GROWTH TABLES OF IMPORTANT COPPICE ORIGIN SPECIES FOR MADHYA PRADESH

Dr. G. Krishnamurthy
(Director)

Richa Seth
(Senior Research Officer)

Forest Mensuration and Statistics Branch
State Forest Research Institute
Jabalpur (M.P.)
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G. Krishanmurthy IFS
(Director)

Richa Seth
(Senior Research Officer)

A.K. Hajari
(ACF) RETD

M.K. Parihar
(ACF) RETD

Associates
S.P.S. Mehta
Mahesh P. Soni
Rajesh Upadhyay

Forest Mensuration and Statistics Branch
STATE FOREST RESEARCH INSTITUTE
JABALPUR (M.P.)
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I. INTRODUCTION

The State Forest Department has earmarked sizeable chunks of forest areas to village level JFM committees. These JFM committees have been assigned the responsibilities of protection and management of allotted forest areas. Most of these forests being located in the vicinity of villages are in degraded condition and so managed under CWR system. The treatment prescribed for these areas generally comprises of cutting back of pollard and malformed crop, stump dressing to allow emergence of coppice shoots, singling of coppice shoots, removal of lantana & other weeds and protection from grazing and fire with the willing cooperation of JFMC members. The area is regenerated mainly through coppice. Effective and active management of these forests through JFM is possible only when the JFMC members get sustainable yield/income from these areas.

Although teak and sal are the most valuable and good coppicing timber species, miscellaneous species are of utmost importance from the point of view of ecology, environment and biodiversity conservation. These species are not only important for timber and fuel production but also are the sources of medicines and host of other minor forest products which form the basis of livelihood for forest dependent poor villagers. Therefore, the role of miscellaneous species can not be ignored in the sustainable management of these forests. For micro-planning of these areas and estimation of intermediate and final yields, it is essential to have knowledge of growth trends of the coppice origin plants of economically important miscellaneous tree species also, which is currently lacking. The study aimed to conduct growth studies of coppice origin plants by laying out sample plots in RDF areas worked during last few years in different forest types i.e. Sal, teak and miscellaneous.

2. STUDY SITES

The sites at which the study was conducted were:-

S.no	Forest type	Division
1	Miscellaneous	South Balaghat
2	Sal	Umariya
3	Teak	Narsinghpur

3. METHODOLOGY:

Methodology consisted of the following steps:-

I. Information was collected about RDF areas worked in different years in various forest divisions of Madhya Pradesh, and one division in each forest type was selected.

II. Selected divisions were visited by the project team with concerned field staff.

III. Thereafter, suitable sites were selected on the basis of approach and availability of uniform patches for laying out sample plots.

IV. In every selected division coppicing species available in abundance were selected for this study.

V. Temporary sample plots were laid out in RDF areas of these divisions in felled coupes.

VI. Basic information about the sample plots such as area, position, rock, soil, humus, type of forest etc. was recorded

VII. Information about the situation of the sample plot such as forest range, compartment no. beat, felling series, and coupe no.was recorded.

VIII. Growth data of coppice origin plants of all the species available in the plot were collected.

IX. In each sample plot for every coppicing species data were collected for every girth class ie 0-10 cm, 11-20 cm, 21-30 cm etc.

X. The number of coppice stems was recorded for every stump of the specified species. Collar girth / GBH and height of every coppice stem were also recorded. If any stump didn't have any coppice stem then it was recorded from outside the plot.

XI. After recording the information about the coppices, species wise and girth class wise abstract was prepared. This procedure was repeated for every species found.

XII. Similarly, the girth class wise and height class wise abstracts were prepared . This information was recorded for all the species inside the plot. Stump's girth is recorded in appropriate girth class and stump's height was entered in (0-10 cm, 11-20 cm, 21-30 cm, and above 31cm height classes). This information is useful in finding out the no of coppices found on stump's of different heights.

XIII. For every girth class mean collar girth was calculated using the formula given below:-

Mean collar girth (MCG)(L-H) = $\frac{\sqrt{G_1^2 + G_2^2 + \ldots\ldots\ldots\ldots\ldots\ldots + G_n^2}}{n}$

Where Gi = Collar girth of 1st coppice shoot of that girth class.

n = Total no. of shoots (stems) in that particular girth class.

L = Lower limit of the girth class

H = Higher limit of that girth class

XIV. On the basis of the available information mean coppice shoot was calculated.

XV. The mean coppice shoot calculated above was cut down and its volume was recorded .

XVI. For calculating the volume of mean coppice shoot separate abstract was prepared for each species.

XVII. Volume of mean coppice shoot calculated for different girth classes was shown separately for each girth class.

XVIII. The collected data was compiled and different growth parameters were computed and correlated using best fit regression equations.

XIX. For volume calculation of mean coppice shoot, the shoot was cut into small pieces of 2 m length. The volume calculation was done using the formula- (G2 X L)/4?

Where, G = Mid girth in cm

L = Length of the piece in meter

? = 3.14

XX. In this way all the mean coppice volumes were calculated for all the species of RDF areas felled out in last twenty years.

XXI. Growth tables were prepared using the computed growth indicators.

4. Best fit equation for different Species between Age and growth parameters

Using the available data the best fit curves were drawn for Age V/s Collar girth, Age V/s height and Age V/s volume the best fit equations and correlation cofficient for all the species are given below.

a. Best fit regression equations having maximum correlation coefficient between Age and collar Girth

S.N.	Species	Equation	R^2
1	Saja	$MCG = 8.8026 \times (AGE)^{0.5246}$	0.8922
2	Garari	$MCG = 5.77 \times (AGE)^{0.63}$	0.97
3	Lendiya	$MCG = 8.1518 \times (AGE)^{0.5017}$	0.8864
4	Dhawada	$MCG = 6.25881 \times (AGE)^{0.63949}$	0.87027
5	Sal	$MCG = 5.8496 \times (AGE)^{0.6769}$	0.8243
6	Teak	$MCG = 4.7309 \times (AGE)^{0.7365}$	0.8917
7	Bhirra	$MCG = 5.7394 \times (AGE)^{0.6094}$	0.8331

b. Best fit regression equations having maximum correlation cofficient between Age and Mean Height

S.N.	Species	Equation	R^2
1	Saja	$Mean\ Height = 0.0003 \times (AGE)^{1.6219}$	0.9090
2	Garari	$Mean\ Height = 0.00076 \times (AGE)^{1.20803}$	0.90084
3	Lendiya	$Mean\ Height = 1.1696 \times (AGE)^{0.5527}$	0.8669
4	Dhawada	$Mean\ Height = 1.173x\ (AGE)^{0.5788}$	0.9171
5	Sal	$Mean\ Height = 1.1807 \times (AGE)^{0.4676}$	0.7772
6	Teak	$Mean\ Height = 0.7045 \times (AGE)^{0.801}$	0.8822
7	Bhirra	$Mean\ Height = 0.7572x\ (AGE)^{0.6748}$	0.9026

