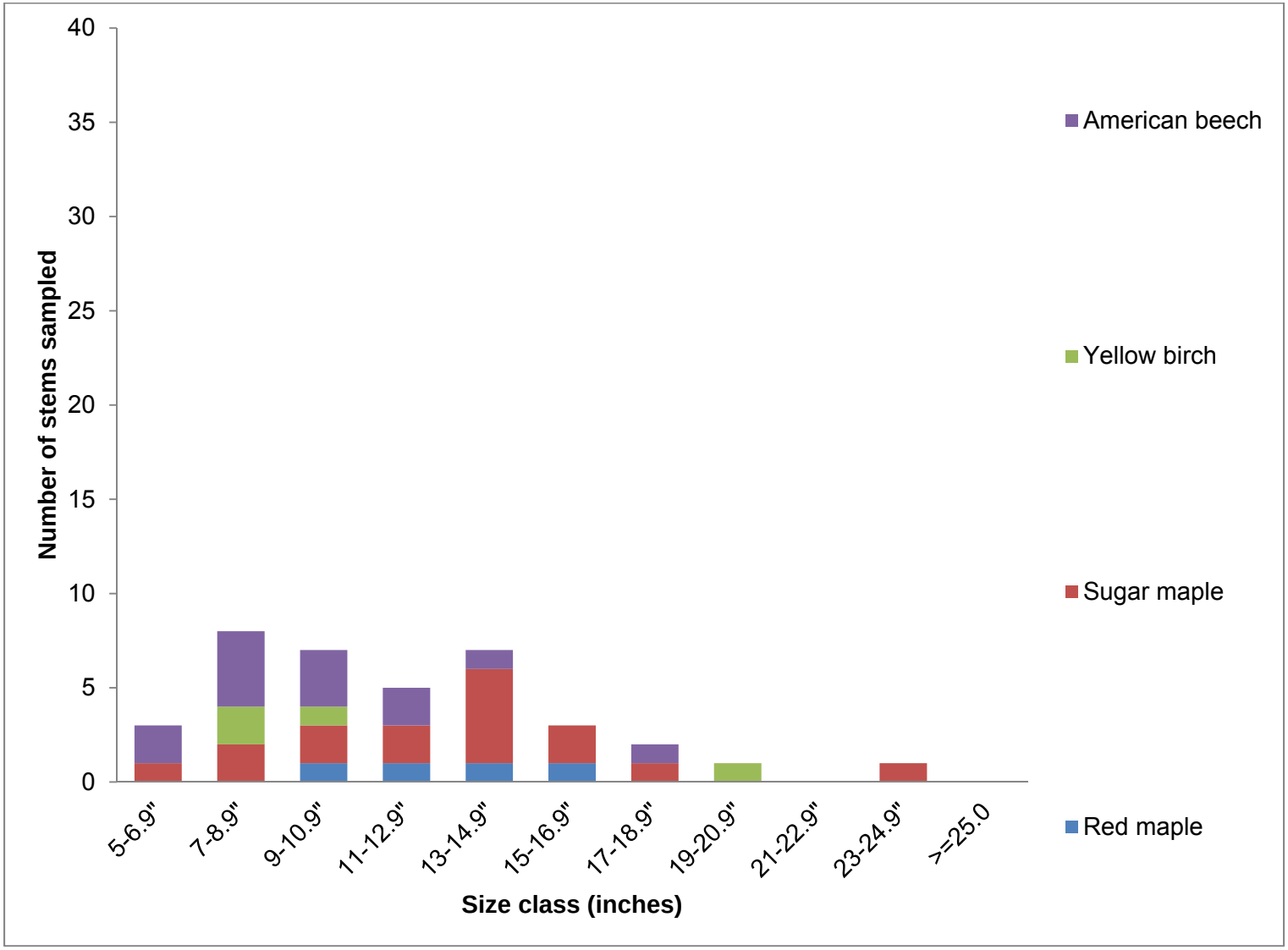
>=25.0
Size class (inches)
American beech
Paper birch
Yellow birch
Sugar maple
Red maple
Balsam fir

