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Study of stand growth prediction model for natural forest in Papua New Guinea

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Background

Natural forest areas in Papua New Guinea (PNG) are depleted at a rate of 120,000 ha per annum due to the logging and other activities. A reduction in the log output from natural forests within the next ten years may be expected to drop in volume for both log export and local processing (PNGFA,1998). To manage these natural forests for timber production has been somewhat difficult. There are several reasons but the most important is that there is very little information available on the growth and yield of the natural forests of PNG. Growth of natural forest is difficult to predict, because its structure is complicated. However, growth prediction is very important for natural forest management in PNG.

Objective

The purpose of this paper is to show stand structure and stand growth characteristics of the two sites in PNG. These characteristics are some of the important parameters engaged in the processes of constructing stand growth model for natural forests.

Methodology

In each plot, a total number of trees in the beginning and at the end of the period are given. Number of trees dead, recruited and growth of each DBH class or relationship between DBH and Periodic Mean Annual diameter Increment (PMAI) with the characteristics of PMAI in each DBH class for all species groups are presented. It is anticipated that the study of stand growth model will predict (i) annual growth in terms of stem numbers, volume, and basal area, (ii) predict stand dynamics for periods of up to 60 yrs , (iii) predict diameter transition probability and(iv) providing decision – support in yield regulation through the simulation of different harvesting prescriptions.

Study Sites

The locations of research sites are in PNG (Fig.1), Manus (4 one-ha plots) (146 ° 44-48 ´ E, 1-2 ° 01-59 ´ S) and Gumi (4) (146 ° 55-58 ´ E, 7 ° 29-30 ´ S).

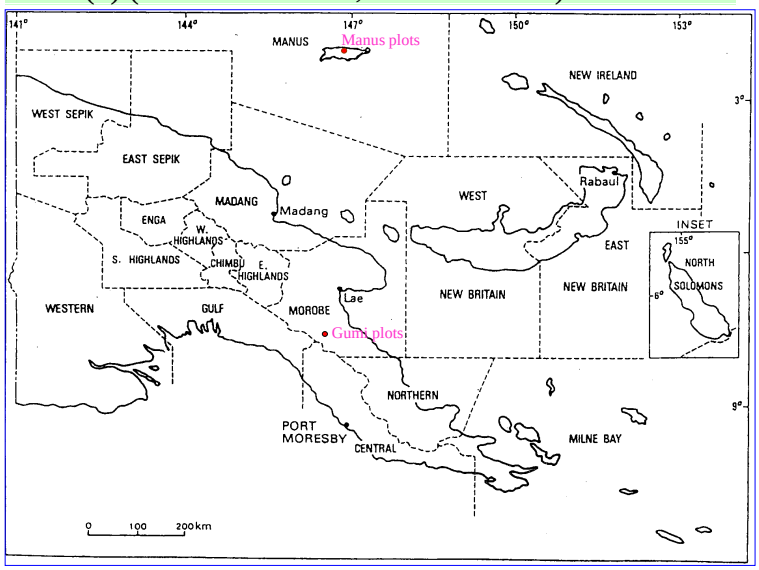


Figure 1. Location of research sites in PNG

Results and Discussion.

The species composition of the four plots varies from site to site. Species in Gumi ranged from 47 to 64, while in Manus is from 37 to 53. In both sites, primary species (P) is dominant. BA ranges from 9.18 to 33.44 m^2/ha in Manus and 18.84 - 44.42 in Gumi. Recruitments in Gumi 3 and 4 are much higher compared to other plots because of high no. of secondary species recruitments. Mortalities in Gumi 3 and 4 include harvested logs and other natural or logging deaths (Table 1). Generally, DBH distribution at all sites showed decreasing exponential patterns (Peki & Ishibashi, 2001; Peki, 2001).

Gumi plots

Figure 2a-b show relationship between diameter and PMAI DBH growth in Gumi 2 and 3, this relationship is again compare in Figure 3a & 3b respectively, to see the mean, standard deviation and variance. In selective cut plot, it could be seen that the mean growth rate increases up to 45 cm DBH class.

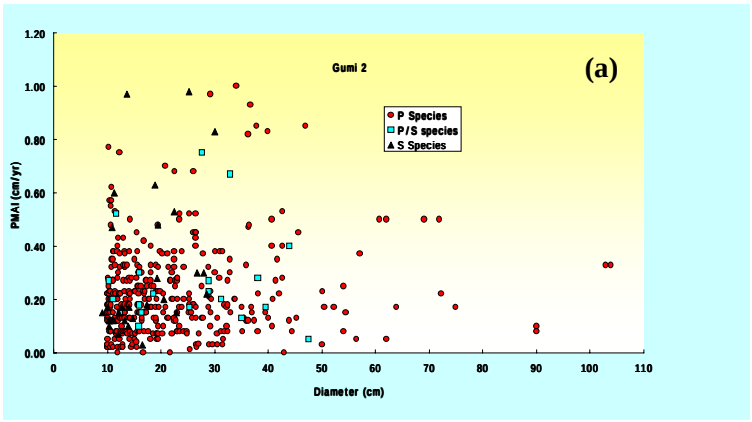
Table 1. Summary of stand characteristics