C. Best fit regression equations having maximum correlation cofficient between Age and Mean Volume

S.N.	Species	Equation	R2
1	Saja	Mean Volume = 1.233 x $(AGE)^{0.5579}$	0.8653
2	Garari	Mean Volume = 0.8433 x $(AGE)^{0.6786}$	0.8628
3	Lendiya	Mean Volume= 0.00060 x $(AGE)^{1.26911}$	0.90185
4	Dhawada	Mean Volume = 0.00022 x $(AGE)^{1.73079}$	0.83606
5	Sal	Mean Volume = 0.0003 x $(AGE)^{1.6053}$	0.8427
6	Teak	Mean Volume = 0.00042 x $(AGE)^{1.62560}$	0.88743
7	Bhirra	Mean Volume = 8E-05x $(AGE)^{1.8401}$	0.7412

5. Growth tables for different species using best fit Equations

Using the best fit equation found out from the best fit curves the growth of various miscellaneous species at different ages have been computed and on the basis of values obtained, growth tables have been prepared which are given below:-

a. Estimated growth table for Saja

Age (year)	Mean Collar girth(cm)	Mean Height(m)	Mean Volume (cmt)
1	8.8	1.2	0.0003
2	12.7	1.8	0.0009
3	15.7	2.3	0.0018
4	18.2	2.7	0.0028
5	20.5	3.0	0.0041
6	22.5	3.3	0.0055
7	24.4	3.6	0.0070
8	26.2	3.9	0.0087
9	27.8	4.2	0.0106
10	29.4	4.4	0.0126
11	30.9	4.7	0.0147
12	32.4	4.9	0.0169
13	33.8	5.1	0.0192
14	35.1	5.4	0.0217
15	36.4	5.6	0.0242
16	37.6	5.8	0.0269
17	38.8	6.0	0.0297
18	40.0	6.2	0.0326
19	41.2	6.4	0.0356
20	42.3	6.5	0.0387
21	43.4	6.7	0.0418
22	44.5	6.9	0.0451
23	45.5	7.1	0.0485
24	46.5	7.2	0.0520
25	47.5	7.4	0.0555

b. Estimated growth table for Garari

Age (year)	Mean Collar girth(cm)	Mean Height (m)	Mean Volume (cmt)
1	5.8	0.8	0.0008
2	8.9	1.3	0.0018
3	11.5	1.8	0.0029
4	13.8	2.2	0.0041
5	15.9	2.5	0.0053
6	17.8	2.8	0.0066
7	19.6	3.2	0.0080
8	21.4	3.5	0.0094
9	23.0	3.7	0.0108
10	24.6	4.0	0.0123
11	26.1	4.3	0.0138
12	27.6	4.5	0.0153
13	29.0	4.8	0.0168
14	30.4	5.0	0.0184
15	31.8	5.3	0.0200
16	33.1	5.5	0.0216
17	34.4	5.8	0.0233
18	35.6	6.0	0.0250
19	36.9	6.2	0.0266
20	38.1	6.4	0.0283
21	39.3	6.6	0.0301
22	40.4	6.9	0.0318
23	41.6	7.1	0.0336
24	42.7	7.3	0.0353
25	43.8	7.5	0.0371

c. Estimated growth table for Lendia

Age (year)	Mean Collar girth(cm)	Mean Height (m)	Mean Volume (cmt)
1	8.2	1.2	0.0006
2	11.5	1.7	0.0014
3	14.1	2.1	0.0024
4	16.3	2.5	0.0035
5	18.3	2.8	0.0046
6	20.0	3.1	0.0058
7	21.6	3.4	0.0071
8	23.1	3.7	0.0084
9	24.5	3.9	0.0098
10	25.8	4.2	0.0111
11	27.1	4.4	0.0126
12	28.3	4.6	0.0141
13	29.5	4.8	0.0156
14	30.6	5.0	0.0171
15	31.7	5.2	0.0187
16	32.7	5.4	0.0202
17	33.7	5.6	0.0219
18	34.7	5.8	0.0235
19	35.6	5.9	0.0252
20	36.6	6.1	0.0269
21	37.5	6.3	0.0286
22	38.3	6.4	0.0303
23	39.2	6.6	0.0321
24	40.1	6.8	0.0339
25	40.9	6.9	0.0357

d. Estimated growth table for Dhawda

Age (year)	Mean Collar girth(cm)	Mean Height (m)	Mean Volume (cmt)
1	6.3	1.2	0.0002
2	9.7	1.8	0.0007
3	12.6	2.2	0.0015
4	15.2	2.6	0.0024
5	17.5	3.0	0.0036
6	19.7	3.3	0.0049
7	21.7	3.6	0.0064
8	23.7	3.9	0.0080
9	25.5	4.2	0.0099
10	27.3	4.4	0.0118
11	29.0	4.7	0.0140
12	30.7	4.9	0.0162
13	32.3	5.2	0.0186
14	33.8	5.4	0.0212
15	35.4	5.6	0.0239
16	36.9	5.8	0.0267
17	38.3	6.0	0.0297
18	39.7	6.2	0.0327
19	41.1	6.4	0.0359
20	42.5	6.6	0.0393
21	43.9	6.8	0.0427
22	45.2	7.0	0.0463
23	46.5	7.2	0.0500
24	47.8	7.4	0.0539
25	49.0	7.6	0.0578

e. Estimated growth table for Sal

Age (y)	Mean Collar girth(cm)	Mean Height (m)	Mean Volume (cmt)
1	6.6	1.3	0.0003
2	10.3	1.8	0.0009
3	13.4	2.1	0.0017
4	16.1	2.4	0.0028
5	18.5	2.7	0.0040
6	20.8	2.9	0.0053
7	22.9	3.1	0.0068
8	25.0	3.3	0.0084
9	26.9	3.4	0.0102
10	28.8	3.6	0.0121
11	30.6	3.7	0.0141
12	32.3	3.9	0.0162
13	34.0	4.0	0.0184
14	35.7	4.1	0.0207
15	37.3	4.3	0.0232
16	38.8	4.4	0.0257
17	40.4	4.5	0.0283
18	41.9	4.6	0.0310
19	43.3	4.7	0.0338
20	44.8	4.8	0.0368
21	46.2	4.9	0.0397
22	47.6	5.0	0.0428
23	49.0	5.1	0.0460
24	50.3	5.2	0.0492
25	51.6	5.3	0.0526

