Tree species mortality rates differ by rock type

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Introduction

- Tree mortality is difficult to predict in growth and yield projection systems.
- A better understanding of tree mortality variation for different species grown on various rock types may help in selecting appropriate species for specific site conditions in plantation establishment and intermediate treatments.

Materials and Methods

- 6 species
  - Douglas-fir
  - Western hemlock
  - Western larch
  - Western white pine
  - Grand fir
  - Western red cedar

Materials and Methods

- 6 rock types
  - Deep deposits
  - Metasedimentary
  - Mixed (glacial)
  - Granite
  - Sedimentary
  - Basalt

Materials and Methods

- Model fitting – a variation of logistic model

$$P = (1+\exp(-(b_0+ROCK+GROW+COMP)))^{-LGP}$$

$$ROCK = \Sigma\, b_{1k} RC_k$$

$$GROW = b_i\, DBH / 100 + b_l\, DI$$

$$COMP = b_j\, BA + b_m\, BAL$$

- RISK program was used in analysis.

Results

- Goodness-of-fit statistics
  - Douglas-fir

Rock type	Total trees	Dead trees		Chi-square (X^2)	
		Obs	Pred	Live trees	Dead trees
Deep deposit	150	11	10.3	0.0035	0.0476
Metasedimentary	1925	219	221.9	0.0049	0.0379
Mixed	764	36	36.6	0.0005	0.0098
Granite	789	15	15.1	0.0000	0.0007
Sedimentary	329	2	2.0	0.0000	0.0000
Basalt	992	6	6.0	0.0000	0.0000
Sum	4949	289	291.9	0.0090	0.0960

Western hemlock

Rock type	Total trees	Dead trees		Chi-square (X^2)	
		Obs	Pred	Live trees	Dead trees
Deep deposit	56	3	3.0	0.0000	0.0000
Metasedimentary	1255	124	124.1	0.0000	0.0001
Mixed	96	6	6.1	0.0001	0.0016
Granite	77	7	7.2	0.0006	0.0056
Sum	1484	140	140.4	0.0007	0.0073

Western larch

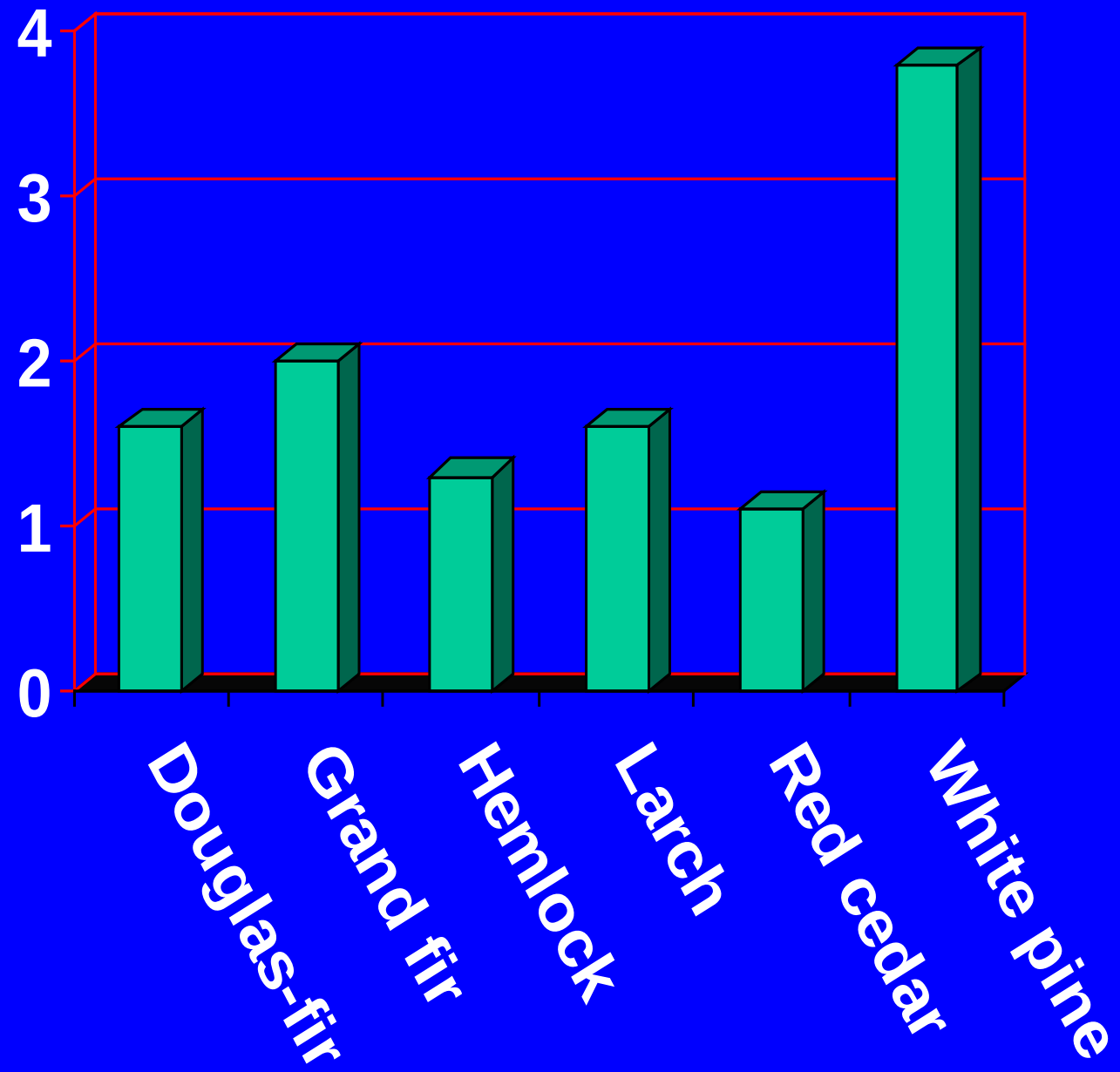
Rock type	Total trees	Dead trees		Chi-square (X^2)	
		Obs	Pred	Live trees	Dead trees
Deep deposit	94	8	8.1	0.0001	0.0012
Metasedimentary	520	51	50.8	0.0001	0.0008
Mixed	341	30	29.3	0.0016	0.0167
Granite	61	4	3.9	0.0002	0.0026
Sedimentary	40	1	1.1	0.0003	0.0091
Basalt	58	0	2.0	0.0714	2.0000
Sum	1114	94	95.2	0.0736	2.0304

Western white pine

Rock type	Total trees	Dead trees		Chi-square (X^2)	
		Obs	Pred	Live trees	Dead trees
Deep deposit	748	163	163.1	0.0000	0.0001
Metasedimentary	4017	968	972.7	0.0073	0.0227
Mixed	760	84	85.1	0.0018	0.0142
Granite	46	3	2.9	0.0002	0.0034
Sedimentary	440	53	53.0	0.0000	0.0000
Sum	6011	1271	1276.8	0.0093	0.0404

