A TIMBER INVENTORY OF THE

WAIAKEA TIMBER MANAGEMENT AREA

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Executive summary:

In 1997, the first comprehensive inventory of timber resources in the Waiakea Timber Management Area (WTMA) was conducted. Primary survey objectives included producing accurate forest type maps, estimating wood volume, and providing training for field crew members in timber inventory methodology.

Mapping efforts revealed that the WTMA was comprised of 228 timber stands, 28 forest types, and occupies 12,043 acres. Sampling was conducted on a systematic grid of fixed radius plots over the entire landscape. The grid was intensified in high volume *Flindersia brayleyana* stands to provide stronger estimates for this species of special commercial interest.

The sum of merchantable volume in all forest types exceeded 16,300,000 cubic feet, or approximately 81,500,000 board feet assuming a conversion factor of five board feet per cubic foot. The survey intensity and resulting volume and value analyses of this study were designed to provide guidelines for long-term forest management, and were not intended to be the sole basis for conducting timber sales.

Various eucalyptus species and Queensland maple appear to be well suited to the growing conditions found in the WTMA. Mean annual increment (MAI) values for these species ranged between 150-500 ft^3 $acre^{-1}$ $year^{-1}$. *Toona ciliata* and *Fraxinus uhdei* are not well adapted to site conditions within the WTMA, with mean annual increments typically less than 25 ft^3 $acre^{-1}$ $year^{-1}$.

Introduction:

From June to October, 1997, the Hawaii Forestry and Communities Initiative (HFCI) timber survey crew conducted an inventory of timber resources located within the Waiakea Timber Management Area (WTMA). The primary objectives of the inventory were to provide:

1. Accurate forest type maps.
2. Volume estimates of commercial timber resources.
3. Training for the HFCI survey crew in timber inventory methodology.

The WTMA is located along Stainback Highway, on the northeast slopes of Mauna Loa. Elevations within the tract range from approximately 380-3200 feet. Rainfall exceeds 200 inches per annum at lower elevations, and gradually declines with increasing elevation. A majority of the WTMA is situated on relatively recent lava flows (less than 1,500 years old), and surface soils are typically rocky with only a few inches of mineral soil. Surface soils can be broadly categorized as aa lava, pahoehoe lava, or mineral. The latter occurred in areas of older and more weathered lava flows, areas of ash accumulation from a past eruption of Puu Makaala, or depressions with accumulation of mineral sized soil particles.

Originally comprised of wet ohia (*Metrosideros polymorpha*) - hapuu (*Cibotium* spp.) forests, most areas within the WTMA were cleared by bulldozer in the mid-1960's and converted to plantations of commercial non-native hardwood species. Most hardwoods were planted using a 10 x 10 foot spacing with the exception of some low-elevation eucalyptus stands that were planted at 8 x 8 foot spacing. Primary planting efforts occurred from 1960-1980, after which harvesting of some *E. saligna* occurred. The latter areas were re-planted with *E. grandis*.

Survey methodology:

Planting maps, harvest maps, satellite imagery and aerial photographs were used to develop initial stand boundaries for the WTMA. During field inventory work, the survey crew verified and updated these boundaries, while concurrently assigning forest types to each stand based on primary commercial species present, age, and stand composition.

Sampling was based on a systematic grid with one point every five acres. Using a random start, sample plots were established at every ninth grid point over the entire landscape. Within *Flindersia brayleyana* stands, sample plots were established at every grid point. Once the initial survey was completed, all timber stands were post-stratified by type, and all plot data were aggregated by forest type for subsequent volume analyses. Additional grid points were randomly selected and sampled to increase the plot sample size in forest types that had inadequate plot representation in the standard grid system.

Circular sample plots were 0.20 acres in size, with a fixed radius of 52.66 feet. All trees larger than 5" diameter at breast height (DBH) were measured as "main plot" trees. Each plot tree was numbered and measured for DBH. Total height was recorded for every fifth tree of each species encountered on the plot. Regeneration data were recorded by tallying all tree stems in a DBH range of 2-5" within a nested 0.10 acre (26.33 feet in radius) "sub-plot."

Three primary overstory, understory, and groundcover species at or near each plot point were recorded in order of decreasing abundance. These data did not represent actual stem counts. All tree species encountered were included in volume analyses, though some may currently be considered non-merchantable (Appendix A). Other descriptive data collected included slope, aspect, surface soil type, and weather conditions.

Survey data were analyzed using Forestry Projection System software version 5.3a (Forest Biometrics, 1998). Gross wood volume calculations represented volume from tree base to tree tip. Merchantable wood volume calculations were based on 16 foot log sections, a minimum top diameter of four inches, a stump height of one foot, and a minimum DBH of eight inches. No defect deductions were applied to volume analyses in this study. Volume calculations were based on data from all cruised stands within each forest type. These data were subsequently used to predict volume in non-cruised stands of the same type.

Three local taper profiles were available for volume analyses of species encountered during this survey, necessitating the use of taper profiles from alternate species and regions (Appendix B).

Survey results:

The post stratified WTMA survey map contained 228 timber stands totaling 12,043 acres (Figure 1). Total merchantable wood volume within the WTMA exceeded 16,300,000 cubic feet (Table 1) in 1997. All mapped stands were stratified into 28 unique forest types based on dominant overstory tree species, age and stand structure, allowing type-level volume summaries (Table 2). Additional detail for type-level volume data are presented in Appendix C. Approximately 51% of total merchantable volume occurred on only 20% of the total acreage in the WTMA (forest type codes of "33" or higher). These stands contained a high proportion of total volume due to relatively high tree stocking and large tree size. The remaining 49% of total merchantable volume occurred on 80% of the total acreage in the WTMA (forest type codes of "22" or lower). The latter forest types included stands that had poor survival or growth, were poorly stocked, were recently planted, or were cut over. If the entire inventory of trees within the WTMA were harvested at once and cut into sixteen foot logs, total merchantable wood in log diameter classes of 4-8", 8-12", and 12+" would equal 7,163,586, 5,473,901, 3,681,865 cubic feet, respectively (44%, 34%, and 23% of total merchantable volume, respectively).

Table 1. Total merchantable wood volume summary for WTMA timber resources. Values in parentheses represent nearest whole percentages of area and volume totals.

Species	Total Acres	Total merchantable volume (ft^3)
Eucalyptus robusta	227 (2)	1,007,433 (6)
E. saligna & E. grandis	3,749 (31)	8,180,306 (50)
E. deglupta & E. pilularis	54 (0)	88,711 (1)
Flindersia brayleyana	1,485 (12)	2,557,756 (16)
Toona ciliata	3,500 (29)	2,682,282 (16)
Fraxinus uhdei	2,060 (17)	1,128,586 (7)
Cryptomeria japonica	102 (1)	30,798 (0)
Alnus nepalensis	24 (0)	110,855 (1)
Metrosideros polymorpha	205 (2)	167,113 (1)
Acacia koa	272 (2)	327,086 (2)
Experimental Hardwoods	28 (0)	38,427 (0)
Out or Non-stocked	17 (0)	0 (0)
Block Roads	320 (3)	0 (0)
Total	12,043	16,319,353

Differentiation between *Eucalyptus saligna* and *E. grandis* proved to be very difficult during the field survey – particularly for trees younger than 15 years of age. Many *E. saligna* stands were harvested and re-planted to *E. grandis* in the mid-1980's. Numerous trees that were sampled and identified as *E. saligna* in these stands were undoubtedly *E. grandis*. Taper profiles for these two species are very similar, and we expect volume differences to be minor.

Figure 1. Timber stands represented by primary overstory species in the WTMA.

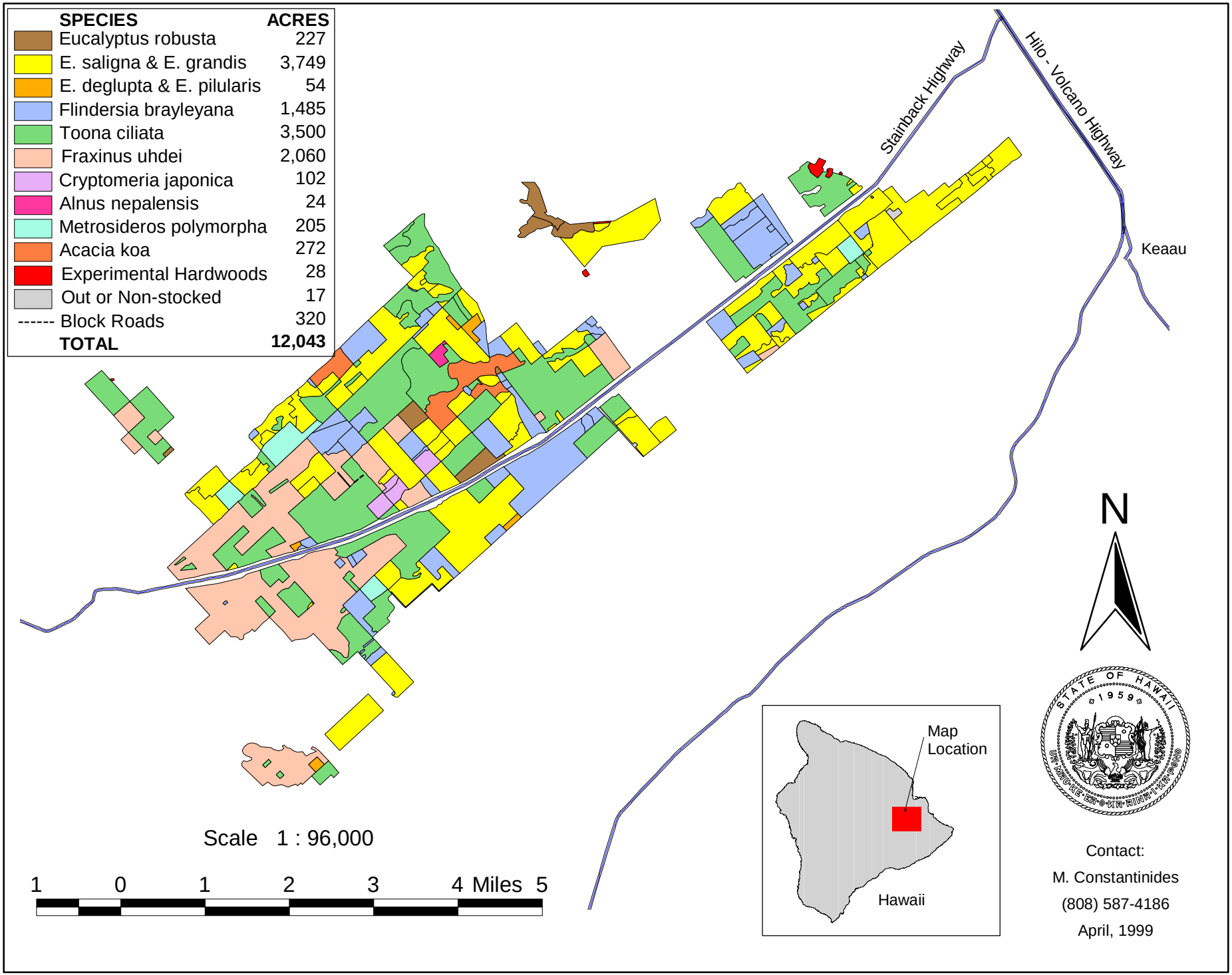


Table 2. Descriptive statistics for timber types in the WTMA. Age data represent original planting date, while stocking and DBH data represent all tree species with a minimum DBH of 2 inches. Maximum DBH data represent planted, non-native trees only.