f. Estimated growth table for Teak

Age (y)	Mean Collar girth(cm)	Mean Height (m)	Mean Volume (cmt)
1	4.73	0.70	0.0004
2	7.88	1.23	0.0013
3	10.62	1.70	0.0025
4	13.12	2.14	0.0040
5	15.46	2.56	0.0057
6	17.68	2.96	0.0077
7	19.81	3.35	0.0099
8	21.85	3.72	0.0123
9	23.83	4.09	0.0149
10	25.75	4.45	0.0177
11	27.63	4.81	0.0207
12	29.45	5.15	0.0239
13	31.24	5.49	0.0272
14	32.99	5.83	0.0306
15	34.71	6.16	0.0343
16	36.40	6.49	0.0381
17	38.06	6.81	0.0420
18	39.70	7.13	0.0461
19	41.31	7.44	0.0503
20	42.90	7.76	0.0547
21	44.46	8.07	0.0592
22	46.01	8.37	0.0639
23	47.54	8.68	0.0687
24	49.06	8.98	0.0736
25	50.55	9.28	0.0787

g. Estimated growth table for Bhirra

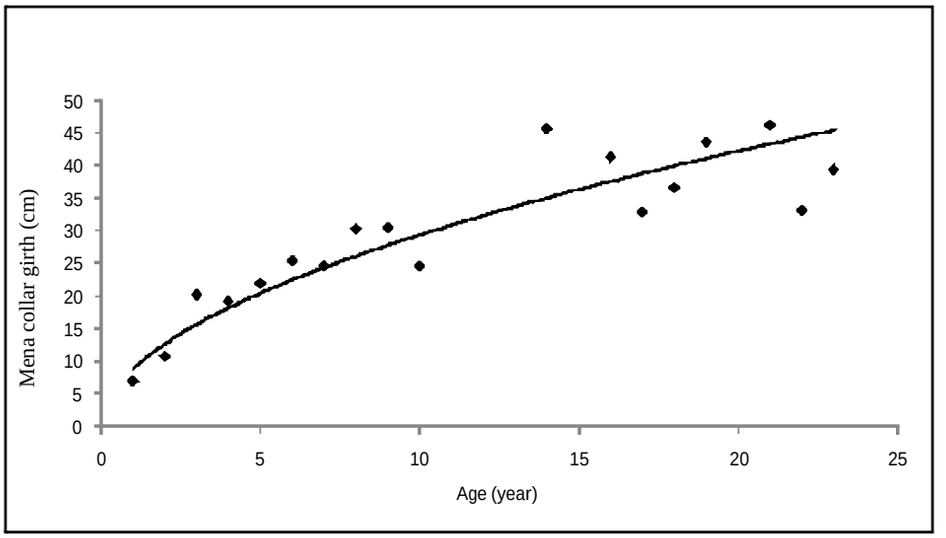
Age (year)	Mean Collar girth(cm)	Mean Height (m)	Mean Volume (cmt)
1	5.7	0.8	0.0001
2	8.8	1.2	0.0003
3	11.2	1.6	0.0006
4	13.4	1.9	0.0010
5	15.3	2.2	0.0015
6	17.1	2.5	0.0022
7	18.8	2.8	0.0029
8	20.4	3.1	0.0037
9	21.9	3.3	0.0046
10	23.3	3.6	0.0055
11	24.7	3.8	0.0066
12	26.1	4.0	0.0077
13	27.4	4.3	0.0090
14	28.6	4.5	0.0103
15	29.9	4.7	0.0117
16	31.1	4.9	0.0131
17	32.2	5.1	0.0147
18	33.4	5.3	0.0163
19	34.5	5.5	0.0180
20	35.6	5.7	0.0198
21	36.6	5.9	0.0217
22	37.7	6.1	0.0236
23	38.7	6.3	0.0256
24	39.8	6.4	0.0277
25	40.8	6.6	0.0299

6. Best fit curves between age and other growth parameters for different species.

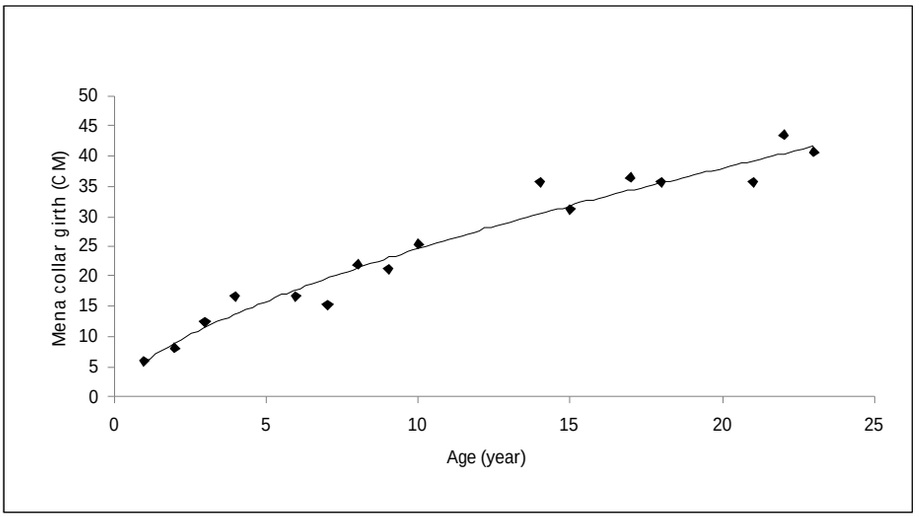
The growth data recorded were put on the graph and best fit curves were drawn out between age and other growth parameter curves for each species studied are given below:

a. Best fit curve between Age and Mean collar girth.

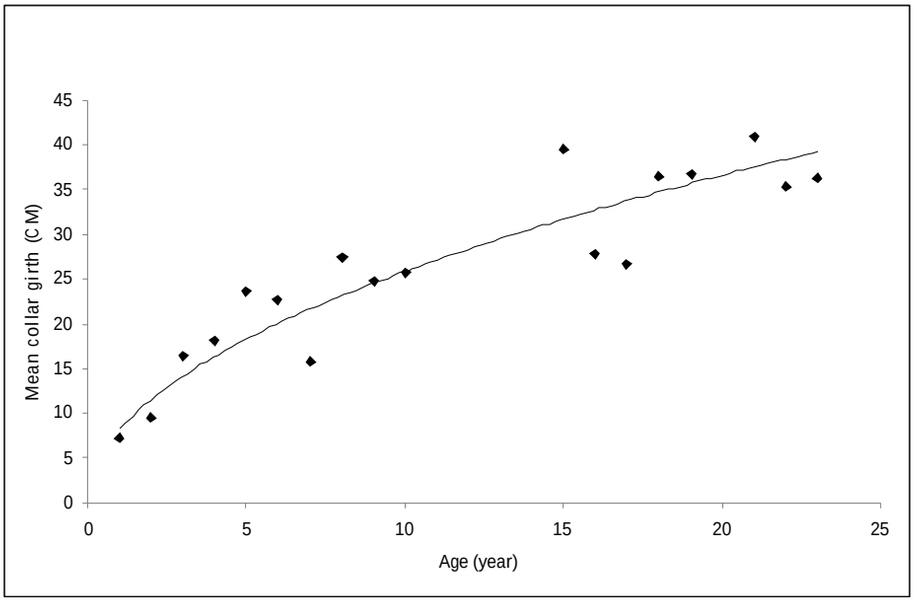
1(a). Age versus Mean Collar girth - Saja



