The Reverse-J and Beyond: Developing Practical, Effective Marking Guides

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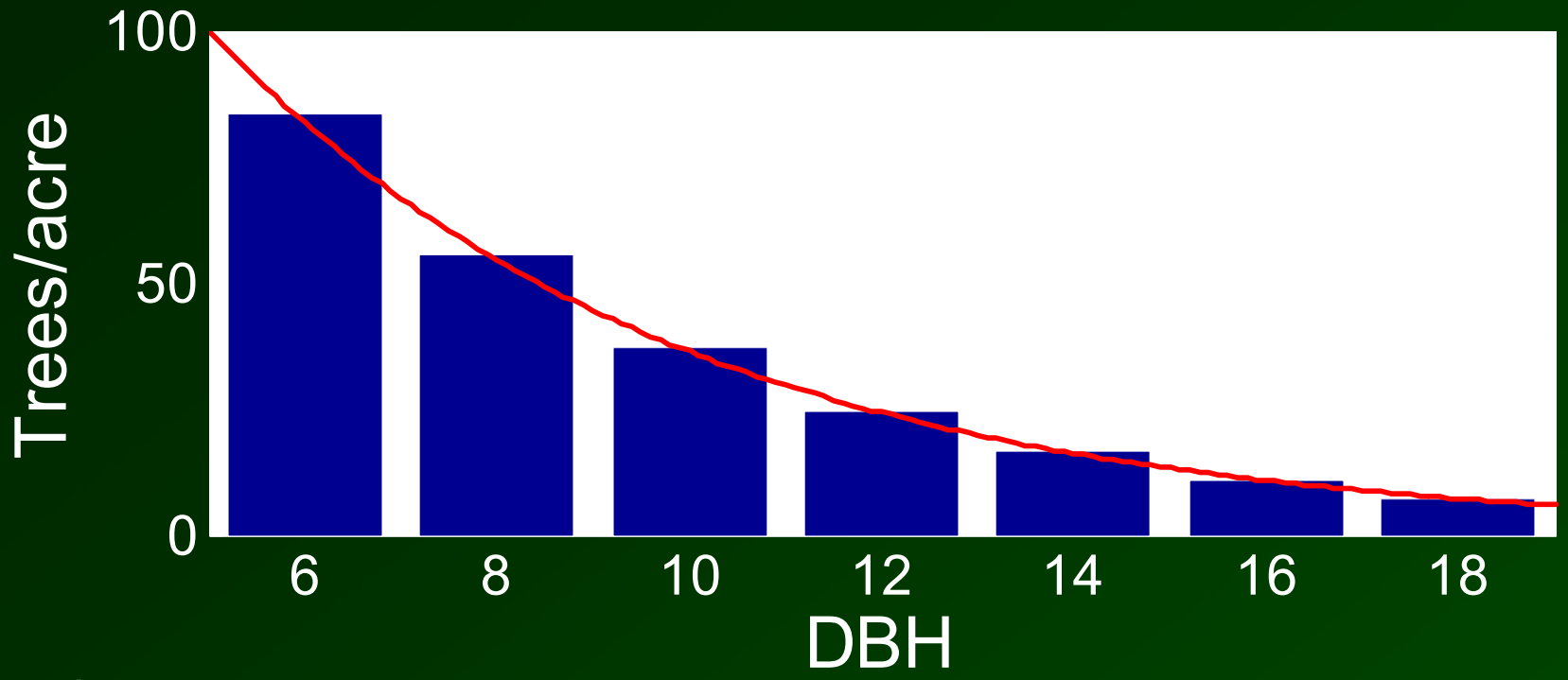
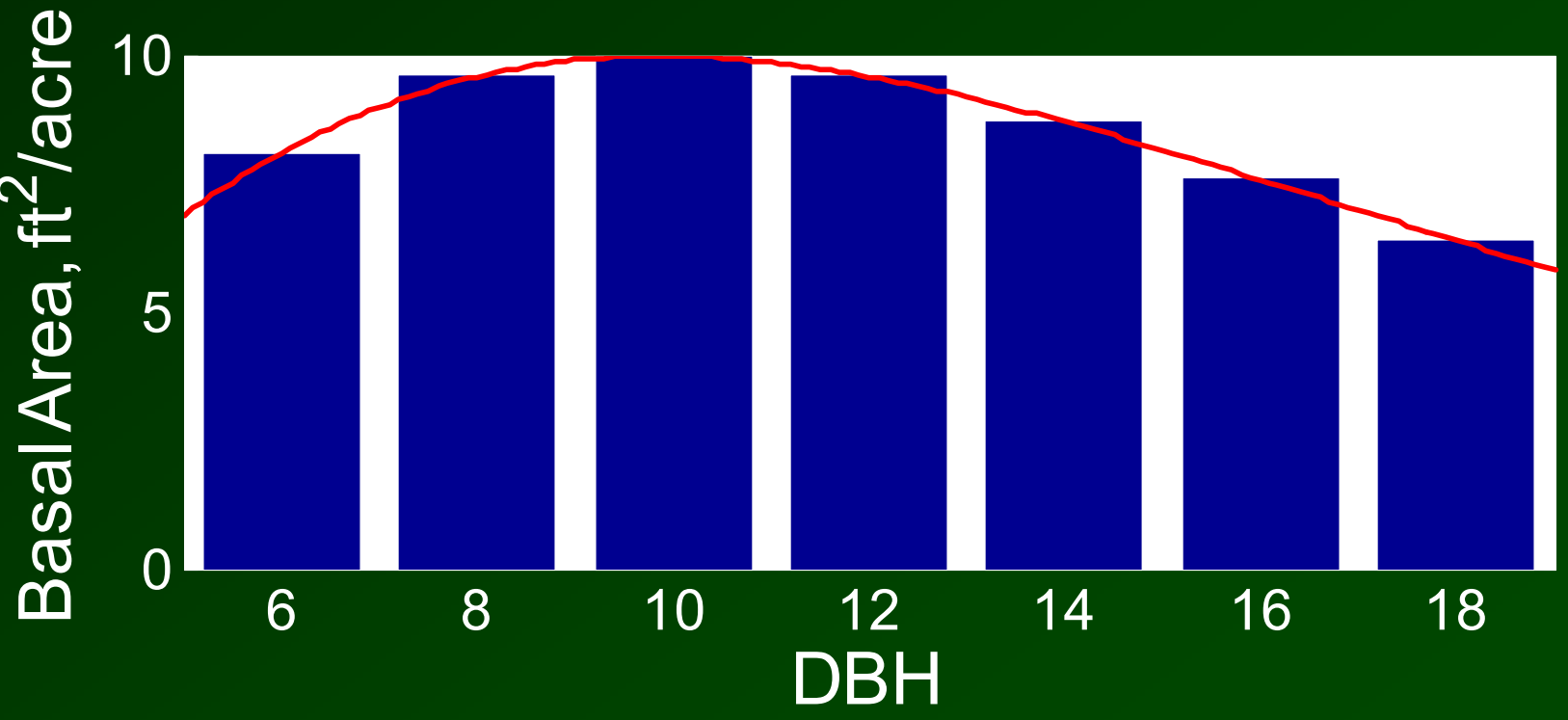
Overview