SH-N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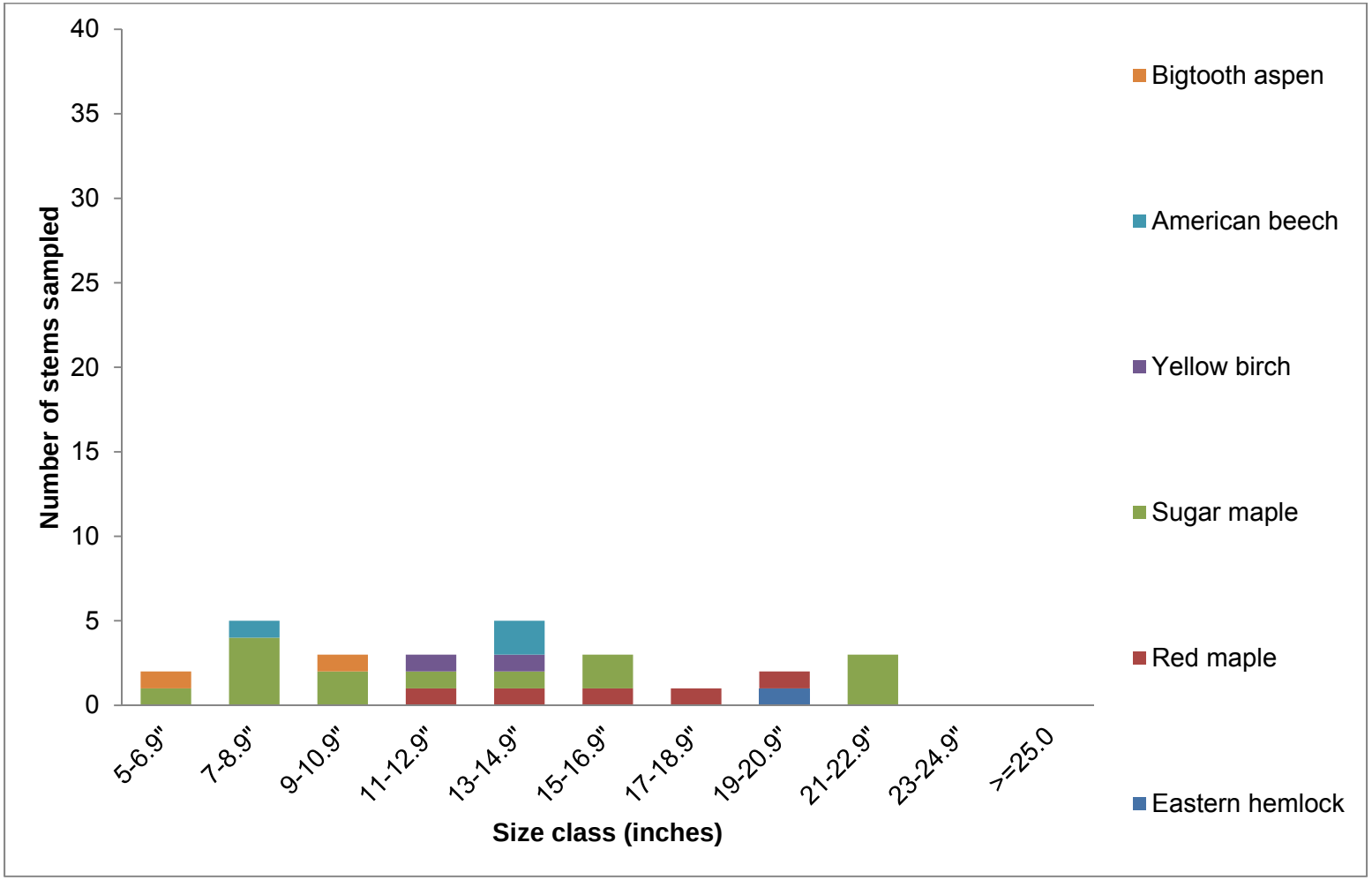
Yellow birch
Sugar maple
Red maple

CHF-TA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17-18.9"
19-20.9"
21-22.9"
23-24.9"
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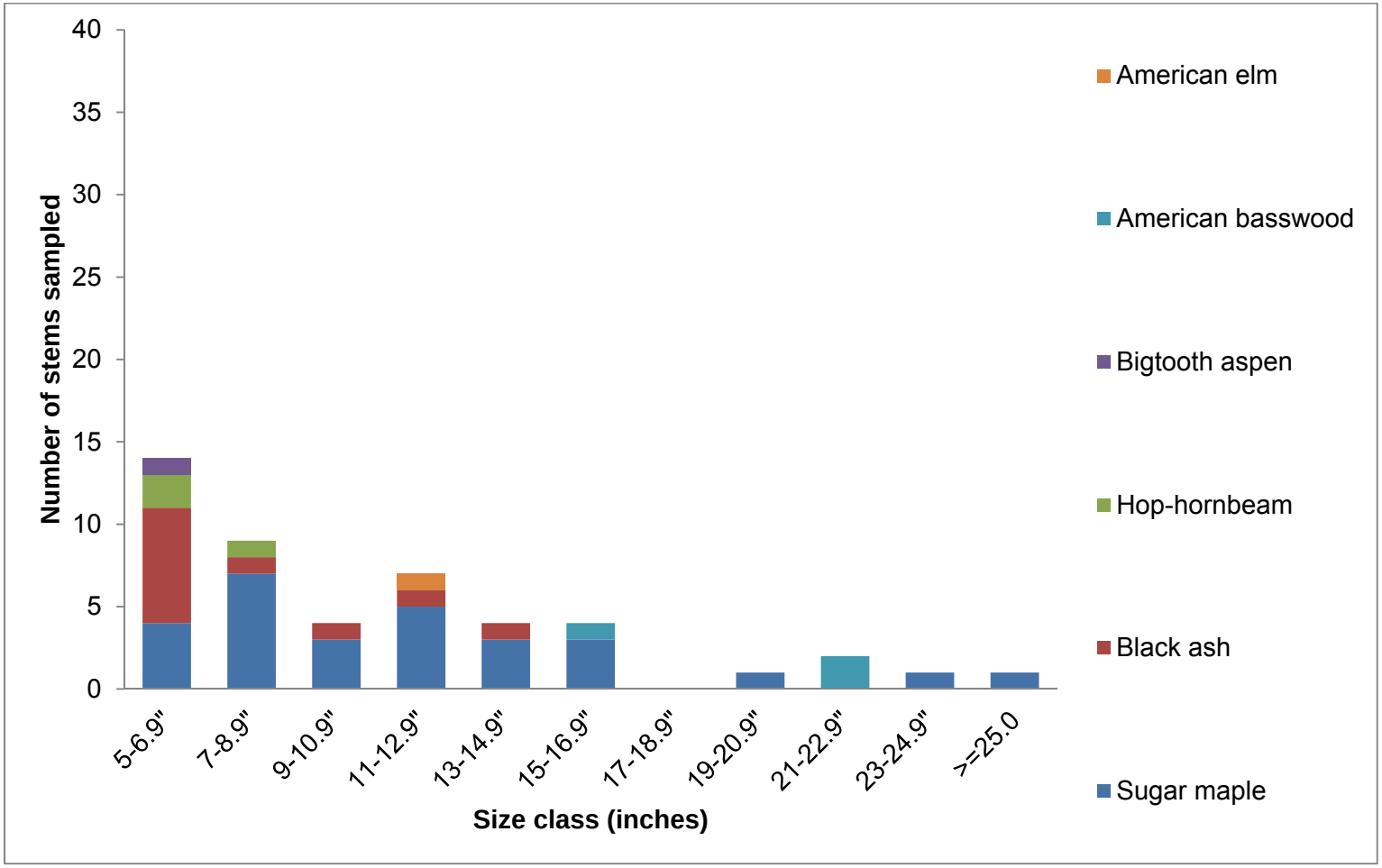
Size class (inches)
Bigtooth aspen
American beech
Yellow birch
Sugar maple
Red maple
Eastern hemlock

