SITE-SPECIFIC DOUGLAS-FIR ALLOMETRIC RELATIONSHIPS: NUTRIENT MANAGEMENT STUDY

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Background

- Applicable for a wide geographic range
- Generalize site variation
- Common Equation limitations

Purpose of Project

- Goal: To provide site specific nutrient budget for Douglas-fir
- Objective: Determine if site type is a factor in Douglas-fir biomass production
- Null Hypothesis: Rock and vegetation type do not effect biomass regression equations

Other Equations

- Brown 1978
  - Idaho and Montana
  - Dbh range: 1-11 cm (0.4- 4.33 inches)
- Marshall & Wang 1995
  - British Columbia
  - Dbh range: 1.9-21.3 inches
- Gholz 1979
  - Oregon Cascades
  - Diameter Range: 2-162 cm (0.78-63.78 inches)

Study Design

- Sample size: 72 trees
- Dry Grand Fir forest type
- Two rock types- Basalt and Quartzite.
- Dbh Sample Stratification

Field Methods

- Stands are chosen that meet the specified site criteria
- Stand mensuration data collected
- Cruise data stratified
- Sample trees selected

Field Methods

Field Methods

Bark samples and cores

Field Methods

The crown measured & divided

Field methods

Samples Weighed

Field Methods

Field Methods

The stem is cut and weighted.

Field Methods

Stem samples collected

Lab Procedure

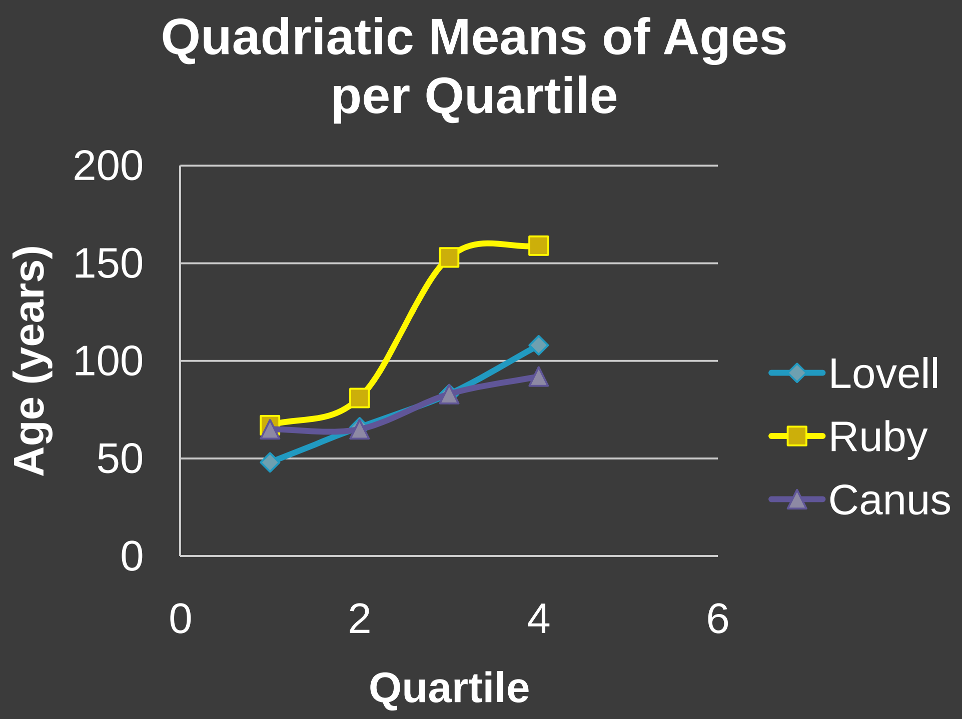
- Samples processed and oven dried
  - Foliage
  - Branches
  - Discs
  - Bark & Cores

