### PLANKTON AND PERIPHYTON COMMUNITIES

Planktonic plants or phytoplankton, planktonic animals or zooplankton which living free-floating in the water and planktonic plants or animal which growing on stones are covered in this chapter. The phytoplankton is ussually great in excess of the zooplankton. In general, Diatoms or Chrysophyta are the most dominant in the Brantas River.

### The abundance and the distribution

#### Plankton

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During the dry season 1997 (Table 10) the abundance of plankton was shown in Karangkates reservoir which is dominated by Chorhormidium. In this site, this species was occupied almost 87% of the total amount of plankton. The abundance are shown also in Ngunut and Surabaya estuary.

In the beginning of the rainy season, the amount decrease in Karangkates without domination of species. The highest abundance is shown in Sengguruh, followed by Wonokromo estuary, Surabaya estuary, Ngunut and Surabaya river (Table 11).

It is to be noted that in both of two seasons the abundance of plankton occurs in the stagnant water or in the reservoirs and in some sites which having a slow current velocity. In the view of species number or diversity, from the upperstream to the lower part of the Brantas river has a tendency to increase. The phytoplankton is ussually great in excess of the zooplankton. Diatoms or Chrysophyta are the most dominant.

Most of sites have a distribution pattern smoothly. In some cases certain sites show a domination of one species especially in the dry season. This domination is shown by Chorhormidium in Karangkates reservoir (87%), Oscillatoria in Lengkong reservoir (80%) and in Wonokromo river (71%) and Spirulina in Surabaya river (71.5%).

The distribution pattern of plankton in the begining of the rainy season shows more spread evenly. The domination occurs only for Microcystis in Surabaya river which occupy almost 72% of the total amount of plankton. Other species such as Scenedesmus are predominant in Wonokromo estuary (43%).

Table 10. Plankton of the Brantas River in the dry season. Represented value in each collum shows the number of cell or individu in each drop of water in the object glass.

PLANKTON (cell/0.05ml)	1	Sampling Sites											
Dry Season	1	2	3	4	5	6	7	8	9	10	11	total	%
Actinastrum							16				14	30	3.80
Anomoeoneis			4			Ī						4	0.51
Characium								10				10	1.27
Chorhormldium						197	ĺ	ļ				197	25.00
Chlorococcum						1	I	I			10	10	1.27
Caelastrum				Ī			38				9	47	5.96
Coelosphaerium										1		1	0.13
Cyclotella									ļ	1		1	0.13
Diatoma		3	2	14	2		2	1				23	2.92
Dinophysis									1			1	0.13
Gyrosigma			·	1		2	15					18	2.28
Kirchneriella										2		2	0.25
Licmophora		1	1						1			1	0.13
Microcystis			İ.		.,					12		12	1.52
Navicula	6		4	4	7		95	1				117	14.8
Nitzschla			8		15	5					1	29	3.68
Osciliatoria			1					51		44	47	142	18.00
Pediastrum						8			7		11	26	3.30
Phacus longicanda		•	-			15		1	1			17	2.1
Phormidium			1	j							1	1	0.13
Pinnularia			-		1							1	0.13
Scenedesmus				1	Í					1	2	2	0.2
Spirulina			-	1	1				30	1	4	34	4.3
Staurastrum					1	1				1	2	2	0.2
Surirella			3	1	1	1				1	Ī	3	0.3
Synedra		3	2	1	1	1				ĺ		7	0.8
Tabellaria	2	2	5		5	1	19				1	33	4.1
Tetramastix apoliensis					1	1		1	1	1		3	0.3
Trigonophysis arcula		1	1	1	Ì			1		1		1	0.1
Trochiscia pachydesma	••••			-	Î	1	1		1	T	Ĩ	1	0,1
Ulothrix		•	13		-	1	1	1		1		13	1.6
Total	8	8	41	20	31	227	185	64	42	62	10	1 789	100.0
Total taxa	2	3	8	4	6	5	6	5	7	7	10	<u> </u>	

1. Sumber Brantas, 2. Junggo, 3. Sengkaling, 4. Malang, 5. Sengguruh,

6. Karangkates, 7. Ngunut, 8. Lengkong, 9. Surabaya river, 10. Wonokromo river, 11. Surabaya estuary. Table 11. Plankton of the Brantas River in the beginning of rainy season 1997. Represented value in each collum shows the number of cell or individu in each drop of water in the object glass.