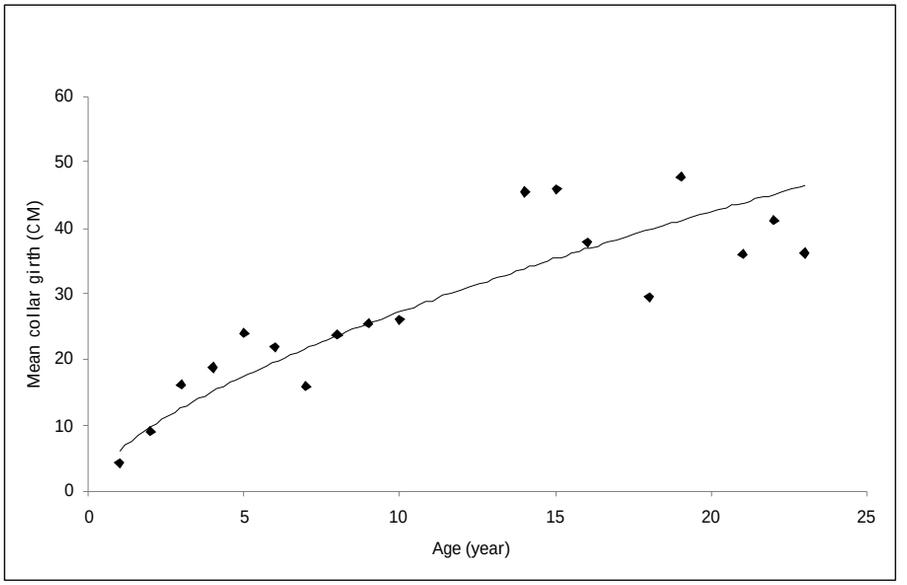
2(a). Age versus Mean Collar girth - Garari



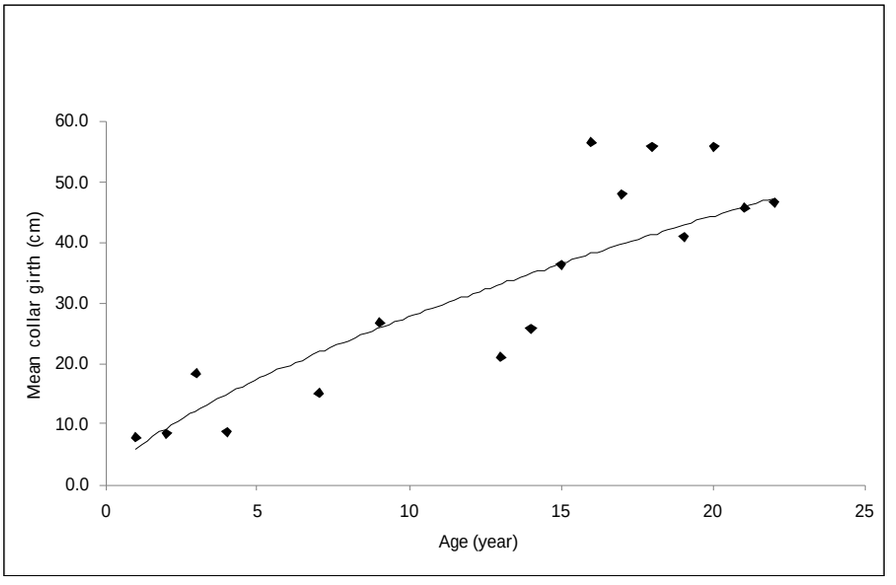
3(a). Age Versus Mean Collar girth Lendia



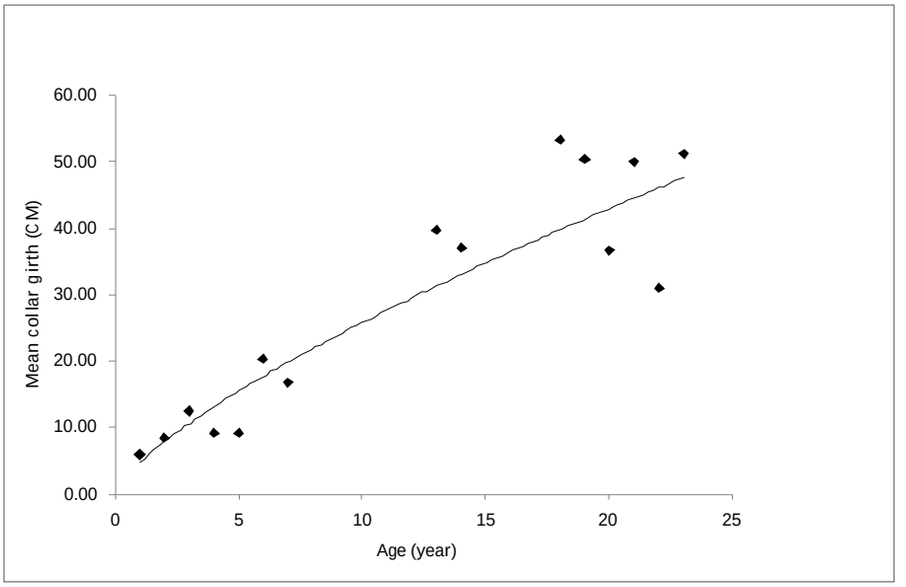
4(a). Age versus Mean Collar girth - Dhawda



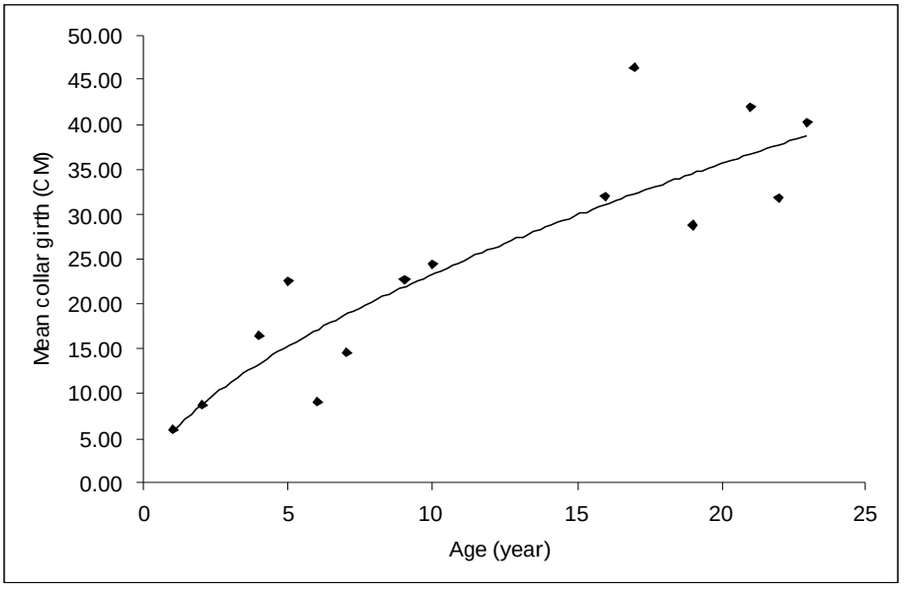
5(a). Age versus Mean Collar girth - Sal