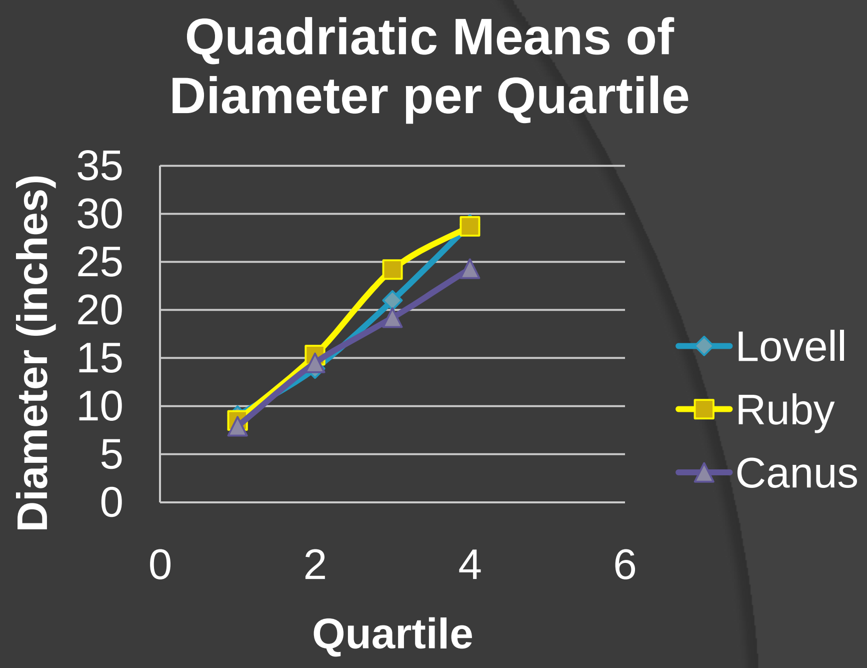
Analysis

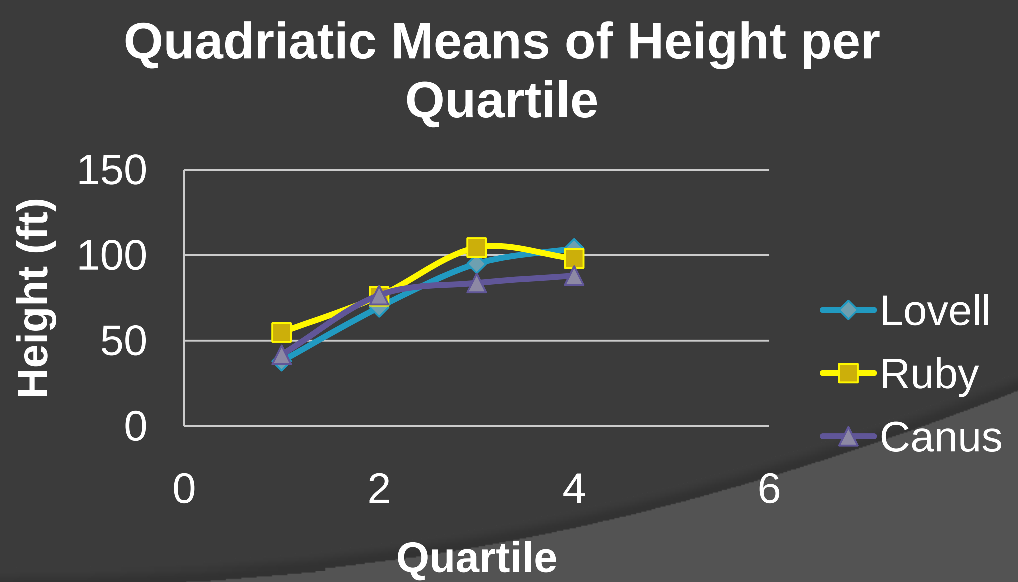
- Oven dry weights determined
- Ratios determined
  - Branch/foliage
  - Wood/bark

