
Chapter 4 – Biotope Map of the Study Areas

4.1. Biotopes of Cempaka and Bukit Boloh Study Areas.

In Chapter 2, a methodology for mapping biotopes in the study areas Bukit Boloh and Cempaka was outlined in detail. It was shown how to integrate GIS, GPS, satellite images and Digital Lot map into the classification of biotopes. The results of the classification are presented in this chapter. To monitor and evaluate the accuracy of the classified biotope maps several visits to the study areas were undertaken with ground truth reconfirming made using a handheld Garmin 12 XL.

Using the selective biotope mapping method of the study areas located in the District of Temerloh, Pahang state (Figure 4.1), characteristic species groups for the biotope types for the two study areas were identified, and these are given in Table 4.1A & 4.1B.

Biotope types of Cempaka and Bukit Boloh are given with their numbers, surface areas, perimeter and the characteristic species groups associated with them in Table 4.2A and 4.2B. Semi-natural biotopes Secondary Forest, Belukar, Swamp Fresh Water, Grass, Pond, Scrub, Shrubs, and Grass Land together with cultural biotopes such as agricultural fields and settlement areas are shown in the biotope map of Figure (4.2A, 4.2B, 4.2C and 4.2D). All the selected biotopes were shown in the map as the mapping scale was 1:1555.

The results show that there were 22 biotopes as pure stands for the area of Bukit Boloh and 17 biotopes for the area of Cempaka. When classification was applied to these biotopes, it was found that 8 of them were semi-natural biotopes (Secondary Forest, Belukar/SU, Swamp Fresh Water, High Forest, Grass, Pond, Scrub, Shrubs, and Grass Land) and 8 were cultural biotopes were (Cleared Areas, Newly Cleared Areas, Paths in the cleared areas, Main Road, Small Road, Highway, Agriculture Fields and Settlement Areas with their mosque and cemetery).

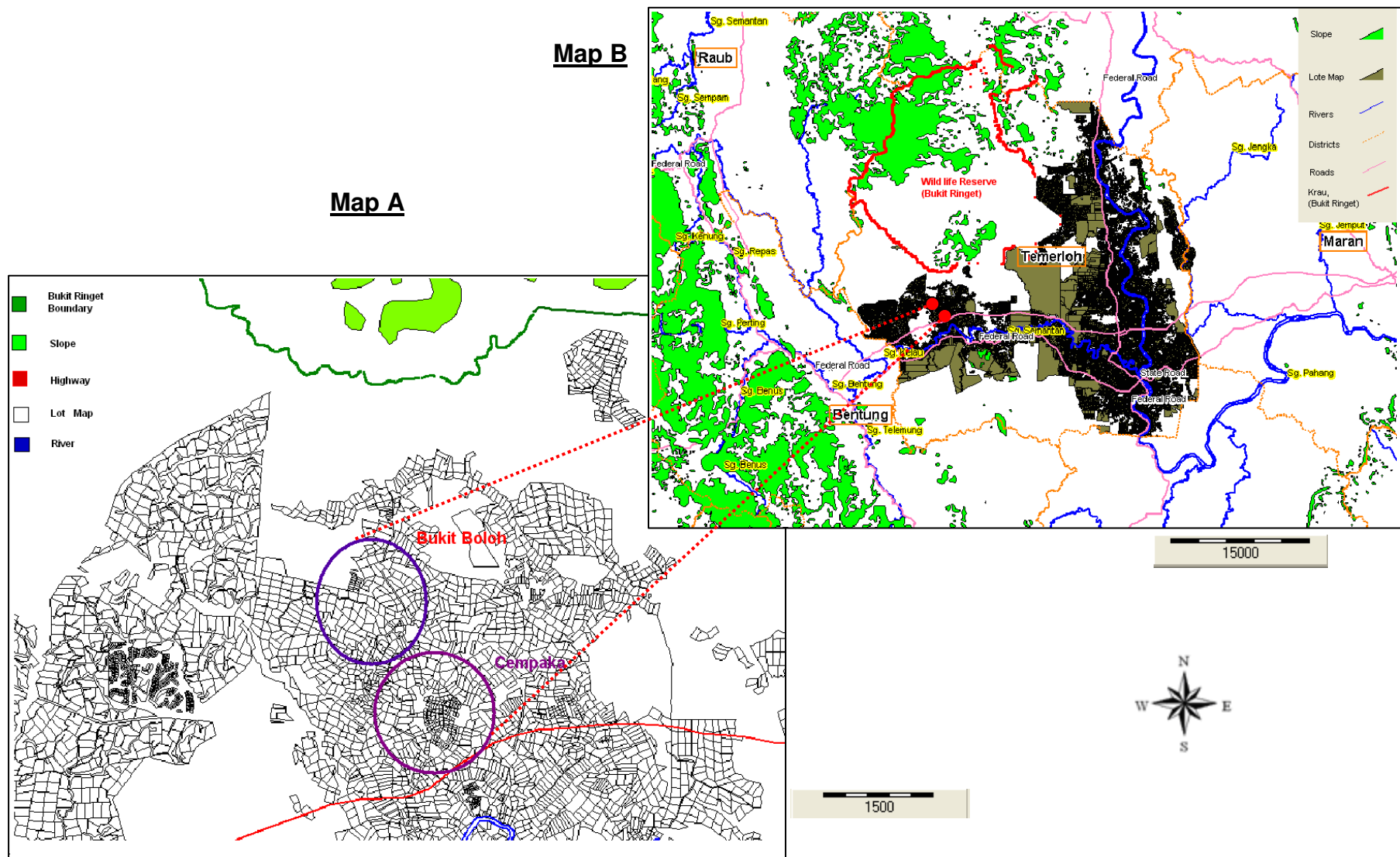


Figure 4.1 Areas of Bukit Boloh and Cempaka (Map A) at the scale of 1:55870 and Temerloh District (Map B) at the scale of 1:487900

