Soil Disturbance Associated with Timber Harvest Systems in the Northern Region

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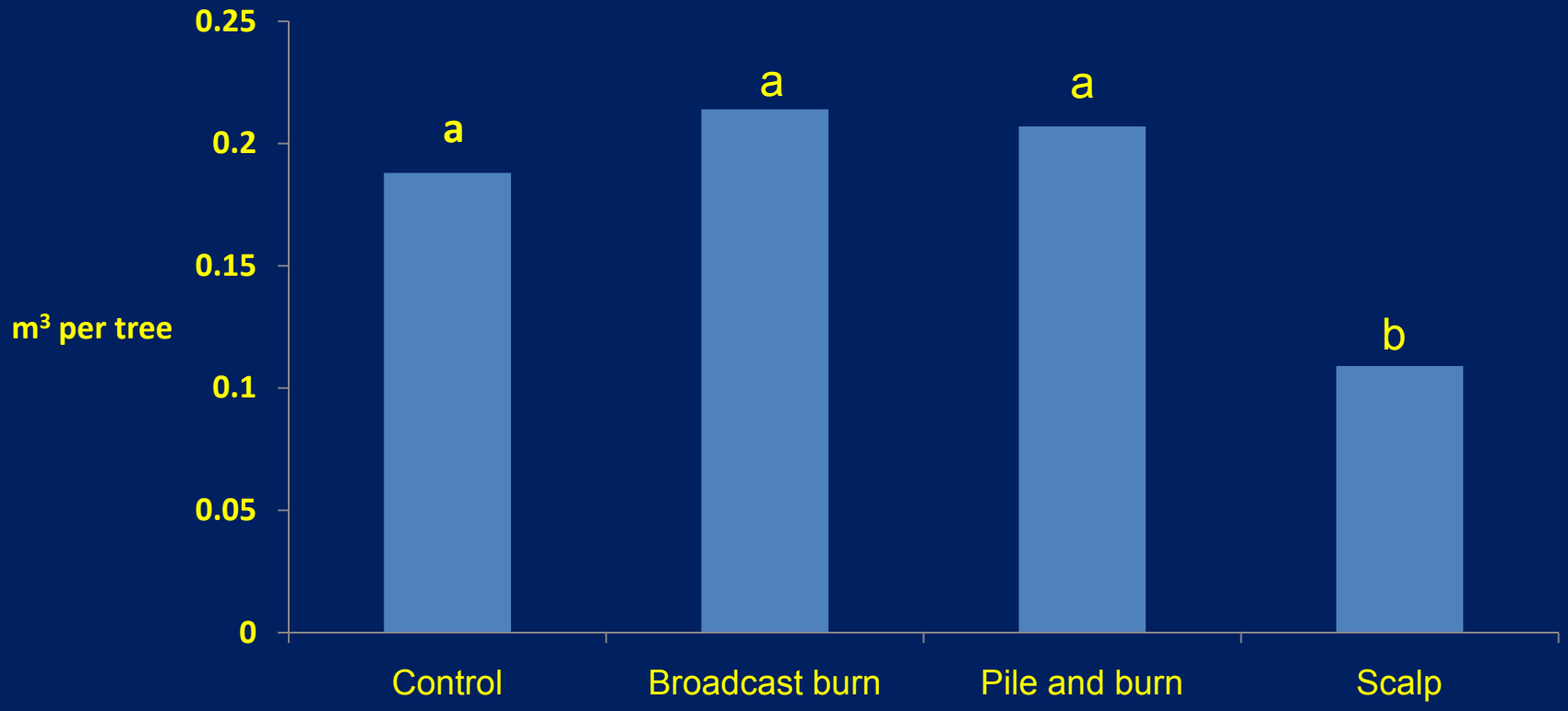
Project Justification

- Legislative mandate (NFMA, 1976):
  - "will not produce substantial and permanent impairment of productivity"

  - Soil Quality Standards (R1)- limit "detrimental soil disturbance" to 15% areal extent of activity area to maintain productivity
  - Implementation of first monitoring protocols

Does soil disturbance matter?