Results

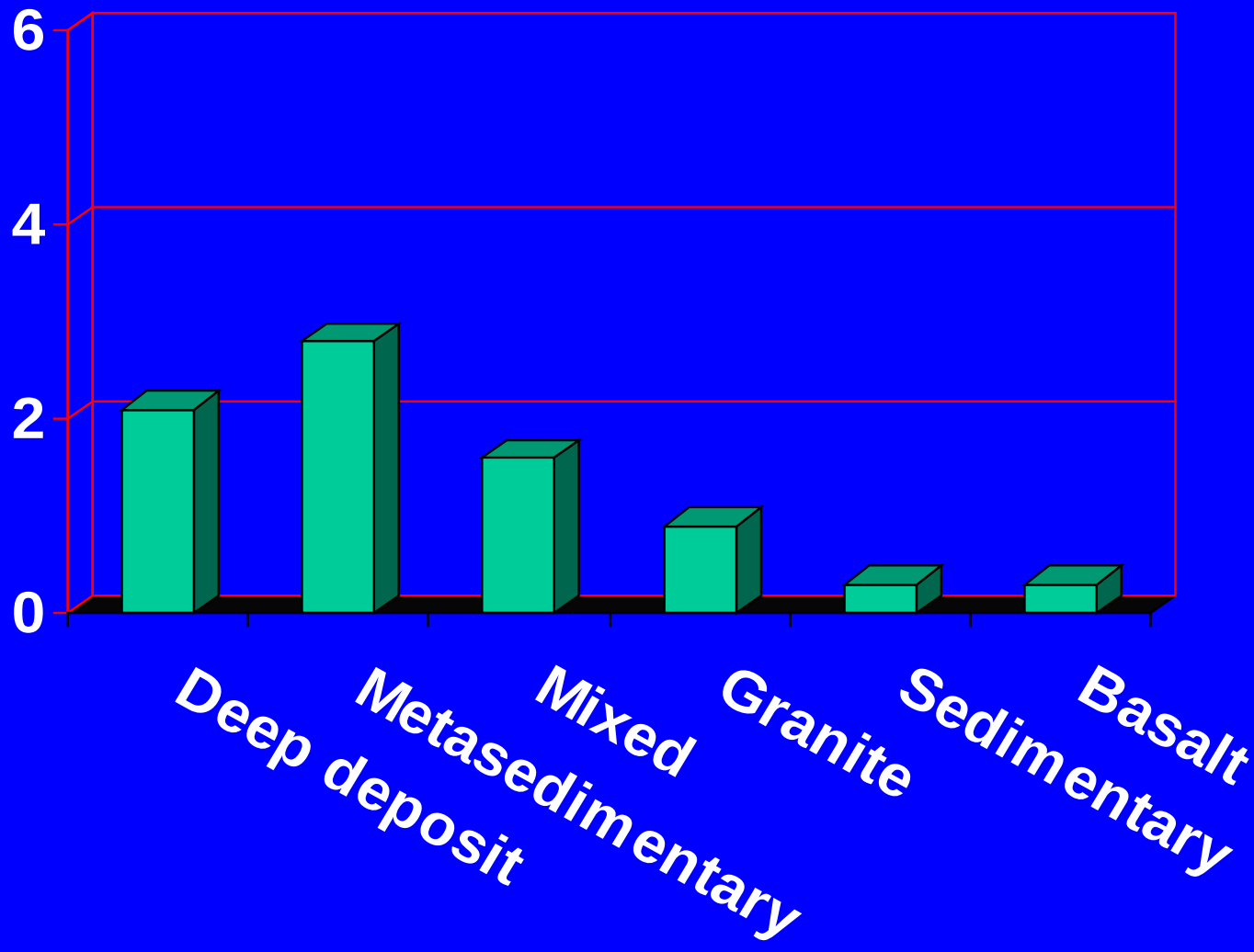
- Predicted annual probability of mortality for different species across rock types


4
3
2
1
0
Douglas-fir
Grand fir
Hemlock
Larch
Red cedar
White pine

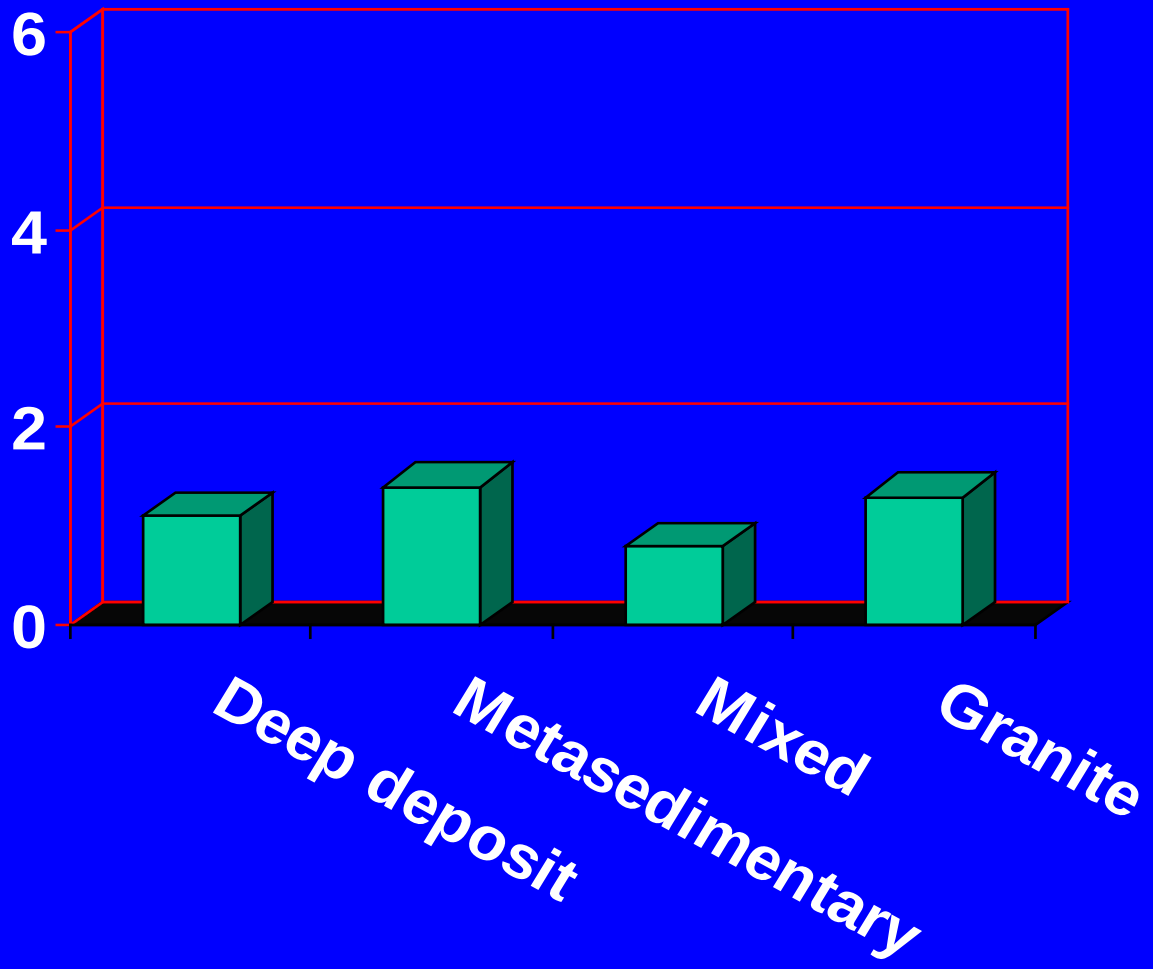
Results

- Predicted annual probability of mortality for individual species on different rock types