Species & Type	Description	Net Acres	Age in Years	Stocking Trees ac^{-1}	DBH Range	Mean DBH	--Mean ft^3 ac^{-1}-- Gross	Merch	Total merchantable volume (ft^3) by log minimum diameter class 4-8"	8-12"	> 12"	Row Sub-Totals
Flindersia brayleyana												
FB00	Recent plantings / sapling stands	242	1-15	256	2-17	6	742	481	91,682	14,418	10,306	**116,407**
FB11	Low volume pole and saw timber	715	28-35	161	2-23	8	1,095	901	282,010	236,022	125,904	**643,936**
FB22	Low to moderate volume pole and saw timber	114	28-31	221	2-30	10	2,782	2,442	95,683	96,576	85,164	**277,424**
FB33	Moderate volume pole and saw timber	171	32	208	2-27	11	3,808	3,447	170,624	238,173	181,978	**590,775**
FB44	High volume pole and saw timber	120	32	255	2-28	12	5,649	5,214	203,486	265,708	158,616	**627,810**
FB55	Similar to FB33 with 20% volume as Toona ciliata	123	29	153	2-29	11	2,716	2,460	86,411	112,601	102,392	**301,404**
Sub-Total FB:		**1,485**							**929,896**	**963,499**	**664,361**	**2,557,756**
Eucalyptus saligna and grandis												
ES00	Recent plantings / sapling stands	113	5-8	314	2-10	5	478	206	13,613	3,145	5,898	**22,655**
ES11	Cut over, or low volume pole and saw timber	730	12-30	192	2-28	7	1,141	913	307,493	197,181	161,797	**666,470**
ES22	Low to moderate volume pole and saw timber	1447	11-31	280	2-26	7	2,119	1,653	1,313,800	853,728	224,350	**2,391,877**
ES33	Moderate volume pole and saw timber	1057	29	279	2-31	8	3,498	3,105	1,289,546	1,270,558	729,895	**3,289,999**
ES44	High volume pole and saw timber	185	14	241	2-19	11	6,243	5,699	443,557	473,387	136,282	**1,053,226**
ES55	Moderate volume saw timber	218	28	117	2-29	12	3,710	3,476	153,420	238,481	364,177	**756,078**
Sub-Total ES:		**3,749**							**3,521,429**	**3,036,479**	**1,622,397**	**8,180,306**
Eucalyptus robusta												
ER22	Low to moderate volume pole and saw timber	44	30	50	8-31	18	2,663	2,564	15,781	27,897	68,374	**112,051**
ER33	Moderate volume pole and saw timber	87	31-53	163	2-42	11	3,536	3,305	45,406	63,642	179,507	**288,556**
ER55	Moderate volume saw timber	57	53	208	2-40	12	4,814	4,475	49,946	59,546	146,017	**255,509**
ER66	High volume saw timber	39	59	219	2-37	16	9,541	9,078	65,106	81,882	204,329	**351,317**
Sub-Total ER:		**227**							**176,240**	**232,967**	**598,226**	**1,007,433**
Eucalyptus deglupta and pilularis												
ED11	Cut over, or low volume pole and saw timber	20	29	88	2-9	6	354	184	1,507	755	1,489	**3,752**
ED22	Low to moderate volume pole and saw timber	34	29	156	2-17	10	2,825	2,499	23,020	29,717	32,221	**84,959**
Sub-Total ED:		**54**							**24,527**	**30,473**	**33,711**	**88,711**
Toona ciliata												
TC11	Low volume pole and saw timber	3,178	30-35	263	2-24	6	873	595	1,088,854	487,061	314,593	**1,890,508**
TC22	Low to moderate volume pole and saw timber	69	30	199	2-15	9	1,986	1,698	73,634	43,879	0	**117,513**
TC33	Moderate volume pole and saw timber	253	30-35	239	2-20	9	3,023	2,667	309,814	255,219	109,229	**674,262**
Sub-Total TC:		**3,500**							**1,472,301**	**786,159**	**423,822**	**2,682,282**

Table 2. Continued.

Species & Type	Description	Net Acres	Age in Years	Stocking Trees ac^{-1}	DBH Range	Mean DBH	--Mean ft^3 ac^{-1}-- Gross	Merch	Total merchantable volume (ft^3) by log minimum diameter class 4-8"	8-12"	> 12"	Row Sub-Totals
Other species												
FU11	Low volume tropical ash pole and saw timber	2,060	34	348	2-18	5	902	548	855,304	250,770	22,512	**1,128,586**
AN33	Moderate volume Nepal alder pole and saw timber	24	30	154	2-27	14	4,956	4,677	30,245	41,110	39,500	**110,855**
CJ00	Recent Sugi plantings / sapling stands	102	7-10	395	2-14	5	618	303	17,333	4,039	9,426	**30,798**
AK11	Low volume koa pole and saw timber	272	NA	Native species			1,296	1,204	63,272	70,620	193,194	**327,086**
MP22	Low volume ohia pole and saw timber	205	NA	Native species			978	817	58,435	45,139	63,538	**167,113**
XH33	Moderate volume experimental hardwoods	28	38	Experimental species			1,512	1,387	14,603	12,646	11,178	**38,427**
Sub-Total other species:		**2,689**							**1,039,192**	**424,324**	**339,348**	**1,802,864**

Total forested acreage: **11,704**

Merchantable volume summary:
Cubic foot totals by log diameter and timber type class.

Type Class	Acres	----Log minimum diameter---- 4-8"	8-12"	> 12"	Total
00	456	122,629	21,602	25,630	169,860
11	6,975	2,598,440	1,242,408	819,490	4,660,338
22	1,912	1,580,353	1,096,936	473,647	3,150,937
33	1,620	1,860,237	1,881,348	1,251,287	4,992,872
44	305	647,043	739,095	294,897	1,681,036
55	397	289,777	410,628	612,586	1,312,992
66	39	65,106	81,882	204,329	351,317
Total	11,704	7,163,586	5,473,901	3,681,865	16,319,352

Volume results expressed in units of mean cubic feet per acre were derived from statistical sampling, and are therefore estimates. Standard error (SE) analysis provides one tool for assessing the strength of the field survey data. Because sampling intensity was proportional to area, volume analyses for larger forest types were based on a larger number of sample plots. In forest types with codes of "33" or more, standard error values rarely exceeded 10 percent of the mean, except in smaller types (Table 3). In forest types with codes of "22" or less, standard error values commonly exceeded 10 percent of the mean due to factors such as a small number of sample plots, or relatively heterogeneous stand conditions. Confidence intervals offer a second approach for analyzing cruise precision (Table 3). The reported confidence intervals represent ranges of gross volume per acre that are 80% likely to contain the true mean volume per acre for each forest type.

While stands were assigned to forest types based on the dominant overstory species, type level volume data also included components of secondary species. Most forest types had three or fewer principal species components (Table 4). *Toona ciliata* was a common secondary overstory species in both *Flindersia brayleyana* and *Eucalyptus saligna* stands, while ohia was evenly distributed throughout the entire WTMA (Figure 2). Though sparse in distribution, the remaining *Acacia koa* were concentrated near the north end of Flume Road.

Relatively undisturbed blocks of *Metrosideros polymorpha* and *Acacia koa* forest exist in approximately 4% of the total area of the WTMA (Figure 1). Within the remaining non-native timber plantations, large ohia and koa trees were left standing during initial land clearing operations, some of which remain to this day. As a result of this practice, ohia and to a lesser extent koa, were observed as secondary overstory species at 17% and 3% of all sampled points, respectively.

Other tree species observed and measured in minor quantities during the survey included olapa (*Cheirodendron* spp.), loulu palms (*Pritchardia* spp.), iron wood (*Casuarina equisetifolia*), blackwood acacia (*Acacia melanoxylon*), silk oak (*Grevillia robusta*), gunpowder tree (*Trema orientalis*), paperbark (*Melaleuca quinquenervia*) and African tulip tree (*Spathodea campanulata*). Detailed volume and distribution analyses were not conducted for these species due to their scattered occurrence.

Relative abundance data for understory species revealed that *Cibotium* spp. and *Psidium* spp. dominate the forest understory throughout the WTMA. Combined, these two species account for 86% of primary understory species (Figure 3), and 70% of secondary understory species (data not shown) observed at all sample plots. *Psidium cattleianum* is the most common and aggressive species of guava present in the WTMA. *Psidium* spp. appears to be encroaching from lower elevation, and from the South. In a vast majority of cases, where *Psidium* spp. was the primary understory species, *Cibotium* spp. was the secondary understory species, and vice versa. Excluding *Cibotium* spp., native tree and shrub species were recorded as primary and secondary understory species on 3%, and 16 % of sample plots, respectively.

Psidium spp. occurred as the primary groundcover species almost exclusively in well-stocked and mature stands of timber, revealing a relatively strong shade tolerance for this shrub

Table 3. Cruise precision analyses for the WTMA timber inventory. Volume data are presented in gross cubic feet.

Type	Acres	Sample Plots	Mean	SE	% SE	----80 % CI---- Low	High
			-----ft^3 ac^{-1}-----			-----ft^3 ac^{-1}-----	
FB00	242	7	742	294	40	319	1,164
FB11	715	13	1,095	154	14	886	1,304
FB22	114	20	2,782	194	7	2,525	3,040
FB33	171	26	3,808	284	7	3,434	4,182
FB44	120	24	5,649	326	6	5,219	6,080
FB55	123	26	2,716	178	7	2,482	2,951
ES00	113	2	478	19	4	420	535
ES11	730	17	1,141	128	11	970	1,313
ES22	1,447	41	2,119	105	5	1,982	2,255
ES33	1,057	26	3,498	281	8	3,128	3,868
ES44	185	4	6,243	681	11	5,129	7,358
ES55	218	6	3,710	383	10	3,145	4,275
ER22	44	1	2,663	NA	NA	NA	NA
ER33	87	8	3,536	687	19	2,564	4,507
ER55	57	7	4,814	352	7	4,307	5,321
ER66	39	6	9,541	508	5	8,791	10,290
ED11	20	3	354	89	25	185	522
ED22	34	3	2,825	1,370	48	241	5,410
TC11	3,178	71	873	50	6	808	938
TC22	69	1	1,986	NA	NA	NA	NA
TC33	253	6	3,023	447	15	2,363	3,683
FU11	2,060	47	902	37	4	853	950
AN33	24	3	4,956	287	6	4,415	5,497
CJ00	102	3	618	238	39	169	1,067
AK11	272	6	1,296	259	20	914	1,678
MP22	205	4	978	252	26	564	1,391
XH33	28	1	1,512	NA	NA	NA	NA
XX00	17	0	NA	NA	NA	NA	NA
Roads	320	0	NA	NA	NA	NA	NA
Total	**12,042**	**382**					

SE = standard error; % SE = standard error / mean volume per acre * 100
80 % CI = 80 percent confidence interval

FB = Flindersia brayleyana; ES = Eucalyptus saligna & E. grandis; ER = E. robusta
ED = E. deglupta; TC = Toona ciliata; FU = Fraxinus uhdei; AN = Alnus nepalensis
CJ = Cryptomeria japonica; AK = Acacia koa; MP = Metrosideros polymporpha
XH = experimental hardwoods; XX = open or cleared area; NA = not applicable

Table 4. Component merchantable volume for timber types in the WTMA.

		--mean ft^3 ac^{-1}--			----------Component merchantable volume per acre by species* (ft^3 ac^{-1})----------													
Type	**Acres**	**Gross**	**Merch**	**% Merch**	**FB**	**TC**	**MP**	**ES**	**ER**	**ED**	**AK**	**FU**	**TO**	**EM**	**CJ**	**AN**	**MQ**	**OTH**
FB00	242	742	481	65		359	56				17	12					26	11
FB11	715	1,095	901	82	592	83	100				63	59						4
FB22	114	2,782	2,442	88	1,922	100	225		7		10	178						
FB33	171	3,808	3,447	91	3,056	21	235				8	124						2
FB44	120	5,649	5,214	92	5,058	63	94											
FB55	123	2,716	2,460	91	1,756	427	229				46						2	
ES00	113	478	206	43		34	118	54										
ES11	730	1,141	913	80		35	81	729			68							
ES22	1,447	2,119	1,653	78		24	18	1,538	22	2	1	11	38					
ES33	1,057	3,498	3,105	89		146	20	2,810				40	80					7
ES44	185	6,243	5,699	91				5,629					71					
ES55	218	3,710	3,476	94		36	92	3,349										
ER22	44	2,663	2,564	96		1,155			1,410									
ER33	87	3,536	3,305	93			666	1,537	1,015			53					28	5
ER55	57	4,814	4,475	93			118	862	3,041			31		74			349	
ER66	39	9,541	9,078	95				369	8,709									
ED11	20	354	184	52			124			53								7
ED22	34	2,825	2,499	88			469			1,885	144							
TC11	3,178	873	595	68		300	228	5	1		45	10						7
TC22	69	1,986	1,698	86		1,698												
TC33	253	3,023	2,667	88		2,105	10				552							
FU11	2,060	902	548	61		29	28					487						3
AN33	24	4,956	4,677	94			61				193					4,424		
CJ00	102	618	303	49			150					132			24			
AK11	272	1,296	1,204	93		28	725				452							
MP22	205	978	817	84			811											5
XH33	28	1,512	1,387	92			263											1,124
XX00	17	NA	NA	NA														
Roads	320	NA	NA	NA														

*FB = Flindersia brayleyana; ES = Eucalyptus saligna & E. grandis; ER = E. robusta; ED = E. deglupta; TC = Toona ciliata
FU = Fraxinus uhdei; AN = Alnus nepalensis; CJ = Cryptomeria japonica; AK = Acacia koa; MP = Metrosideros polymporpha
TO = Trema orientalis; EM = E. microcorys; MQ = Melaleuca quinquenervia
XH = experimental hardwoods; XX = open or cleared area; NA = not applicable

Figure 2. Secondary overstory species at sample plot locations in the WTMA.