Table 4.1A Characteristic Plant Species Groups for Bukit Boloh Biotopes

A- Belukar forest species Bukit Boloh

B- Belukar/SU

1. *Artocarpus elasticus*
2. *Barringtonia racemosa*
3. *Bouea oppositifolia*
4. *Durian carinatus*
5. *Archidendron Clypearia*
6. *Archidendron ellipitikum*
7. *Mallotus macrostachyus*
8. *Microcos tormentosa*
9. *Dialium indum*
10. *Nephelium maingayi*
11. *Pimelo dendron griffithianum*
12. *Rhodamnia cinerea jack*
13. *Vitex Pinnata*
14. *Shorea acuminate dyer*
15. *Scaphium Macropodum*
16. *Pithecellobium clyperia*
17. *Trema cannabina*
18. *Eucalyptus cornuta*
19. *Zizyphus jujube*
20. *Baccaurea Lour*
21. *Delima sarmentosa*
22. *Mikania scandens*
23. *Citrifolia marinda*
24. *Amomum kepulaga*
25. *Artocarpus heterophyllus*
26. *Garcinia atroviridis*
27. *Calophyllum molle King*
28. *Fagraea racemosa*

BP- Banana
Plantation

29. *Koompassia malaccensis*
30. *Willughbeia*
31. *Abrus Precatorious*
32. *Psidium guajava*
33. *Dendrocalamus pendulus*
34. *Schizostachyum zollingeri*
35. *Magnifera odorata*
36. *Intasia palemonica*
37. *Bouea macrophylla*
38. *Zalacca edulis*
39. *Mangifera foetida*
40. *Canarium odoratum*
41. *Bridelia stipularis*
42. *Cinnamomum iners*
43. *Mallotus macrostachyus*
44. *Hevea brasiliensis*
45. *Arenga pinnata*
46. *Scurrula ferruginea*
47. *Salacca zalacca*
48. *Scindapsus hederaceus*
49. *Eleiodoxa conferta*
50. *Eugeissona tristis*
51. *Iguanura Wallichiana*
52. *Daemonorops grandis*

CFF- Coffee

Coffea canephora

GR- Grass

Themeda villosa

RB- Rubber
Plantation

Hevea brasiliensis

SF- Secondary
Forest

O- Orchard

1. *Durio Zibethinus Murray*
2. *Cocos nucifera*
3. *Mangifera caesia*
4. *Garcinia mangostana*
5. *Lansium domesticum*
6. *Nephelium lappaceum*
7. *Averrhoa carambola*
8. *Ananas comosus*
10. *Artocarpus champeden*
12. *Manilkara acharas*
13. *Citrullus lanatus*

C- Crop

1. *Zingiber officinale*
2. *Piper nigrum*
3. *Ipomoea batatas*
4. *Arachis Hipogaea*
5. *Cucumis sativus*
6. *Solanum lycopersicum*
7. *Vigna sesquipedalis*
8. *Capsicum annuum*

SGL -UB
Scrub-Grass Land

1. *Themeda villosa*
2. *Smilax setosa*
3. *Scleria sumatrensis*
4. *Etlingera littoralis*
5. *Eleusine indica*
6. *Alocasia longiloba*
7. *Blechnum indicum Burm*
8. *Cyperus digitatus*

SH- Shrubs

1. *Citrifolia marinda*
2. *Nephelium lappaceum*
3. *Heliotropium indicum*
4. *Ficus tristanifolia*
5. *Microcos tormentosa*
6. *Breynia reclinata*
7. *Mallotus macrostachyus*
8. *Vitex Pinnata*
9. *Alstonia angustiloba*
10. *Chasalia chartacea*
11. *Chromolaena odorata*
12. *Microdemis caseariifolia*
13. *Arenga pinnata*
14. *Blumea balsafimera*

Table 4.1B Characteristic Plant Species Groups for Cempaka Biotopes

B- Belukar/SU

1. *Alstonia angustilaba*
2. *Artocarpus elasticus*
3. *Barringtonia racemosa*
4. *Bouea oppositifolia*
5. *Durian carinatus*
6. *Elaterios permum tapos*
7. *Archidendron clypearia*
8. *Archidendron ellipitikum*
9. *Mallotus macrostachyus*
10. *Microcos tormentosa*
11. *parkia speciosa*
12. *Dialium indum*
13. *Nephelium maingayi*
14. *Pimelo dendron griffithianum*
15. *Rhodamnia cinerea jack*
16. *Vitex Pinnata*
17. *Shorea acuminate dyer*
18. *Shorea ovalis*
19. *Scaphium Macropodium*
20. *Pithecellobium clyperia*
21. *Trema cannabina*
22. *Aguilaria Malaccensis*
23. *Eucalyptus cornuta*
24. *Zizyphus jujube*
25. *Baccaurea Lour*
26. *Delima sarmentosa*
27. *Macaranga gigantea*
28. *Mikania scandens*
29. *Citrifolia marinda*
30. *Amomum kepulaga*
31. *Artocarpus heterophyllus*
32. *Garcinia atroviridis*
33. *Calophyllum molle King*
34. *Fagraea racemosa*
35. *Gironniera nervosa*
36. *Koompassia malaccensis*
37. *Willughbeia*
38. *Abrus Precatorious*
39. *Psidium guajava*
40. *Anthocephalus indicus*
41. *Dendrocalamus pendulus*
42. *Schizostachyum zollingeri*
43. *Magnifera odorata*
44. *Melanorrhoea Wallichii*
45. *Intasia palembonica*
46. *Bouea macrophylla*
47. *Zalacca edulis*
48. *Mangifera foetida*
49. *Canarium odoratum*
50. *Bridelia stipularis*
51. *Arthrophyllum diversifolium*
52. *Cinnamomum iners*
53. *Mallotus macrostachyus*
54. *Hevea brasiliensis*
55. *Arenga pinnata*
56. *Carayota mitis lar*
57. *Eleiodoxa conferta*
58. *Eugeissona tristis*
59. *Iguanura Wallichiana*
60. *Daemonorops grandis*
61. *Cyrtostachys renda blume*
62. *Salacca zalacca*
63. *Scindapsus hederaceus*
64. *Scurrula ferruginea*