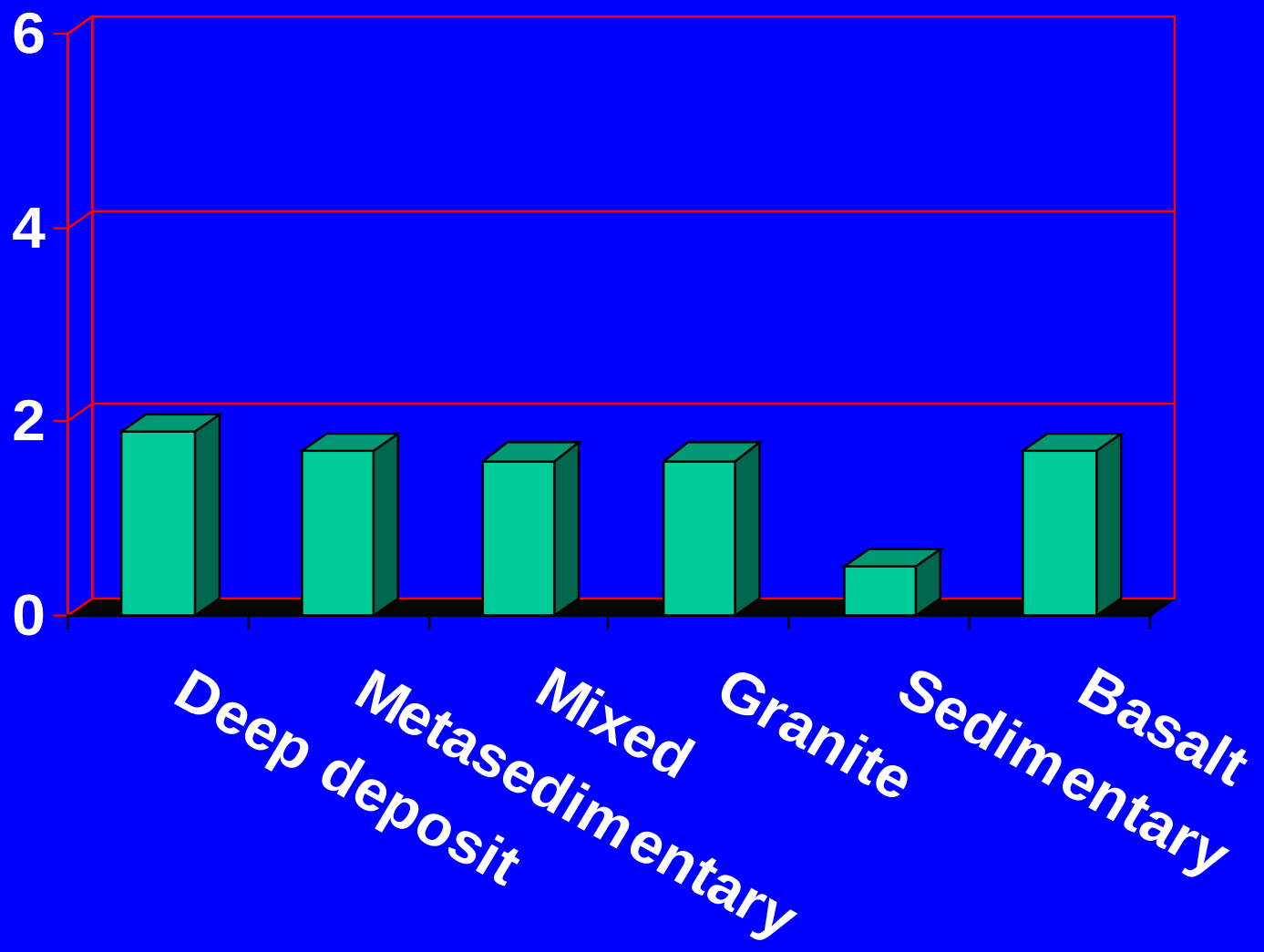
Douglas-fir


6
4
2
0
Deep deposit
Metasedimentary
Mixed
Granite
Sedimentary
Basalt

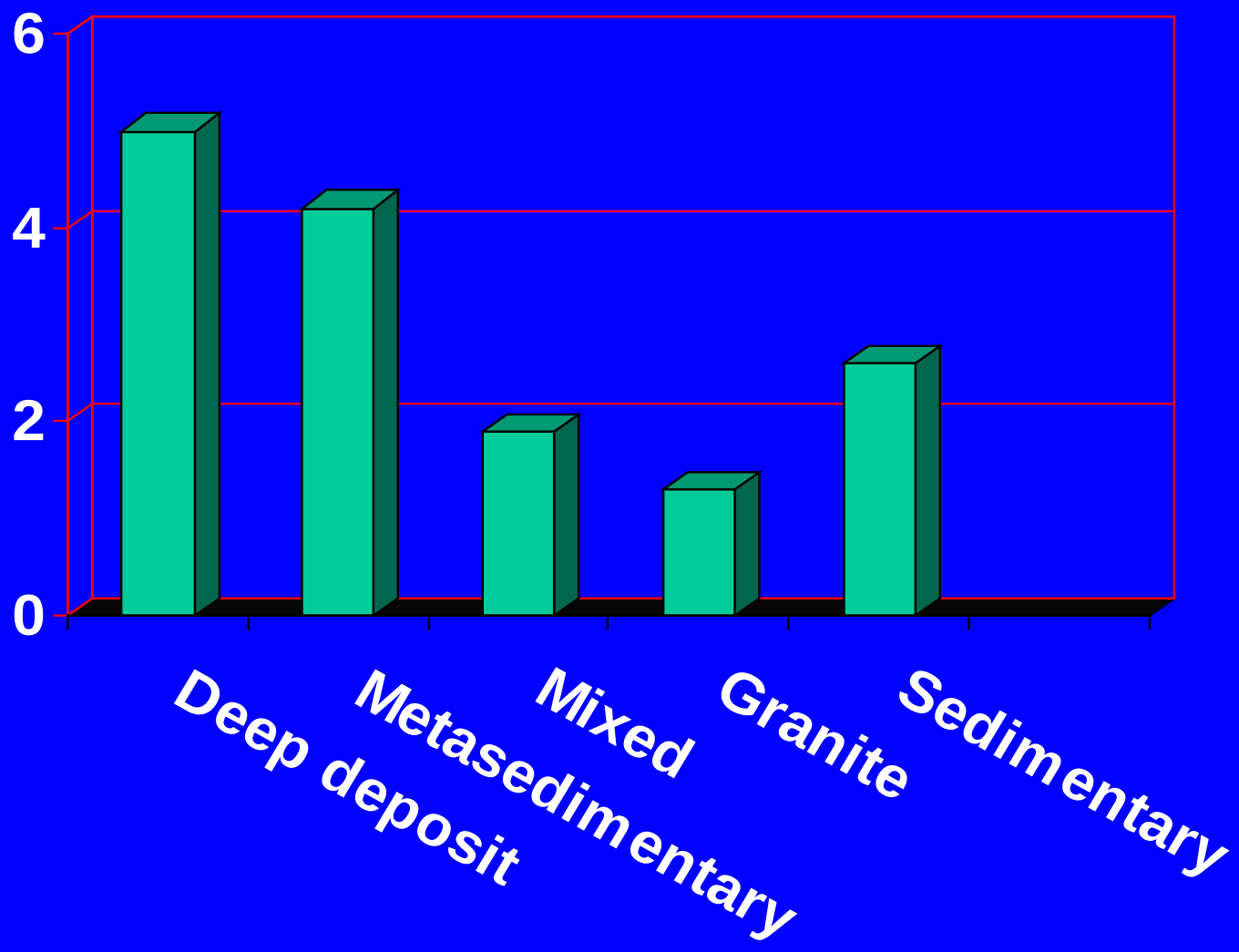
Western hemlock



Western larch



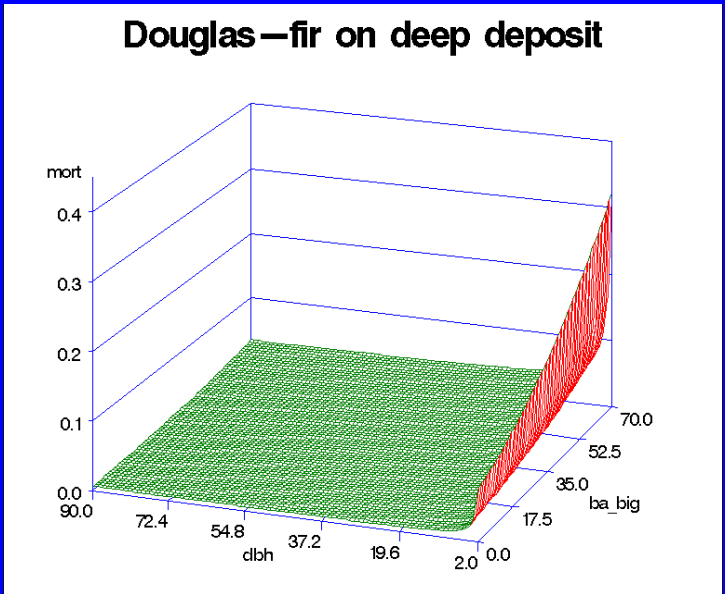
Western white pine

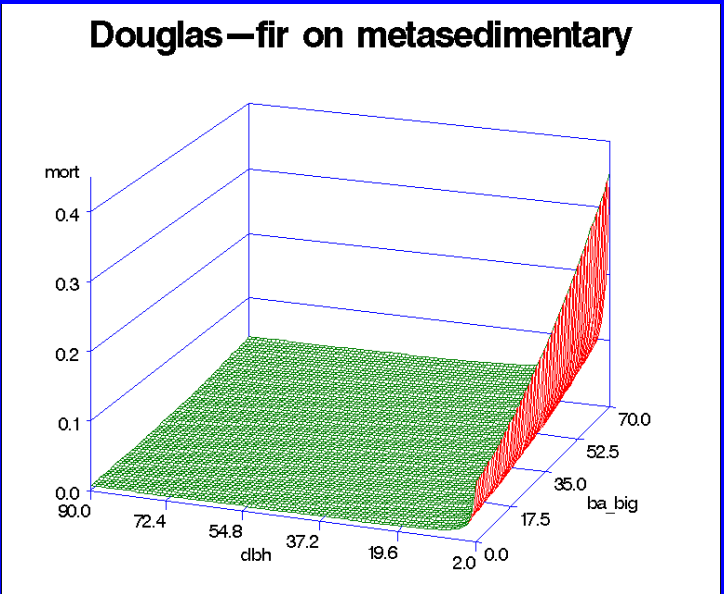


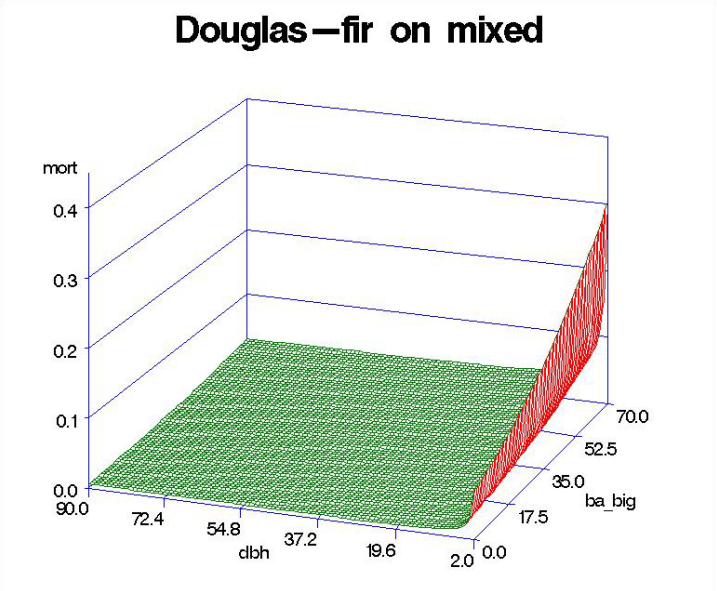