6(a). Age versus Mean Collar girth - Teak

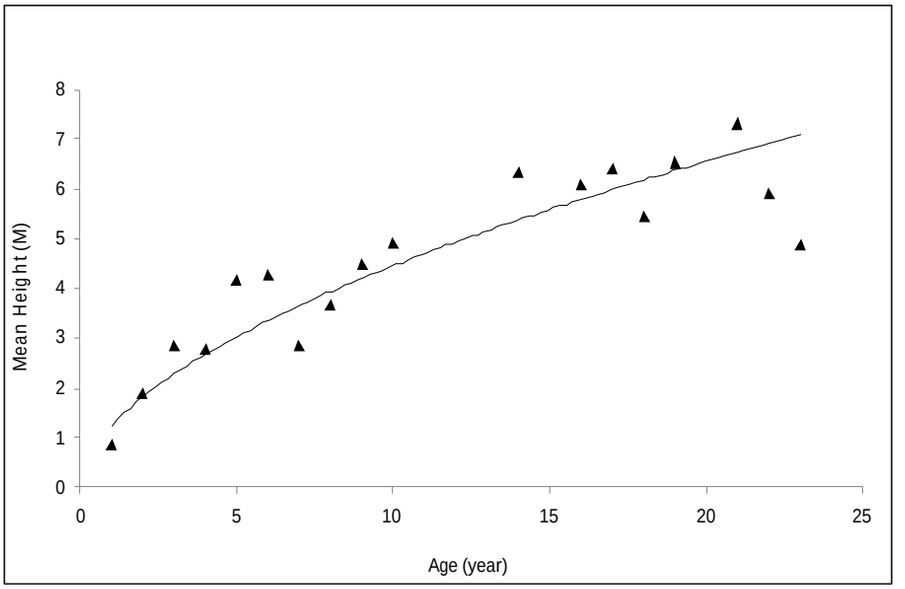


7(a). Age versus Mean Collar girth - Bhirra

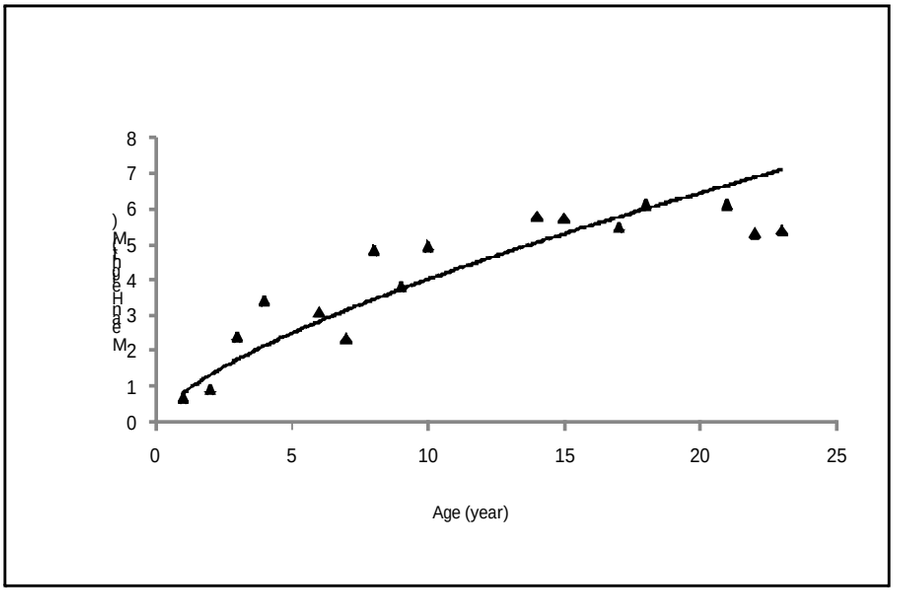


b. Best fit curves between Age and Mean collar Height.