IMA- Mangosteen Patch*Garcinia mangostana***Oil Palm***Elaeis guineensis***RB- Rubber Plantation***Hevea brasiliensis***High Patch of Forest & Belukar**

1. *Artocarpus elasticus*
2. *Cinnamomum iners*
3. *Carallia brachiata*
4. *Diospyros maingayi*

O- Orchard

1. *Durio Zibethinus Murray*
2. *Cocos nucifera*
3. *Mangifera caesia*
4. *Garcinia mangostana*
5. *Lansium domesticum*
6. *Nephelium lappaceum*
7. *Averrhoa carambola*
8. *Ananas comosus*
9. *Averhoa bilimbi*
10. *Artocarpus champeden*
11. *Carica papaya*
12. *Manilkara achara*
13. *Citrullus lanatus*

C- Crop

1. *Solanum lycopersicum*
2. *Arachis Hipogaea*
4. *Cucumis sativus*
5. *Capsicum annum*
6. *Solanum lycopersicum*
7. *Ipomoea batatas*

GR- Grass

- Themeda villosa*
3. *Scleria sumatrensis*
 6. *Alocasia longiloba*

SH- Shrubs

1. *clidemia hirta*
2. *Dracaena*
3. *melastoma malabathricum*
4. *Phyllanthus pulcher*
5. *Piper aduncum*
6. *Microcos tormentosa*
7. *Breynia reclinata*
8. *Mallotus macrostachyus*
9. *Vitex Pinnata*
10. *Alstonia angustilaba*
11. *Chasalia chartacea*
12. *Chromolaena odorata*
13. *Microdemis caseariifolia*
14. *Arenga pinnata*
15. *Citrifolia marinda*
16. *Nephelium lappaceum*
17. *Heliotropium indicum*
18. *Ficus tristanifolia*

Table 4.2A Biotopes Types in Cempaka

No.	Biotope type	Name	Number of sites	Area (Ha)	Perimeter (m)	Maximum Area	Minimum Area	Average Area	Maximum Perimeter	Minimum Perimeter	Average Perimeter
1	Belukar	BK/SU	40	86.11375	38698.919	12.28892	0.15282	2.15284	3217.442	199.357	967.472
2	Clear Area	CA	19	23.8556	11807.603	4.71742	0.07458	1.2555	2028.701	105.202	621.452
3	Cemetery	CE	1	0.09037	125.184	□	□	□	□	□	□
4	Crop	CR/Crop	24	68.63495	20363.281	6.85839	0.45676	2.859	1736.439	301.276	848.47
5	High Forest	FO-H	2	1.25394	888.3348	0.50585	0.74809	0.62697	325.554	562.78	444.167
6	Grass	GA/GR/Grass	4	1.40722	1320.0759	0.82707	0.13983	0.351805	451.065	150.239	330.018
7	House / H+Clear	H-CR	84	13.30531	14672.423	0.78375	0.04115	0.1565	479.455	77.544	172.616
8	Highway	H-W	2	31.26783	8114.434	27.90042	3.36741	15.6339	6366.63	1747.796	4057.217
9	Mangosteen Patch	IMA	2	1.67629	977.7883	0.96985	0.70644	0.8381	634.895	342.892	488.894
10	Mosque	MO	1	0.24589	242.779	□	□	□	□	□	□
11	Main Road	MR	3	10.42258	17959.53	7.64544	0.53652	3.4741	14836.82	768.216	5986.51
12	Oil Palm	OP/O.P	5	32.30233	7278.92	19.28843	1.34733	6.4604	3508.423	457.466	1455.784
13	Orchards	OR	25	45.3165	27961.419	5.62599	0.15565	1.81266	2562.531	150.673	1118.456
14	Rubber Plantation	RB	25	266.8824	47835.16	36.64232	0.26934	10.662	6360.382	222.156	1839.813
15	Swamp Fresh										
15	Water	SFW	6	57.851726	26058.49	19.56929	2.55755	9.64195	7615.99	1592.947	4343.082
16	Shrubs	SH	1	1.22166	477.57	□	□	□	□	□	□
17	Small Road	SR	1	1.09415	1671.9	□	□	□	□	□	□
TOTAL			245	642.9424	226453.81						