Predicted annual probability of mortality as related to tree size and competitive status

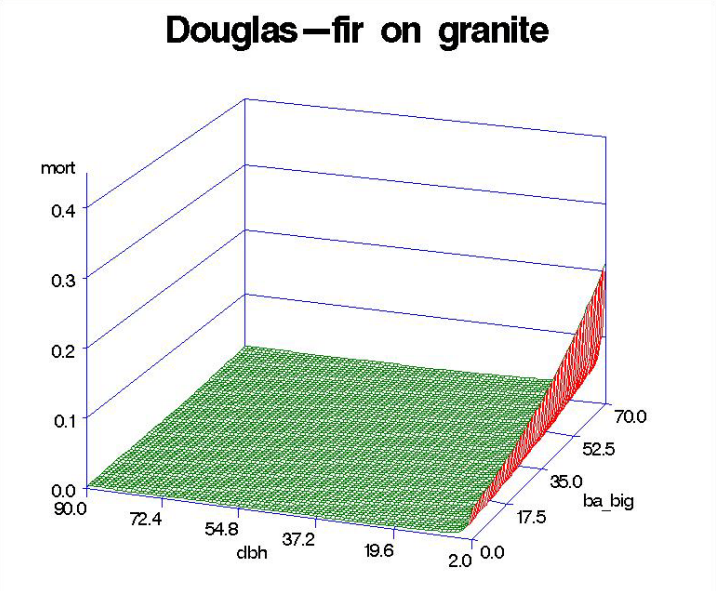
- 4 species as examples
  - Douglas-fir
  - Western hemlock
  - Western larch
  - Western white pine

Douglas-fir

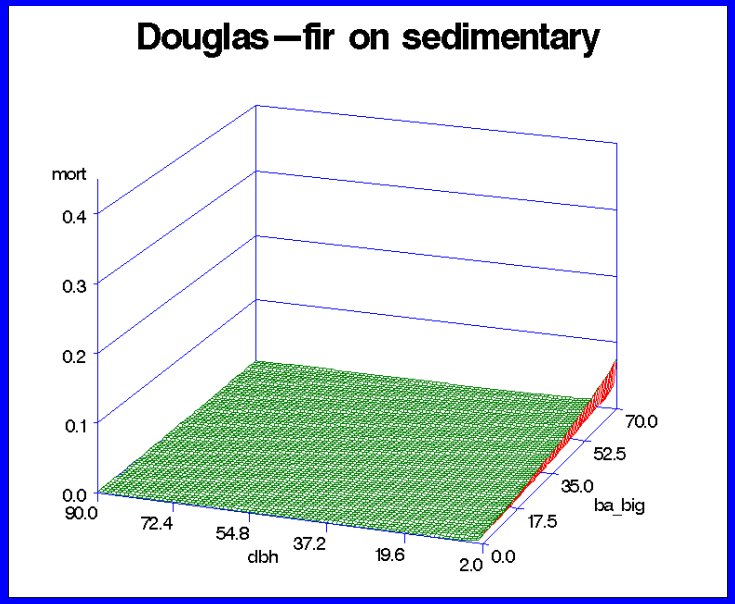

Douglas—fir on deep deposit
mort
0.4
0.3
0.2
0.1
0.0
90.0
72.4
54.8
37.2
19.6
2.0
dbh
0.0
17.5
35.0
52.5
70.0
ba_big