PLANKTON (cell/0.05 ml)	1	2	3	4 1	5	6	pling S	8	9 !	10	11	otal	%
ainy season					26			15	<u> </u>	32	52	125	13.00
Actinastrum		<u></u>			20		11	13		J2	J2	12	1.30
Actinosphaerum				3			•••••	· · · · · · · · · · · · · · · · · · ·				3	0.30
Amphora										··		6	0.60
Anomoeoneis	ļļ.		6				7					7	0.80
Botryodiopsis Characium			3	3		1				2	4	15	1.60
			3	3	2 17					<u> </u>		17	1.80
Chorhormidium												14	1.50
Chlorella	8				6		······	, ļ.				3	0,30
Chlorococcum					2			1		ļ			
Chlorosarcina					19							19 13	2.00 1.40
Closteriopsis						8			2	3			
Closterium								1			····	1	0.10
Cocconels .	4	20				2						26	2.80
Coelastrum					12	18						30	3.20
Cyclotelia		2		3	3			2		3	2	15	1.60
Cymbella								1				1	0.10
Diatoma	16	2	3	6		l				12		39	4.20
Eunotia								1				1	0.10
Fragillaria	1	6	3				2					12	1.30
Gyrosigma							2					2	0.20
Hemidiscus	1			3		Î		Ì				3	0.30
Phormidium	1					11	5			Ĩ		16	1.70
Melosira						1			2	2	4	8	0.90
Merismopedia					48	1				1		48	5.20
Microcystis						Î		Î	76			76	8.20
Navicula	1	2	3	3	5	2	2		2	5	4	29	3.10
Nitzschia	7		12	3			3		2	2		29	3.10
Oscillatoria	11		3					1		5	10	18	1.90
Pediastrum					16	31		16			24	87	9.30
Pleurosigma										2		2	0.20
Scenedesmus			9	12			9	4	20	54		108	12.00
Scenedesmus acuminatus	-				8		15			1	•••••	23	2.50
Selenastrum											2	2	0.20
Sphaerocystis							31			••••		31	3.3
Spirulina		2	3							2	14	21	2.30
Staurastrum					2	2	3					7	0.8
Stauroneis		2	3	3			•••••				2	10	1.10
Surirella		2	3	3	1		3		2	2		16	1.7
Synedra		2	<u>-</u>		2		2				2	8	0.9
Tabellaria	1	8	l		1		15					26	2.8
Tetraedron						1		1				2	0.2
Total individu	38	48	51	42	171		110		106	126	120		
Total of taxa	7	10	11	10	17	9	14	10	7	13	11	+	

1. Sumber Brantas, 2. Junggo, 3. Sengkaling, 4. Malang, 5. Sengguruh, 6. Karangkates, 7. Ngunut, 8. Lengkong, 9. Surabaya river, 10. Wonokromo river, 11. Surabaya estuary.

#### Periphyton

During the dry season (Table 12) the highest abundance of periphyton is reached in Ngunut. Tabellaria is dominant in Ngunut during the dry season and it represents almost 70% of the total amount. In the same season, other species such as Botryodyopis seem predominantly with about 50% occupation.

In the begining of rainy season (Table 13) the highest abundance occurs in Canggu. In this season Ulothrix represent about 72% of the total amount of periphyton. Other species such as Navicula is predominant in Malang (57%) and in Canggu (55%).

Either in the dry and in the rainy season, many species have a wide distribution from the upperstream in Sumber Brantas to the lowerstream in Canggu, these are shown by Navicula, Diatoma, Anomoeneis and Tabellaria. Table 12. Periphyton of the Brantas River during the dry season 1997. Represented value in each collum shows the number of cell or individu in each drop of water in the object glass.

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PERIPHYTON (cells/0.05ml)	<del></del>				Samplin	ng Sites				
	1 1	2	3	4	5	6	7	8	Total	%
Dry season Amphora		1				1		1	4	1.94
	5								5	2.43
Anabaena	9	2	3	1	4	1			19	9.22
Anomoeoneis							9		9	4.37
Botryodiopsis		·····	·····						1	0.49
Coleosphaerium			·		2	5	2	•••••	9	4.37
Cymbella	4	1	4	1	1	5			16	7.77
Diatoma	4				3		4		7	3.40
Fragiliaria									4	1.94
Gleocystis		4		1	2				4	1,94
Gyrosigma	1					3			4	1.94
Melosira		1			2	8		2	22	10.70
Navicula	4	1	1	4		о 		<i>4</i> -	9	4.37
Nitzschla			2	1	6			••••••	18	8.74
Oscillatoria		5				13				0.49
Pinnularia	1									2.91
Rhizoclonium	·	6							6	7.77
Spirotaenia	1	5		1		9			16	0.49
Staurastrum						1			1	
Stauroneis	8		5	1			1		15	7.28
Surirella				2					2	0.97
Synecococcus		3						1	4	1.94
Synedra			1		2	<u> </u>	2		5	2.4
Tabellaria		2		1		6		9	18	8.74
Uiothrix		1	7					L	7	3.40
Total individu	34	32	23	13	22	51	18	13	206	100.00
Total of taxa	- 9-	12	7	9	8	9	5	4		