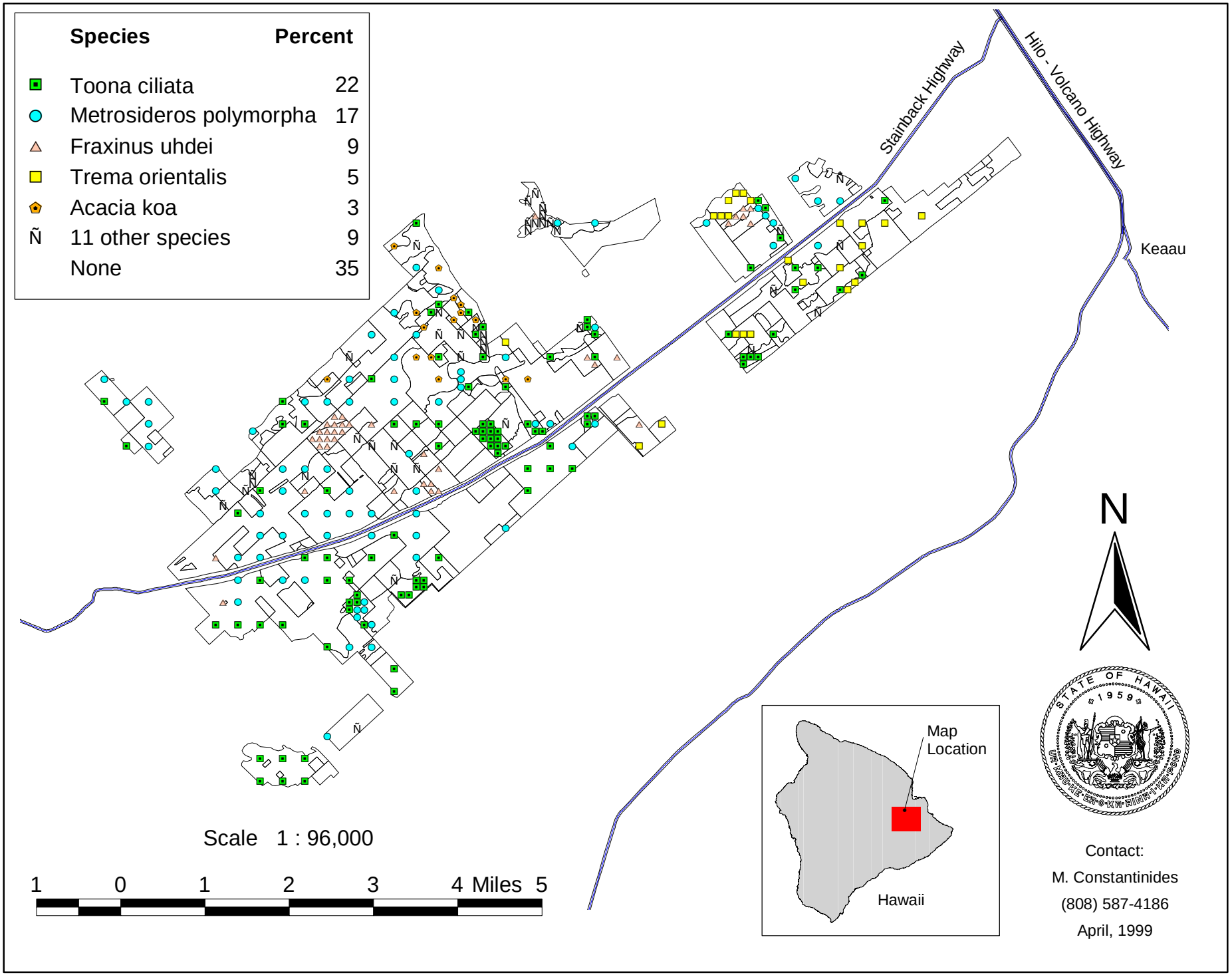
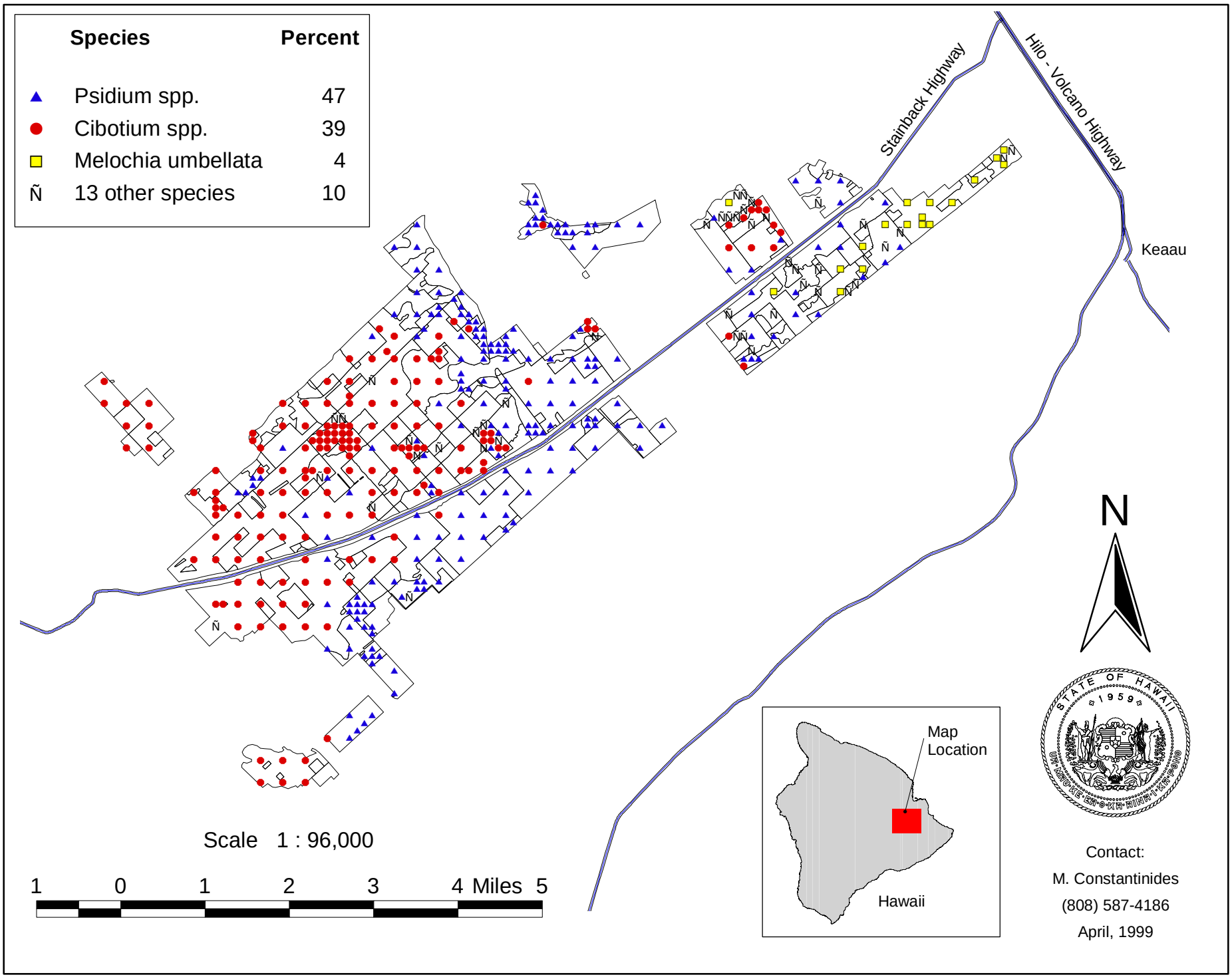


Figure 3. Primary understory species at sample plot locations in the WTMA.



species (Figure 4). In most other areas, *Dicranopteris linearis* dominated the groundcover layer, with the exception of an apparent outbreak of *Setaria palmifolia* in the north-central zone of the WTMA. Excluding *Dicranopteris linearis.*, native tree and shrub species were recorded as primary and secondary understory species on 3%, and 11 % of sample plots, respectively.

The low-elevation zone of the WTMA provided an exception to the understory and groundcover trends discussed above. The lower sites appeared to be a zone of concentration for *Trema orientalis* in the overstory (Figure 2), *Melochia umbellata* in the understory (Figure 3), and *Melastoma* spp. and *Nephrolepis multiflora* in the groundcover layer (Figure 4).

Discussion and planning implications:

The commercial timber plantings within the WTMA exhibited a wide range of growth potential both within, and among species. Site adaptation, surface soil conditions, and site preparation appeared to be the primary factors that influenced stand growth potential. Current within-species productivity differences can not be attributed to varying stand management or maintenance, since little has been implemented historically in the WTMA. However, intensive stand management in future rotations may significantly increase the productivity and yield of timber stands in the WTMA.

In order to compare productivity of different species, representative stands within the most important commercial forest types were selected for mean annual increment (MAI) analyses (Table 5). Among the original and secondary hardwood species planted, the eucalypts were best adapted to site conditions within the WTMA. *E. saligna* and *E. grandis* stands commonly had MAI values ranging from 250 –500 ft^3 ac^{-1} yr^{-1}. Surface soils appeared to be the primary factor influencing within-species differences in MAI. For example, though they had similar ages, stand 10010 was located on relatively deep mineral soil, stand 10200 had mixed aa-mineral soils and included a depression (zone of mineral soil accumulation), and stand 11110 had relatively shallow and rocky surface soils. Stands 10892 and 11380 were older, and were probably in a condition where mortality and residual growth did not differ greatly. Again, we attribute the differences between MAI in the latter two stands to surface soils conditions – 11380 had relatively deep mineral surface soils, while 10892 had primarily aa.

Relatively low MAI values for *E. robusta* may be misleading since most of these stands are the oldest within the WTMA, and had stagnated. Based on visual observations, young *E. robusta* trees often had similar size and vigor as adjacent *E. grandis*. Two stands of *E. microcorys* and *E. pilularis* appeared to be vigorous as well. *E. deglupta* had a relatively moderate MAI value in stand 10430 (Table 5), but scattered individuals at other locations within the WTMA appeared to be fast growing and vigorous.

Queensland maple (*Flindersia brayleyana*) is the most promising non-eucalyptus hardwood from the original WTMA plantings. With the exception of shallow pahoehoe sites, this

Figure 4. Primary groundcover species at sample plot locations in the WTMA.

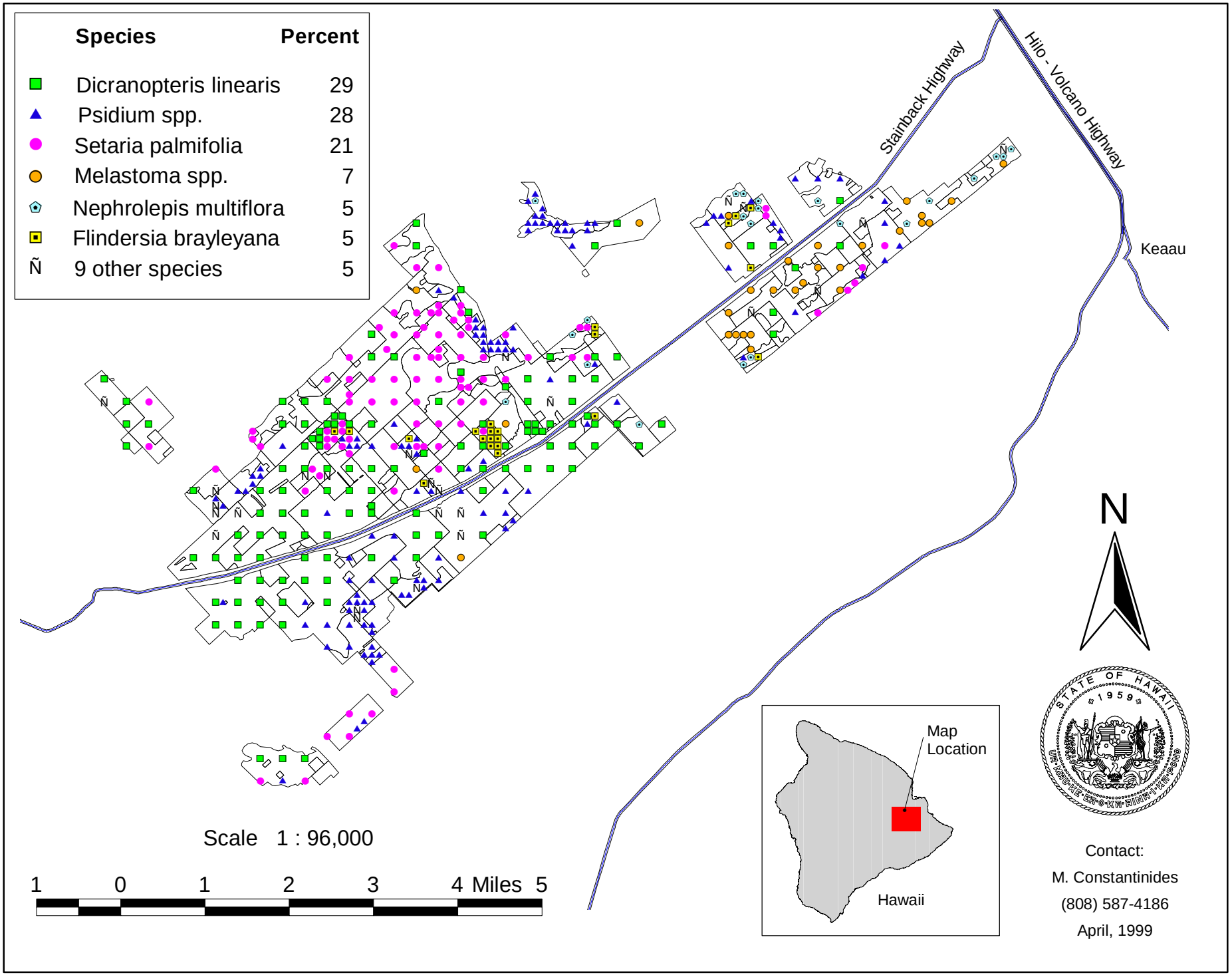


Table 5. Mean annual increment (MAI) analyses for selected stands in the WTMA based on 1997 data. All figures in each species section represent trees of that species only that have a miniumum DBH of two inches.