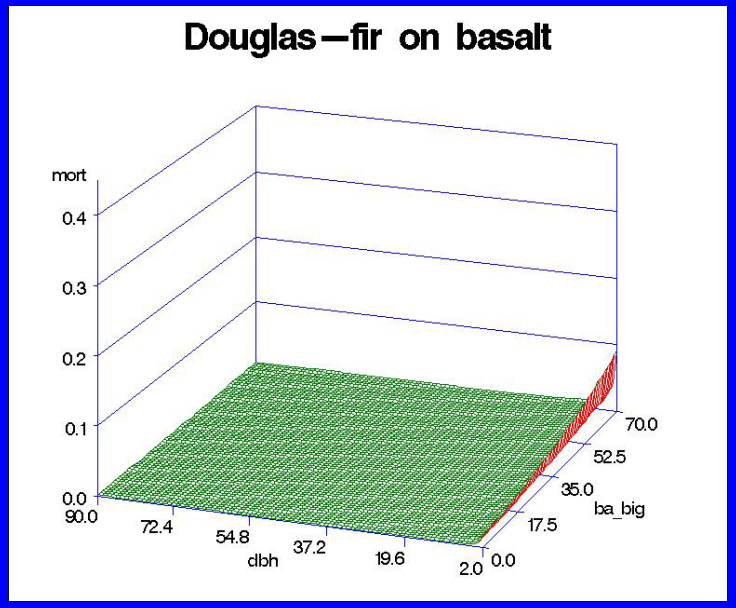

Douglas—fir on metasedimentary
mort
0.4
0.3
0.2
0.1
0.0
90.0
72.4
54.8
37.2
19.6
2.0
dbh
0.0
17.5
35.0
52.5
70.0
ba_big


Douglas—fir on mixed
mort
0.4
0.3
0.2
0.1
0.0
90.0
72.4
54.8
37.2
19.6
2.0
dbh
0.0
17.5
35.0
52.5
70.0
ba_big

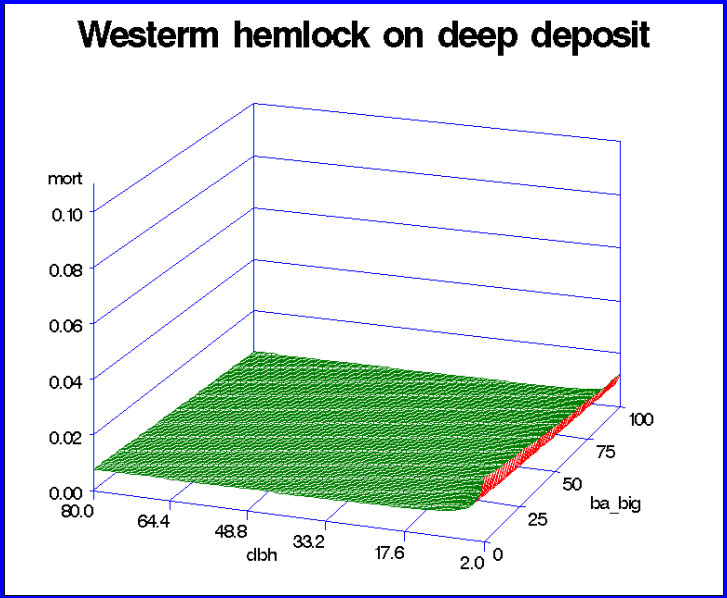

Douglas—fir on granite
mort
0.4
0.3
0.2
0.1
0.0
90.0
72.4
54.8
37.2
19.6
2.0
dbh
0.0
17.5
35.0
52.5
70.0
ba_big

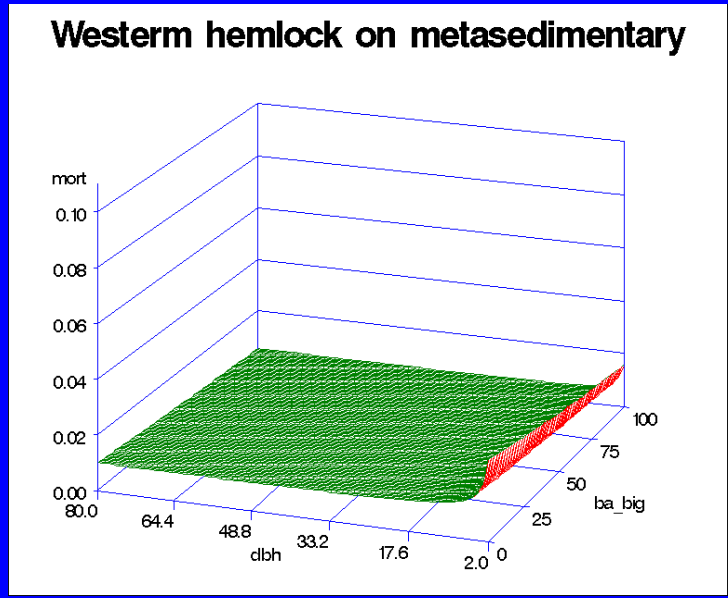
Douglas-fir

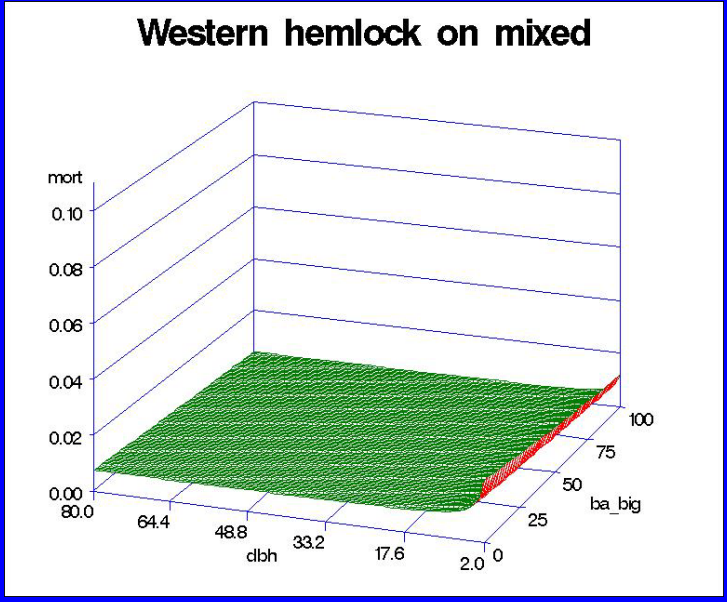

Douglas—fir on sedimentary
mort
0.4
0.3
0.2
0.1
0.0
90.0
72.4
54.8
37.2
19.6
2.0
dbh
0.0
17.5
35.0
52.5
70.0
ba_big