Note : 1. Sumber Brantas, 2. Junggo, 3. Sengkaling, 4. Malang,

5. Sengguruh, 6. Ngunut, 7. Ploso, 8. Canggu

ERIPHYTON (cells/0.05ml) ainy Season				、	Sampli	ing Sites				
Rainv Season	1 1	2	3	4	5	6	7	8	Total	%
Amphora			1						1	0.25
Anomoeoneis	1	4	1		1	3	1	4	15	3.73
Calothrix	<b>.</b>					1			1	0.25
Ceratoneis	2								2	0.50
Chlorella		1	ļ.						1	025
Chlorococcum	{						5		5	1.24
Cocconeis		3	· · · · · · · · · · · · · · · · · · ·			1	2	1	7	1.74
Cyclotella			· · · · · · · · · · · · · · · · · · ·			3		2	5	1.24
Cymbelia	1	1		1		3	8	2	15	3.73
Diatoma		6	3	7		2	2	1	21	5.22
Eunotia				3					3	0.75
Fragillaria	1	1		1		3		2	8	1.99
Gyrosigma		,	1		1				2	0.50
Lyngbya	2	3			4	1	1		11	2.74
Navicula	7	9	3	35	6	4	4	56	124	30.8
Názschia	8		4	11	4		1	1	29	7.2
Nodularia		5		• • • • • • • • • • • • • • • • • • • •					5	1.24
Oscillatoria	1			2	5		6	12	26	6.4
Phormidium				•••••			7		7	1.7
Rivularia	11	12	····					4	27	6.7.
Scenedesmus						4		4	8	1.9
Spirogyra	3			•	1				3	0.7
Staurastrum						1			1	0.2
Stauroneis			2	•••••	1	<b>.</b>	····		3	0.7
Surirella			-		1	1	1	5	7	1.7
Synedra	2	1			2	•••••••••••••••••••••••••••••••••••••••		1	5	1.2
Tabellaria	8		-	1	3	2	1	1	16	3.9
Ulothrix		-	38		1	-	•	6	44	10.9
Total	46	45	53	61	27	29	39	102	402	100.0
Total taxa	11	10	8	8	9	13	12	15	1	

Table 13. Periphyton of the Brantas River in the beginning of rainy season 1997. Represented value in each collum shows the number of cell or individu in each drop of water in the object glass.

Note : 1. Sumber Brantas, 2. Junggo, 3. Sengkaling, 4. Malang,

5. Sengguruh, 6. Ngunut, 7. Ploso, 8. Canggu

### Diversity index of Plankton and Periphyton

It has been known that in typical communities there are a few species which are abundant, several species which are less abundant and many species which occur very rare. This model describes the structure of communities of organisms which can be calculated by using diversity index.

According to Hellawell (1985), the use of index of community diversity is based upon the concept that the structure of normal communities may be changed by perturbation in the environtment and the degree of change in community structure may be used to assess the environmental stress.

plankton and periphyton consider the diversity of fo community, data on the annexe are calculated by using Shanon-Wiener index. The value is written as "H'" (Odum, 1973; Omori et al., 1984), which describe a symbol of diversity. The higher value of index, the higher diversity in the community. Figure 16 shows that the diversity varied both by the seasons and the sites. These values can be classified into 3 groups as follows:

H' < 1 : low diversity 1 < H'< 3 : moderate diversity  $H^1 > 3$  : high diversity

These classified value are often useful for the prediction of environmental stress or the instability of environment. A lower diversity means an instability of environment caused by certain factors, contrarely, a higher diversity indicate a stability of communities in the environment.

#### <u>Plankton</u>

During the dry season, a lower diversity of plankton occurs in Sumber Brantas, Malang, Karangkates reservoir, Lengkong and Wonokromo estuary, while the other sites show moderate diversity.