Species & Type	Stand ID	Net Acres	Plots	Age (Yr)	Trees Per Acre	Maximum DBH	Median DBH	Basal Area (ft^2)	Gross volume ($ft^3\ ac^{-1}$)	MAI ($ft^3\ ac^{-1}\ yr^{-1}$)
Flindersia brayleyana										
FB11	10710	22	4	32	144	17	7	54	1,145	36
FB11	11050	308	7	30	42	18	11	27	563	19
FB22	10680	16	4	31	80	27	12	84	2,194	71
FB33	10711	64	12	32	143	23	11	105	2,935	92
FB33	11331	58	10	32	102	27	14	121	3,662	114
FB44	10581	37	8	31	230	28	10	166	5,085	164
Eucalyptus saligna and E. grandis										
ES22	11110	381	9	10	206	17	7	71	2,665	267
ES33	10200	84	7	11	147	20	10	89	4,574	416
ES33	10892	61	5	27	119	23	10	82	2,896	107
ES44	10010	185	6	14	266	19	10	166	7,090	506
ES55	11380	118	6	29	122	28	11	103	4,552	157
Eucalyptus robusta										
ER33	10610	53	3	31	283	26	4	89	2,068	67
ER55	8138	57	7	53	134	40	6	119	3,245	61
ER66	8134	39	6	59	217	37	11	283	9,163	155
Eucalyptus deglupta										
ED22	10430	23	3	29	125	17	9	66	2,845	98
Toona ciliata										
TC11	10340	390	7	35	137	20	7	45	775	22
TC22	10070	69	1	30	180	15	8	87	1,966	66
TC33	10560	186	4	30	213	20	7	83	2,203	73
Fraxinus uhdei										
FU11	11200	915	19	34	167	17	6	42	690	20
Alnus nepalensis										
AN33	10463	24	3	30	152	27	13	164	4,643	155

species always exhibited vigorous growth once established. However, maple may be more difficult to establish than the eucalypts. Almost without exception, type codes FB33, FB44, and FB55 were comprised of stands where surface soils at sample plots were recorded as aa. This indicates that maple was either intentionally planted on aa sites, or that a unique scarification method was applied to surface soils prior to planting. Many FB11 stands are represented by low stocking and MAI values (e.g. stand 11050, Table 5), suggesting problems with seedling establishment or early weed competition. One area was planted across a surface soil change (Stands 10710 and 10711) from shallow pahoehoe to aa, and the latter stand had MAI that was nearly triple that of the former. Maple is probably the most shade tolerant hardwood planted within the WTMA, and natural regeneration was often prolific under dense canopies. Thinning and uneven-age management of this species merit future research.

The single stand of *Alnus nepalensis* within the WTMA had an MAI value similar to that for the best maple stands. However, this stand appeared to be located on a site having surface soils of above average productivity. Any future attempt to plant *Alnus nepalensis* as a commercial species in the WTM A should be preceded by additional site suitability tests.

Toona ciliata and *Fraxinus uhdei* plantings essentially failed on a large scale. *T. ciliata* showed moderate growth potential only on the best sites (e.g. stand 10560, Table 5). These species otherwise exhibited poor growth, and are not suited to site conditions within the WTMA. *Cryptomeria japonica* trees were too young to evaluate at this time, but field observations indicated that survival and growth rates for 7-10 year old stands of this species have been reasonable. These stands will likely require 35 or more years to reach merchantable size.

Tree DBH ranges and mean DBH values were relatively similar among forest types of the same species (Table 2), suggesting that type differences were directly proportional to stocking differences. What are not apparent in these data are differences in DBH distribution. For example, Queensland maple types FB33 and FB44 had similar DBH ranges and mean DBH values, most trees within FB33 had DBH near the mean value of 11 inches, while FB44 had a relatively even distribution of tree DBH ranging in size from 8-28 inches. FB44 therefore had higher volume per acre due to higher stocking and larger volume contribution per tree from larger diameter classes.

Qualitative data collection for the relative abundance of primary and secondary species in the above ground forest strata indicated that the WTMA is dominated by non-native timbers, underlain by invasive non-native weed species. If current commercial timber resources are harvested, control of these weed species will probably require significant resources during planting and establishment of future timber plantations. Overstory ohia and koa trees that remain within non-native timber plantations are generally senescent, contain considerable defect, and have poor form. Excluding *Cibotium* spp. and *Dicranopteris linearis*, the presence of native tree and shrub species in understory and groundcover layers was negligible.

Total wood volume estimates within the WTMA exceeded 16,300,000 merchantable cubic feet, or approximately 81,500,000 merchantable board feet. Forest types coded "22" or lower could be considered to represent pre- or non-commercial timber acreage as of 1997 due to their low volume or heterogeneous composition. Well-stocked stands in these forest types could have significant commercial value in future years, while others will have salvage potential at best unless they are replaced. Forest types coded "33" or higher contained a majority of timber resources with current commercial value, where total merchantable volume exceeded 8,300,000 cubic feet, or approximately 41,500,000 merchantable board feet.

The WTMA represents a readily accessible timber resource due to its close proximity to Hilo and an extremely well laid out road network. Though several block roads have become overgrown with weeds, they could be easily cleared, and would be operable 365 days per year. Within the tract, slopes typically range between 5-10%, which would not limit operation of mechanized equipment. One exception would small areas having relatively deep mineral surface soils that may become inaccessible when saturated. The close proximity of virtually all stands to Stainback Highway would facilitate harvesting and transportation of logs, replanting, and stand management efforts.

Analysis of survey precision indicated that reported timber volumes were robust – particularly in forest types representing the greatest current commercial value (type codes "33" or higher). The volume data in this report are not intended to be the sole basis for negotiation of timber sale contracts, but rather a guideline to long term timber management planning within the WTMA. Additional inventory data, or careful scaling of timber removed from harvest sites are highly recommended for all harvest contracts.

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Appendix A. Botanical species tallied during the WTMA survey.

TREE SPECIES

Latin genus and species	Common name
Acacia koa	Koa
Acacia melanoxylon	Blackwood
Alnus nepalensis	Nepal alder
Casuarina equisetifolia	Ironwood
Cheirodendron trigynum	Olapa
Cryptomeria japonica	Sugi
Eucalyptus deglupta	Mindanao gum
Eucalyptus grandis	Rose gum
Eucalyptus microcorys	Tallow-wood
Eucalyptus pilularis	Black butt
Eucalyptus robusta	Swamp mahogany
Eucalyptus saligna	Sydney blue gum
Flindersia brayleyana	Queensland maple
Fraxinus uhdei	Tropical ash
Grevillia robusta	Silk oak
Melaleuca quinquenervia	Paper bark
Metrosideros polymorpha	Ohia
Pritchardia spp.	Loulu
Spathodea campanulata	African tulip tree
Toona ciliata	Australian red cedar
Trema orientalis	Gunpowder tree

UNDERSTORY AND GROUNDCOVER SPECIES

Latin genus and species	Common name
Cheirodendron trigynum	Olapa
Cibotium spp.	Tree ferns
Dicranopteris linearis	Uluhe fern
Melastoma spp.	Melastoma family
Melochia umbellata	Melochia
Nephrolepis multiflora	Sword fern
Psidium spp.	Guavas
Setaria palmifolia	Palm grass
Zanthoxylum dipetalum	Kawau

Appendix B. Species assignments by taper profile class for volume analyses.

Species analyzed using *Flindersia brayleyana* taper profile:

1. *Acacia koa*
2. *Acacia melanoxylon*
3. *Alnus nepalensis*
4. *Casuarina equisetifolia*
5. *Cheirodendron trigynum*
6. *Flindersia brayleyana*
7. *Fraxinus Uhdei*
8. *Grevillia robusta*
9. *Metrosideros polymorpha*
10. *Pritchardia* spp.
11. *Toona ciliata*
12. *Trema orientalis*
13. *Spathodea campanulata*
14. *Zanthoxylum dipetalum*

Species analyzed using *Eucalyptus saligna* taper profile:

1. *Eucalyptus microcorys* (bark thickness coefficients 1.5 times those of *E. saligna*)
2. *E. robusta* (bark thickness coefficients 2.0 times those of *E. saligna*)
3. *E. saligna*
4. *Melaleuca quinquenervia* (bark thickness coefficients 2.0 times those of *E. saligna*)

Species analyzed using *Eucalyptus grandis* taper profile:

1. *Eucalyptus deglupta*
2. *E. grandis*

Species analyzed using a West-coast *Thuja plicata* (Western red cedar) taper profile:

1. *Cryptomeria japonica*

Appendix C. Stand tables by forest type.

Guidelines for interpreting stand table data:

1. Stand tables summarize sample plot analyses by presenting one inch DBH classes. Statistics provided for each DBH class include trees per acre, basal area per acre (ft^2), average tree height (feet), and cubic foot volume per acre. Gross cubic volume represents the tree bole from tree base to tree tip. Merchantable wood volume calculations were based on 16 foot log sections, a minimum top diameter of four inches, a stump height of one foot, and a minimum DBH of eight inches.

2. For each forest type, statistics are first presented by tree species. The last row of each species section gives a species summary (species codes typically use the first initial from both genus and species names). The species summary shows average DBH, total trees per acre, total basal area per acre, and total volume per acre.

3. After all species for a particular forest type have been listed, two final rows provide type level summary statistics. The first row represents all trees with a DBH of two inches or larger. The second row represents only trees with a minimum DBH of eight inches. Type level summaries show average DBH, total trees per acre, total basal area per acre, and total volume per acre. Type level volume totals may differ slightly from those reported in Tables 2-4 due to rounding errors.

Forest type FB00: Recent *Flindersia brayleyana* plantings / sapling stands.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Eucalyptus saligna			
	4	29	2.9	0	2	0
ES summary:	4		2.9	0	3	0
			Melaleuca quinquenervia			
	17	90	0.7	1	26	25
MQ summary:	17		0.7	1	27	26
			Flindersia brayleyana			
	2	22	6.4	0	1	0
	4	46	2.9	0	3	0
	6	61	1.6	0	6	0
FB summary:	3		10.9	1	12	0
			Toona ciliata			
	2	19	51.4	1	9	0
	4	29	60	5	58	0
	6	39	17.2	3	49	0
	7	37	8.6	2	32	0
	8	40	12.3	4	65	55
	9	44	5	2	36	31
	10	54	7.4	4	78	71
	11	52	7.9	5	99	90
	12	44	3.6	3	46	42
	13	51	1.4	1	24	22
	14	53	0.7	1	14	13
	16	55	0.7	1	19	18
TC summary:	6		176.3	34	534	346

Appendix C (continued).

Forest type FB00 (continued):

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3): Gross	Merch
			Fraxinus uhdei			
	11	17	0.7	0	4	3
	15	27	0.7	1	9	8
FU summary:	13		1.4	1	14	12
			Metrosideros polymorpha			
	2	18	20	0	3	0
	4	34	17.1	1	18	0
	6	43	4.3	1	13	0
	7	44	0.7	0	3	0
	11	58	0.7	0	9	8
	26	59	0.7	3	50	48
MP summary:	5		43.6	6	99	56
			Acacia koa			
	2	24	11.4	0	2	0
	9	73	0.7	0	8	7
	10	76	0.7	0	10	9
AK summary:	4		12.9	1	21	17
			Acacia melanoxylon			
	13	49	0.7	1	12	11
AM summary:	13		0.7	1	12	11
			Trema orientalis			
	4	21	5.7	0	4	0
	6	33	1.6	0	3	0
TO summary:	4		7.3	1	8	0
			-- Type Level Summary --			
All trees:	5.7		256	46	730	468
Merch trees:	10.8		44	29		

Forest type FB11: Low volume *Flindersia brayleyana* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3): Gross	Merch
			Fraxinus uhdei			
	2	14	4.6	0	0	0
	4	25	6.2	1	5	0
	6	34	3.1	1	7	0
	7	36	1.5	0	5	0
	8	45	0.8	0	4	3
	9	40	2.3	1	15	13
	10	47	0.4	0	3	3
	11	50	1.2	1	13	12
	12	52	0.8	1	11	10
	14	59	0.8	1	17	16
FU summary:	7		21.5	5	86	60

Appendix C (continued).