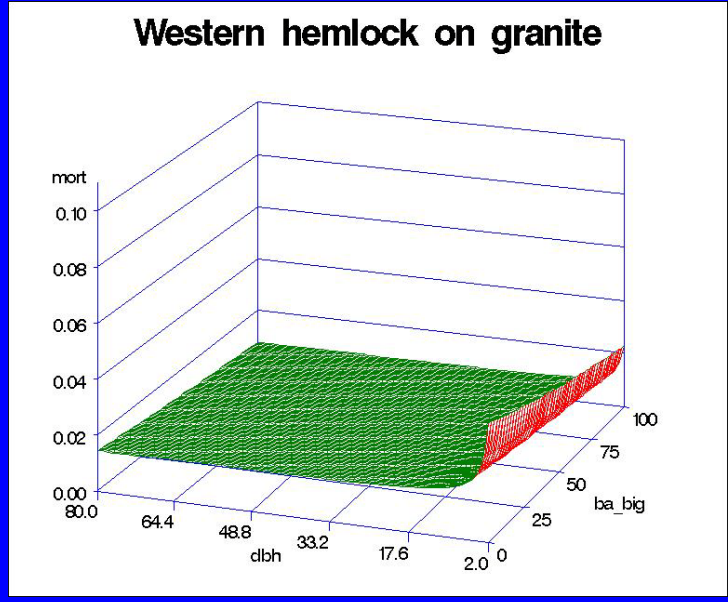

Douglas—fir on basalt
mort
0.4
0.3
0.2
0.1
0.0
90.0
72.4
54.8
37.2
19.6
2.0
dbh
0.0
17.5
35.0
52.5
70.0
ba_big