- A brief history of *q* and the reverse-J
- Some cautions
- Simplified marking guides
- More cautions
- Conclusions

Once upon a time...

- The reverse-J diameter distribution and uneven-aged stands
- de Liocourt (1898): these distributions often follow a regular progression
- This progression can be described using a "*q*" factor
- *q* is the ratio of number of trees in adjacent diameter classes


100
50
0
Trees/acre
6
8
10
12
14
16
18
DBH


10
5
0
Basal Area, ft2/acre
6
8
10
12
14
16
18
DBH

Diameter Regulation in Uneven-Aged Silviculture

- Define a “normative” condition for stands
- Regulate the amount and timing of harvest
- Provide a stand structure that allows adequate desired regeneration
- Provide a stand structure that allows vigorous growth of residual stems
- Describe this structure simply but quantitatively

Not *such* ancient history

- Popularized in U.S. by H.A. Meyer (1943, 1952)
- Leak (1963, 1964, 1965): mathematical connections, possible discrepancies
- Emergence of alternatives (1970's)
  - primarily in modeling literature
  - field trials remained simple
- *q* approach remains dominant in U.S. textbooks and practice


CAUTION
THIS SIGN HAS
SHARP EDGES
DO NOT TOUCH THE EDGES OF THIS SIGN
ALSO, THE BRIDGE IS OUT AHEAD

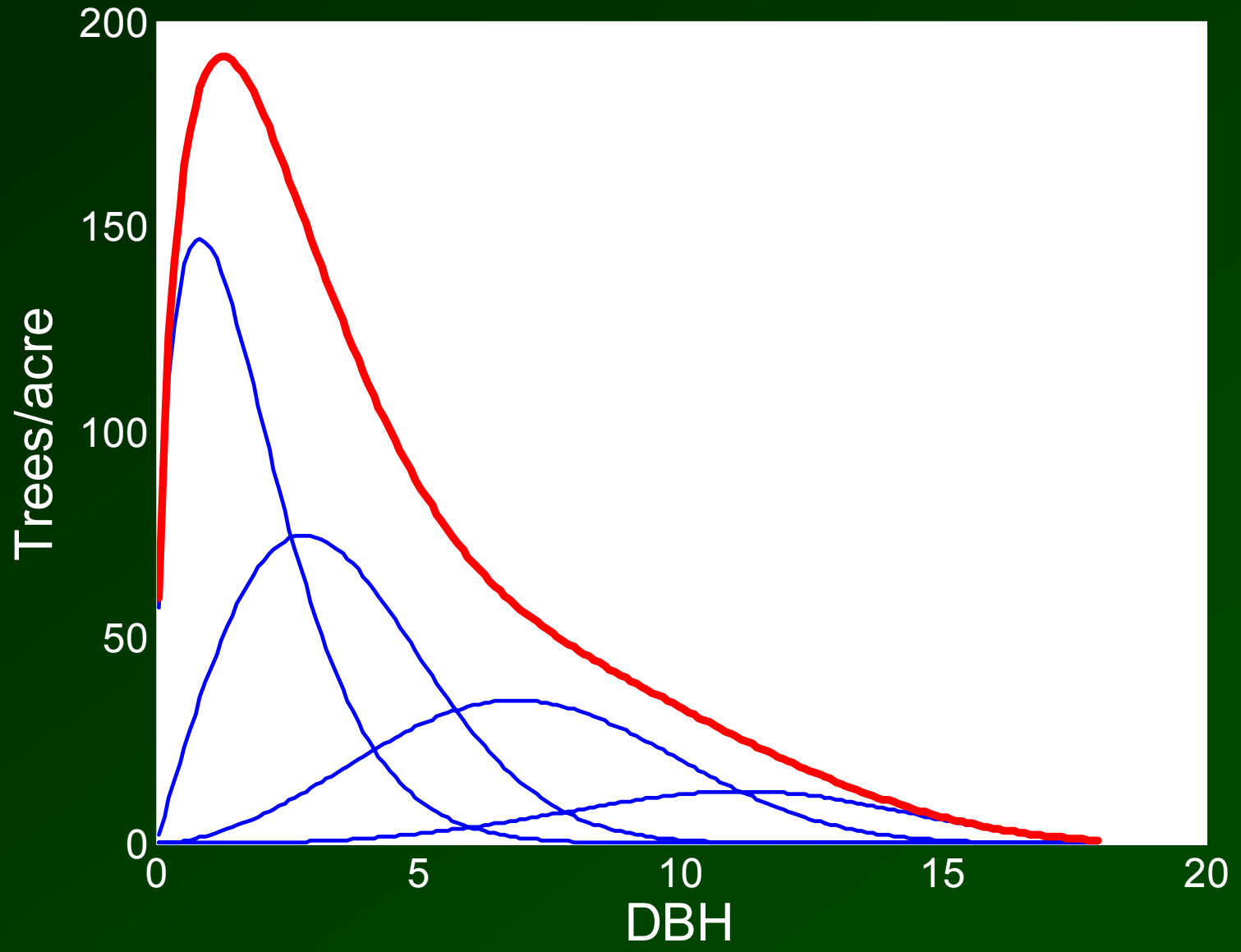
When is the *q* approach tempting... but possibly inappropriate?

- Stratified single-cohort mixtures
- Conversion and transitional stands
- Group and patch selection
- Other disasters and challenges

Does a reverse-J diameter distribution always mean the stand is uneven-aged?

- No.
- Especially not in complex forests (i.e. New England).
- Stratified mixtures are extremely common, but do *not* generally act like “gap-phase” or multi-cohort stands.

Stratified, Single-Cohort Mixture



Conversion and Transition

- Species composition shifts are likely
- “Inherited” stands are often in need of rehabilitation
- May not be wise to jump immediately to final structural goal
- Focus first on grade and species improvement

Group and Patch Selection

- Diameter regulation is a lot of work
- Area regulation is easier!
- There are plenty of ways of jumbling trees together, that *don’t* meet the goals of group/patch selection...