CHF-TB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19-20.9"
21-22.9"
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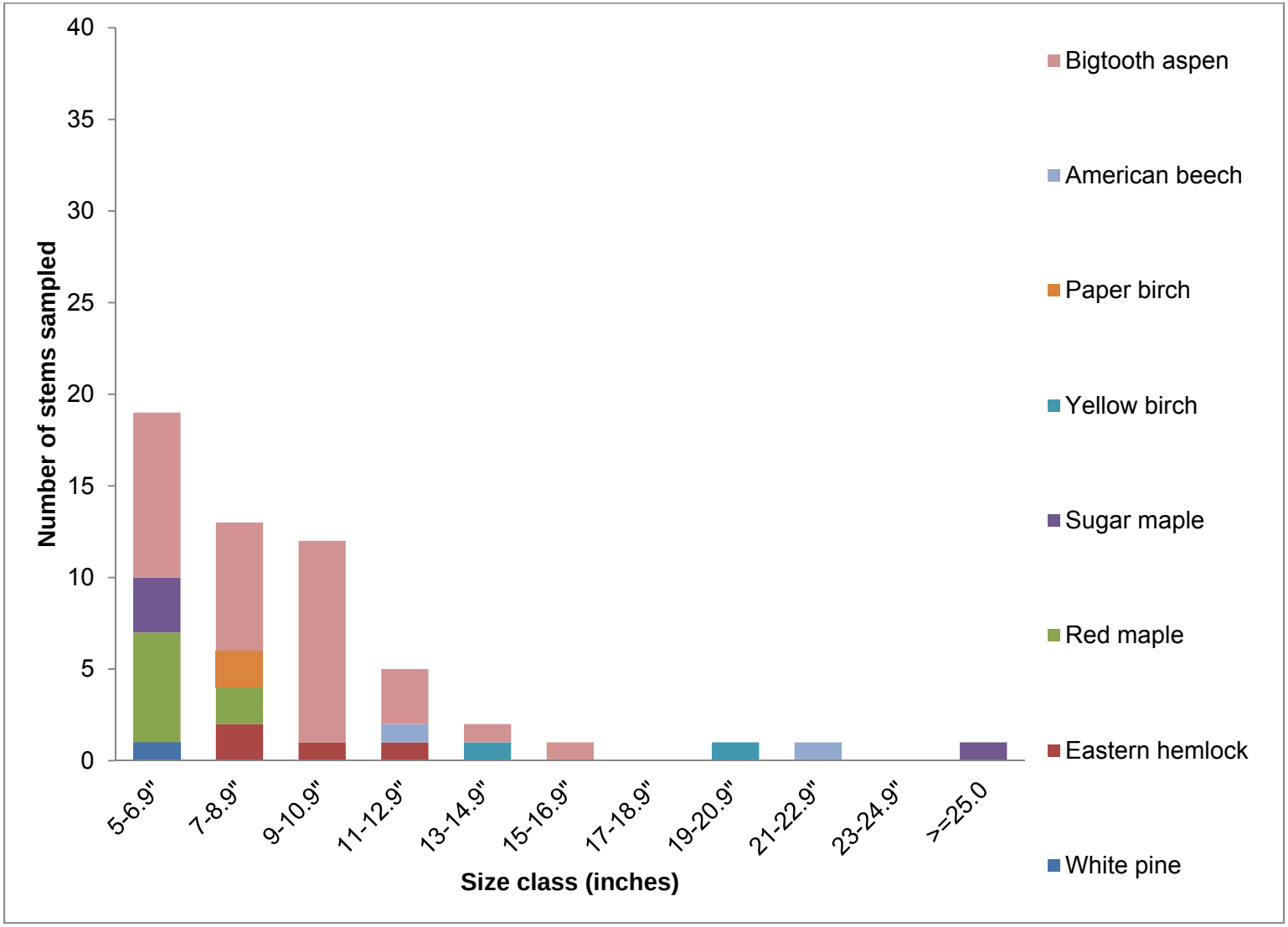
>=25.0
Size class (inches)
American elm
American basswood
Bigtooth aspen
Hop-hornbeam
Black ash
Sugar maple