Plot ID	BA_1	N_1	BA_{rem}	N_{rem}	BA_{rec}	N_{rec}	BA_{mor}	N_{mor}	BA_2	N_2
Gumi 1	18.17	426	17.20	351	1.64	91	3.71	82	18.84	442
Gumi 2	28.28	517	26.35	440	1.45	70	5.59	92	27.80	510
Gumi 3	32.86	748	24.98	569	10.22	186	0.56	24	35.20	755
Gumi 4	43.98	730	28.72	554	15.70	178	0.11	8	44.42	732
Manus 1	10.39	217	8.24	153	0.94	55	4.08	66	9.18	208
Manus 2	10.39	217	8.24	153	4.08	66	0.94	55	12.32	219
Manus 3	33.71	463	33.42	449	0.02	2	1.13	14	33.14	451
Manus 4	31.46	472	32.83	462	0.04	4	0.82	10	32.87	466

Note:
BA = Basal area, N = No.of trees, 1 = initial observation, 2 = last observation, rem = remaining trees from 1, rec = recruited trees at 10 cm DBH, mor = total trees dead/logged (per/ha)

The mean is a combination for all species (Fig.3a).

This trend is similar in Gumi 1.Mean annual growth rates for Gumi 1 and 2 ranged from 0.20 to 0.45 cm/yr. In Gumi 3, growth rate was slower than in 1 and 2. It ranged from 0.10 to 0.20 cm/yr, with highest in 30 and 40 cm DBH class, again similar in Gumi 4(Fig.3b).



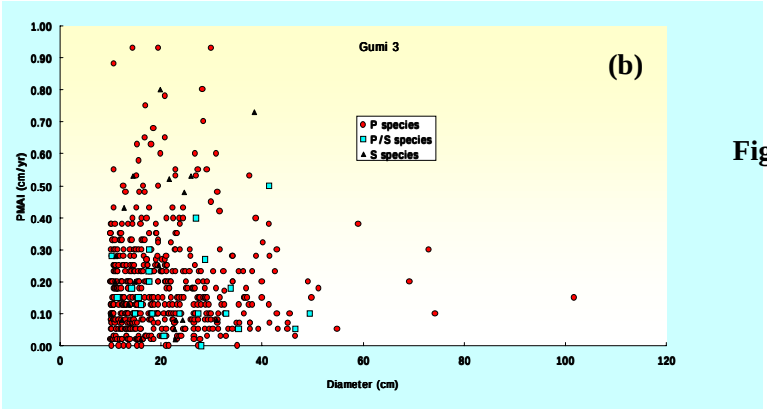
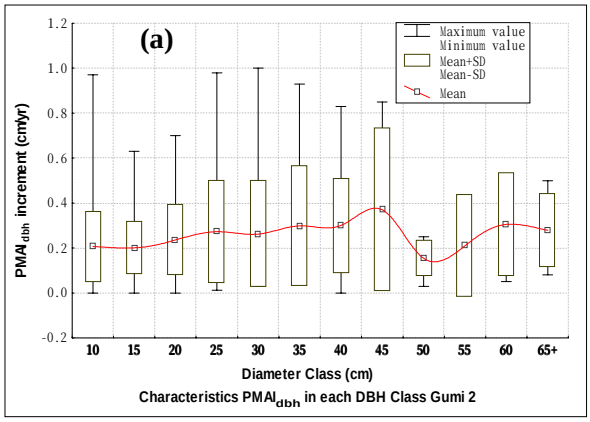


Figure 2a –b. Relationship between diameter and PMAI at Gumi



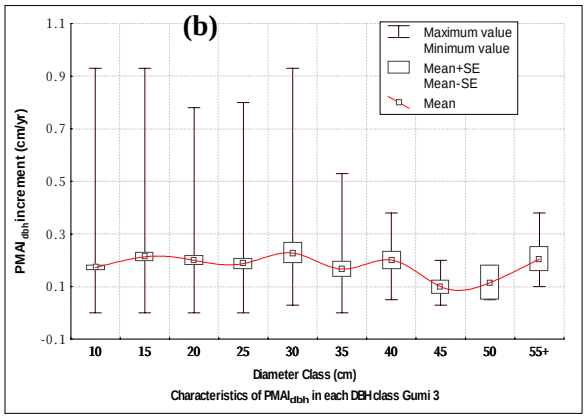


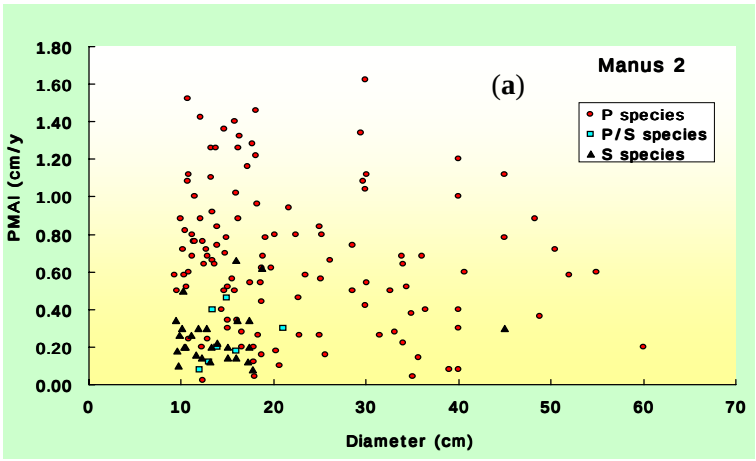
Figure 3a – b. Characteristics of PMAI in each DBH class in at Gumi