Site Information

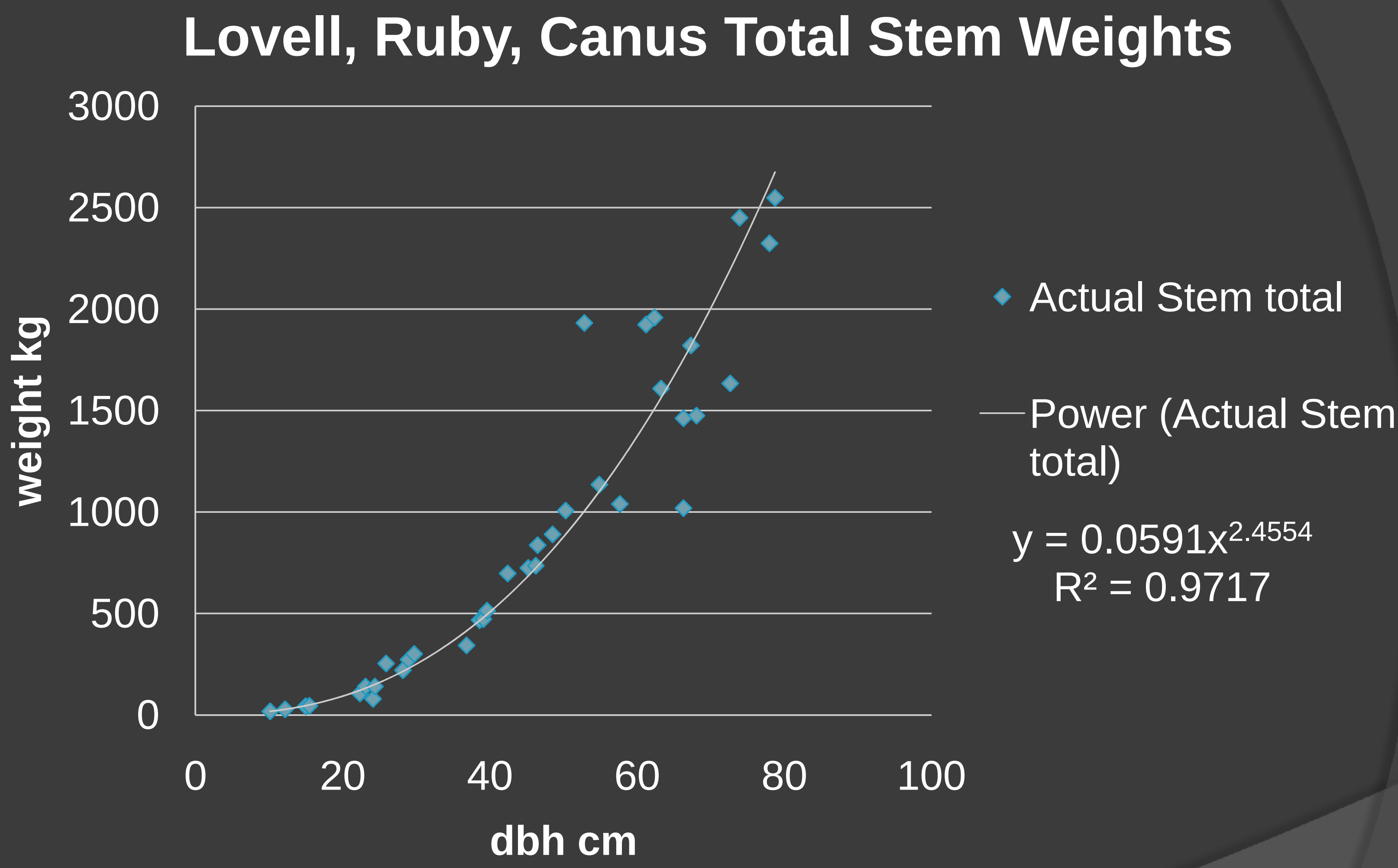
Site	Lovell Valley	Ruby Bugs	Canus
Site Index	77	69	73
Vegetation Series	Dry Grand fir	Dry Grand fir	Dry Grand fir
Rock Type	Quartzite	Quartzite	Basalt
Soil Moisture/Temp Regime	Xeric/Frigid	Xeric/Frigid	Xeric/Frigid
Height-Growth Ratio- *referenced from ring counts after "release" with 30ft interval*	.86 ft/yr	.66 ft/yr	1.17 ft/yr


Quadriatic Means of Ages per Quartile
Age (years)
200
150
100
50
0
0
2
4
6
Quartile
Lovell
Ruby
Canus