Western hemlock

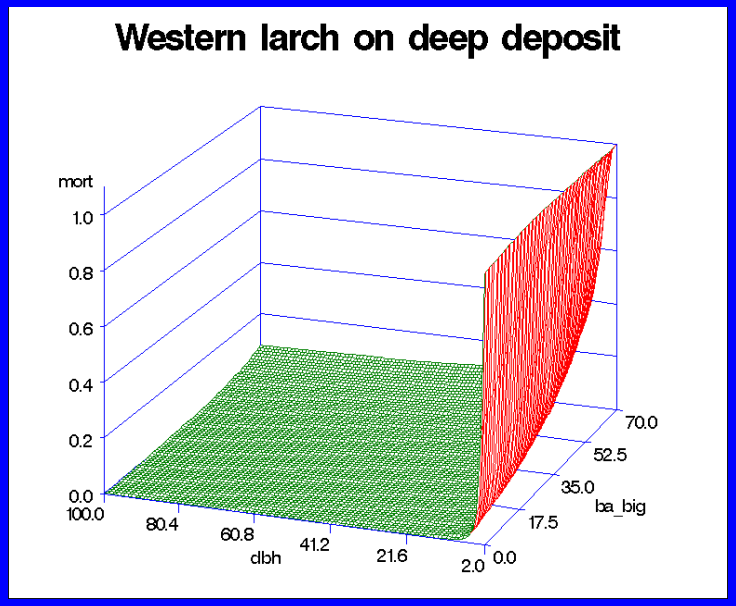


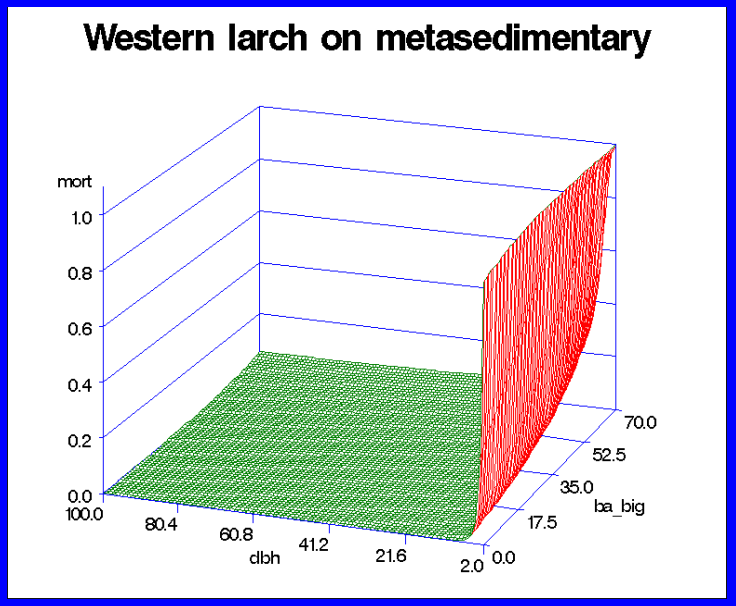


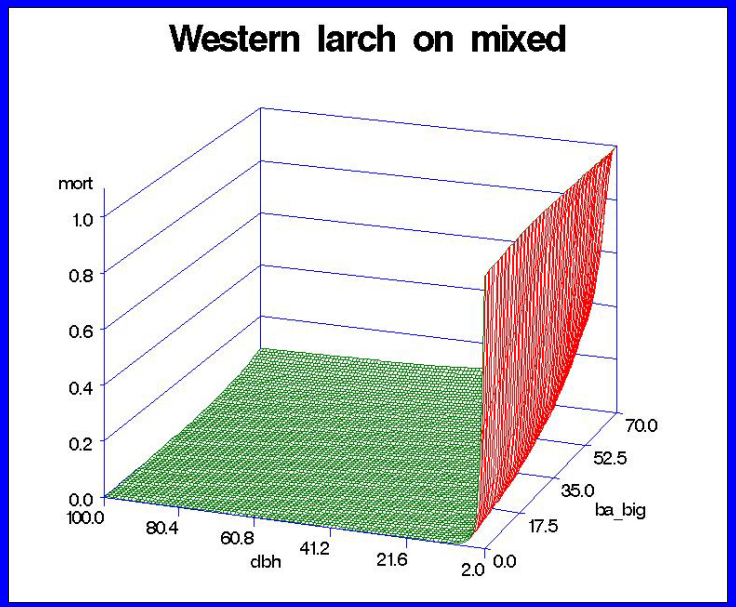


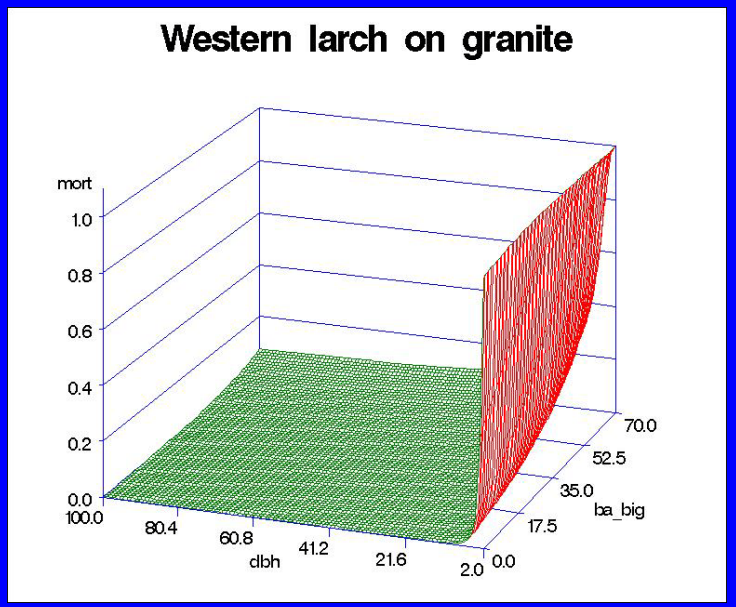


Western larch

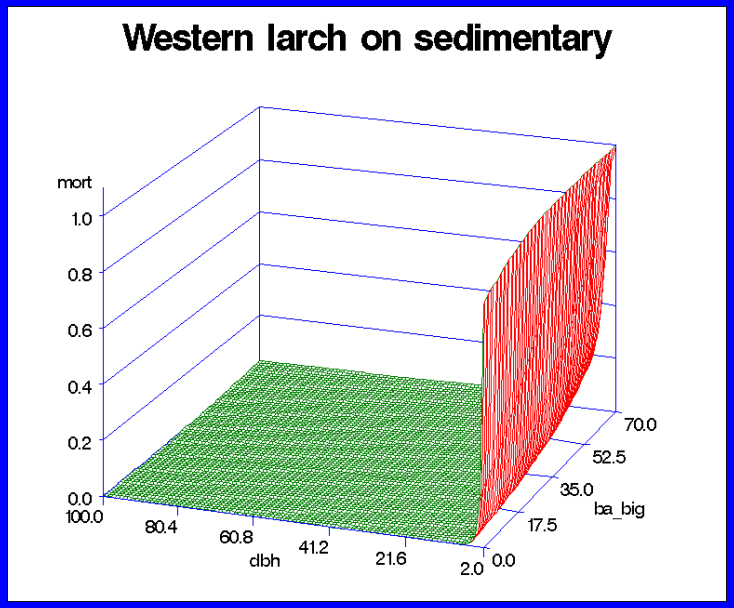


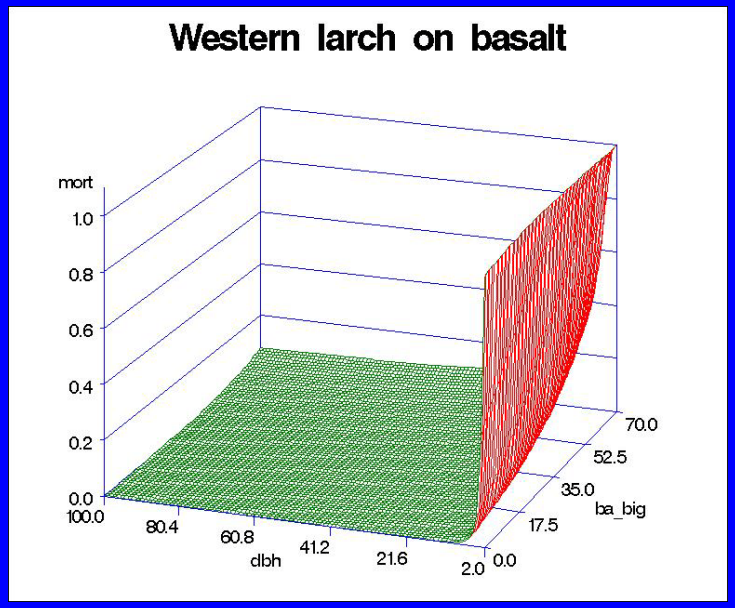




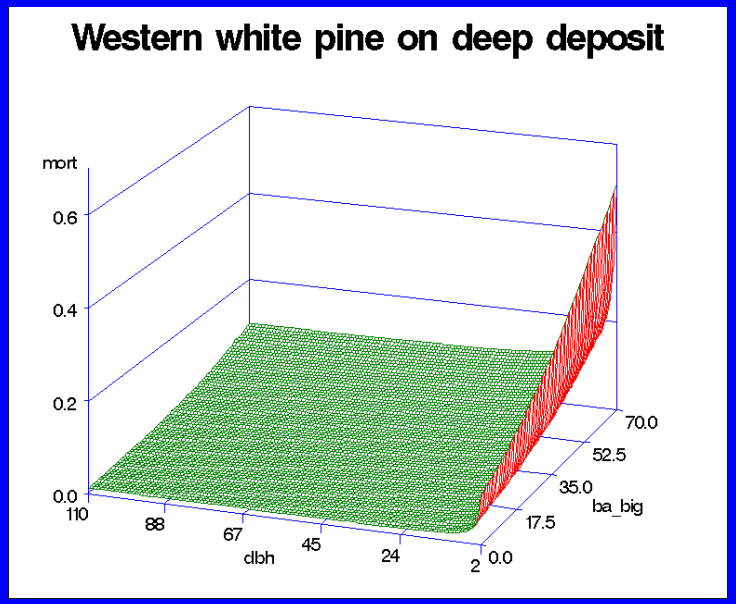


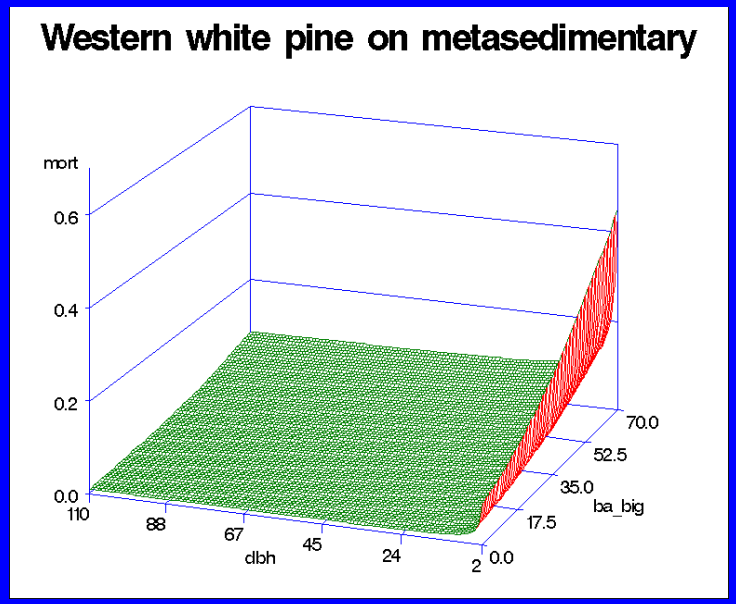
Western larch

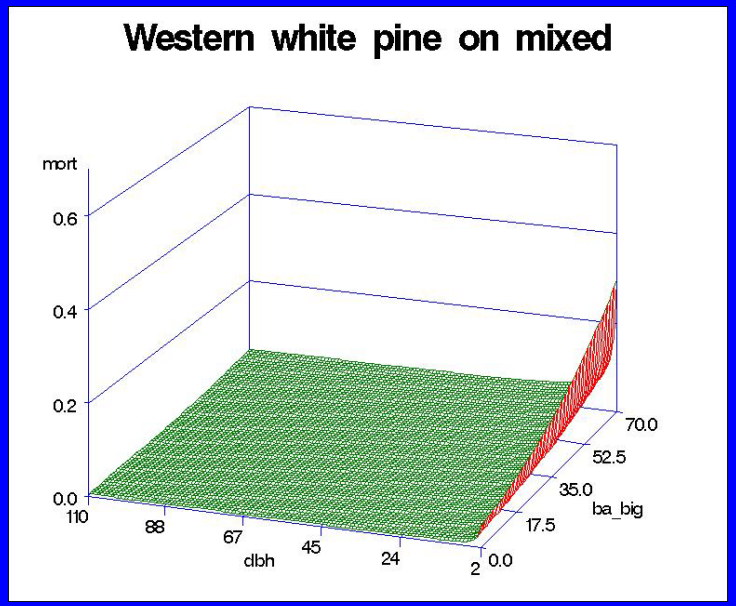


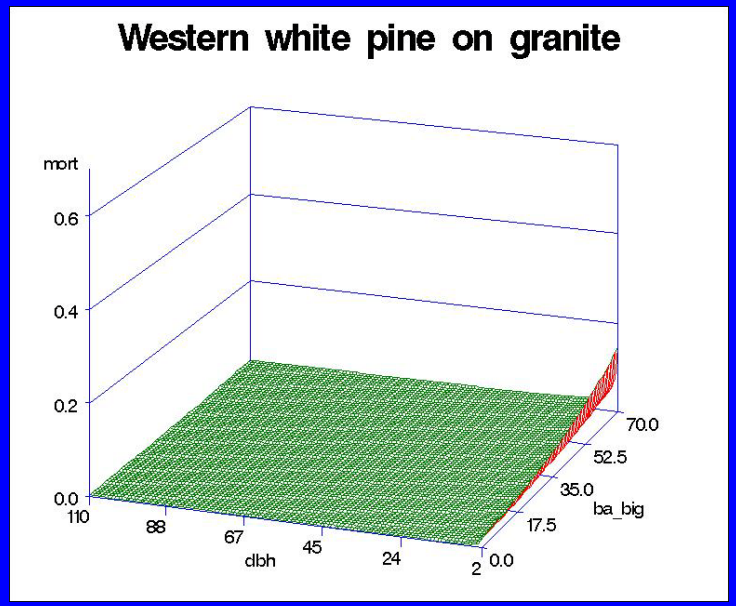


Western white pine

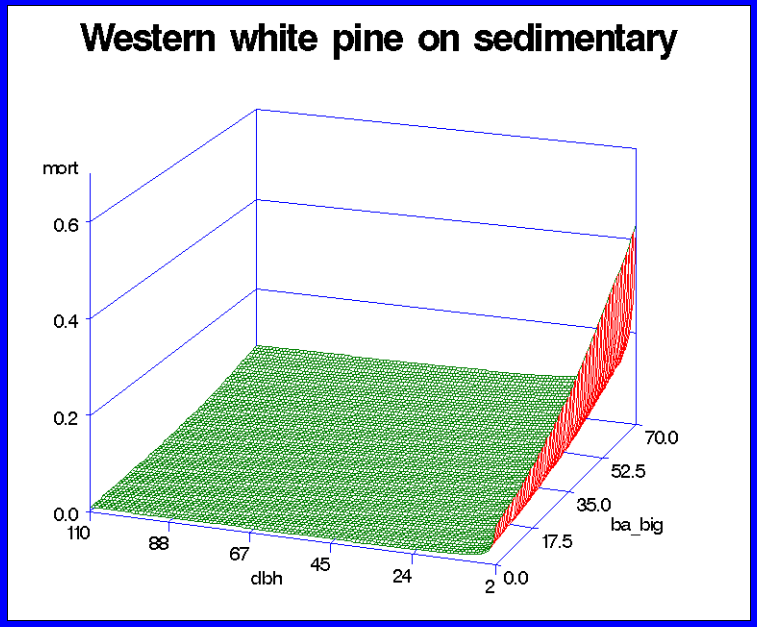