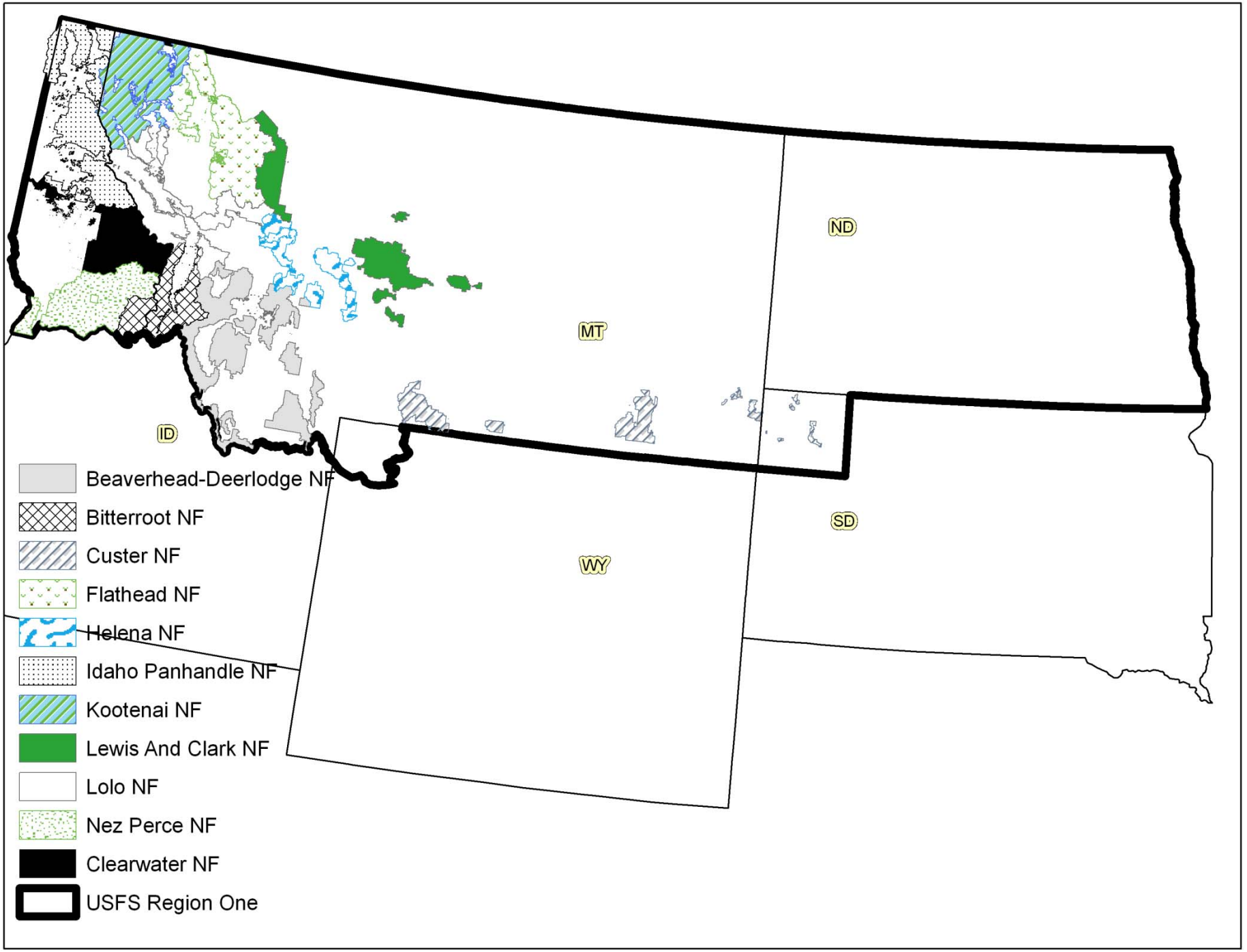


24 years post treatment

Kimsey and Roche, (*in prep.)*

Project Objectives

- Determine relative levels of soil disturbance by harvest system
- Correlate soil disturbance to physical site characteristics
- Create predictive model based on site characteristics
- Standardize legacy soil disturbance data


ND
MT
ID
SD
WY
Beaverhead-Deerlodge NF
Bitterroot NF
Custer NF
Flathead NF
Helena NF
Idaho Panhandle NF
Kootenai NF
Lewis And Clark NF
Lolo NF
Nez Perce NF
Clearwater NF
USFS Region One