Forest type FB11 (continued):

	DBH (in)	Average Height (ft)	Number of Trees	Basal Area	--Volume (ft^3)-- Gross	Merch
			Flindersia brayleyana			
	2	28	7.7	0	1	0
	4	41	13.8	1	16	0
	6	50	2.7	1	9	0
	7	56	5.4	1	29	0
	8	53	4.6	2	31	26
	9	68	2.3	1	24	21
	10	58	3.1	2	35	31
	11	58	4.2	3	57	53
	12	59	5.4	4	89	82
	13	58	2.7	2	51	47
	14	65	1.5	2	37	35
	15	66	2.7	3	75	71
	16	67	0.8	1	24	23
	17	82	2.3	4	99	95
	18	67	0.8	1	31	29
	20	82	0.4	1	22	21
	22	82	0.4	1	27	26
	23	70	0.4	1	25	24
FB summary:	10		61.2	31	690	592
			Toona ciliata			
	2	13	13.8	0	2	0
	4	26	9.2	1	8	0
	6	50	2.7	1	9	0
	7	35	2.7	1	10	0
	8	38	1.5	1	8	7
	9	50	0.8	0	5	5
	10	58	0.4	0	4	3
	11	57	0.4	0	5	4
	12	74	0.8	1	15	14
	14	66	0.4	0	9	8
	15	77	0.4	0	13	12
	16	72	0.4	1	12	11
	17	75	0.4	1	16	15
TC summary:	6		33.8	6	120	83
			Metrosideros polymorpha			
	2	8	23.1	1	4	0
	4	22	12.3	1	10	0
	6	34	1.9	0	4	0
	7	40	0.8	0	3	0
	8	50	0.4	0	2	2
	9	48	0.4	0	3	2
	12	63	0.4	0	6	6
	17	67	0.4	1	13	13
	18	65	1.2	2	45	43
	19	70	0.4	1	17	17
	20	71	0.4	1	20	19
MP summary:	6		41.5	7	132	104
			Spathodea campanulata			
	9	68	0.4	0	4	3
SC summary:	9		0.4	0	4	4

Appendix C (continued).

Forest type FB11 (continued):

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3): Gross	Merch
			Acacia koa			
	8	81	0.4	0	3	3
	9	83	0.4	0	4	4
	10	84	0.4	0	6	5
	11	86	0.8	1	14	13
	13	88	0.8	1	21	20
	16	91	0.4	1	16	15
AK summary:	12		3.1	2	67	63
			-- Type Level Summary --			
All trees:	7.7		161	52	1099	905
Merch trees:	12.5		50	43		

Forest type FB22: Low to moderate volume *Flindersia brayleyana* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3): Gross	Merch
			Acacia koa			
	11	69	0.3	0	3	3
	13	78	0.3	0	6	6
AK summary:	12		0.5	0	11	10
			Flindersia brayleyana			
	2	15	9	0	1	0
	4	37	7	1	7	0
	6	60	5.3	1	21	0
	7	56	6	2	32	0
	8	61	4	1	30	26
	9	65	7.2	3	73	65
	10	79	8.4	5	124	113
	11	66	6.5	4	98	91
	12	76	7.8	6	160	150
	13	69	4.8	4	107	100
	14	85	5.9	6	182	173
	15	91	3	4	112	107
	16	84	4.3	6	169	161
	17	89	3.1	5	146	140
	18	82	2.9	5	141	135
	19	84	2.8	5	151	145
	20	82	1.3	3	74	71
	21	98	1.8	4	134	129
	22	75	0.8	2	49	47
	23	80	1.3	4	94	90
	24	89	0.3	1	22	21
	25	80	0.3	1	22	21
	26	90	0.3	1	26	25
	27	90	0.6	2	71	68
	30	92	0.3	1	35	34
FB summary:	12		94.5	78	2093	1924

Appendix C (continued).

Forest type FB22 (continued):

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Toona ciliata			
	2	18	5	0	0	0
	4	32	4	0	4	0
	6	42	3.8	1	11	0
	7	52	1.8	0	8	0
	8	60	1.3	0	9	0
	9	59	2	1	18	16
	10	47	0.3	0	2	2
	11	59	0.8	1	10	9
	12	39	0.8	1	8	7
	13	85	1	1	27	26
	14	81	0.8	1	21	20
	15	80	0.3	0	7	7
	17	77	0.3	0	10	9
TC summary:	7		21.8	7	143	100
			Fraxinus uhdei			
	2	9	12	0	1	0
	4	20	12	1	9	0
	6	31	7.7	2	18	0
	7	43	11.9	3	50	0
	8	51	7.5	3	48	41
	9	50	5.5	2	45	39
	10	49	3.5	2	34	30
	11	63	2	1	29	27
	12	76	1.8	1	35	33
	13	68	0.3	0	5	5
FU summary:	7		64.1	16	279	178
			Metrosideros polymorpha			
	2	12	26	1	3	0
	4	28	6	1	5	0
	6	40	0.8	0	2	0
	8	57	0.7	0	4	4
	9	53	0.9	0	7	6
	10	56	1	1	10	9
	11	51	0.9	1	11	10
	12	65	0.3	0	4	4
	13	63	0.3	0	5	4
	14	66	0.8	1	18	17
	15	86	0.8	1	26	25
	16	69	0.5	1	16	15
	18	72	0.3	0	10	10
	22	77	0.3	1	16	15
	25	78	0.5	2	43	41
	30	85	0.5	2	65	63
MP summary:	7		40.3	11	254	230
			Eucalyptus robusta			
	16	75	0.3	0	7	7
ER summary:	16		0.3	0	7	7
			-- Type Level Summary --			
All trees:	9.6		221	112	2787	2449
Merch trees:	13.4		102	99		

Appendix C (continued).

Forest type FB33: Moderate volume *Flindersia brayleyana* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Flindersia brayleyana			
	2	17	5.4	0	0	0
	4	41	6.9	1	8	0
	6	52	4.7	1	17	0
	7	66	7.9	2	48	0
	8	70	5.7	2	48	41
	9	74	10.3	5	117	105
	10	79	7.9	4	117	108
	11	86	8.5	6	166	155
	12	75	8.3	7	170	159
	13	82	10.7	10	276	261
	14	86	9.4	10	295	281
	15	81	8.2	10	276	263
	16	94	7.5	10	328	315
	17	90	7.5	12	355	341
	18	93	4.1	7	222	213
	19	105	3.1	6	208	201
	20	90	4.2	9	275	265
	21	90	1.4	3	99	96
	22	94	0.8	2	62	60
	23	87	0.6	2	47	45
	24	88	0.2	1	17	16
	25	96	0.6	2	60	58
	26	97	0.4	1	43	42
	27	98	0.2	1	23	22
FB summary:	13		124.4	130	3289	3056
			Toona ciliata			
	2	7	1.5	0	0	0
	4	22	3.1	0	2	0
	6	51	0.8	0	2	0
	7	41	1	0	3	0
	8	59	1.3	0	9	8
	9	46	0.4	0	2	2
	11	72	0.4	0	6	5
	12	76	0.2	0	3	3
TC summary:	6		8.7	2	33	21
			Fraxinus uhdei			
	2	14	5.4	0	0	0
	4	26	22.3	2	20	0
	6	41	10.3	2	30	0
	7	43	8.3	2	35	0
	8	41	5.4	2	29	24
	9	49	3.3	1	26	23
	10	59	2	1	22	20
	11	58	1	1	14	13
	12	62	0.2	0	3	3
	13	80	0.2	0	4	4
	14	68	0.4	0	9	9
	17	77	0.6	1	23	22
FU summary:	6		59.3	12	221	121

Appendix C (continued).

Forest type FB33: (continued).

	DBH (in)	Average Height (ft)	Values per acre — Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Metrosideros polymorpha			
	2	5	6.9	0	0	0
	4	13	1.5	0	0	0
	6	72	0.8	0	4	0
	7	33	0.2	0	0	0
	8	50	1.2	0	7	0
	9	62	1	0	9	8
	10	50	0.6	0	5	5
	11	56	0.2	0	2	2
	12	61	0.2	0	3	3
	14	45	0.2	0	3	2
	15	79	0.6	1	19	18
	16	31	0.4	1	6	5
	18	82	0.2	0	9	8
	19	84	0.2	0	10	10
	20	65	0.4	1	18	17
	21	89	0.4	1	27	26
	22	91	0.2	1	15	14
	24	95	0.2	1	18	17
	26	70	0.2	1	15	14
	28	48	0.2	1	13	12
	30	78	0.2	1	23	22
	31	105	0.2	1	31	30
MP summary:	11		16	10	246	222
			Acacia koa			
	15	95	0.2	0	7	7
AK summary:	15		0.2	0	8	8
			Pritchardia spp.			
	9	29	0.2	0	1	0
	11	37	0.2	0	1	1
PR summary:	10		0.4	0	3	2
			-- Type Level Summary --			
All trees:	11		208	139	3800	3429
Merch trees:	13.9		120	127		

Forest type FB44: High volume *Flindersia brayleyana* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre — Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Acacia koa			
	8	65	1	0	7	0
AK summary:	8		1	0	8	0

Appendix C (continued).

Forest type FB44: (continued).

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Flindersia brayleyana			
	2	12	23.3	1	3	0
	4	35	21.7	2	23	0
	6	57	8.6	2	33	0
	7	51	13.3	4	65	0
	8	75	12.3	4	112	97
	9	77	12.7	6	150	135
	10	83	15.2	8	236	216
	11	86	15	10	291	271
	12	87	16.3	13	379	357
	13	85	15.5	14	413	391
	14	87	16.5	18	517	493
	15	91	17.2	21	646	617
	16	87	14.8	21	605	580
	17	89	8.5	13	398	382
	18	90	9.6	17	511	492
	19	84	5.6	11	306	294
	20	98	3.9	8	271	261
	21	94	1.9	5	141	136
	22	98	1.4	4	117	114
	23	102	0.4	1	39	38
	24	103	1	3	107	104
	25	104	0.2	1	23	22
	27	92	0.2	1	24	23
	28	106	0.2	1	29	28
FB summary:	12		235.1	187	5452	5060
			Toona ciliata			
	4	23	1.7	0	1	0
	6	44	1.5	0	4	0
	7	59	2.3	1	13	0
	8	70	0.8	0	7	6
	9	70	2.3	1	25	22
	10	54	1.3	1	13	12
	11	73	0.2	0	3	3
	12	59	0.2	0	3	3
	13	80	0.4	0	10	9
	16	60	0.2	0	6	5
TC summary:	8		10.9	4	88	63
			Metrosideros polymorpha			
	2	5	5.8	0	0	0
	4	6	0.8	0	1	0
	16	80	0.2	0	7	7
	17	54	0.2	0	5	5
	18	57	0.2	0	7	7
	20	63	0.2	0	9	9
	25	85	0.2	1	19	18
	28	51	0.2	1	14	13
	35	77	0.2	1	33	31
MP summary:	10		8.1	4	100	94
			-- Type Level Summary --			
All trees:	11.9		255	196	5648	5217
Merch trees:	14		175	187		

Appendix C (continued).

Forest type FB55: Similar to FB33 *Flindersia brayleyana* with 20% volume as Toona ciliata.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Melaleuca quinquenervia			
	9	65	0.3	0	2	2
MQ summary:	9		0.3	0	2	2
			Flindersia brayleyana			
	2	21	1.5	0	0	0
	4	43	4.6	0	5	0
	6	60	0.4	0	1	0
	7	62	1.5	0	9	0
	8	64	1.9	1	15	13
	9	61	2.5	1	24	21
	10	57	1.5	1	17	15
	11	71	4.1	3	67	62
	12	67	4	3	72	68
	13	76	4	4	97	92
	14	83	5.8	6	173	165
	15	84	5.9	7	205	196
	16	82	5	7	194	185
	17	85	3.5	5	157	151
	18	81	3.1	5	148	142
	19	86	3.4	7	191	184
	20	78	1.8	4	103	99
	21	85	1.3	3	90	87
	22	100	0.6	2	49	47
	23	84	1	3	76	73
	24	80	1.1	3	88	85
	26	87	0.2	1	19	19
	27	88	0.2	1	23	22
	29	89	0.2	1	24	23
FB summary:	15		59.2	69	1860	1756
			Toona ciliata			
	2	6	5.4	0	1	0
	4	20	18.5	2	14	0
	6	36	8.7	2	23	0
	7	42	9.5	3	40	0
	8	47	8.2	3	49	41
	9	52	6.2	3	51	45
	10	63	6.8	4	82	74
	11	56	3.2	2	42	38
	12	71	3.4	3	65	61
	13	70	1.2	1	25	24
	14	72	0.8	1	20	19
	15	76	1	1	31	29
	16	84	0.4	1	15	14
	17	79	0.8	1	32	30
	19	83	0.2	0	11	11
	20	80	0.4	1	22	21
	21	85	0.2	0	12	12
TC summary:	8		74.7	27	543	427

Appendix C (continued).