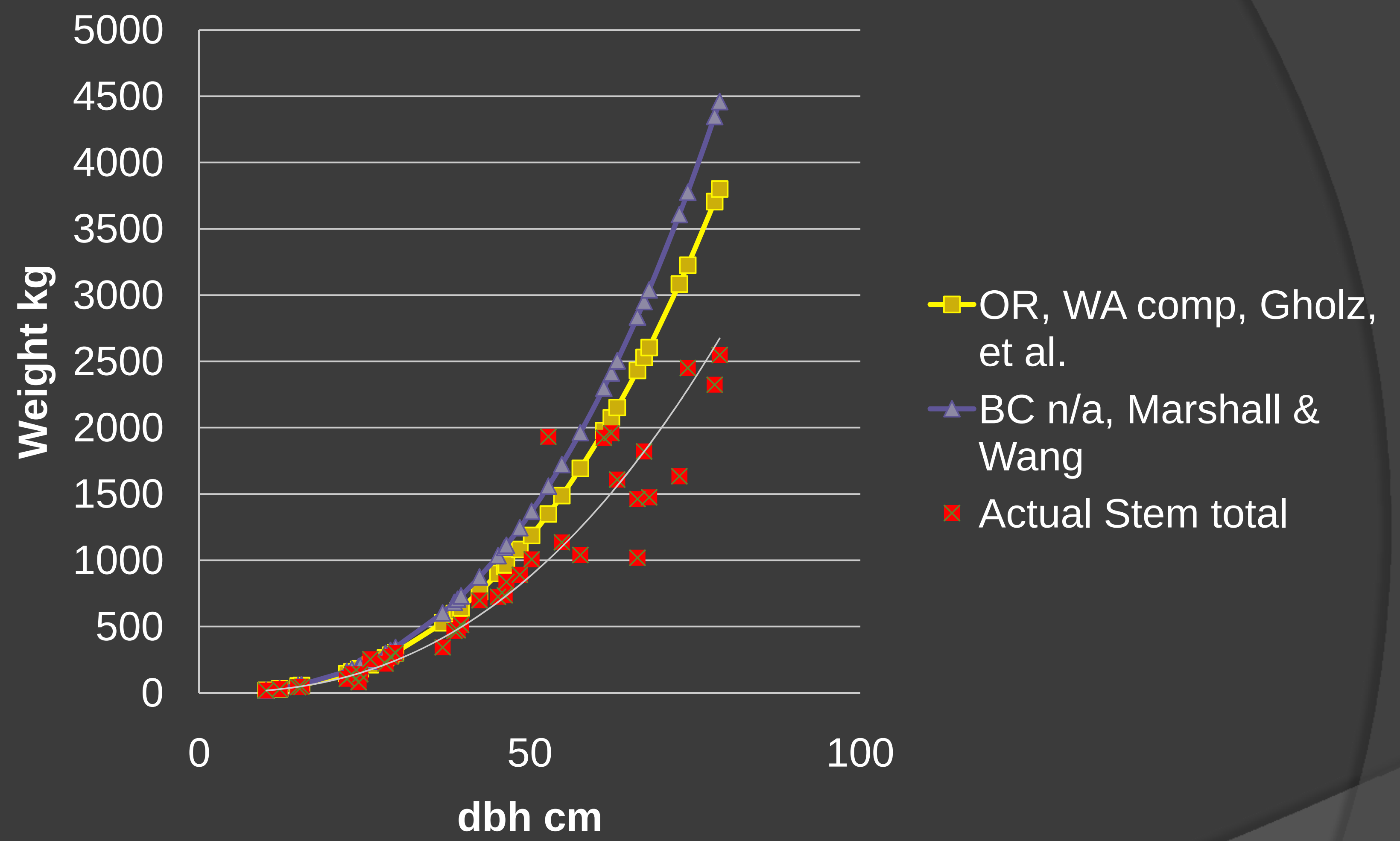

Quadriatic Means of Diameter per Quartile
Diameter (inches)
35
30
25
20
15
10
5
0
0
2
4
6
Quartile
Lovell
Ruby
Canus


Quadriatic Means of Height per Quartile
Height (ft)
150
100
50
0
0
2
4
6
Quartile
Lovell
Ruby
Canus