HARD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21-22.9"
23-24.9"
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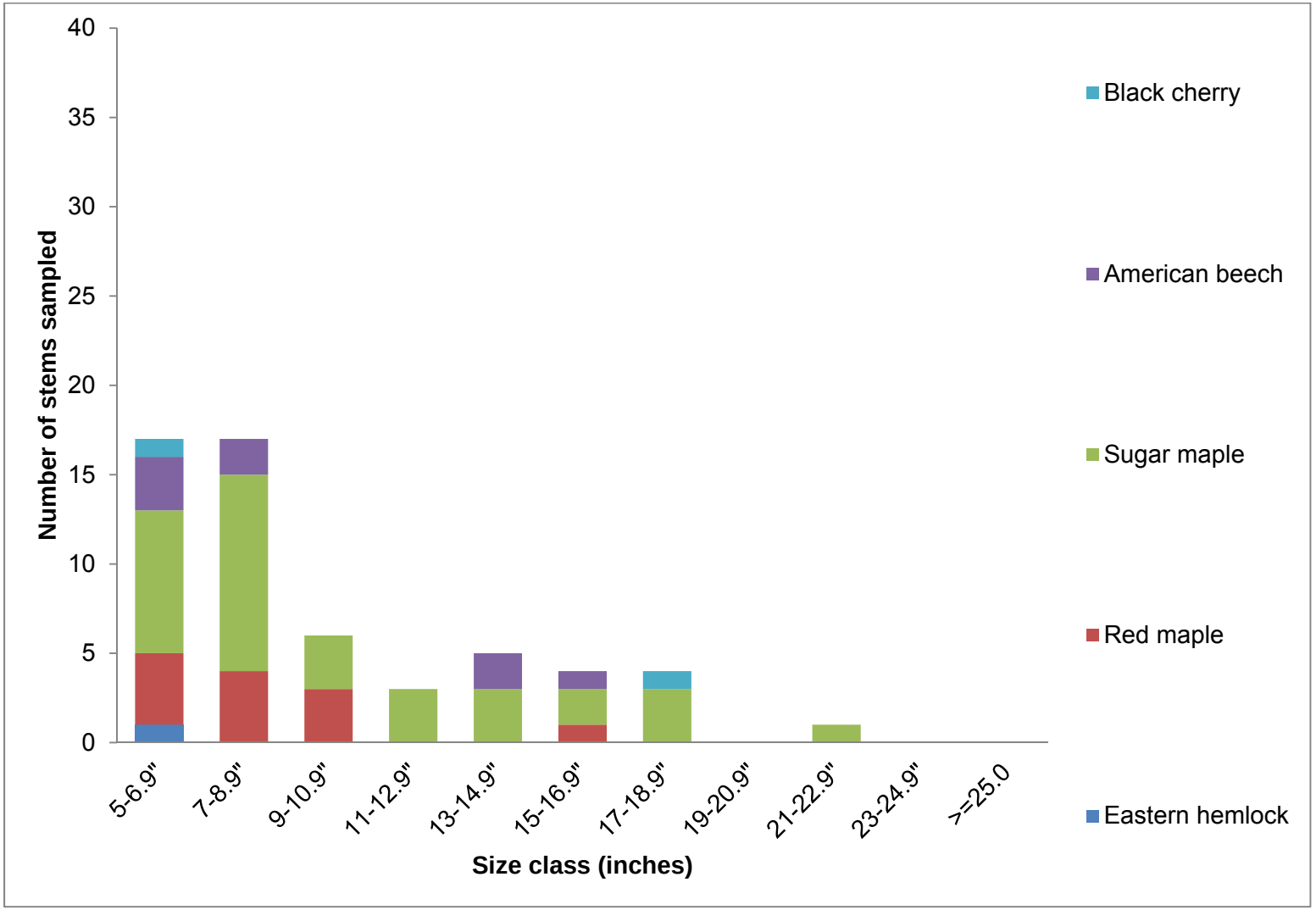
Bigtooth aspen
American beech
Paper birch
Yellow birch
Sugar maple
Red maple
Eastern hemlock
White pine