Forest type FB55: (continued).

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3): Gross	Merch
			Metrosideros polymorpha			
	2	5	6.2	0	0	0
	4	13	5.4	0	3	0
	7	17	0.2	0	0	0
	9	75	0.8	0	8	7
	22	69	0.4	1	23	22
	25	42	0.2	1	9	8
	28	55	0.3	1	23	22
	30	67	0.3	2	32	30
	31	68	0.2	1	21	20
	35	72	0.2	1	28	27
	36	73	0.6	4	91	87
MP summary:	12		14.7	12	244	228
			Acacia koa			
	7	72	0.6	0	3	0
	8	70	1.2	0	9	0
	9	68	0.2	0	1	1
	10	60	0.4	0	4	4
	11	75	1	1	16	15
	12	57	0.8	1	12	11
	14	61	0.4	0	9	8
	15	60	0.2	0	5	4
AK summary:	10		4.6	3	63	46
			-- Type Level Summary --			
All trees:	11.5		153	110	2712	2459
Merch trees:	14.4		89	102		

Forest type ES00: Recent *Eucalyptus saligna* plantings / sapling stands.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3): Gross	Merch
			Eucalyptus saligna			
	2	12	70	2	10	0
	4	29	30	3	28	0
	6	41	7.5	1	22	0
	7	45	7.5	2	33	0
	8	49	10	3	63	53
ES summary:	4		125	11	158	54
			Toona ciliata			
	2	8	20	0	3	0
	4	17	20	2	15	0
	6	25	17.5	4	37	0
	7	30	12.5	3	41	0
	8	27	5	2	21	18
	10	33	2.5	1	17	15
TC summary:	5		77.5	12	138	34

Appendix C (continued).

Forest type ES00: (continued).

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3): Gross	Merch
			Metrosideros polymorpha			
	2	16	30	1	4	0
	4	23	10	1	8	0
	6	28	5	1	11	0
	12	35	2.5	2	26	23
	19	42	2.5	5	73	68
MP summary:	6		50	9	125	92
			Casuarina equisetifolia			
	8	43	2.5	1	12	0
CE summary:	8		2.5	1	13	0
			Trema orientalis			
	2	8	50	1	9	0
	4	17	10	1	7	0
TO summary:	2		60	2	17	0
			-- Type Level Summary --			
All trees:	4.6		315	36	450	180
Merch trees:	10.6		22	14		

Forest type ES11: Cut over, or low volume *Eucalyptus saligna* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3): Gross	Merch
			Eucalyptus saligna			
	2	8	41.2	1	6	0
	4	30	21.2	2	20	0
	6	50	11.2	2	39	0
	7	60	9.4	3	53	0
	8	76	7.1	2	65	56
	9	74	6.8	3	77	69
	10	80	2.9	2	44	41
	11	87	5	3	99	93
	12	89	2.4	2	56	53
	13	94	2.6	2	79	75
	14	100	2.1	2	74	71
	15	108	1.2	1	52	50
	18	109	0.3	1	18	18
	19	111	0.3	1	21	20
	22	117	0.3	1	29	28
	23	119	0.6	2	65	63
	28	102	0.6	3	81	79
ES summary:	7		115	32	889	724
			Eucalyptus robusta			
	7	61	0.3	0	1	0
	7	60	0.9	0	4	0
	8	66	0.3	0	1	0
ER summary:	7		1.5	0	7	0

Appendix C (continued).

Forest type ES11: (continued).

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Toona ciliata			
	2	18	1.2	0	0	0
	4	31	3.5	0	3	0
	6	38	1.8	0	4	0
	7	50	1.2	0	5	0
	8	44	0.6	0	3	2
	10	53	0.3	0	3	2
	11	57	1.2	1	15	14
	12	59	0.6	0	9	8
	14	63	0.3	0	6	6
TC summary:	7		10.6	3	52	35
			Fraxinus uhdei			
	2	6	23.5	1	0	0
	4	20	7.1	1	5	0
	6	42	0.9	0	2	0
FU summary:	3		31.5	1	8	0
			Metrosideros polymorpha			
	2	10	14.1	0	2	0
	4	24	2.4	0	2	0
	6	33	0.9	0	2	0
	7	34	0.6	0	2	0
	9	42	0.3	0	2	1
	11	46	0.6	0	6	5
	12	52	0.3	0	4	3
	13	49	0.3	0	4	4
	15	51	0.3	0	6	6
	18	54	0.3	1	9	9
	19	47	0.3	1	9	8
	20	58	0.6	1	25	23
	21	56	0.3	1	13	12
MP summary:	7		21.2	5	91	77
			Acacia koa			
	7	40	0.3	0	1	0
	8	48	0.9	0	5	4
	9	50	1.5	1	11	10
	10	49	0.9	0	8	7
	11	56	0.6	0	8	7
	14	74	0.3	0	8	8
	16	84	0.3	0	11	10
	19	98	0.3	1	18	18
	27	45	0.3	1	17	16
AK summary:	12		5.3	4	91	83
			Trema orientalis			
	2	8	2.4	0	0	0
	4	30	4.7	0	4	0
TO:	3		7.1	0	5	0
			-- Type Level Summary --			
All trees:	6.7		192	47	1143	919
Merch trees:	12.2		43	35		

Appendix C (continued).

Forest type ES22: Low to moderate volume *Eucalyptus saligna* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Eucalyptus grandis			
	6	78	0.1	0	0	0
	8	99	0.1	0	1	1
	10	115	0.2	0	6	5
	11	108	0.2	0	7	6
	12	111	0.1	0	4	4
	13	114	0.4	0	15	15
	14	107	0.4	0	16	16
	16	122	0.4	1	24	24
EG summary:	13		2	2	78	74
			Eucalyptus saligna			
	2	13	41.5	1	6	0
	4	41	41.2	4	50	0
	6	68	18.6	4	84	0
	7	75	16.1	4	111	0
	8	91	14.3	5	156	136
	9	84	11.1	5	144	130
	10	90	11	6	187	173
	11	92	9.5	6	199	186
	12	93	6.4	5	161	152
	13	105	4.8	4	159	152
	14	108	5.3	6	207	198
	15	95	2.6	3	102	98
	16	112	1.2	2	63	61
	17	67	0.6	1	22	21
	18	116	0.1	0	8	8
	19	102	0.5	1	32	31
	20	120	0.4	1	33	32
	21	121	0.1	0	11	11
	22	123	0.1	0	12	12
	24	125	0.1	0	15	15
	26	120	0.1	0	17	16
ES summary:	8		185.9	59	1790	1440
			Deglupta Eucalyptus			
	6	42	0.4	0	1	0
	7	45	0.5	0	2	0
	10	62	0.1	0	1	1
ED summary:	7		1	0	6	2
			Eucalyptus robusta			
	2	8	2	0	0	0
	4	29	4.9	0	3	0
	6	55	1.5	0	4	0
	7	60	1.8	0	8	0
	8	71	1.1	0	7	6
	9	69	0.7	0	6	5
	10	78	0.2	0	2	2
	11	75	0.4	0	5	4
	12	87	0.1	0	2	2
ER summary:	6		12.7	2	41	21

Appendix C (continued).

Forest type ES22: (continued).

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Fraxinus uhdei			
	2	5	1.5	0	0	0
	4	10	0.5	0	0	0
	6	21	0.2	0	0	0
	7	27	0.4	0	1	0
	9	39	0.2	0	1	1
	11	41	0.1	0	1	1
	12	59	0.4	0	5	5
	14	63	0.1	0	2	2
FU summary:	7		3.4	1	13	11
			Acacia koa			
	4	19	0.5	0	0	0
	7	38	0.1	0	0	0
	8	60	0.1	0	0	0
AK summary:	5		0.7	0	2	1
			Toona ciliata			
	2	22	7.1	0	1	0
	4	35	12.7	1	13	0
	5	59	0.1	0	0	0
	6	48	3.3	1	11	0
	7	44	1.6	0	7	0
	8	57	0.9	0	6	5
	9	75	0.2	0	2	2
	10	48	0.2	0	2	2
	12	53	0.1	0	1	1
	16	72	0.4	1	13	12
TC summary:	5		26.7	4	61	24
			Metrosideros polymorpha			
	2	5	12.9	0	0	0
	4	9	2.9	0	1	0
	6	41	0.2	0	0	0
	7	26	0.1	0	0	0
	11	49	0.1	0	1	1
	12	44	0.4	0	4	4
	20	57	0.1	0	5	4
	26	52	0.1	0	7	7
MP summary:	4		17	2	22	18
			Trema orientalis			
	2	52	12.7	0	4	0
	4	59	8.8	1	14	0
	6	66	3	1	13	0
	7	62	1.9	1	11	0
	8	69	1.6	1	13	11
	9	60	0.8	0	7	7
	10	85	0.8	0	12	11
	11	69	0.1	0	1	1
	12	69	0.4	0	6	6
TO summary:	5		30.1	4	87	38

Appendix C (continued).

Forest type ES22: (continued).

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	--Volume (ft^3)-- Gross	Merch
			Spathodea campanulata			
	4	41	1	0	1	0
SC summary:	4		1	0	1	0
			-- Type Level Summary --			
All trees:	6.9		280	74	2100	1629
Merch trees:	11.1		80	54		

Forest type ES33: Moderate volume *Eucalyptus saligna* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	--Volume (ft^3)-- Gross	Merch
			Eucalyptus saligna			
	2	11	10.8	0	1	0
	4	38	25.4	2	29	0
	6	61	9.6	2	39	0
	7	71	11.5	3	76	0
	8	84	6.8	2	69	60
	9	87	11.8	5	158	143
	10	104	11.3	6	219	203
	11	109	7.4	5	182	172
	12	110	9.3	7	274	261
	13	121	7.3	7	275	263
	14	115	8.1	9	335	323
	15	122	5.9	7	296	286
	16	112	5.5	8	286	277
	17	126	3.2	5	210	204
	18	105	2.4	4	151	146
	19	120	0.6	1	49	48
	20	129	1.3	3	124	121
	21	97	1	2	74	72
	22	135	1	3	110	108
	23	135	0.2	1	24	23
	24	136	0.2	1	26	25
	25	138	0.2	1	28	28
	31	145	0.2	1	45	44
ES summary:	11		141	85	3093	2814
			Fraxinus uhdei			
	2	5	17.7	0	0	0
	4	12	7.7	1	4	0
	6	40	0.4	0	1	0
	7	17	1.3	0	3	0
	8	66	1	0	7	0
	9	53	0.6	0	5	4
	10	64	0.6	0	7	6
	11	45	0.6	0	6	5
	14	86	0.2	0	5	5
	15	92	0.2	0	7	7
	16	96	0.2	0	8	7
FU summary:	5		30.4	3	57	37

Appendix C (continued).

Forest type ES33: (continued).

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Toona ciliata			
	2	14	13.1	0	2	0
	4	30	8.5	1	8	0
	6	49	2.9	1	10	0
	7	49	1.7	0	8	0
	8	52	2.8	1	18	15
	9	63	1.2	1	11	10
	10	90	1.3	1	22	20
	11	100	0.4	0	8	8
	12	67	0.6	0	10	9
	13	76	1	1	23	21
	14	105	1	1	36	34
	15	92	0.4	0	14	13
	18	103	0.2	0	11	11
TC summary:	6		34.9	8	186	146
			Metrosideros polymorpha			
	2	11	22.3	0	3	0
	4	25	6.2	1	5	0
	6	30	0.2	0	0	0
	8	41	0.2	0	1	0
	10	45	0.2	0	1	1
	21	60	0.2	0	9	8
	22	47	0.2	1	9	8
MP summary:	4		29.4	3	31	20
			Trema orientalis			
	2	6	13.8	0	4	0
	4	20	9.2	1	7	0
	6	35	2.8	1	7	0
	7	46	1.8	0	8	0
	8	56	2.5	1	17	14
	9	47	0.2	0	1	1
	10	67	1.2	1	15	13
	11	82	0.8	1	15	14
	12	60	0.2	0	3	2
	13	77	0.2	0	4	4
	15	83	0.2	0	6	6
	17	82	0.2	0	8	8
	18	92	0.3	0	14	13
TO summary:	6		33.4	6	114	80
			Spathodea campanulata			
	2	28	0.8	0	0	0
	6	56	0.6	0	2	0
	8	67	0.4	0	3	2
	9	68	0.2	0	2	1
	11	70	0.2	0	3	2
SC summary:	6		2.1	0	11	7

Appendix C (continued).