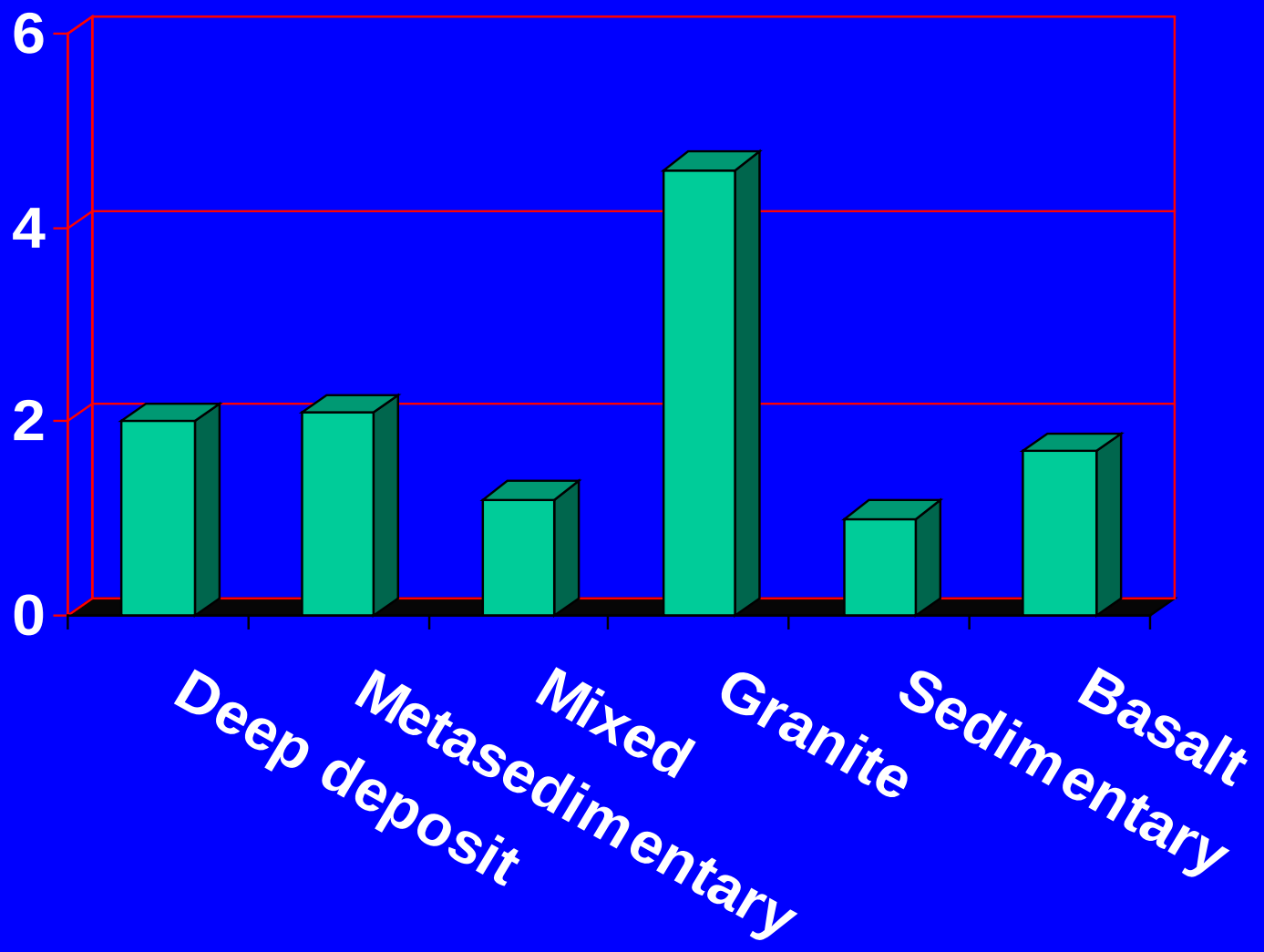
Western white pine



Conclusions

- Significant difference among species in individual tree mortality.
- Significant difference in tree mortality by rock type for all species except western hemlock.
- Western larch mortality was mainly due to competition.
- Western hemlock mortality was low for all rock types and competitive status situations.
- White pine mortality was high, likely due to blister rust.

Grand fir


6
4
2
0
Deep deposit
Metasedimentary
Mixed
Granite
Sedimentary
Basalt

Western red cedar