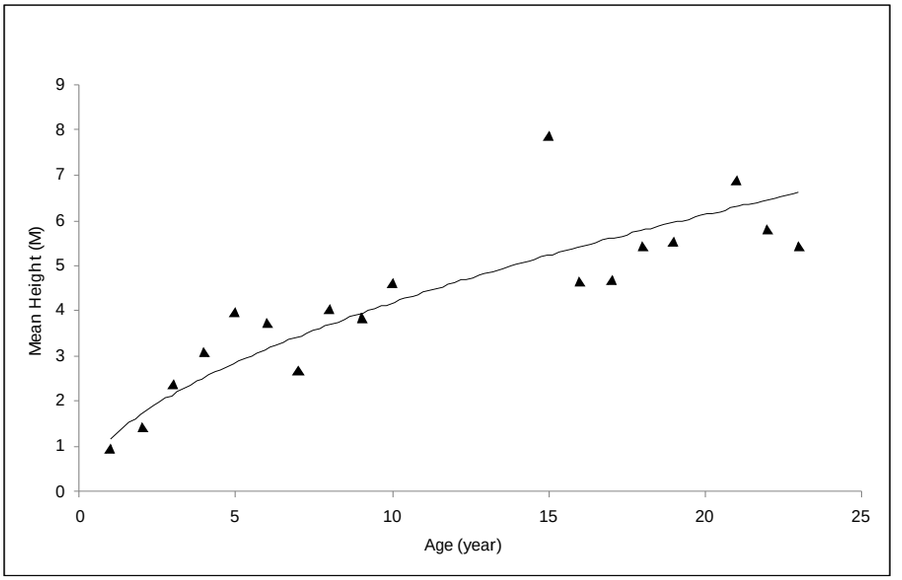
1(b). Age versus Mean Height - Saja



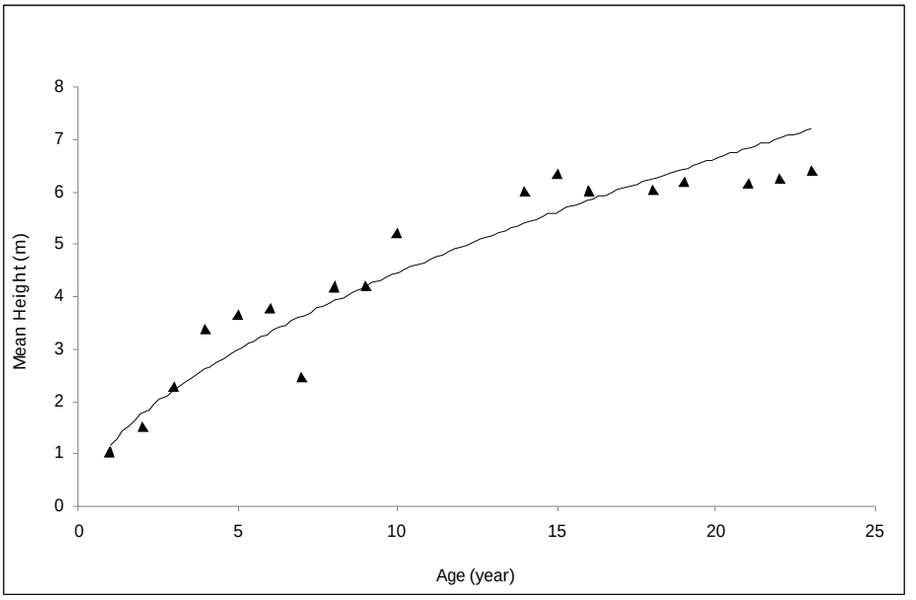
2(b). Age versus Mean Height - Garari



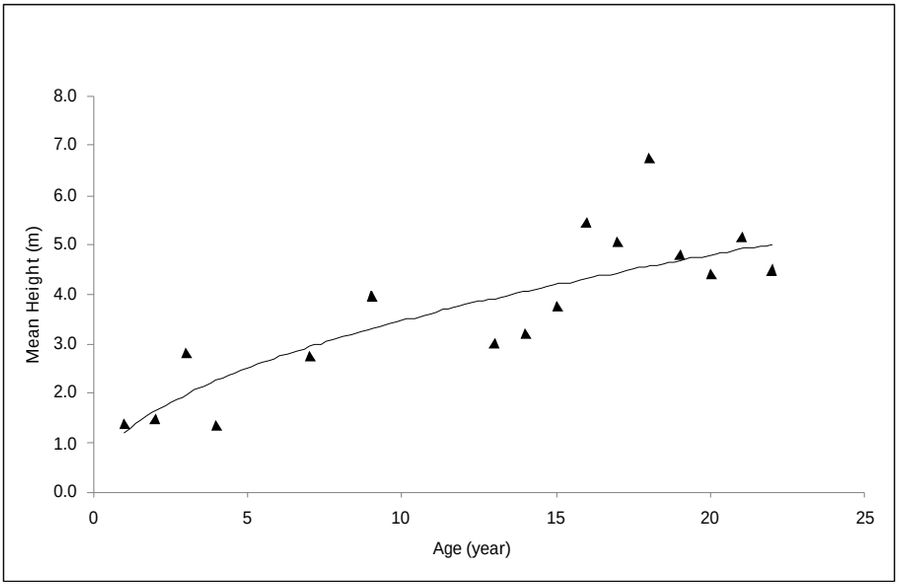
3(b). Age versus Mean Height - Lendia



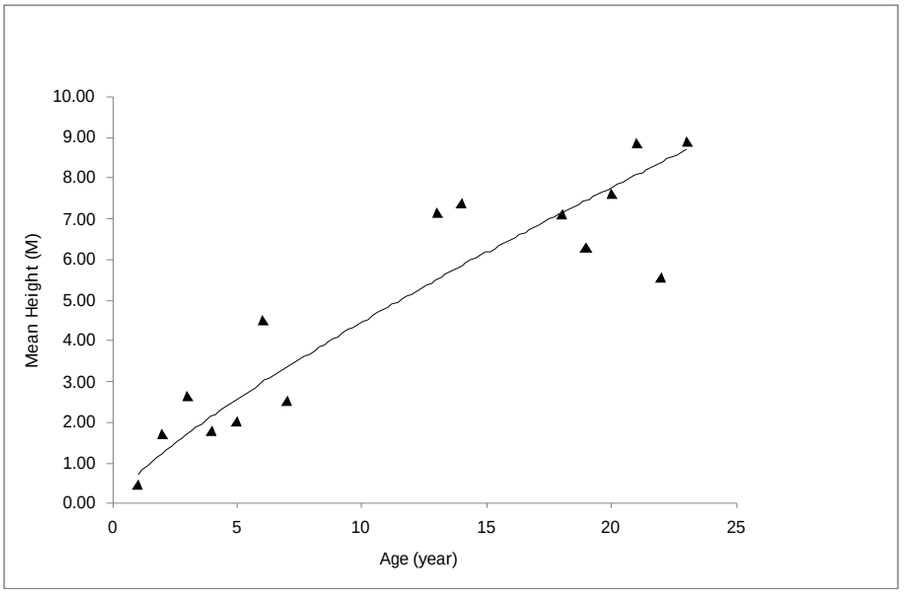
4(b). Age versus Mean Height - Dhawda