WILD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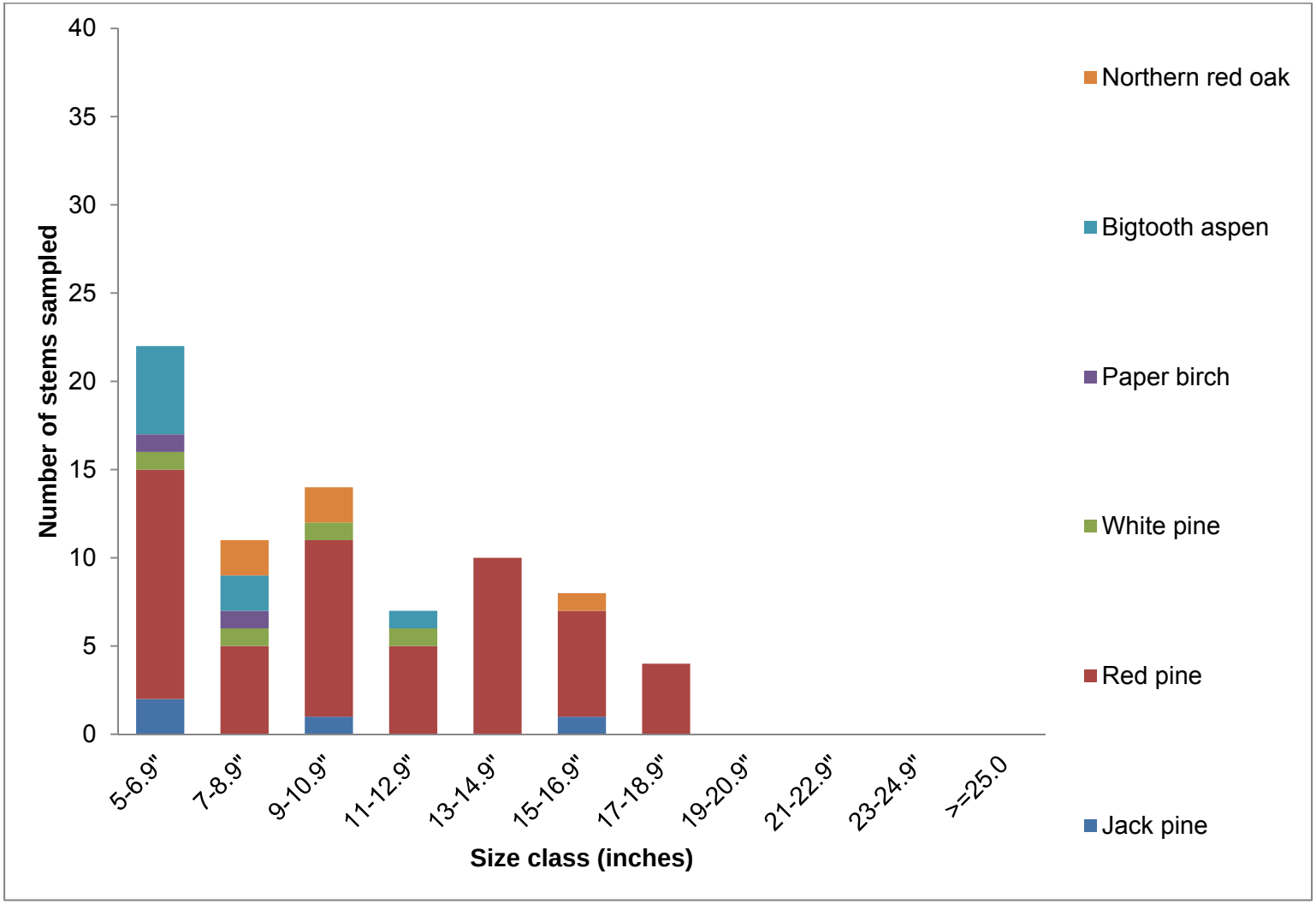
17-18.9"
19-20.9"
21-22.9"
23-24.9"
>=25.0
Size class (inches)
Black cherry
American beech
Sugar maple
Red maple
Eastern hemlock