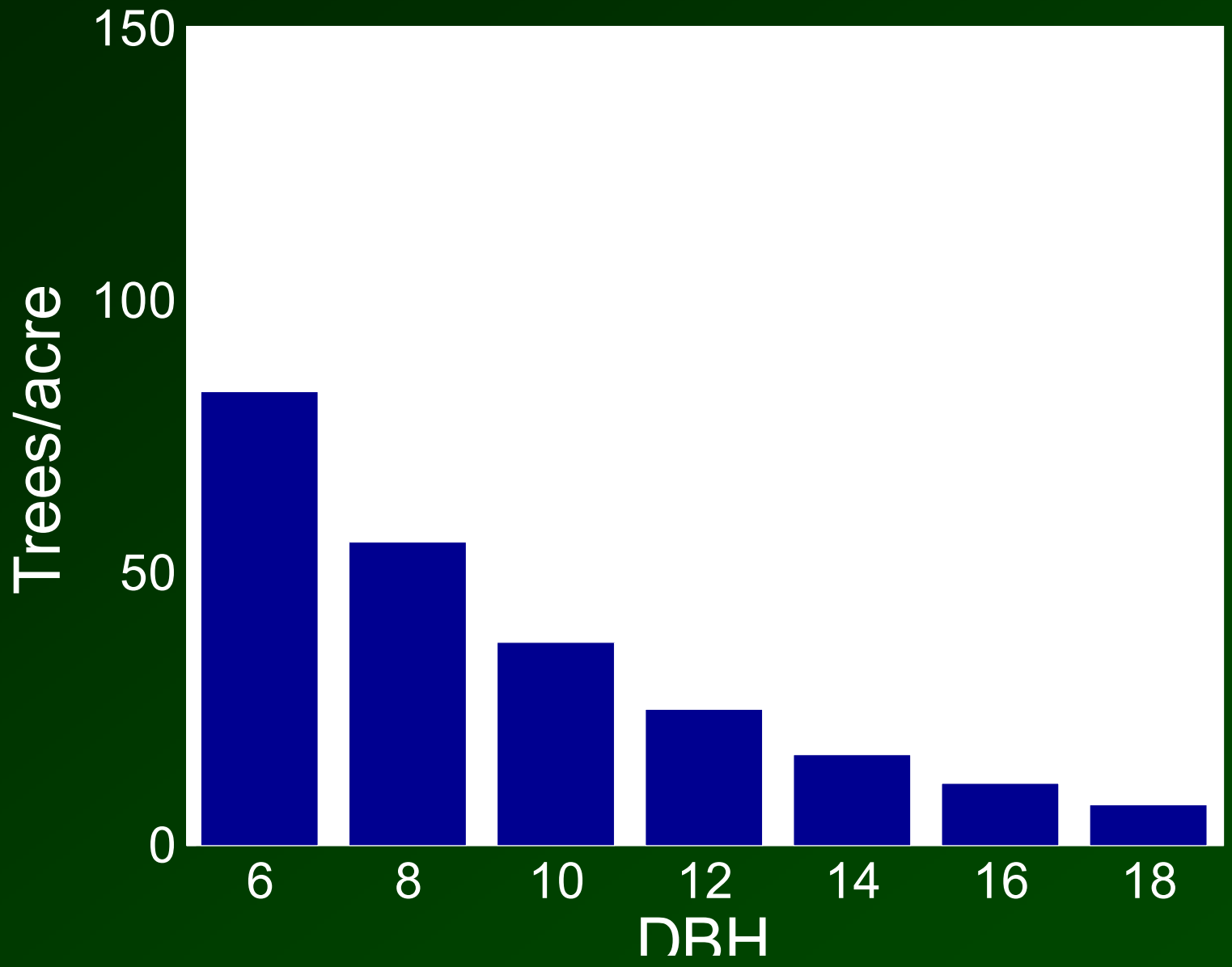
How to implement *q* regulation?

- Single-tree and tiny-patch selection
- BD*q*: the basics
- Ideal scenario
- Practical scenario

Three Numbers (BD*q*)
Specify the "Curve"

- B: The total basal area (ft^2/acre) to leave.
  - Often specified for 6" and larger classes
  - Critical for regen and growth
- D: The maximum diameter tree to leave.
  - Important for economics.
  - Important for structure.
- *q*: Sets the curve shape