Forest type ES33: (continued).

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3): Gross	Merch
			Casuarina equisetifolia			
	2	11	6.2	0	0	0
	4	38	1.5	0	1	0
CE summary:	3		7.7	0	3	0
			-- Type Level Summary --			
All trees:	8.3		279	105	3494	3106
Merch trees:	12.7		102	90		

Forest type ES44: High volume *Eucalyptus saligna* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3): Gross	Merch
			Eucalyptus saligna			
	4	56	25	2	39	0
	6	75	13.5	3	71	0
	7	95	14.8	4	131	0
	8	109	18.3	7	245	216
	9	105	21.5	10	352	321
	10	123	20.3	11	469	437
	11	117	19	13	495	467
	12	122	27	21	872	831
	13	136	16.5	15	691	664
	14	133	17.3	18	798	769
	15	140	17.3	21	993	961
	16	141	5.5	8	364	354
	18	155	5.5	10	503	491
	19	148	1.3	2	116	113
ES summary:	11		222.5	145	6146	5629
			Trema orientalis			
	2	31	10	0	2	0
	6	60	2.5	1	10	0
	7	65	1.3	0	6	0
	10	77	3.8	2	55	51
	11	79	1.3	1	21	19
TO summary:	6		18.8	4	97	71
			-- Type Level Summary --			
All trees:	10.6		241	149	6243	5699
Merch trees:	12.1		174	139		

Appendix C (continued).

Forest type ES55: Moderate volume *Eucalyptus saligna* saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Eucalyptus saligna			
	2	14	10	0	1	0
	4	46	6.7	1	9	0
	6	75	6.7	1	33	0
	7	85	4.2	1	32	0
	8	95	5	2	56	49
	9	103	5	2	77	70
	10	109	0.8	0	16	15
	11	115	5	3	129	121
	12	113	10	8	301	287
	13	134	2.5	2	103	99
	14	129	1.7	2	77	74
	15	145	6.7	8	392	380
	16	149	2.5	3	171	167
	17	110	3.3	5	193	187
	18	145	3.3	6	279	272
	19	150	3.3	7	320	312
	20	147	0.8	2	86	84
	22	151	1.7	4	213	208
	26	179	3.3	12	688	676
	28	168	0.8	4	186	182
	29	135	0.8	4	161	157
ES summary:	13		84.2	78	3533	3349
			Toona ciliata			
	4	46	6.7	1	8	0
	6	57	2.5	0	9	0
	7	63	2.5	1	14	0
	8	65	0.8	0	6	0
	12	76	0.8	1	16	15
	13	80	0.8	1	21	19
TC summary:	7		14.2	3	77	36
			Metrosideros polymorpha			
	2	12	16.7	0	2	0
	14	48	0.8	1	15	13
	18	60	0.8	1	29	27
	24	60	0.8	3	53	50
MP summary:	7		19.2	5	100	92
			-- Type Level Summary --			
All trees:	11.6		117	87	3710	3476
Merch trees:	15.6		60	81		

Appendix C (continued).

Forest type ER22: Low to moderate volume *Eucalyptus robusta* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Eucalyptus robusta			
	14	105	5	5	153	146
	23	119	5	14	449	436
	31	126	5	26	827	807
ER summary:	24		15	46	1431	1390
			Toona ciliata			
	8	65	5	2	41	35
	9	67	5	2	53	47
	11	72	5	3	87	80
	14	75	5	6	145	137
	19	79	5	10	255	244
	20	81	5	11	304	292
	21	82	5	12	313	300
TC summary:	15		35	46	1200	1140
			-- Type Level Summary --			
All trees:	18.3		50	92	2631	2531
Merch trees:	18.3		49	92		

Forest type ER33: Moderate volume *Eucalyptus robusta* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Eucalyptus robusta			
	2	35	52.5	1	11	0
	4	53	17.5	2	21	0
	6	81	3.8	1	15	0
	7	71	7.5	2	39	0
	8	69	2.5	1	17	13
	9	71	5.6	2	49	43
	10	109	2.5	1	40	37
	11	45	5	3	44	40
	12	105	1.3	1	28	26
	13	90	2.5	2	57	54
	14	77	3.1	3	72	68
	15	92	2.5	3	78	74
	16	94	2.5	3	90	86
	17	96	1.3	2	51	49
	18	98	0.6	1	29	28
	20	144	0.6	1	51	50
	21	102	2.5	6	164	158
	22	104	0.6	2	45	43
	24	106	0.6	2	54	52
	26	108	0.6	2	64	62
	36	117	0.6	4	126	122
ER summary:	9		116.3	47	1155	1015

Appendix C (continued).

Forest type ER33: (continued).

	DBH (in)	Average Height (ft)	Number of Trees	Basal Area	--Volume (ft^3)-- Gross	Merch
			Eucalyptus saligna			
	4	26	2.5	0	2	0
	8	69	0.6	0	5	4
	9	84	0.6	0	8	7
	10	85	0.6	0	10	9
	12	98	0.6	0	16	15
	13	93	0.6	1	18	17
	15	113	0.6	1	29	28
	17	141	2.5	4	183	178
	18	125	0.6	1	45	44
	20	153	0.6	1	67	66
	22	136	0.6	2	72	70
	23	138	2.5	7	320	313
	24	140	0.6	2	88	86
	25	114	0.6	2	78	76
	26	153	1.3	5	222	217
	28	148	0.6	3	123	121
	42	164	0.6	6	286	280
ES summary:	20		16.9	36	1578	1537
			Melaleuca quinquenervia			
	24	57	0.6	2	29	28
MQ summary:	24		0.6	2	30	28
			Fraxinus uhdei			
	2	24	7.5	0	1	0
	4	35	10	1	10	0
	6	42	1.3	0	3	0
	8	48	0.6	0	3	3
	9	62	0.6	0	6	5
	11	54	0.6	0	7	7
	14	47	0.6	1	11	10
	19	64	0.6	1	26	25
FU summary:	6		21.9	4	73	52
			Metrosideros polymorpha			
	7	10	0.6	0	1	0
	15	41	0.6	1	11	10
	18	49	0.6	1	19	17
	20	60	0.6	1	28	26
	21	100	0.6	2	49	47
	22	44	1.3	3	50	47
	25	77	0.6	2	53	51
	28	95	0.6	3	80	77
	54	125	0.6	10	334	325
MP summary:	26		6.3	23	628	604
			Spathodea campanulata			
	7	47	0.6	0	2	0
	9	65	0.6	0	6	5
SC summary:	8		1.3	0	9	5
			-- Type Level Summary --			
All trees:	11.2		163	112	3472	3241
Merch trees:	18		59	105		

Appendix C (continued).

Forest type ER55: Moderate volume *Eucalyptus robusta* saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Eucalyptus saligna			
	6	91	0.7	0	4	0
	9	85	2.1	1	27	25
	10	130	0.7	0	17	15
	12	107	1.4	1	40	38
	15	111	0.7	1	32	31
	17	93	0.7	1	35	34
	20	134	0.7	2	68	66
	23	120	0.7	2	80	78
	26	121	1.4	5	204	198
	32	125	0.7	4	154	150
	39	128	0.7	6	227	222
ES summary:	20		10.7	23	893	862
			Eucalyptus robusta			
	2	11	28.6	1	3	0
	4	34	28.6	2	24	0
	6	61	10	2	32	0
	7	52	5.7	2	22	0
	8	76	5	2	36	30
	9	95	6.4	3	74	65
	10	79	2.1	1	26	23
	11	88	6.4	4	104	96
	12	77	5	4	85	79
	13	90	1.4	1	33	31
	14	126	5.7	6	208	199
	15	92	1.4	2	44	42
	16	75	2.9	4	83	79
	17	100	1.4	2	61	59
	18	97	4.3	8	199	192
	20	120	2.1	5	148	144
	21	107	1.4	3	98	94
	22	108	2.1	6	162	157
	23	110	0.7	2	59	57
	24	111	0.7	2	65	63
	25	115	2.9	10	291	283
	26	113	1.4	5	153	149
	27	100	1.4	6	146	142
	29	116	2.1	10	288	281
	30	116	0.7	4	103	100
	32	118	0.7	4	117	114
	33	110	1.4	8	231	225
	34	140	0.7	5	154	151
	40	120	0.7	6	180	176
ER summary:	13		134.3	119	3246	3041
			Fraxinus uhdei			
	13	36	0.7	1	9	8
	14	39	0.7	1	11	10
	15	42	0.7	1	12	11
FU summary:	14		2.1	2	34	31

Appendix C (continued).

Forest type ER55: (continued).

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Alnus nepalensis			
	7	50	1.4	0	6	0
AN summary:	7		1.4	0	7	0
			Eucalyptus microcorys			
	2	30	2.9	0	0	0
	4	54	2.9	0	3	0
	6	66	0.7	0	2	0
	7	65	0.7	0	3	0
	8	74	0.7	0	5	4
	9	76	0.7	0	7	6
	10	90	1.4	1	21	20
	21	84	0.7	2	43	41
EM summary:	8		10.7	4	90	74
			Melaleuca quinquenervia			
	2	52	2.9	0	0	0
	6	64	0.7	0	2	0
	8	75	2.1	1	15	0
	9	67	2.9	1	25	21
	11	69	0.7	0	9	9
	12	55	0.7	1	9	8
	14	71	1.4	2	31	29
	15	65	1.4	2	33	31
	16	90	1.4	2	51	49
	17	67	2.1	3	65	62
	18	73	0.7	1	26	25
	20	74	0.7	2	30	29
	21	74	0.7	2	36	34
	25	80	0.7	2	50	48
MQ summary:	14		19.3	19	388	349
			Metrosideros polymorpha			
	2	18	2.9	0	0	0
	4	29	17.1	1	16	0
	6	37	1.4	0	3	0
	7	43	2.9	1	12	0
	8	45	2.9	1	16	14
	9	46	0.7	0	5	4
	13	55	0.7	1	12	11
	20	52	0.7	2	27	26
	24	83	0.7	2	60	58
MP summary:	7		30	9	157	115
			-- Type Level Summary --			
All trees:	12.4		208	176	4814	4472
Merch trees:	17.7		96	165		

Appendix C (continued).

Forest type ER66: High volume *Eucalyptus robusta* saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Eucalyptus saligna			
	12	125	0.8	1	27	26
	20	153	0.8	2	90	88
	33	173	0.8	5	259	254
ES summary:	23		2.5	7	377	369
			Eucalyptus robusta			
	2	22	3.3	0	0	0
	4	42	26.7	2	26	0
	6	65	14.2	3	48	0
	7	68	15.8	4	79	0
	8	71	8.3	3	58	47
	9	88	16.7	7	180	157
	10	68	11.7	6	124	111
	11	88	13.3	9	217	200
	12	91	11.7	9	232	217
	13	95	7.5	7	182	172
	14	101	9.2	10	272	259
	15	107	7.5	9	268	257
	16	136	3.3	5	169	163
	17	125	10	16	528	510
	18	116	6.7	12	365	353
	19	119	3.3	7	207	201
	20	130	6.7	15	500	486
	21	125	4.2	10	329	320
	22	128	3.3	9	294	286
	23	138	5.8	17	603	588
	24	117	2.5	8	240	233
	25	125	5	17	550	535
	26	134	5	18	633	618
	27	140	0.8	3	117	115
	28	142	2.5	11	384	375
	29	135	1.7	8	259	253
	30	148	3.3	16	606	593
	31	149	0.8	4	161	157
	32	151	1.7	9	346	338
	34	154	0.8	5	197	193
	36	150	1.7	12	426	418
	37	184	1.7	12	546	536
ER summary:	15		216.7	283	9163	8709
			-- Type Level Summary --			
All trees:	15.6		219	291	9541	9078
Merch trees:	18		159	281		

Appendix C (continued).