Data Collection Methods

- Forest soils monitoring reports
- Field collection
- FSDMP

FSDMP

- Rapid field assessment
- Visual observations
- Assigns soil disturbance class (0-3)
- Transect based- can be replicated
- Statistically rigorous
- Provides common definitions

(Page-Dumroese et al. 2009)

Stratification Factors

- Slope
- Soil texture
- Aspect
- Harvest system
- Season of harvest
- Forest

Soil Distribution

Soil texture	Units represented
All soils containing a coarse modifier, regardless of texture	34
coarse sand – loamy sand,	2
loamy very fine sand- fine sandy loam	14
very fine sandy loam- silt	100
clay loam- silty clay loam	7

19 soil textures are represented in the data

Overall Disturbance Evaluation

- 157 harvest units representing 13,870 monitoring points

Forest	# of units	# of data points	% of total data points
Beaverhead-Deerlodge	2	200	1.4
Custer	1	200	1.4
Nez Perce	6	270	1.9
Lewis and Clark	7	810	5.8
Bitterroot	10	890	6.4
Clearwater	23	1552	11.2
Flathead	15	1558	11.2
Idaho Panhandle	23	1743	12.6
Kootenai	25	1808	13.0
Helena	12	2249	16.2
Lolo	33	2590	18.7

Data Transposition

- All data was transposed to standardize legacy data

FSDMP class	Howes class	Key component
0	0	undisturbed
1	1,2	forest floor is intact
2	3	forest floor is not intact, ruts go to 10 cm. deep
3	4,5,(6)	forest floor is missing, compaction is evident

Analysis

- All units were assigned a “mean soil disturbance value”
- MSD= $\sum (P_c \times C) \div P_t$
- Pearson, Spearman, and partial matrix correlation

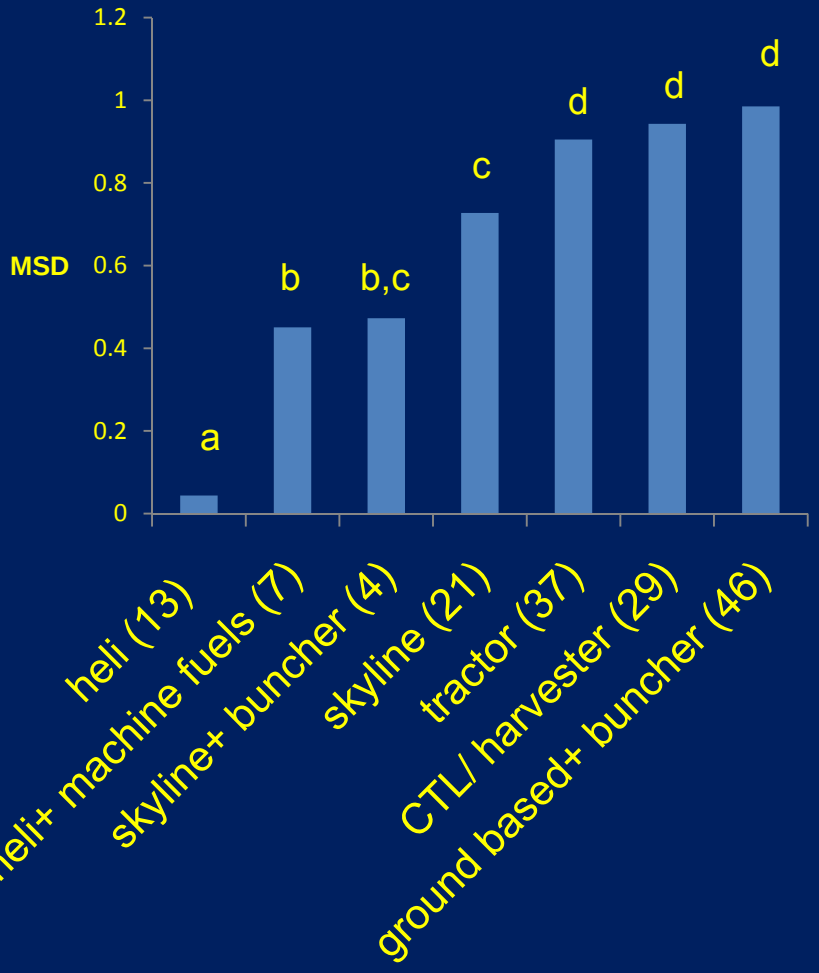
Variable	p-Value
Forest	**<.0001**
Slope class	.6407
Aspect	.1214
Season of harvest	.5733
Soil texture	.6388
Harvest system	**<.0001**