The Ideal Case: B=60, D=19”, *q*=1.5



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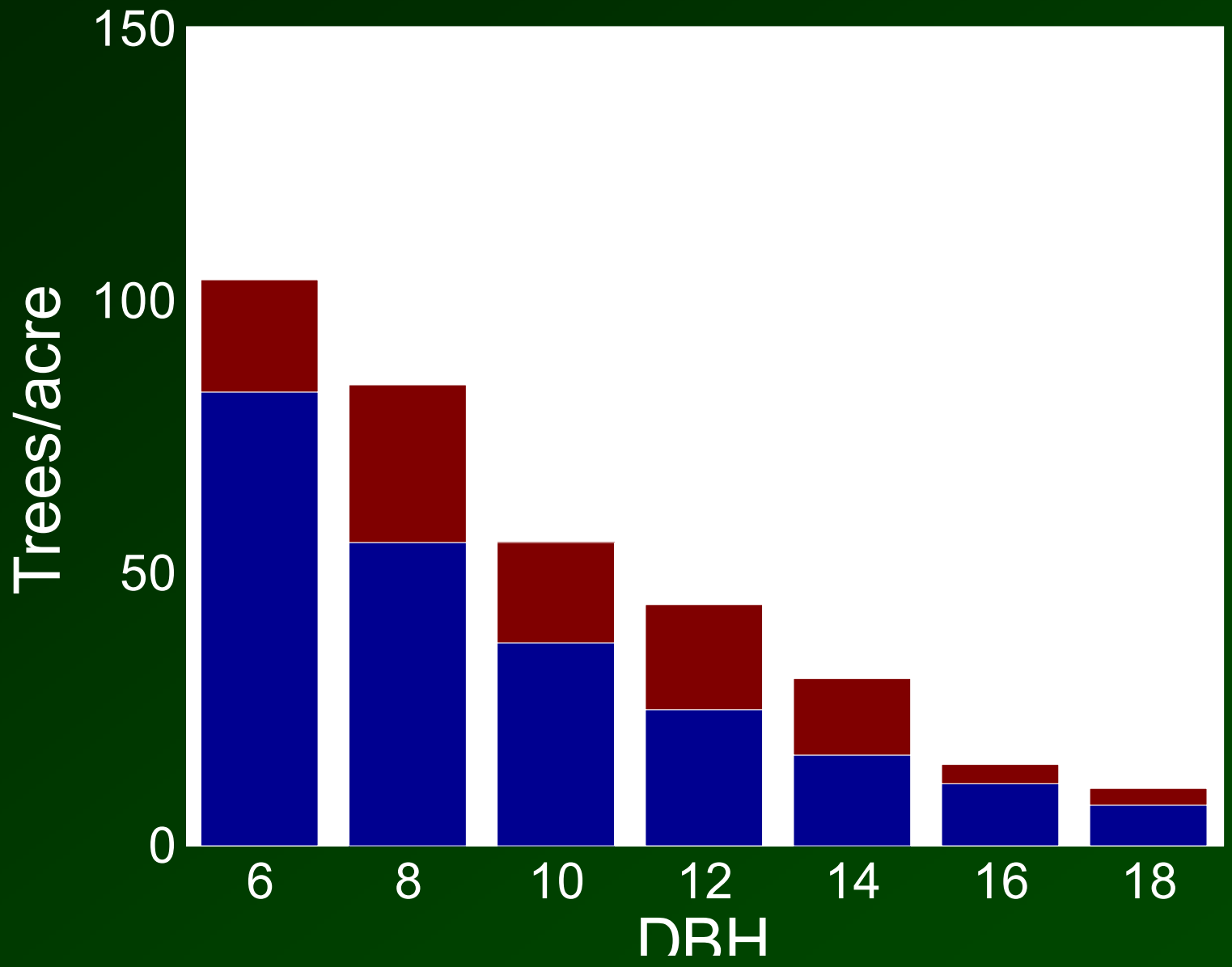
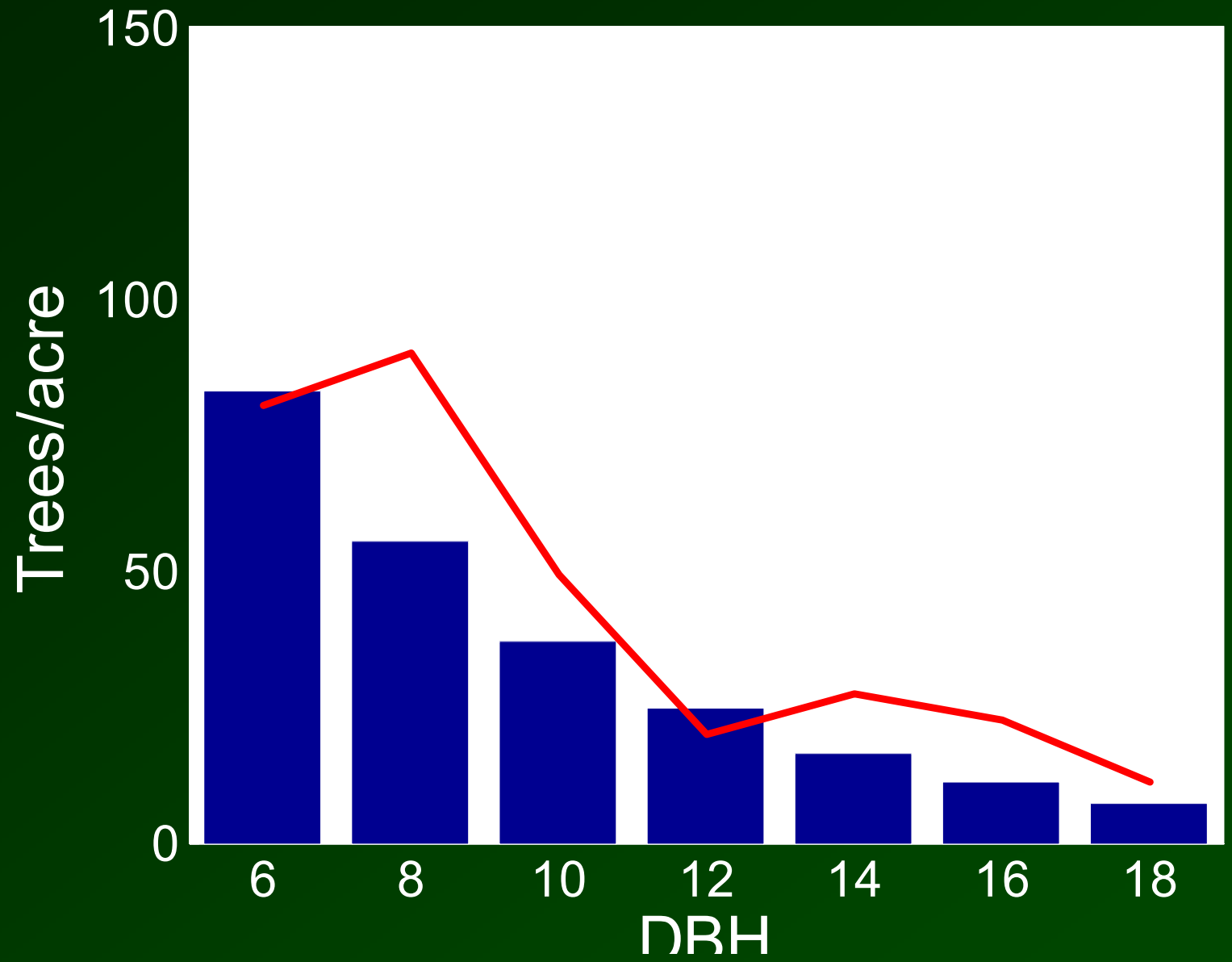


... but cruise data is *sample data* ...