D-CUT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19-20.9"
21-22.9"
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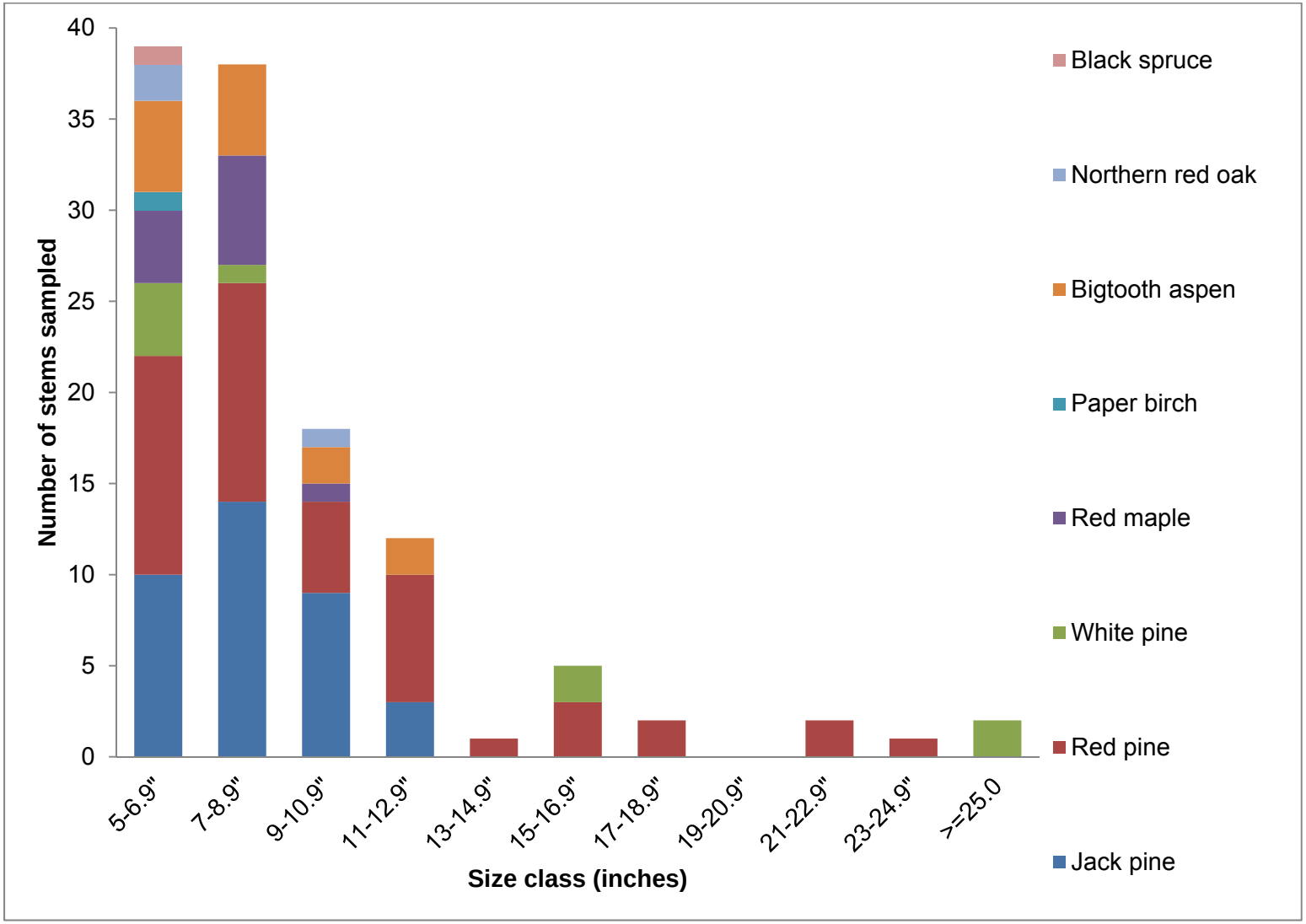
Size class (inches)
Northern red oak
Bigtooth aspen
Paper birch
White pine
Red pine
Jack pine

D-PINE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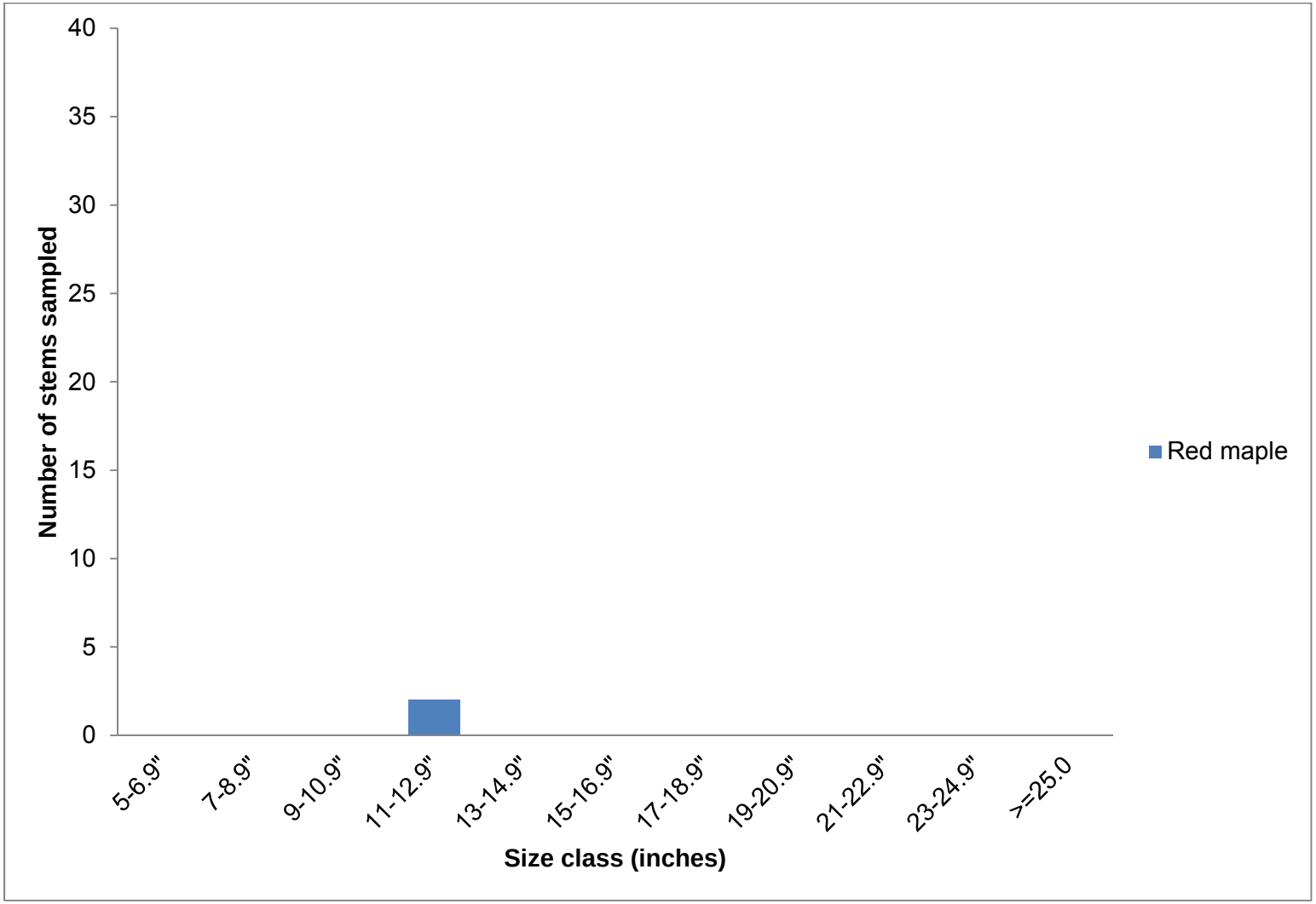
17-18.9"
19-20.9"
21-22.9"
23-24.9"
>=25.0
Size class (inches)
Black spruce
Northern red oak
Bigtooth aspen
Paper birch
Red maple
White pine
Red pine
Jack pine