The mean growth rates as showed especially in selectively cut sites for all species combined was higher at 30 cm to 40 cm DBH. The DBH increment above 50 cm DBH is not clear most were deformed and lower in density (number of trees).

It was also noted that the growth rate of recruited trees especially the secondary species is much higher e.g. *Paraserianthes falcataria* (L.) Nielsen growth at Gumi 1 showed 3-6 cm per year.

Manus plots

In Manus selectively cut plots (1 and 2), PMAI for all species combined generally have highest increment in 25 cm and 40 cm DBH class respectively (0.80 cm and 0.70 cm/yr) (Fig.4a&5a). On the other hand, not cut plots (3 & 4), the PMAI showed somewhat steady increment and at 55 cm DBH class, there was a slight increase (0.25 cm – 0.5 cm/yr) (Fig. 4b &5b).



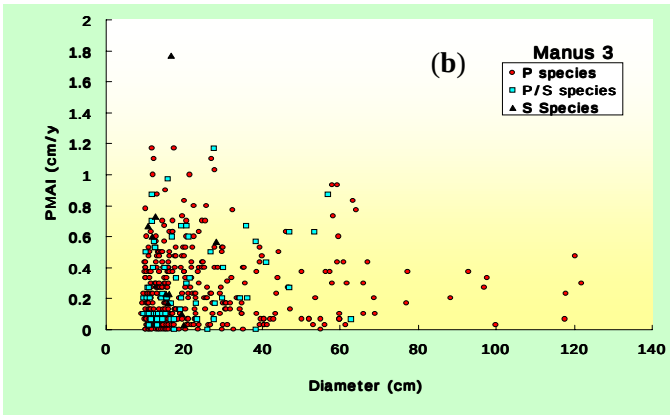
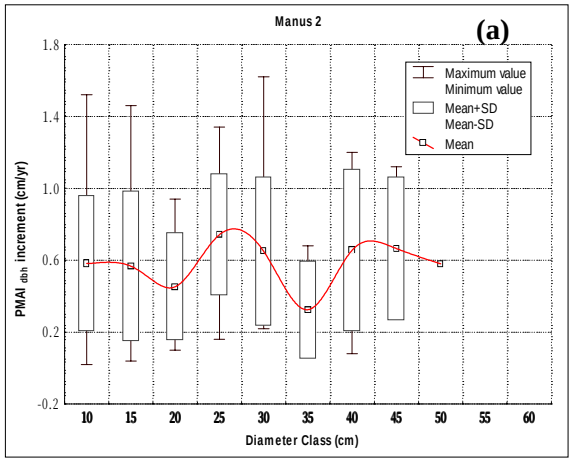


Figure 4a-b. Relationship between DBH and PMAI Manus



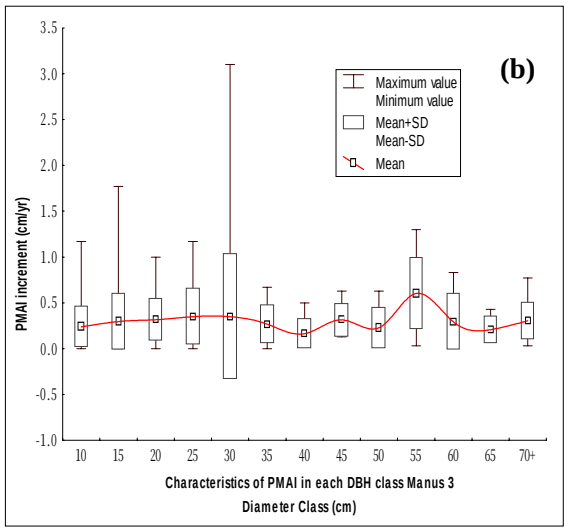


Figure 5a-b. Characteristics of PMAI in each DBH class at Manus plots

Conclusion

Diameter distributions in the two sites showed inverse J shape normally for natural forests. In uncut plots in Manus 3 &4, diameter increment is slower than the selectively cut sites in other plots. Analysis of stand characteristics in these two sites and from the other sites in PNG, it is imperative to say that to constructing stand growth model for natural forests It is important to consider major factors which influence tree growth should be taken into consideration when constructing a model. The four main factors include species, tree size, site condition and competition. After evaluating various expression of the above factors, the general growth function must be established. The independent variables include individual tree attributes and stand attributes.

References

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