- Suppose we want a stand with q=1.5, and 60 ft^2/ac of basal area across the 6 to 18” DBH classes
- Our target in the 16” class is 7.6 ft^2/ac
- Suppose the actual stand has 10 ft^2/ac, and we cruised using nine BAF 10 prism points
- We are “supposed” to cut 2.4 ft2/ac in this class
- Our standard error will be about 3.3 ft2/ac

All we have is *sample* data...



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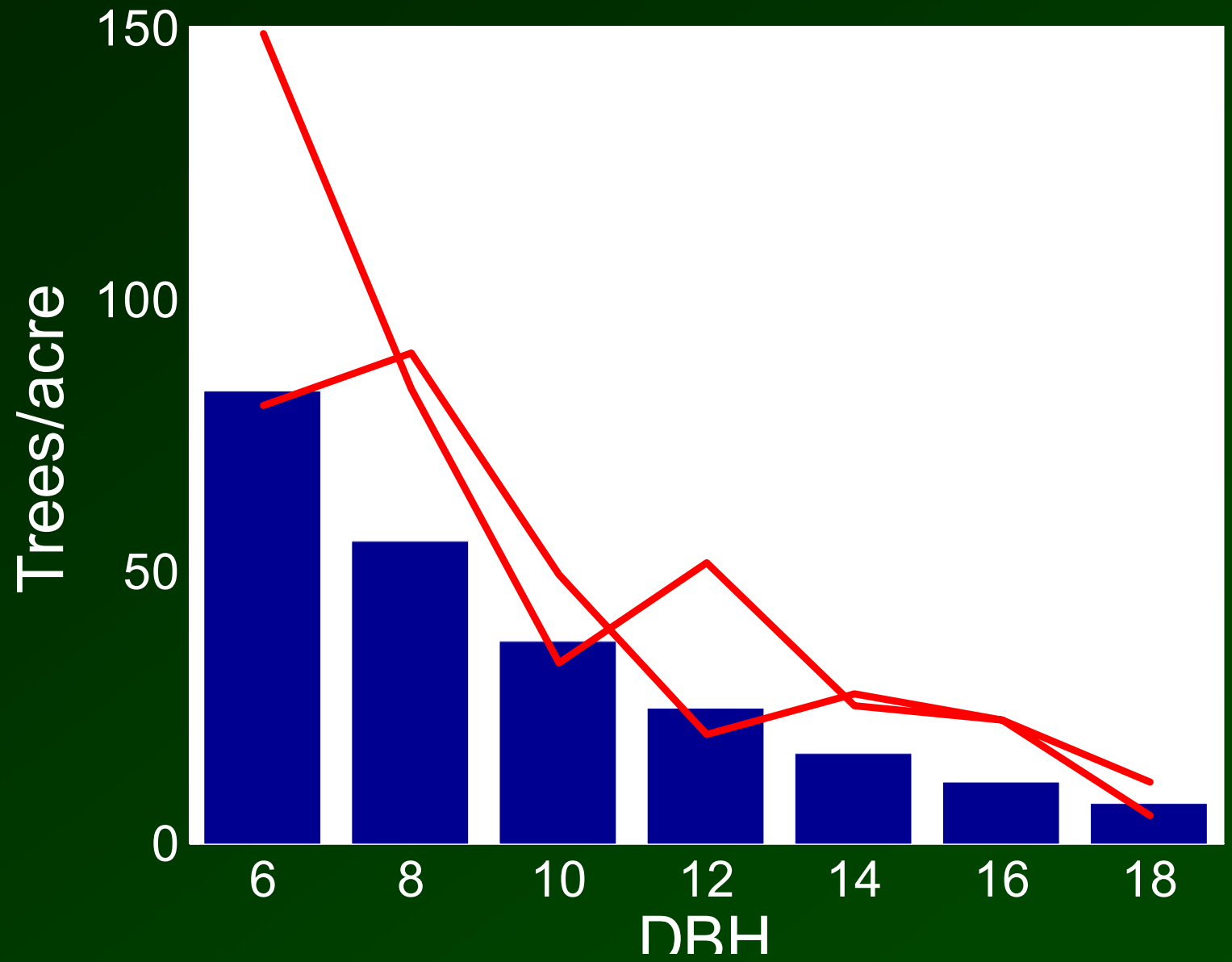