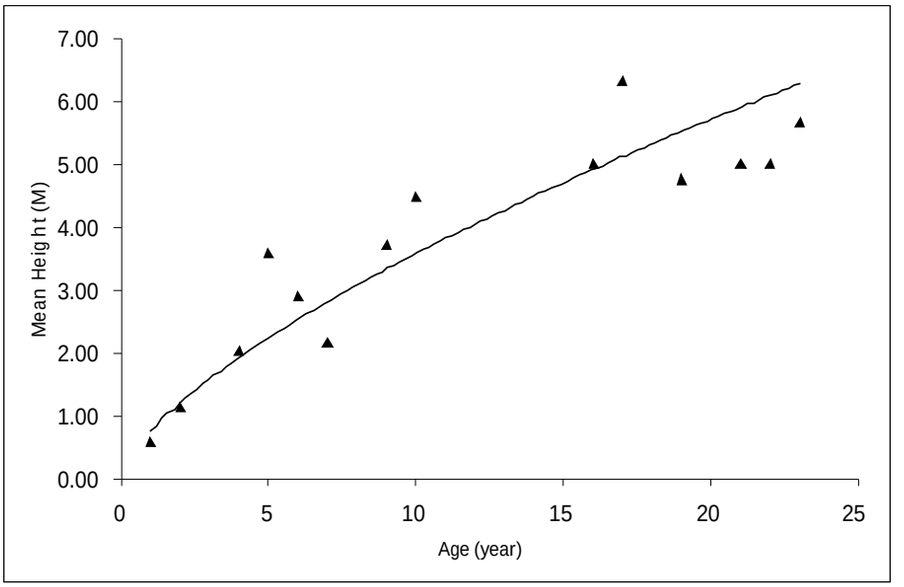
5(b). Age versus Mean Height -Sal



6(b). Age versus Mean Height -Teak

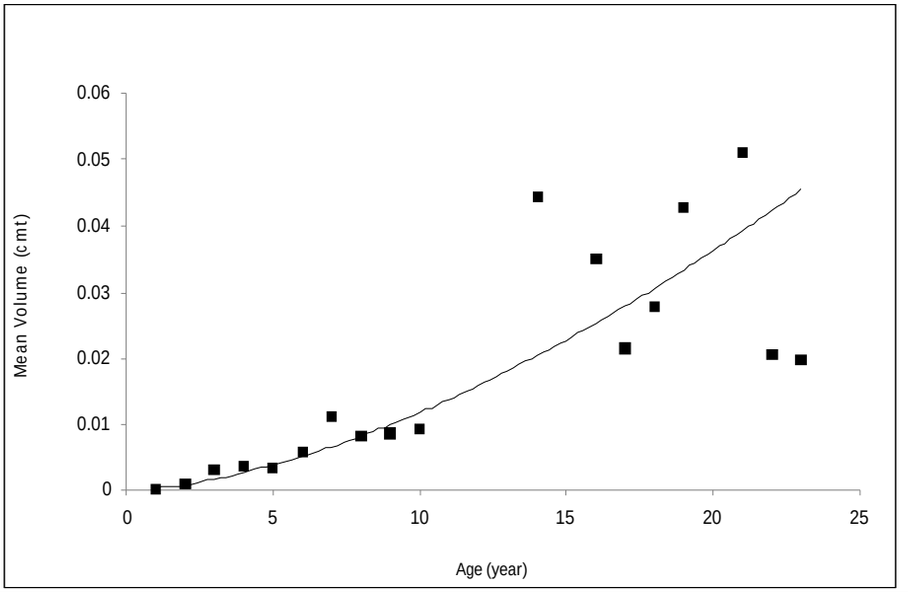


7(b). Age versus Mean Height -Bhirra

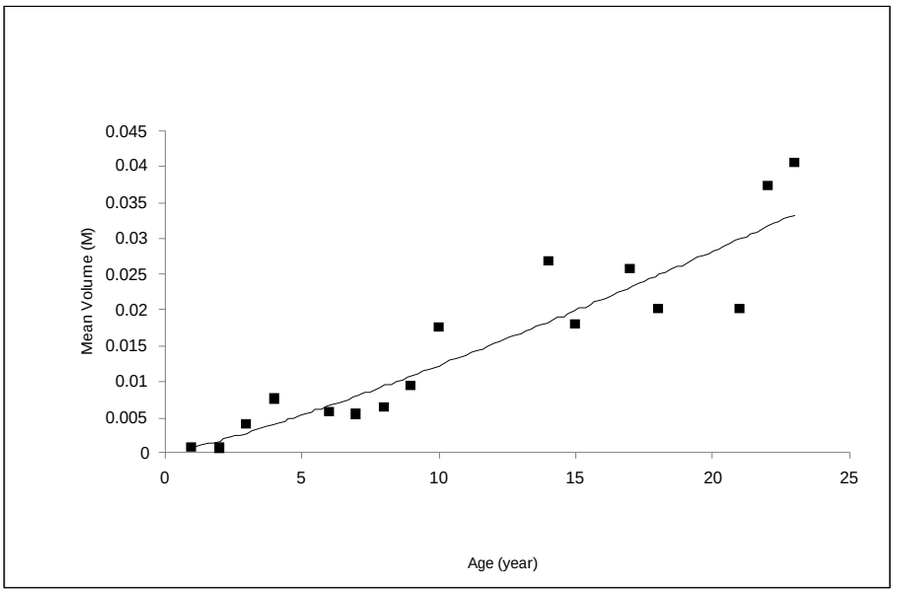


c. Best fit curves between Age and Mean collar Volume.