Table 4.2B Biotopes Types in Bukit Boloh

No.	Biotope type	Name	Number of sites	Area (Ha)	Perimeter	Maximum Area	Minimum Area	Average Area	Maximum Perimeter	Minimum Perimeter	Average Perimeter
1	Belukar/SU	BK	38	42.330057	22182.67	4.94062	0.04233	1.113949	1262.518	106.8002	583.7544
2	Banana Plantation	BPA	1	1.44658	672.7744	□	□	□	□	□	□
3	Clear area	CA	7	8.76113	3773.048	3.51827	0.0558	1.25159	1153.241	110.1901	539.00682
4	Coffee	CFF	1	0.6232	348.5011	□	□	□	□	□	□
5	Crop	CR	11	17.12379	6519.568	3.34829	0.12374	1.556708	1028.874	183.6857	592.68803
6	Grass	GR	2	1.77542	1195.742	1.44487	0.33055	0.88771	903.8887	291.8534	597.87103
7	House/House-Clear	H	29	4.8929988	5620.694	0.69818	0.02505	0.168724	581.0087	61.01865	193.81703
8	Mosque	MO	1	0.02769	65.53973	□	□	□	□	□	□
9	Main Road	MR	1	1.52889	4080.084	□	□	□	□	□	□
10	New clear area	NCL	3	8.28582	2846.564	4.1742	2.00442	2.76194	1241.466	644.9712	948.85458
11	Oil Palm	OP	1	2.82311	722.8915	□	□	□	□	□	□
12	Orchard	OR	10	11.3623	6563.216	3.30542	0.0702	1.13623	1628.342	137.0287	656.32159
13	Path in the clear area	PCA	1	0.15122	448.9711	□	□	□	□	□	□
14	Pond	PO	2	0.98954	611.7191	0.70959	0.27995	0.49477	414.3122	197.407	305.85956
15	Path in the Rubber Plantation	PRP	1	0.11275	263.7355	□	□	□	□	□	□
16	Rubber plantation	RB	11	58.06484	16569.72	16.82967	0.45265	5.278622	3761.389	271.2511	1506.3381
17	Secondary Forest	SF	2	6.19496	1798.377	5.44727	0.74769	3.09748	1333.171	465.206	899.18851
18	Swamp Fresh Water	SFW	10	27.94854	12763.61	15.98336	0.09524	2.794854	6243.375	151.9582	1276.3611
19	Scrub Grass Land	SGL	4	2.2191	1497.338	1.1618	0.20563	0.554775	486.6594	244.8428	374.33444
20	Shrubs	SH	2	0.88063	816.3234	0.80314	0.07749	0.440315	678.1167	138.2067	408.16171
21	Small Road	SR	6	3.2608532	9210.87	1.24806	0.15422	0.543476	3982.381	159.4613	1535.145
22	Scrub	UB	3	0.73182	748.2592	0.47463	0.08044	0.24394	300.1526	169.8087	249.41974
TOTAL			147	201.535	99320.2						

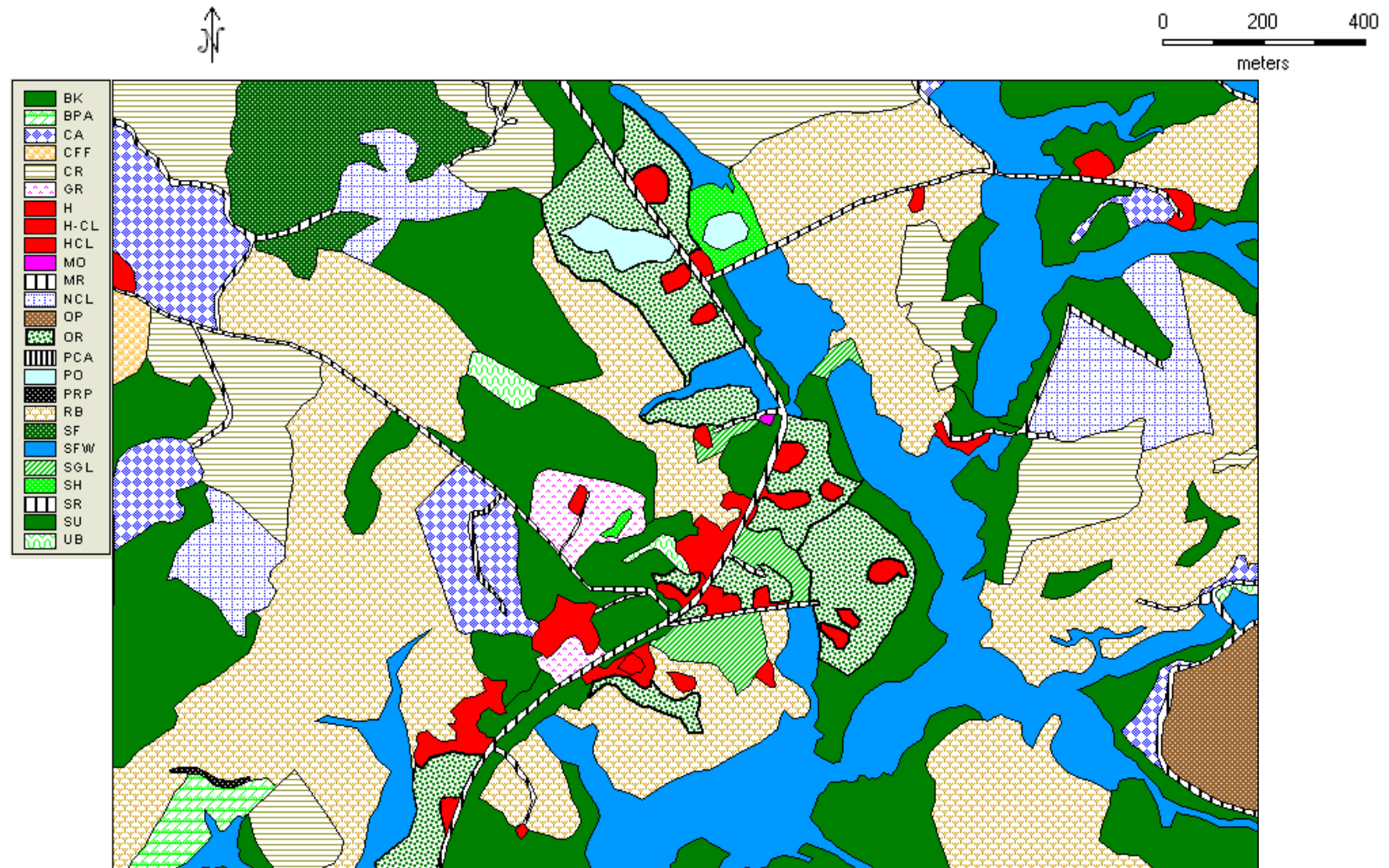


Figure 4.2A Digitized biotope Map and Legend of Bukit Boloh study area, graphically illustrating in some cases features that are linear and representing areas done through the use of color. The number of sites digitally design and evaluated with field work were 147 with a total area of 201.53 ha and total perimeter of 99320.2 m, at the scale of 1:1555.