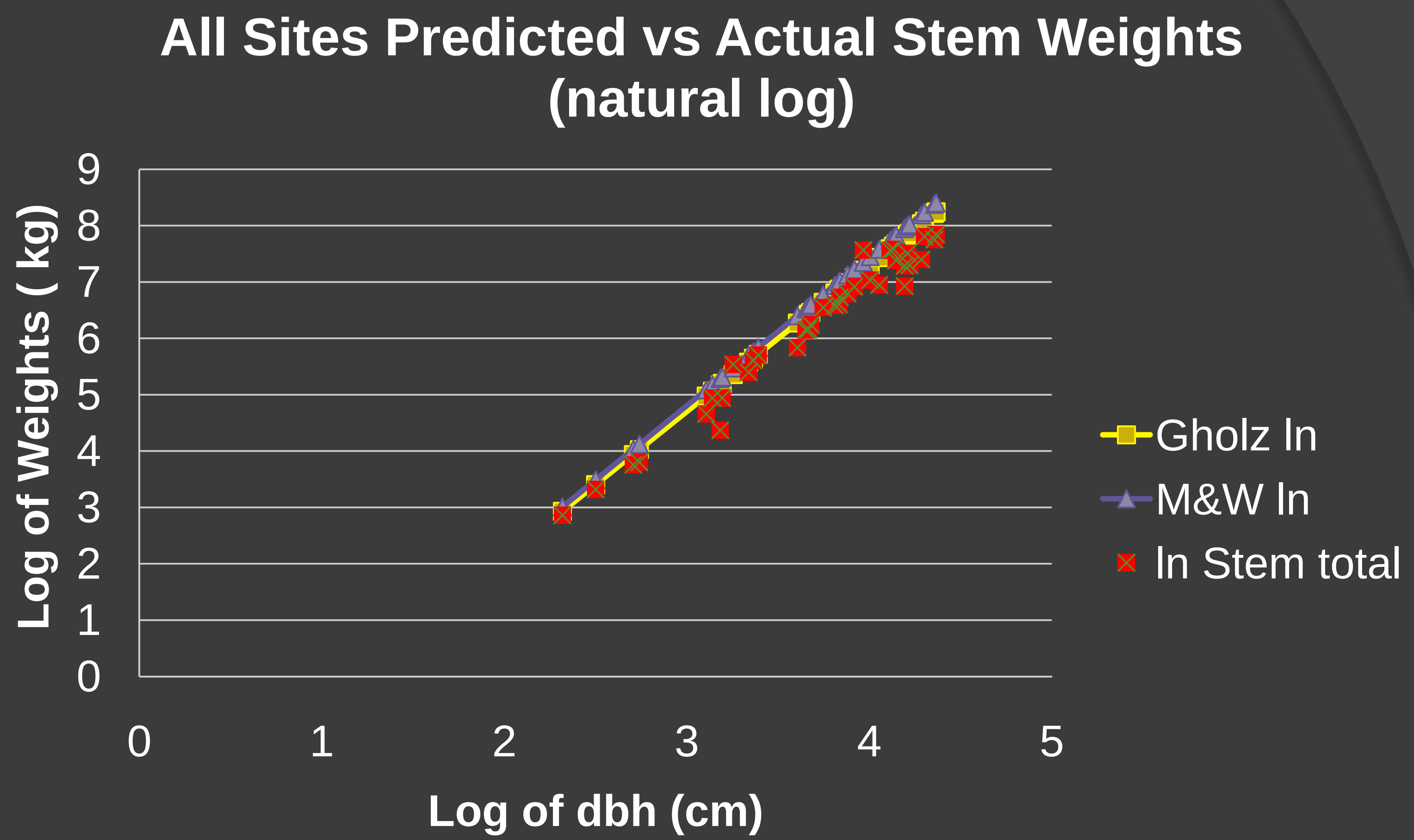
Preliminary Stem Results


Lovell, Ruby, Canus Total Stem Weights
weight kg
3000
2500
2000
1500
1000
500
0
0
20
40
60
80
100
dbh cm
Actual Stem total
Power (Actual Stem total)
y = 0.0591x2.4554
R² = 0.9717