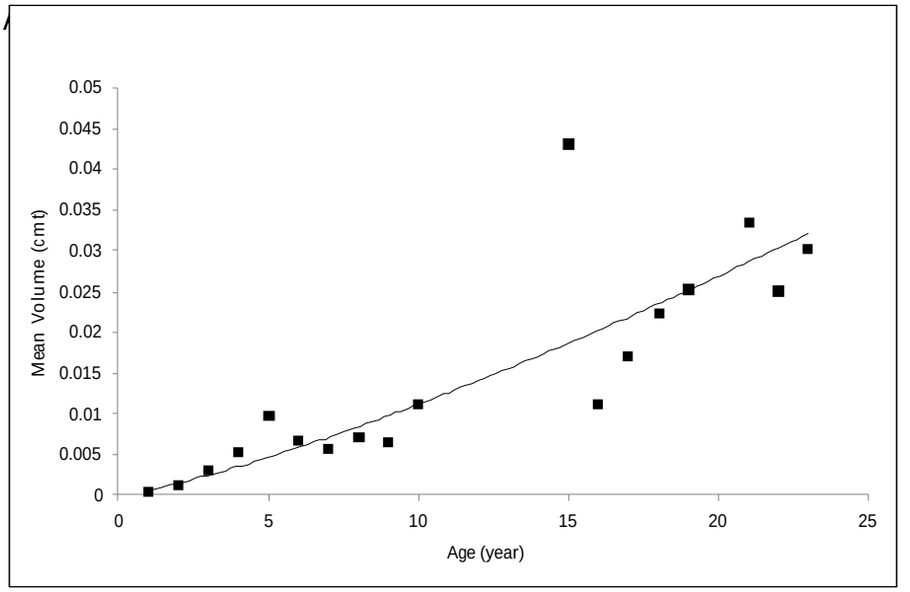
1(c). Age versus Mean Volume -Saja



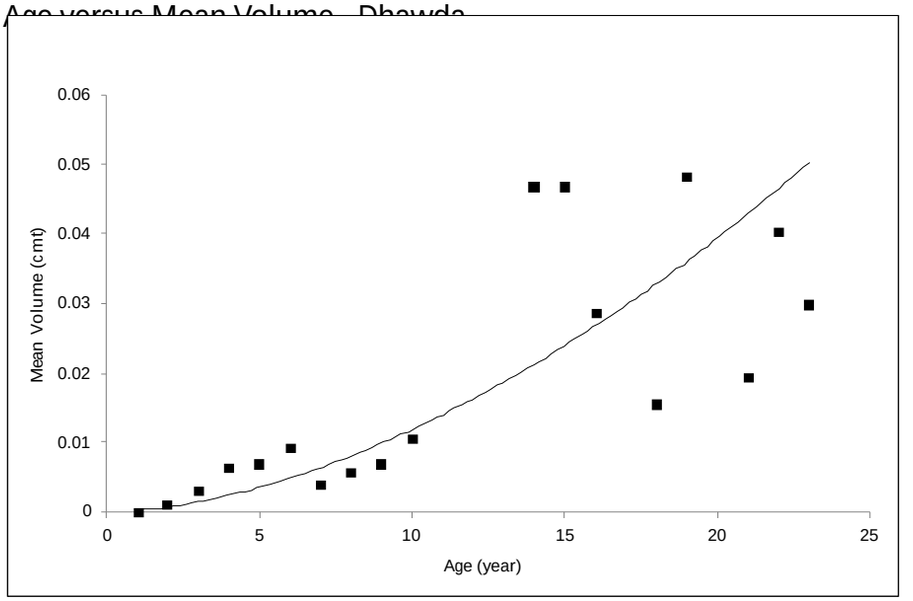
2(c). Age versus Mean Volume - Garari



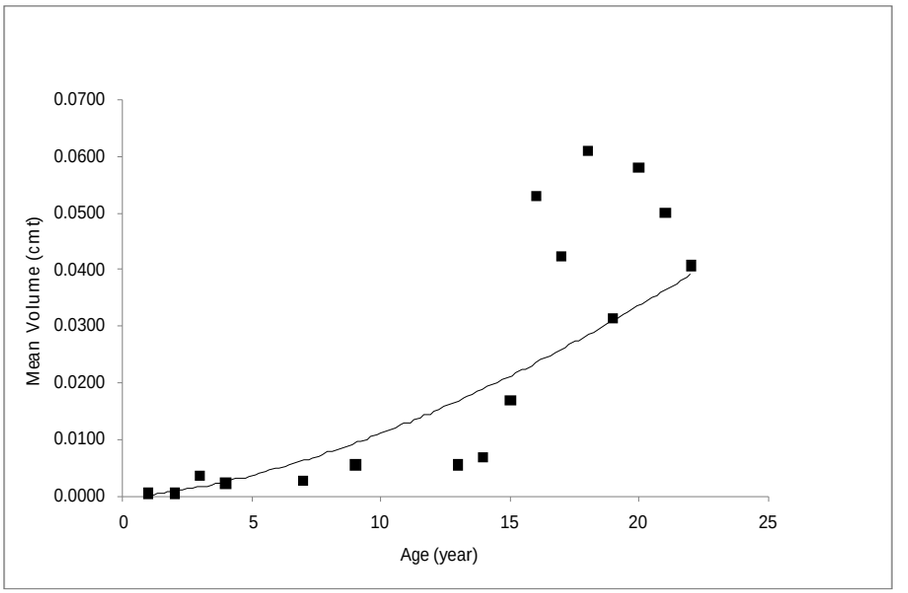
3(c). A



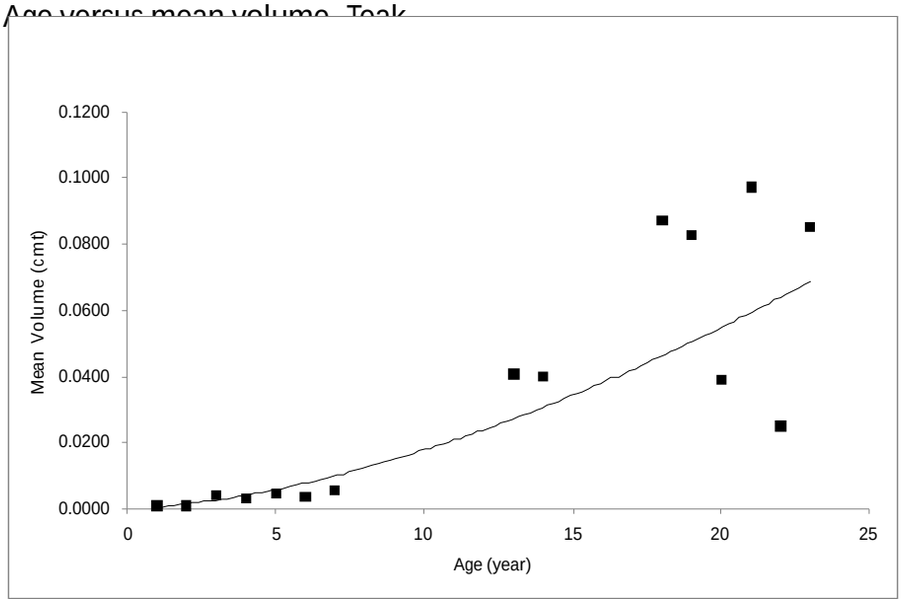
4(c). Age versus Mean Volume - Dhawda



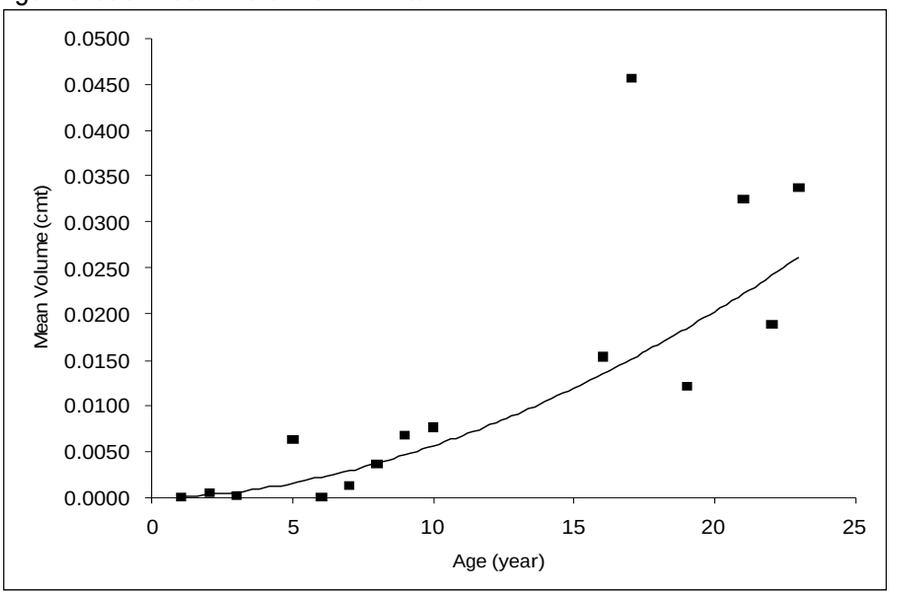
5(c). Age versus Mean Volume -Sal



6(c). Age versus mean volume -Teak



7(c). Age versus Mean Volume -Bhirra



7. Some Important Conclusions

a. Age Vs Mean Collar girth

When we look at the best fit curves of each species the following inferences are obvious:-

All Species ie Saja, Garari, Lendia, Dhawda, Bhirra, Sal, Teak follow the increasing trend.

b. Age Vs Mean Height

All Species ie Saja, Garari, Lendia, Dhawda, Bhirra, Sal, Teak follow the same trend. The curves show an increasing trend.

c. Age Vs Mean Volume

All Species ie Saja, Garari, Lendia, Dhawda, Bhirra, Sal, Teak follow the same trend. The curves show an increasing trend, an obvious consequence of the two curves.