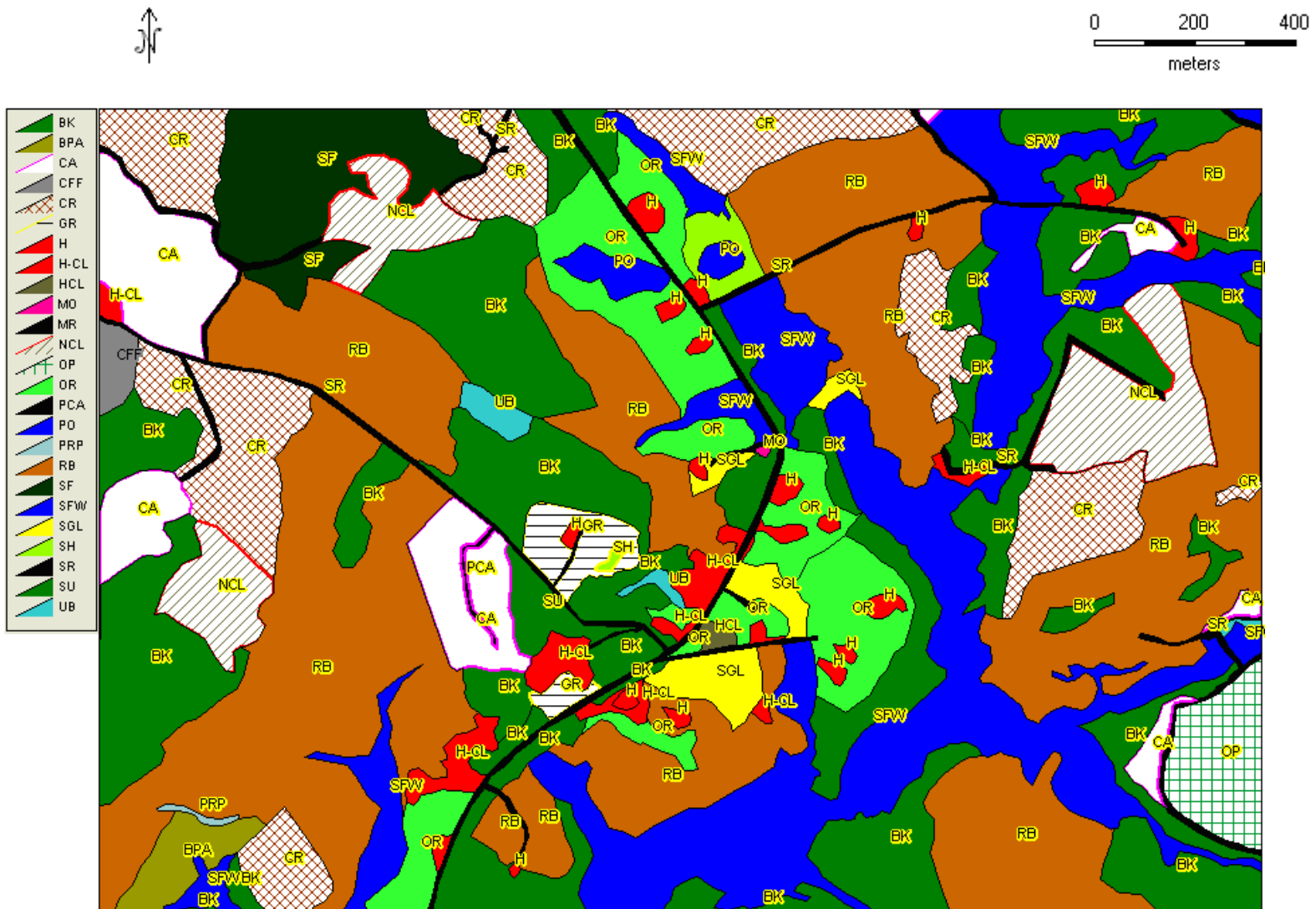


Figure 4.2B Digitized biotope Map of Bukit Boloh highlighting, paths, small roads and main road (black color) within the area