Forest type ED11: Cut over, or low volume Eucalyptus deglupta pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Eucalyptus deglupta			
	2	11	20	0	3	0
	4	30	33.3	3	34	0
	6	45	13.3	3	51	0
	7	51	11.7	3	69	0
	8	54	1.7	1	14	13
	9	58	3.3	2	40	37
ED summary:	5		83.3	11	214	51
			Metrosideros polymorpha			
	18	66	1.7	3	66	63
	20	52	1.7	4	65	61
MP summary:	19		3.3	7	132	124
			Pritchardia spp.			
	9	29	1.7	1	8	6
PR summary:	9		1.7	1	8	7
			-- Type Level Summary --			
All trees:	6.2		88	19	354	182
Merch trees:	13.2		9	9		

Forest type ED22: Low to moderate volume Eucalyptus deglupta pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Eucalyptus deglupta			
	2	15	13.3	0	2	0
	4	34	33.3	3	37	0
	6	52	16.7	3	73	0
	7	82	6.7	2	60	0
	8	70	5	2	51	46
	9	62	15	7	176	161
	10	71	13.3	7	217	203
	11	113	3.3	2	101	96
	12	97	3.3	3	104	100
	13	104	5	5	194	187
	14	110	5	5	236	228
	15	115	3.3	4	189	183
	16	122	8.3	12	564	549
	17	126	1.7	3	130	127
ED summary:	9		133.3	57	2141	1885
			Acacia koa			
	6	46	3.3	1	10	0
	7	77	5	1	35	0
	8	63	1.7	1	13	11
	10	75	1.7	1	23	21
	13	92	1.7	2	47	45
	17	75	1.7	3	66	63
AK summary:	10		15	8	198	142

Appendix C (continued).

Forest type ED22: (continued).

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3): Gross	Merch
			Metrosideros polymorpha			
	4	5	6.7	1	0	0
	42	105	1.7	16	485	469
MP summary:	19		8.3	17	485	469
			-- Type Level Summary --			
All trees:	9.8		156	82	2825	2497
Merch trees:	13.5		71	71		

Forest type TC11: Low volume *Toona ciliata* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3): Gross	Merch
			Toona ciliata			
	2	8	25.4	1	4	0
	4	23	33.8	3	28	0
	6	34	15.5	3	39	0
	7	42	15.3	4	64	0
	8	46	9.5	3	57	48
	9	45	8.1	4	60	52
	10	46	4.3	2	40	36
	11	59	3.7	2	51	47
	12	55	2.2	2	33	30
	13	57	1.1	1	19	18
	14	57	0.7	1	15	14
	15	65	0.3	0	7	7
	16	66	0.2	0	6	6
	17	67	0.4	1	12	12
	18	60	0.1	0	5	4
	19	66	0.2	0	9	9
	20	57	0.1	0	3	2
	23	69	0.1	0	4	4
	24	70	0.1	0	5	4
TC summary:	7		121	28	470	301
			Eucalyptus saligna			
	2	14	0.3	0	0	0
	6	49	0.1	0	0	0
	7	51	0.1	0	0	0
	8	58	0.1	0	0	0
	10	65	0.1	0	0	0
	12	70	0.1	0	1	1
	14	74	0.1	0	1	1
ES summary:	8		0.8	0	6	4
			Eucalyptus robusta			
	4	27	0.3	0	0	0
	10	58	0.1	0	0	0
ER summary:	6		0.4	0	1	1

Appendix C (continued).

Forest type TC11: (continued).

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	--Volume (ft^3)-- Gross	Merch
			Melaleuca quinquenervia			
	9	70	0.1	0	0	0
MQ summary:	9		0.1	0	1	0
			Fraxinus uhdei			
	2	24	1.1	0	0	0
	4	34	1.4	0	1	0
	6	38	0.2	0	0	0
	7	46	0.1	0	0	0
	8	46	0.1	0	0	0
	9	48	0.1	0	0	0
	10	49	0.1	0	1	0
	13	54	0.1	0	1	1
	16	53	0.1	0	2	2
	22	65	0.1	0	4	3
FU summary:	6		3.4	1	13	10
			Metrosideros polymorpha			
	2	7	76.7	2	16	0
	4	21	36.6	3	29	0
	6	37	5.2	1	13	0
	7	43	2.3	1	10	0
	8	51	1.8	1	11	10
	9	53	3.5	2	29	25
	10	56	0.9	1	10	9
	11	46	0.8	1	8	8
	12	53	0.7	1	10	9
	13	57	1	1	18	16
	14	74	0.8	1	21	20
	15	56	0.4	0	8	8
	16	67	0.4	1	13	12
	17	63	0.4	1	12	11
	18	75	0.3	0	12	12
	19	63	0.2	0	8	8
	20	73	0.2	0	11	10
	21	70	0.1	0	4	3
	22	75	0.2	1	13	13
	24	43	0.2	1	9	9
	25	66	0.1	0	5	4
	26	55	0.1	0	4	4
	28	25	0.1	0	3	2
	29	75	0.1	1	15	15
	33	57	0.1	0	7	7
MP summary:	5		132.9	19	311	225
			Casuarina equisetifolia			
	9	48	0.1	0	0	0
	12	58	0.1	0	1	1
	13	60	0.1	0	2	2
	14	63	0.1	0	1	1
CE summary:	12		0.4	0	6	6

Appendix C (continued).

Forest type TC11: (continued).

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Acacia koa			
	4	18	0.8	0	0	0
	6	67	0.4	0	1	0
	7	41	0.2	0	0	0
	8	52	0.4	0	2	1
	9	45	0.4	0	2	2
	10	60	0.4	0	4	3
	11	53	0.1	0	0	0
	12	55	0.1	0	1	1
	13	75	0.3	0	6	6
	14	61	0.2	0	4	4
	15	63	0.4	0	9	8
	17	65	0.1	0	2	2
	18	15	0.3	0	4	3
	19	70	0.1	0	3	3
AK summary:	11		3.9	2	46	39
			Spathodea campanulata			
	6	45	0.1	0	0	0
SC summary:	6		0.1	0	0	0
			Pritchardia spp.			
	6	24	0.1	0	0	0
	7	56	0.1	0	0	0
	8	29	0.2	0	0	0
	10	42	0.1	0	0	0
PR summary:	8		0.4	0	2	1
			Cheirodendron trigynum			
	4	20	0.3	0	0	0
	6	34	0.1	0	0	0
CH summary:	5		0.4	0	1	0
			-- Type Level Summary --			
All trees:	5.9		263	50	856	587
Merch trees:	11.3		47	33		

Appendix C (continued).

Forest type TC22: Low to moderate volume *Toona ciliata* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Toona ciliata			
	2	16	20	0	3	0
	6	43	5	1	15	0
	7	50	20	5	97	0
	8	51	30	10	193	165
	9	58	30	13	274	243
	10	61	25	14	294	266
	11	66	15	10	228	211
	12	73	15	12	299	279
	13	73	5	5	116	109
	14	76	10	11	279	264
	15	79	5	6	165	157
TC summary:	9		180	87	1966	1698
			Metrosideros polymorpha			
	4	31	20	2	19	0
MP summary:	4		20	2	20	0
			-- Type Level Summary --			
All trees:	9		199	89	1986	1698
Merch trees:	10.5		134	80		

Appendix C (continued).

Forest type TC33: Moderate volume *Toona ciliata* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Toona ciliata			
	2	7	40	1	9	0
	4	23	40	3	33	0
	6	42	14.2	3	43	0
	7	47	14.2	4	65	0
	8	66	16.7	6	134	116
	9	68	18.3	8	194	173
	10	75	12.5	7	177	162
	11	96	11.7	8	251	234
	12	98	10	8	260	246
	13	79	8.3	8	208	197
	14	63	5	5	117	110
	15	91	3.3	4	126	120
	16	85	6.7	9	266	255
	17	97	2.5	4	127	122
	18	97	2.5	4	142	137
	19	102	0.8	2	55	53
	20	70	3.3	7	171	163
TC summary:	9		210	91	2388	2094
			Metrosideros polymorpha			
	2	5	3.3	0	0	0
	11	59	0.8	1	11	10
MP summary:	5		4.2	1	11	10
			Acacia koa			
	7	90	3.3	1	27	0
	8	37	1.7	1	8	6
	9	77	1.7	1	19	17
	10	72	4.2	2	56	51
	11	74	2.5	2	42	39
	12	56	1.7	1	26	24
	13	77	0.8	1	20	19
	14	86	5.8	6	182	173
	15	80	0.8	1	27	26
	16	81	0.8	1	32	30
	18	84	0.8	1	41	39
	21	87	0.8	2	57	55
AK summary:	12		25	20	542	485
			-- Type Level Summary --			
All trees:	9.3		239	112	2941	2589
Merch trees:	12.1		124	100		

Appendix C (continued).

Forest type FU11: Low volume *Fraxinus uhdei* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Fraxinus uhdei			
	2	7	32.8	1	7	0
	4	20	39.6	3	31	0
	6	34	25.5	5	66	0
	7	40	20.4	5	82	0
	8	46	16.6	6	99	84
	9	46	13	6	98	86
	10	47	7.8	4	73	66
	11	52	6.2	4	76	69
	12	58	3	2	48	44
	13	60	2.1	2	40	37
	14	63	1.4	1	32	30
	15	60	1.1	1	27	26
	16	67	0.5	1	17	16
	17	68	0.2	0	7	7
	18	70	0.2	0	8	8
FU summary:	7		170.3	43	718	479
			Toona ciliata			
	2	7	13.6	0	3	0
	4	19	9.8	1	7	0
	6	34	4.6	1	11	0
	7	43	2.5	1	10	0
	8	36	1.7	1	8	7
	9	48	0.6	0	4	4
	10	34	0.3	0	2	2
	11	54	0.2	0	2	2
	12	54	0.3	0	4	4
	13	59	0.1	0	2	1
	15	64	0.1	0	2	2
	16	66	0.1	0	3	3
TC summary:	5		34	5	65	28
			Metrosideros polymorpha			
	2	33	98.7	2	25	0
	4	36	38.7	3	43	0
	6	39	3.5	1	10	0
	7	40	1.1	0	4	0
	8	39	0.2	0	1	0
	9	32	0.1	0	0	0
	10	50	0.2	0	2	1
	11	12	0.2	0	1	0
	13	40	0.1	0	1	1
	14	37	0.1	0	1	1
	15	55	0.1	0	2	2
	16	60	0.3	0	9	8
	18	41	0.1	0	2	2
	19	35	0.1	0	2	2
	20	61	0.1	0	4	4
MP summary:	3		143.8	9	114	28

Appendix C (continued).

Forest type FU11: (continued).

	Average DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Acacia melanoxylon			
	8	49	0.1	0	0	0
	9	48	0.1	0	0	0
	10	51	0.1	0	1	0
AM summary:	9		0.3	0	3	2
			Pritchardia spp.			
	8	21	0.1	0	0	0
	9	25	0.2	0	1	0
PR summary:	9		0.3	0	1	1
			-- Type Level Summary --			
All trees:	5.4		348	56	901	539
Merch trees:	10.1		57	32		

Forest type AN33: Moderate volume *Nepal alder* pole and saw timber.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Metrosideros polymorpha			
	17	72	1.7	3	64	61
MP summary:	17		1.7	3	64	61
			Acacia koa			
	30	80	1.7	8	200	192
AK summary:	30		1.7	8	201	193
			Alnus nepalensis			
	6	52	1.7	0	6	0
	7	39	8.3	2	33	0
	8	55	10	4	69	59
	9	54	11.7	5	103	91
	10	60	11.7	6	139	126
	11	145	11.7	8	371	349
	12	75	15	12	314	295
	13	95	18.3	17	545	518
	14	47	13.3	15	253	234
	15	65	10	12	278	262
	16	83	8.3	12	341	326
	17	97	5	8	250	241
	18	97	8.3	15	472	455
	19	100	5	10	322	311
	20	111	1.7	4	132	128
	21	64	3.3	8	170	162
	22	85	3.3	9	245	236
	24	113	3.3	11	385	374
	27	119	1.7	7	254	247
AN summary:	14		151.7	163	4691	4424
			-- Type Level Summary --			
All trees:	14.4		154	175	4956	4677
Merch trees:	14.8		144	172		

Appendix C (continued).

Forest type CJ00: Recent *Cryptomeria japonica* plantings / sapling stands.

	DBH (in)	Average Height (ft)	Values per acre: Number of Trees	Basal Area	Volume (ft^3) Gross	Volume (ft^3) Merch
			Toona ciliata			
	7	28	1.7	1	6	0
TC summary:	7		1.7	1	6	0
			Fraxinus uhdei			
	6	31	8.3	2	20	0
	7	29	3.3	1	10	0
	8	43	6.7	2	37	31
	9	19	10	4	41	33
	10	25	3.3	2	19	16
	11	24	3.3	2	23	20
	13	23	1.7	2	16	13
	14	23	1.7	2	18	15
FU summary:	9		38.3	17	188	132
			Metrosideros polymorpha			
	14	47	1.7	2	31	29
	23	76	1.7	5	125	120
MP summary:	19		3.3	7	157	150
			Cryptomeria japonica			
	2	24	206.7	5	38	0
	4	31	113.3	10	105	0
	6	36	18.3	4	57	0
	7	37	10	3	42	0
	9	37	1.7	1	11	10
	10	43	1.7	1	15	14
CJ summary:	3		351.7	22	271	24
			-- Type Level Summary --			
All trees:	4.6		395	46	621	305
Merch trees:	11.2		33	23		