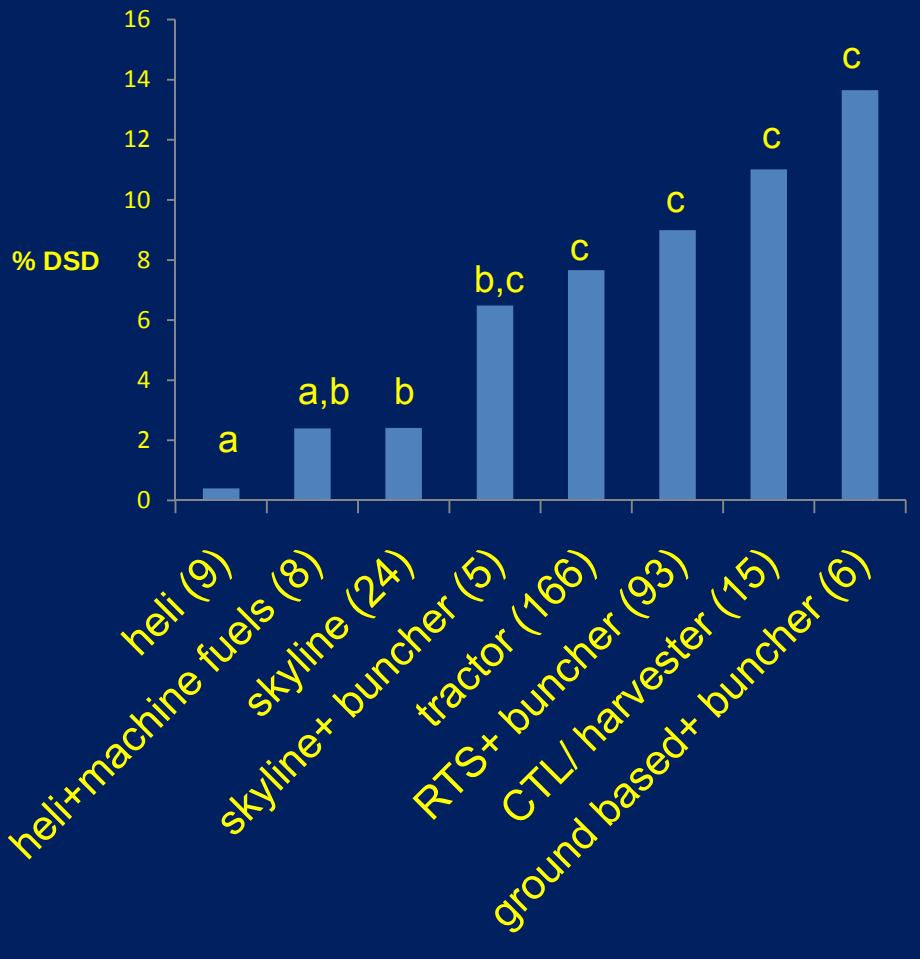
MSD vs. DSD

- MSD= $\sum (P_c \times C) \div P_t$
- Where:
- MSD = mean soil disturbance value for harvest unit
- P_c = percentage of points in disturbance class
- C= numerical value of class (0-3)
- P_t = total n for harvest unit