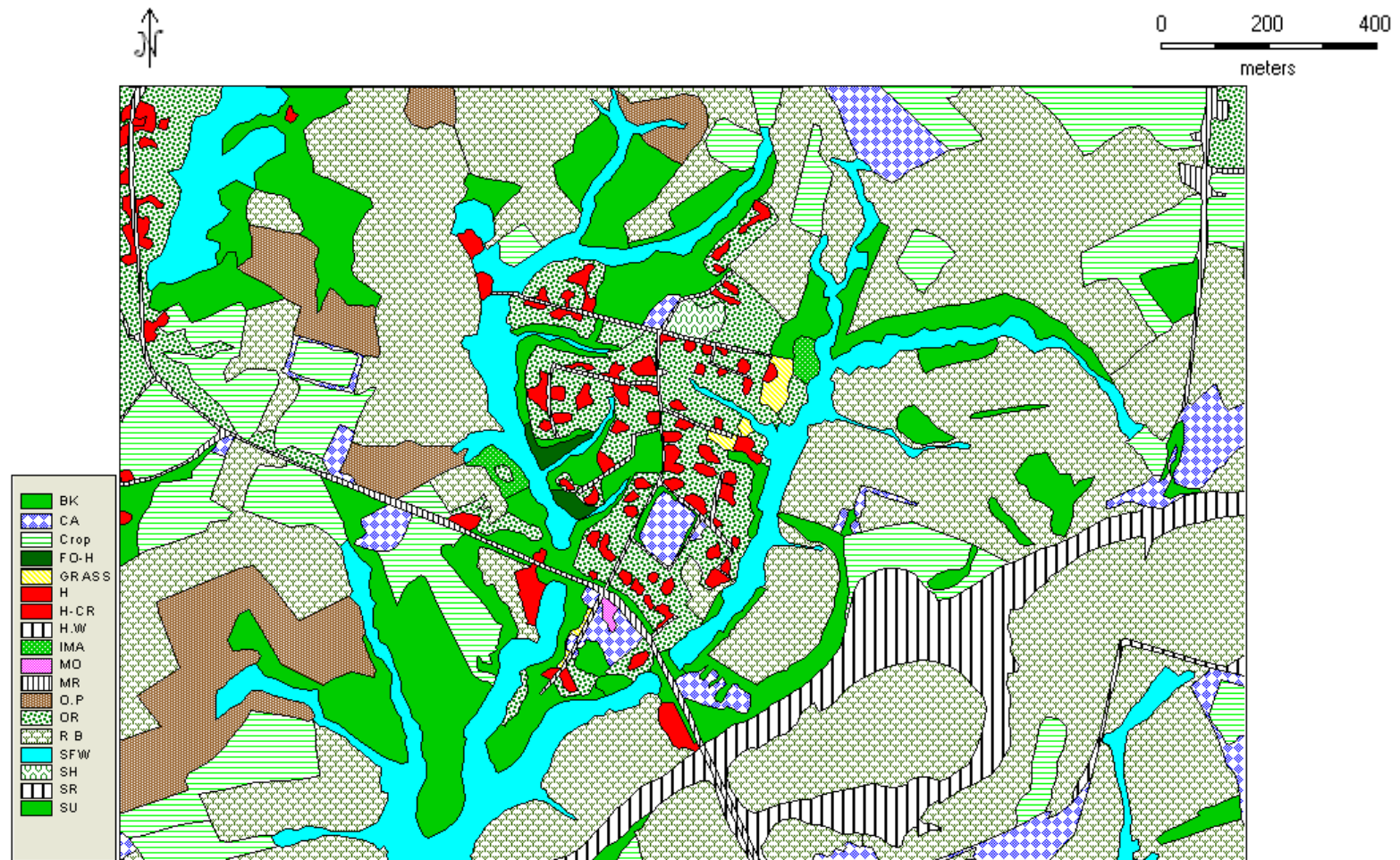


Figure 4.2C. Digitized biotope map and legend of Cempaka study area, graphically illustrating in some cases features that are linear and representing areas done through the use of color. The number of sites digitally design and evaluated with field work were 245 with a total area of 642.94 ha and perimeter of 226453.81 m, at the scale of 1:1555.



Figure 4.2D Digitized Biotope Map of Cempaka highlighting Rubber Plantation, Belukar and Orchards with a range of dark green color (green 64;hue 80;sat 240; lum:30) LIGHT (green 128;hue 80;sat 240;lum 60) Lighter (green 255;hue 80;sat 240; lum;175)

4.1.1 Biotope Map Statistics of the Areas Bukit Boloh and Cempaka

The mean area (ha) for the Biotopes in Bukit Boloh was 1.36 and for Cempaka 2.60 (ha) (Table 4.3). The standard deviation of Bukit Boloh was almost double compared with Cempaka.

Table 4.3 Statistical Summary of the Total Area and Perimeter for the Study Areas

Bukit Boloh	Area (ha)		Perimeter (m)	
	Sites	147	Sites	147
	Min	0.0505	Min	61.018
	Max	16.82967	Max	6243.37
	Mean	1.36965	Mean	675.64
	StdDev	2.3162	StdDev	912.151
	Sum	201.3396	Sum	99320.21
Cempaka	Area (ha)		Perimeter (m)	
	Sites	247	Sites	245
	Min	0.04115	Min	77.5445
	Max	36.6423	Max	14836.8
	Mean	2.603	Mean	916.8171
	StdDev	5.3983	StdDev	1451.02
	Sum	642.94	Sum	226453.8

The total surface area of biotopes was 201.535 ha in Bukit Boloh, and 642.942 ha in Cempaka. The share of semi-natural biotopes as pure stands in both study areas was 230.9184 ha (28 %) while that of cultural biotopes was 613.5594 ha (72 %). With respect to the number of sites, 116 were classified as semi-natural, and 276 as mixed biotopes.

The size of each biotope site varied. The largest semi-natural biotope is the Belukar Forest at Bukit Boloh and Cempaka with a surface area of 42.33 ha and 86.113 ha respectively. The largest biotope in the cultural group is the Rubber Plantation in Bukit Boloh and Cempaka with 58.06 ha and 266.88 ha respectively (Fig. 4.3 A and B).