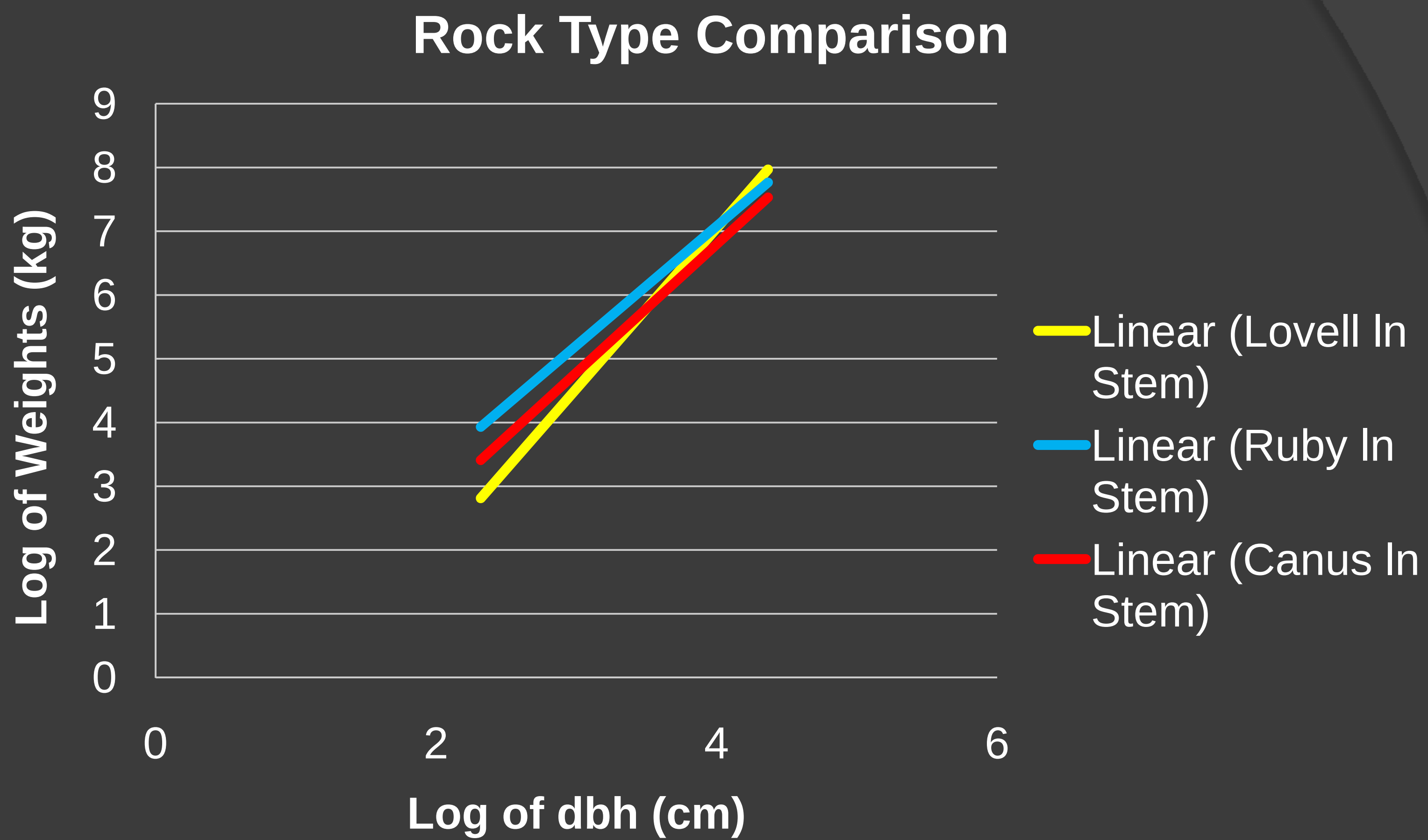
All Sites Stem Weights Predicted vs Actual



Marshall & Wang, and Gholz estimates showed no statistical difference (.05 alpha) when compared to actual weights



Natural log of weights actual and predicted were computed as a way to linearize the data.