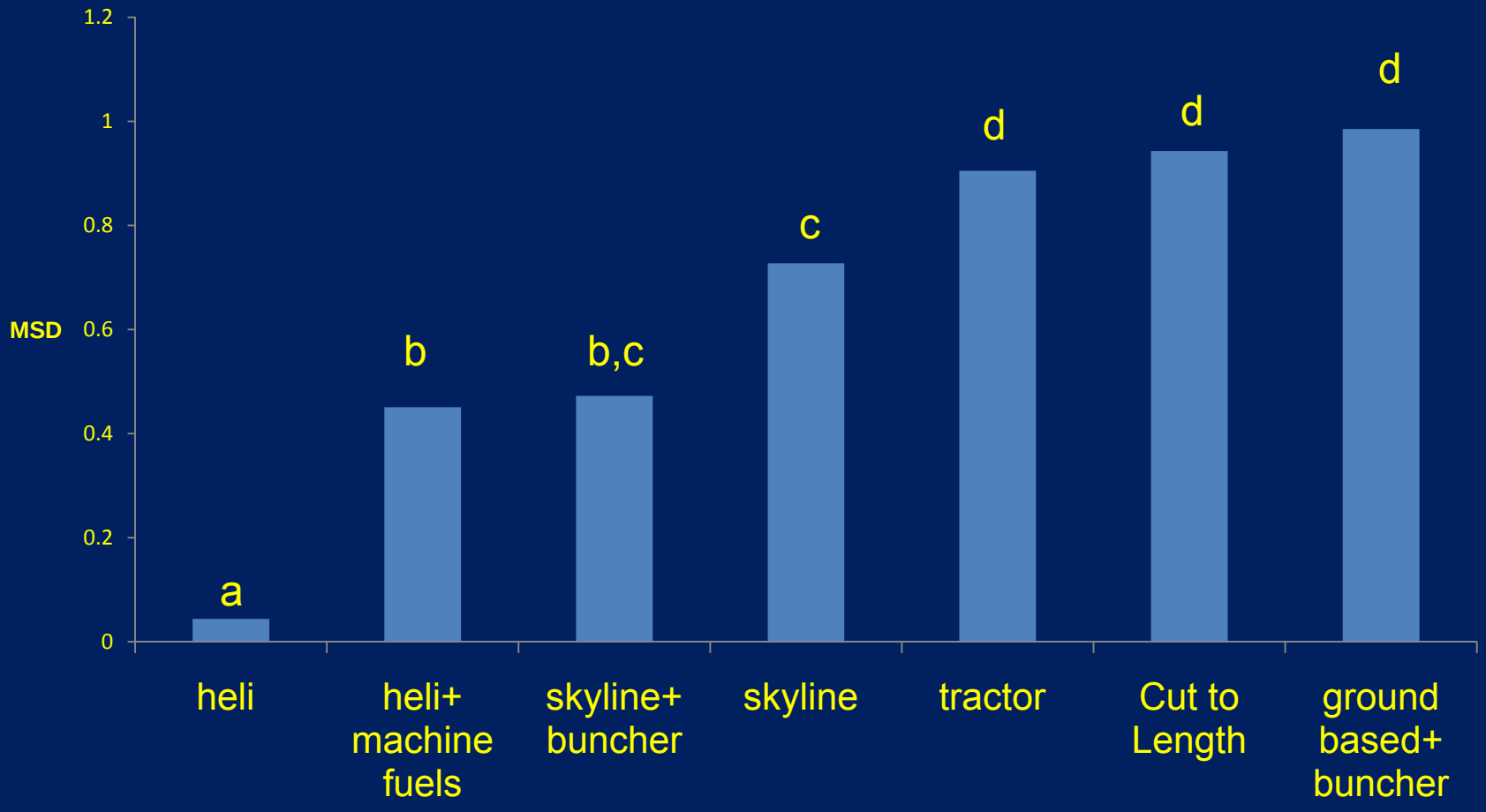
- DSD
- Defined by R1 soil quality standards
- Used to determine areal extent of "detrimental disturbance"

MSD vs. DSD


MSD
1.2
1
0.8
0.6
0.4
0.2
0
a
b
b,c
c
d
d
d
heli (13)
heli+ machine fuels (7)
skyline+ buncher (4)
skyline (21)
tractor (37)
CTL/ harvester (29)
ground based+ buncher (46)


% DSD
16
14
12
10
8
6
4
2
0
a
a,b
b
b,c
c
c
c
c
heli (9)
heli+machine fuels (8)
skyline (24)
skyline+ buncher (5)
tractor (166)
RTS+ buncher (93)
CTL/ harvester (15)
ground based+ buncher (6)