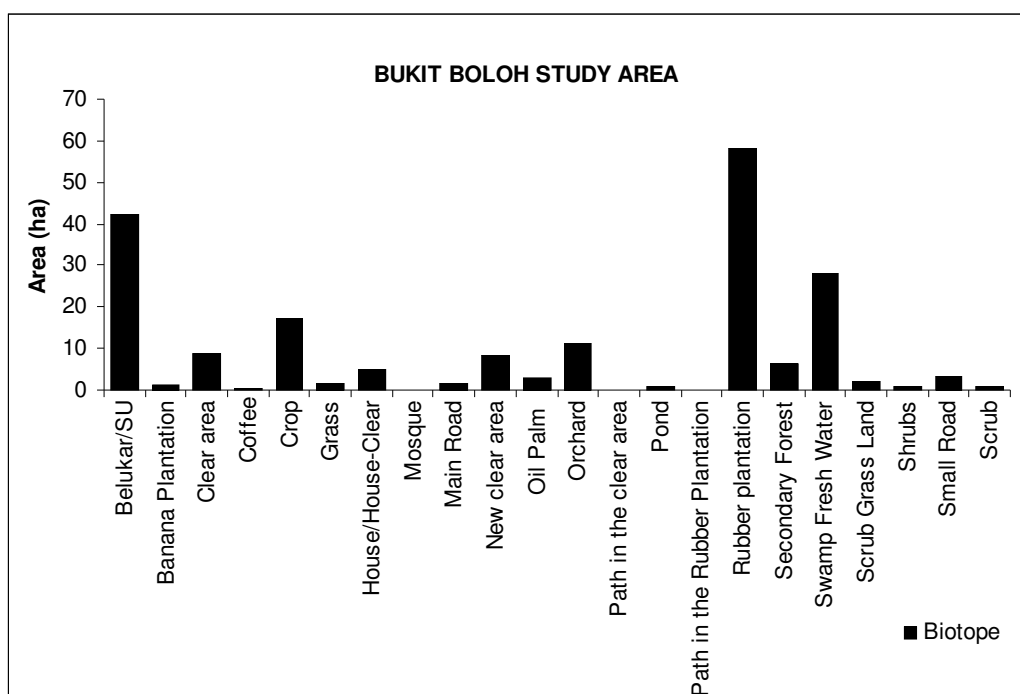


Figure 4.3 A. Area (ha) by Class for Bukit Boloh Biotope Map.

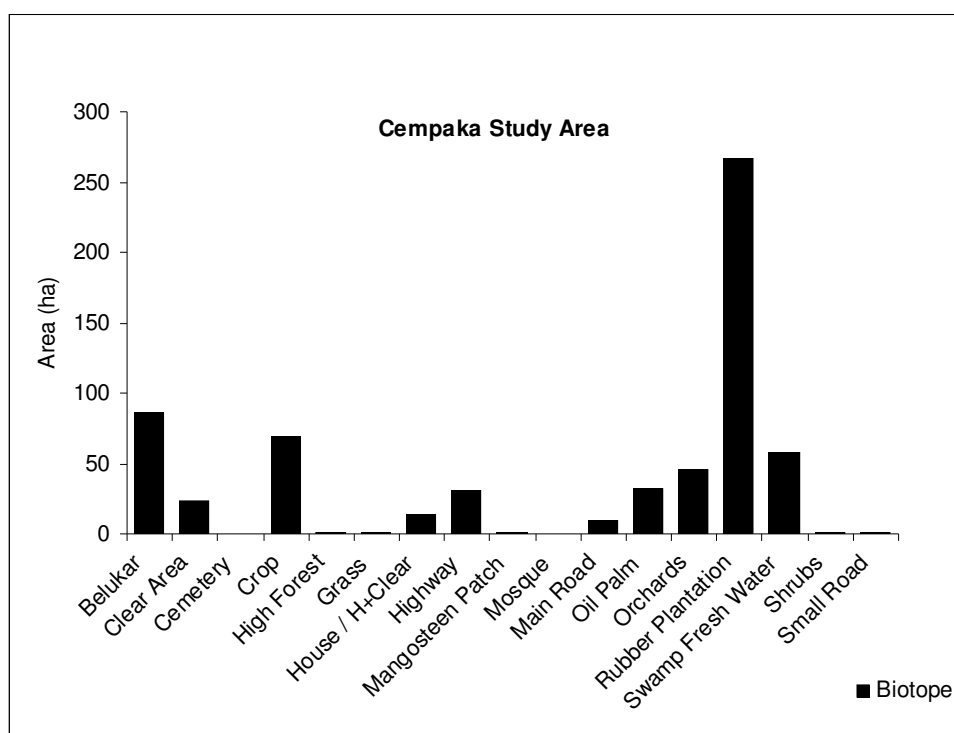


Figure 4.3 B Area (ha) by Class for Cempaka Biotope Map.

The biotope with the highest perimeter values obtained is rubber plantation in Cempaka, and Belakur in Bukit Boloh with 47835.16 and 22182.67 hectares respectively (Fig. 4.4 A & B).