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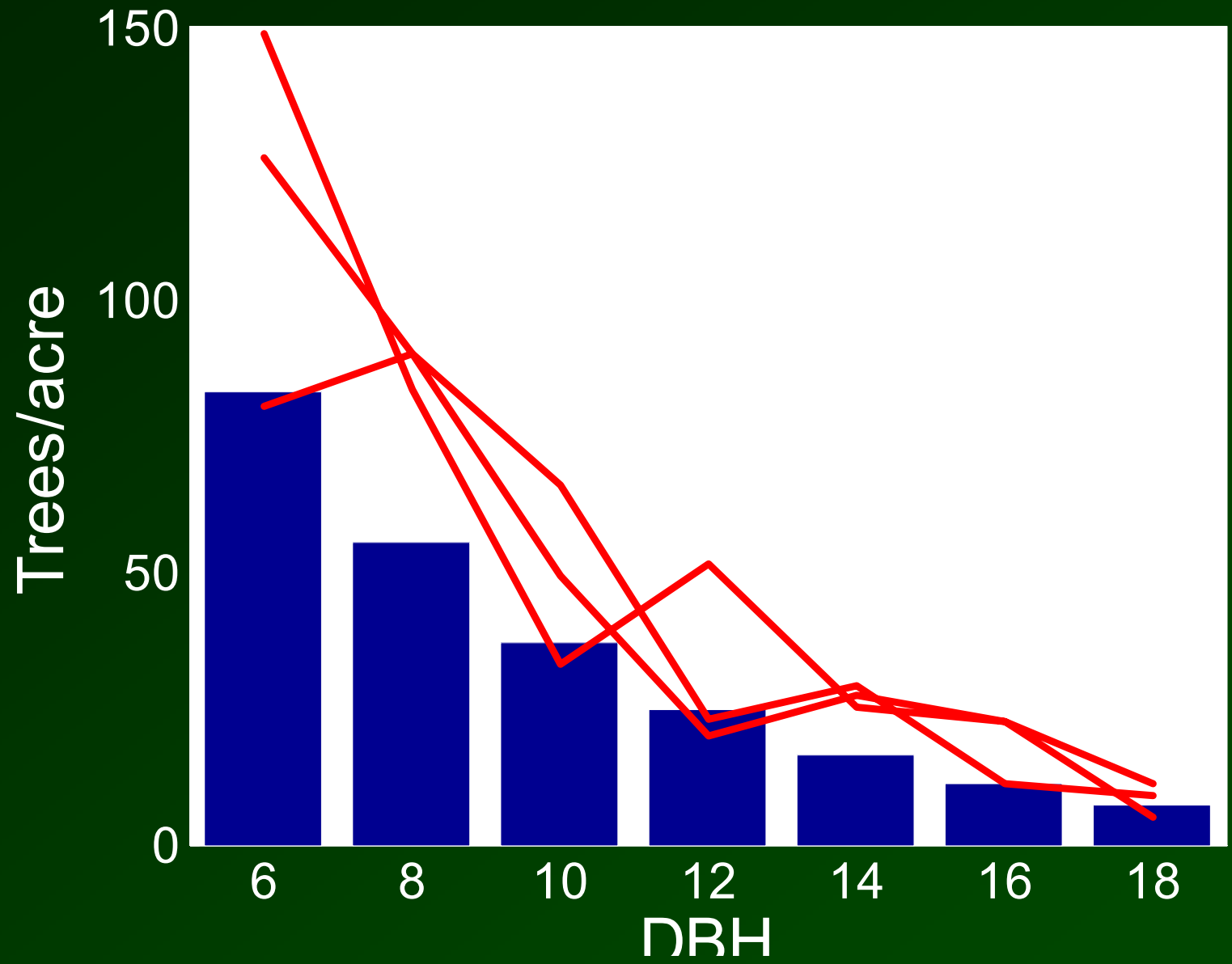