MSD by Harvest System

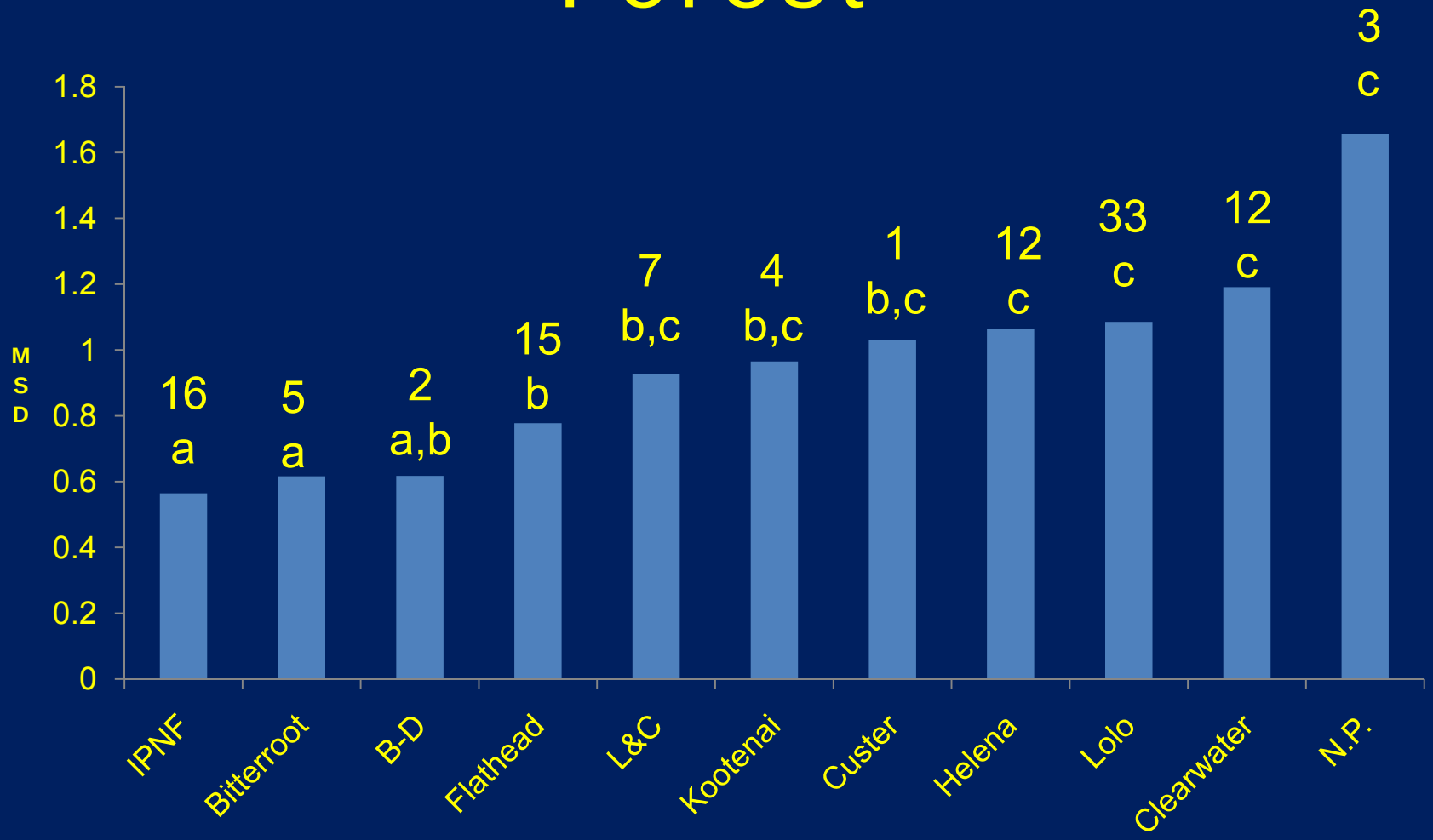


MSD Associated with Ground Based Harvest

- 112 units- harvested from 1999- 2009
- When ground-based harvest is analyzed alone, only Forest is significant

Variable	p-Value
Forest	**<.0001**
Slope class	.1304
Aspect	.7770
Season	.4005
Soil texture	.6653
Harvest system	.4744

Ground Based MSD by Forest



Why Forest is Significant

- Site variability
- Distribution of skilled operators/ sale administrators
- Non-random harvest unit monitoring
- Units are monitored at different times relative to harvest
- Difficulty in “splitting” harvest disturbance from fuels treatment disturbance

Fuels vs. Harvest

Why Forest is Significant

- Data transposition process
- Ocular estimates are inherently subjective
- Non-standard sampling technique

Management Implications

- Significant differences exist in the amount of soil disturbance between harvest systems
- A more precise evaluation will require adopting a common monitoring protocol
- Ability to predict disturbance levels based on site characteristics would be an important tool in the planning phase

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