D-C2O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Number of stems sampled
Red maple
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13-14.9"
15-16.9"
17-18.9"
19-20.9"
21-22.9"
23-24.9"
>=25.0
Size class (inches)

Table 5. Importance Values (see Curtis & McIntosh. 1950. *Ecology* 31:434-455) and related measures.

Stand Name or Code	Species or Species Group [a]	Relative Frequency (F, %)	Relative Density (D, %)	Relative Dominance (Do, %)	Importance Value (F + D + Do / 3, %)
HEM	eastern hemlock	50.0	72.0	62.7	61.6
	other (eastern white pine, northern white cedar, red maple, paper birch)	50.0	28.0	37.3	38.4
COF	sugar maple	66.7	77.8	63.3	69.3
	other (yellow birch, white ash)	33.3	22.2	36.7	30.7
SH-R	maple	61.5	70.0	79.9	70.5
	paper birch	23.1	20.0	16.4	19.8
	other (balsam firm, American beech)	15.4	10.0	3.7	9.7
SH-N	maple	50.0	55.9	69.9	58.6
	American beech	33.3	38.2	27.2	32.9
	other (yellow birch)	16.7	5.9	2.9	8.5
CHF-TA	maple	61.5	72.0	80.9	71.5
	other (yellow birch, American beech, bigtooth aspen)	38.5	28.0	19.1	28.5
CHF-TB	sugar maple	37.5	55.6	63.3	52.1
	Oregon ash	31.3	24.4	10.4	22.0
	other (hop-hornbeam, bigtooth aspen, American basswood, American elm)	31.3	20.0	26.3	25.9

HARD	eastern hemlock	5.9	8.5	7.7	7.4
	maple	35.3	21.3	20.9	25.8
	birch	17.6	8.5	13.6	13.2
	bigtooth aspen	23.5	55.3	45.6	41.5
	other (eastern white pine, American beech)	17.6	6.4	12.3	12.1
WILD	maple	61.9	83.0	82.5	75.8
	American beech	28.6	13.2	11.4	17.7
	other (eastern hemlock, black cherry)	9.5	3.8	6.2	6.5
D-CUT	pine	68.2	82.9	88.0	79.7
	bigtooth aspen	9.1	7.1	4.1	6.8
	northern red oak	13.6	7.1	6.9	9.2
	other (paper birch)	9.1	2.9	1.0	4.3
D-PINE	pine	62.5	78.1	87.1	75.9
	red maple	6.3	9.5	4.7	6.8
	bigtooth aspen	21.9	8.6	6.5	12.3
	other (black spruce, northern red oak)	9.4	3.8	1.7	4.9
D-C2O	red maple	100	100	100	100

[a]Importance values were calculated for those species (or species groups) with ≥4 individual stems per transect. Rarer species were included in the “other”category.

Table 6. Midstory and understory summary.

Stand Name or Code	Mean (±SD) Number Woody Plant Stems < 5" DBH	Mean (±SD) Herbaceous Plant Cover[a]	Percent (%) Plots with Invasive Species
HEM	0±0	0.2±0.3	
COF	0.5±0.8	1.3±0.4	
SH-R	2.8±4.2	1.1±0.7	
SH-N	1.6±1.9	1.3±0.7	
CHF-TA	0.4±0.7	1.0±0.7	
CHF-TB	0.6±1.3	1.9±0.9	
HARD	0.1±0.3	1.1±1.0	
WILD	1.0±1.1	0.8±0.7	
D-CUT	0.1±0.2	2.5±0.6	
D-PINE	0.6±1.9	2.5±0.9	
D-C2O	1.3±1.5	3.0±0.9	

[a]Cover class codes (numeric value): T= trace (0), 1-25% (1), 26-50% (2), 51-75% (3), >75% (4).

EARTHWORM SUMMARY

Table 7. Refuge-scale earthworm abundance and impact.

Metric	Value
Percent (%) plots with earthworms	64
Mean (±SD) earthworm biomass ($AFDg/m^2$)	0.38±0.56
Mean (±SD) forest floor condition[a]	4.24±0.99
Mean (±SD) litter depth (cm)	3.77±1.23

[a]Forest floor condition: ranked from 1-highly altered to 5-minimally altered.

Table 8. Stand-scale earthworm abundance and impact.