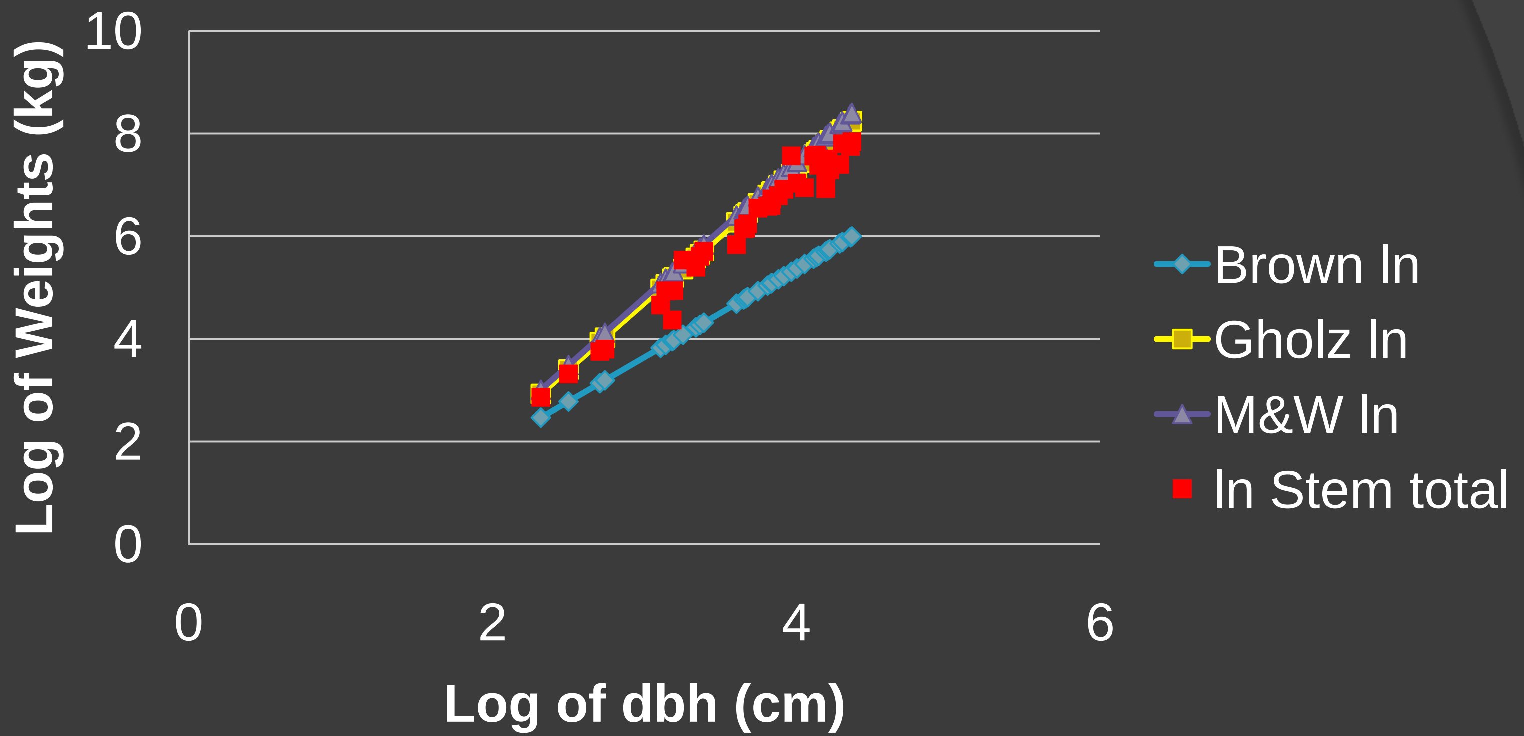


Results also showed no statistically significant difference between stem weights as a function of rock type.