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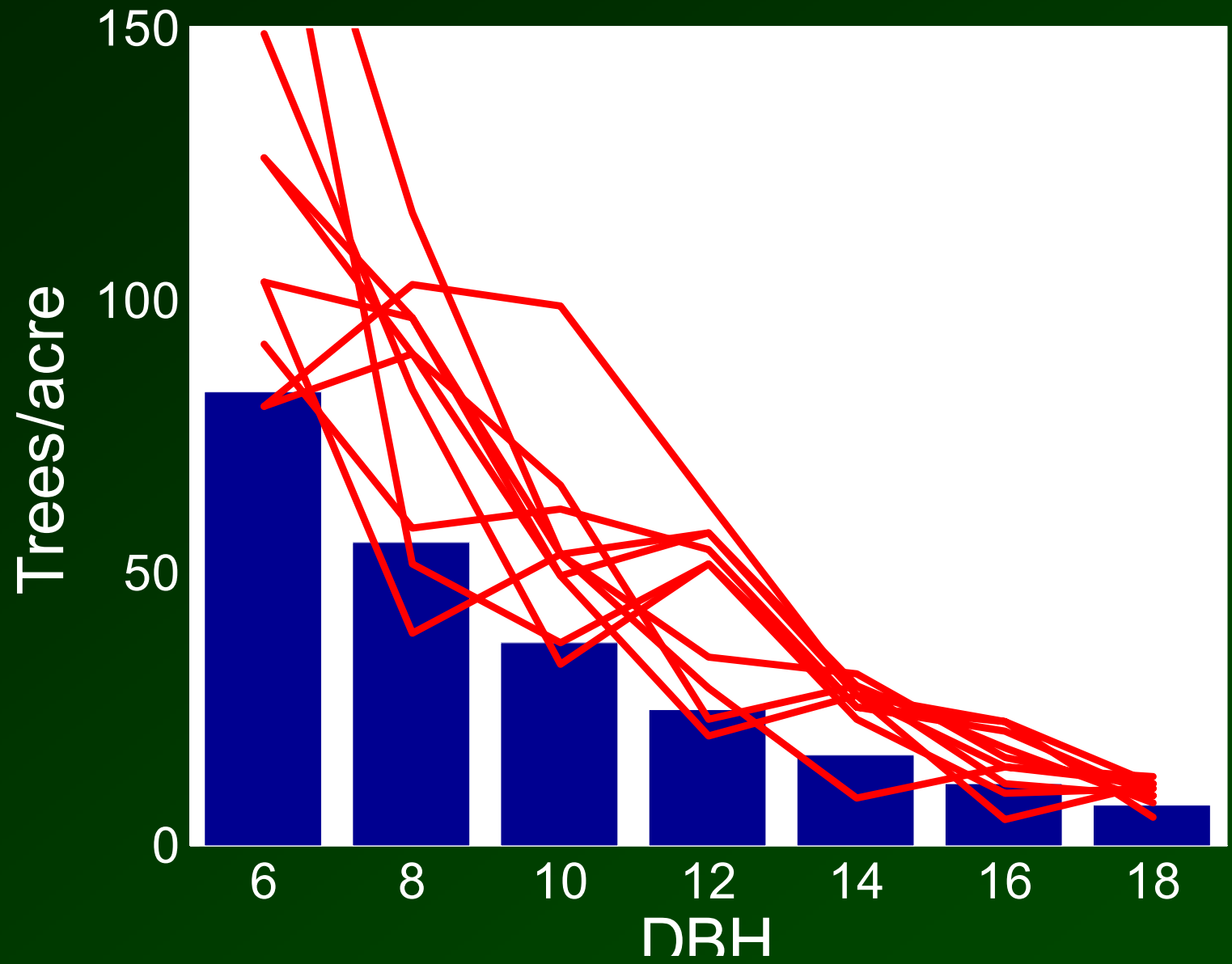

To Reduce Impact of Sampling... (and increase flexibility!)... Use Broader Diameter Categories

- Categories should be related to management objectives
- Some standard categories are used in USFS silvicultural guides
- Categories don’t have to be “equal-width”

The required calculations could be tedious...

- But they can be tabulated for simplicity.
- Tables will be in workshop proceedings:
  - specify B in terms of 6” and larger classes
  - allow D to vary from 16” to 24”
  - allow *q* to vary from 1.2 to 1.8
- *Also* show basal area for small diameter trees

Shortcut Table

D=20”	Diameter Class					
q	0, 2, 4	6, 8, 10	12, 14	16+	Total 6+	Total
1.2	0.04	0.26	0.30	0.44	1.00	1.04
1.3	0.06	0.32	0.30	0.38	1.00	1.06
1.4	0.09	0.38	0.30	0.32	1.00	1.09
1.5	0.12	0.44	0.29	0.27	1.00	1.12
1.6	0.16	0.50	0.28	0.22	1.00	1.16
1.7	0.20	0.54	0.27	0.19	1.00	1.20
1.8	0.25	0.59	0.25	0.16	1.00	1.25

Example: D=20”, *q*=1.5. BA in 6”+ classes is 80.

BA in 0,2,4 = 80x0.12 = 9.6 ft^2/acre

BA in 6,8,10 = 80x0.44 = 35.2 ft^2/acre

BA in 12,14 = 80x0.29 = 23.2 ft^2/acre

BA in 16+ = 80x0.27 = 21.6 ft^2/acre

Other Issues

- Should the prescription be...
  - how much to cut?
  - how much to leave?
  - how much to cut as a *fraction*?
- How rigid should you be?
  - not very!
- BD*q* is just like magic! (yeah, right)
- Remember this is a *means* to an end

Choice of B

- B is probably the *most important*
  - directly impacts success and type of regeneration
  - directly impacts growth rate of residual trees
- B will be a *low* number
- B will depend on *cutting cycle*
- Should be based on long-term research
  - regeneration composition
  - residual growth

Choice of D

- Usually based on economics!
  - Ted Howard will cover this issue
  - “Grade Improvement” rule
- Structural considerations?
  - No large trees means...
  - No large snags means...
  - No large downed logs
  - Retention leads to *tradeoffs*

Choice of q

- This is a *future goal*
- Current "*q*" not necessarily relevant
- Shallow or Steep?
  - Allocate growing stock to sawtimber?
  - Tie up capital in sawtimber?
  - Do you want/need a thicket?
  - Maybe the curve should "bend"...

Conclusions

- BD*q* is a simple approach to diameter regulation
- BD*q* is not a magic recipe!
- In fact, it’s not always appropriate
- Writing prescriptions does not require advanced math
- Implementing prescriptions can be (reasonably) straightforward