Stand Name or Code	Percent (%) of Plots with Earthworms	Mean (±SD) Earthworm Biomass ($AFDg/m^2$)	Mean (±SD) Forest Floor Condition	Mean (±SD) Litter Depth (cm)
HEM	50	0.01±0.02	5.00±0	2.36±0.34
COF	100	0.39±0.45	2.06±0.61	1.72±0.98
SH-R	78	0.44±0.65	4.56±0.53	4.02±0.95
SH-N	89	0.32±0.43	4.48±0.56	4.49±0.68
CHF-TA	100	0.52±0.56	3.67±0.96	2.97±0.75
CHF-TB	100	1.96±1.19	2.81±0.87	2.73±1.02
HARD	100	0.42±0.31	4.38±0.82	4.63±1.35
WILD	31	0.02±0.06	5.00±0	4.18±1.45
D-Cut	33	0.02±0.05	4.75±0.62	5.12±1.78
D-Pine	57	0.04±0.06	4.95±0.22	5.71±1.84
D-C2O	0	0.00±0	5.00±0	3.56±1.44

[a]Forest floor condition: ranked from 1-highly altered to 5-minimally altered (see table below).

Table 9. Forest floor condition codes.

Rating	Forest Floor Condition
1	No forest floor. Previous year's litter over mineral soil. Worm casting and/or *L. terrestris* middens abundant.
2	No humus or small leaf fragments present; larger old leaves may be present under litter. Worm castings present. *L. terrestris* middens present or absent. Roots absent from forest floor.
3	No humus. Small leaf fragments and larger old leaves present. Sparse to no roots in the forest floor. Some worm casting may be present. *L. terrestris* likely to be absent or very sparse.
4	Humus present in patches, may be slightly mixed with mineral soil, the rest of the forest floor is intact. Some roots in the forest floor, but not thick. Small worms may be found in the forest floor, but no large castings or *L. terrestris* middens.
5	Humus fully intact. Roots present in humus and leaf fragments. Forest floor coherent when picked up with intact recognizable layers. No worms or worm sign present.
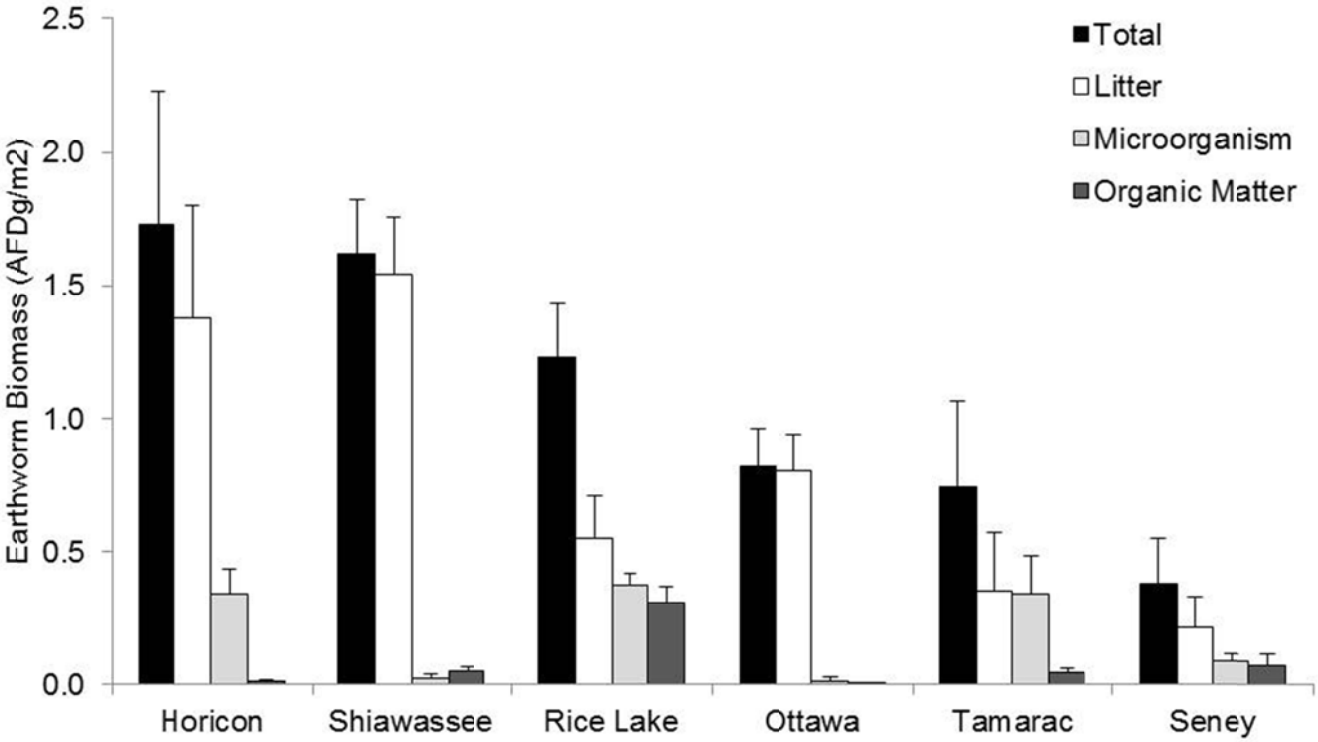
Figure 12. Mean earthworm biomass (AFDg/m2) and community composition for all sampled refuges based on feeding preference. Error bars indicate standard error of the sample.