Using Brown's for Large Stems…

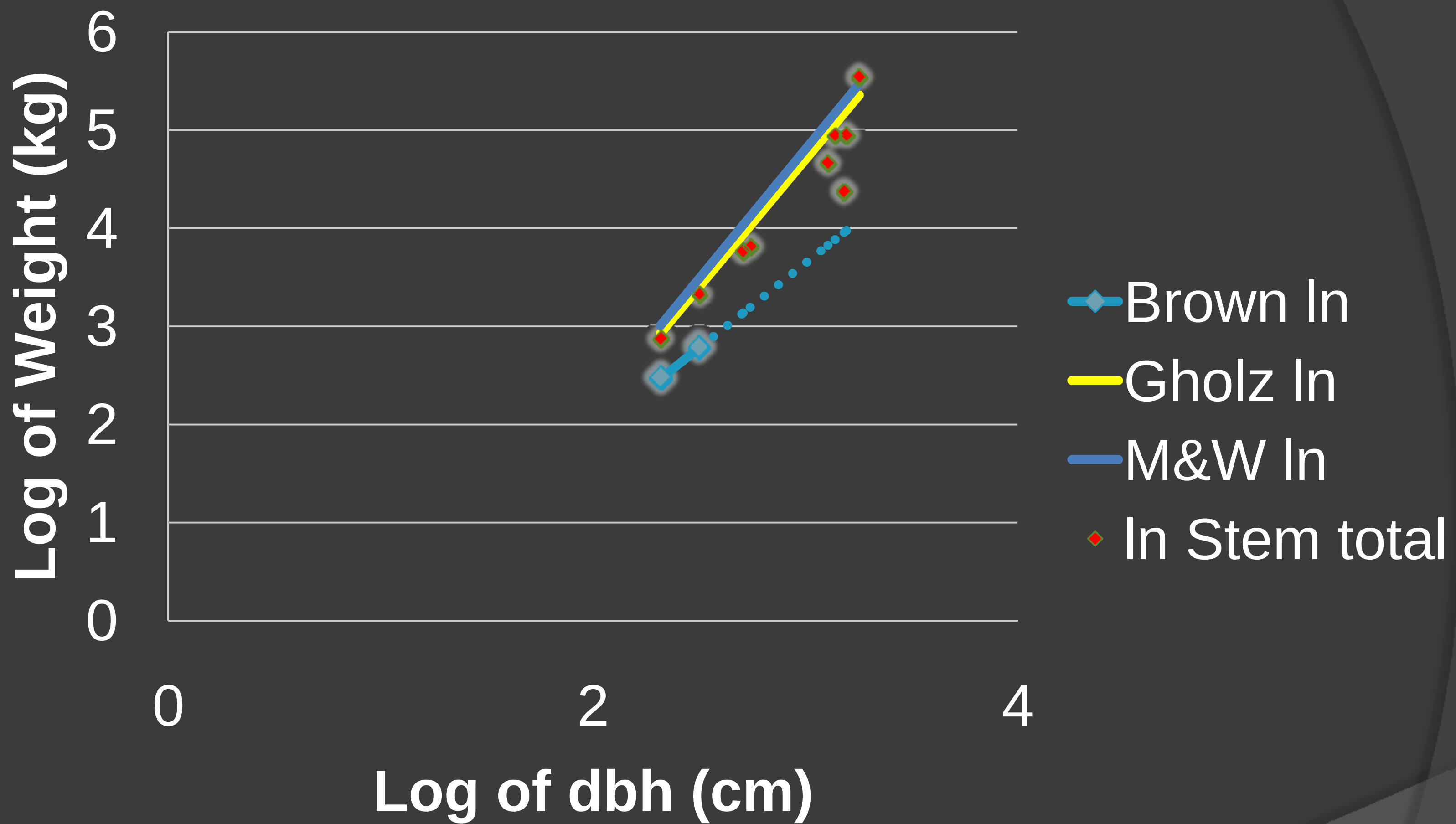
- Brown's 1978 work is meant for crown biomass estimation.
- Large differences are present when Browns equations are used to estimate large diameter stems
- Brown's equations aren't appropriate for all tree components and sizes

All Sites Predicted vs Actual Stem Weights (ln)



Example of large difference shown when using Brown's stem equation out of its range

First dbh Quartile- Predicted vs Actual



A statistical difference between actual and Browns predicted weights in trees 10cm – 25cm dbh (3.9 inches-10 inches).

Products

- Regression equation for Douglas-fir
- Validation/ Model Correction
- Allometric relationships
- Various reference tables, and predictors

Conclusion

- Statistically significant difference is present between Brown and our smallest trees (some were still larger than Brown's listed range)
- Thus far no significant difference is shown for rock type with stem data, suspect crowns will show difference
- No statistical difference between sample weights and Gholz's equation and Marshall's equation for stem
- All of these relationships will be re-explored after crown data is complete, and the remaining sites have been collected.
- Use Brown where appropriate

QUESTIONS or COMMENTS

References

- Brown, J.K., 1978. Weight and density of crowns of Rocky Mountain conifers. U.S. For. Serv. Res. Pap. INT-197: 56.Gholz
- Feller, M.C., 1992. Generalized versus site-specific biomass regression equations for *Pseudotsuga menziesii* var. *menziesii* and *Thuja plicata* in coastal British Columbia. Bioresour. Technol., 39: 9-16.
- Gholz, H.L., Grier, C.C., Campbell, A.G. and Brown, A.T., 1979. Equations for estimating biomass and leaf area of~plants in the pacific northwest. Greg. State Univ. Sch. For. I&s. Pap., 41: 39.
- Marshall, P.L. and Wang, Y., 1995. Above ground tree biomass of interior uneven-aged Douglas-fir stands. Canada-British Columbia Partnership Agreement on Forest Resource Development: FRDA Il. Working Paper WPlS-003. University of British Columbia, Vancouver, 23 pp.
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