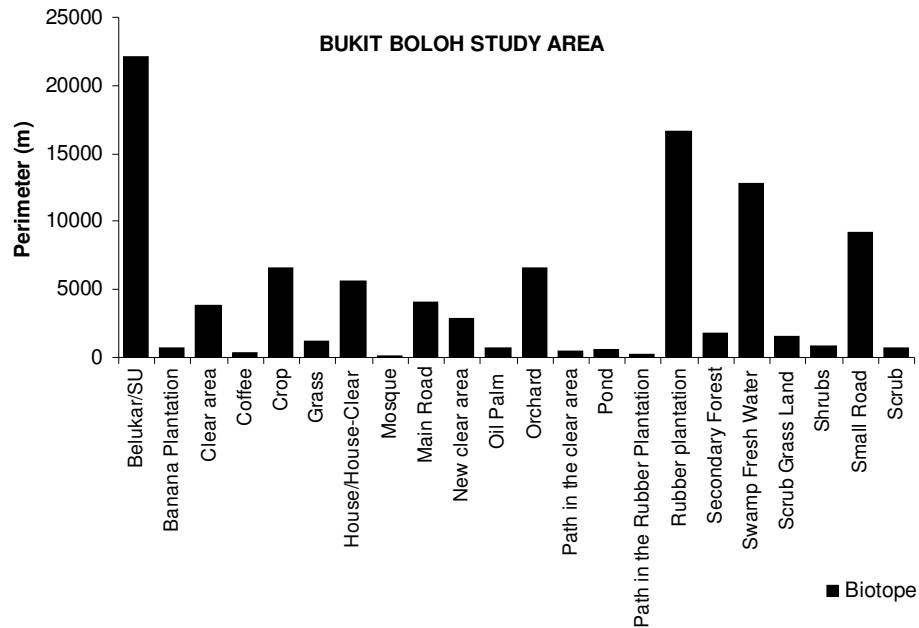


Figure 4.4A Perimeter (m) by Class for Bukit Boloh Biotope Map

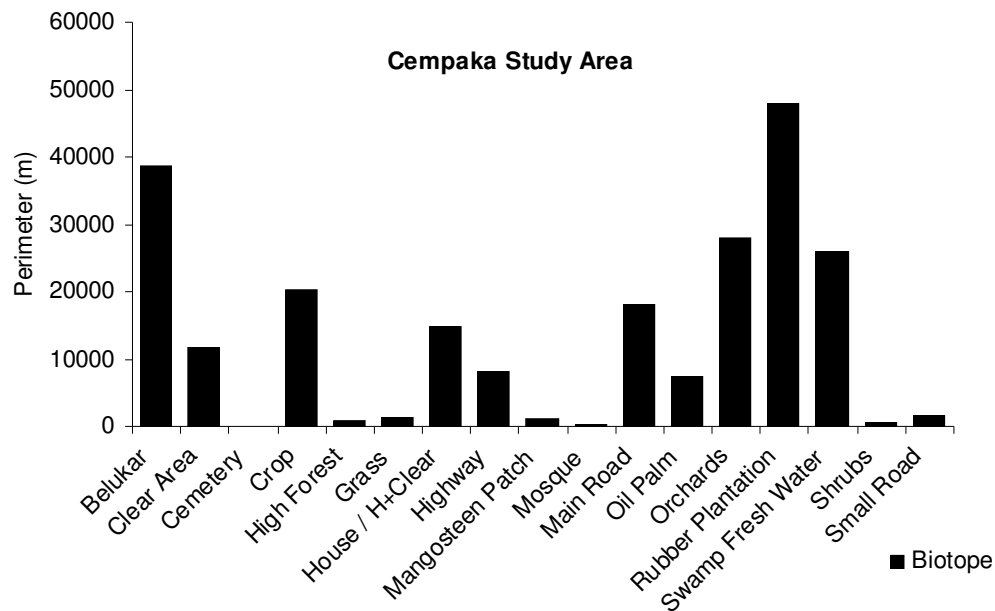


Figure 4.4B Perimeter (m) by Class for Cempaka Biotope Map.

The percentage of the total area represented by each class for the classified biotope maps is shown in Figures 4.5 A&B below.

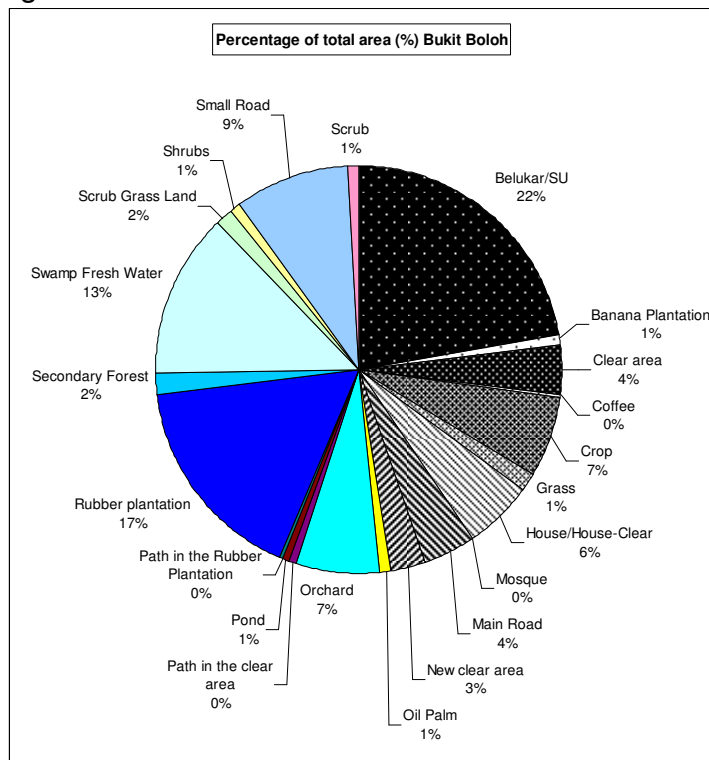


Figure 4.5 A. Percentage Area by Class for Bukit Boloh Biotope Map.

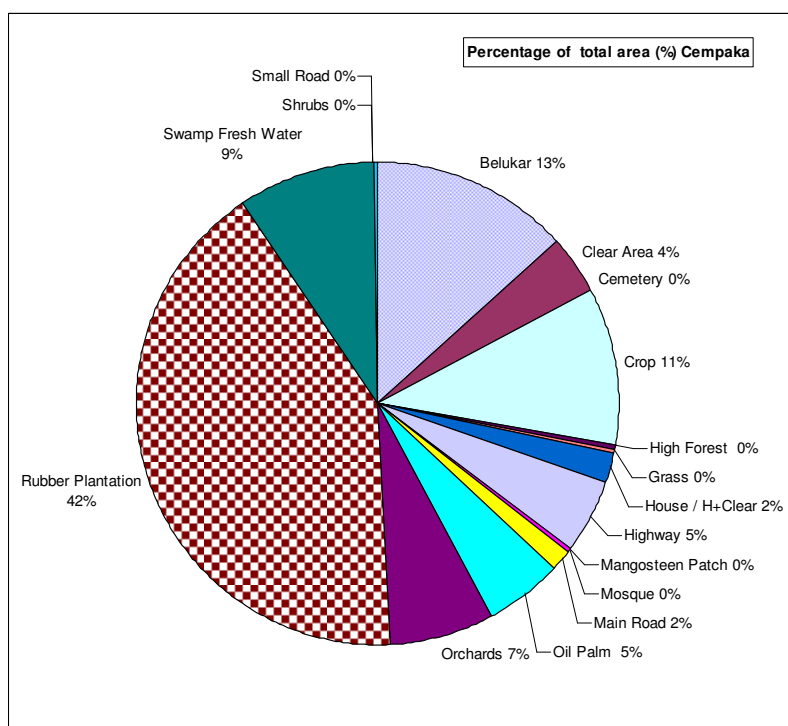


Figure 4.5 B. Percentage Area by Class for Cempaka Biotope Map.