In the beginning of the rainy season, the diversity is higher than in the dry season. Most sites show moderate value and there are three sites which represent higher diversity: Sengkaling, Malang and Ngunut.

#### Periphyton

In the dry season, Junggo has a higher diversity of periphyton. The others show a moderate diversity. In the beginning of the rainy season, a higher diversity is shown in Ngunut and Ploso. The other sites represent a moderate value.

In general, the diversity of plankton from upperstream to the estuary shows very fluctuate during the dry season. Plankton structural communities in the river is very influenced by the change of water and water current. It is clear that the use of plankton diversity index to asses the quality of environment can not be applied for the swift-flowing water, but it can succesfully be applied only for stagnant water.

Periphyton, because they attached on the stones or other materials, can be recommended to asses river condition. Figure 16 shows the same fluctuation for both seasons. A higher diversity in Sumber Brantas and Junggo indicate a good environmental condition and in contrast, Sengkaling and Malang which are situated in the upperstream part of the Brantas River have a relatively lower values. This occurs because these places have a higher nutrients concentration i.e. nitrate and phosphate, as has been written on the previous chapter and because many organic materials exist on these sites. The same pattern is shown also in Canggu.

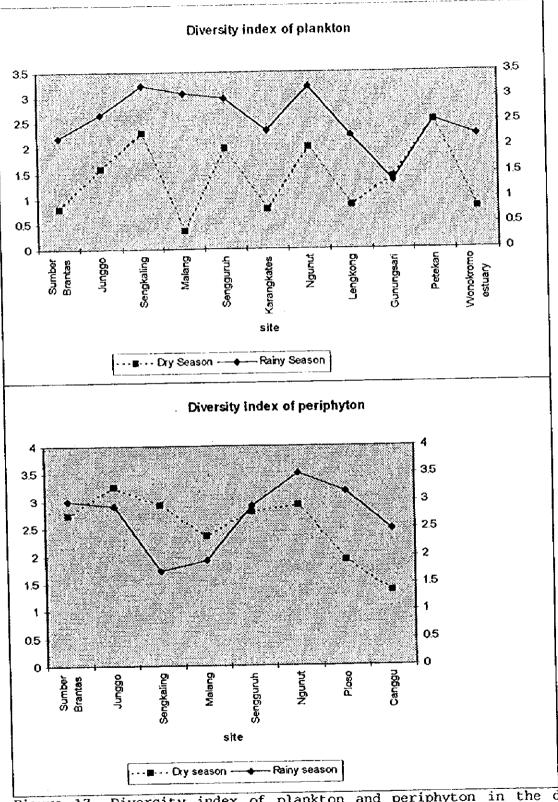


Figure 17. Diversity index of plankton and periphyton in the dry and the rainy season of the different sites of the Brantas River. The value is counted using Shanon-Wiener's equation.

Indicator species.

Plankton, particularly phytoplankton have been used as indicators of water quality. Some species fluorish in highly eutrophic waters while others are very sensitive to organic or chemical wastes. These organisms have a short live cycles, so they respond quickly to environmental changes, and hence the standing crop and species composition indicate the quality of water in which they are found. They strongly influence certain non biological aspects of water quality such as pH, color, taste and odor. Thus, because of these reasons, they are consider as a part of water quality.

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Plankton are generaly abundant in lentic environments or in large rivers with slow-current velocity, close to stagnant condition. According to Franson (1985), Plankton is less valuable in assessing water quality in rivers environment, especially in the water which has a swift current velocity. Thus, the use of plankton as bioindicator can only by applied for stagnant water.

In rivers environment where there is a movement and exchange of water, periphyton is more useful in assessing the effect of pollutants. Data taken from the Brantas River may also be classified into different categories. Some organisms are grouped, based on the water quality condition and on the presence of benthic fauna. The consideration of plankton or periphyton to different water quality should carried out with notice to their quantity occurrence in each site.

<u>Indicator of Clean Water</u> : Anomoeneis Cocconeis Diatoma Rivularia Stauroneis Tabellaria

Actinastrum Chorhormidium Chlorococcum Microscystis Oscillatoria Pediastrum Phacus Scenedesmus Spirulina

Our observation also shows that *Ulothrix* presence in important quantity especially in the environment where the nutrient, such as nitrate is rich. *Ulothrix* growths are apparently promoted by increased nutrient level, especially nitrate. It is in accordance with the rise the remainder of nitrate from agrarian farms, which dissolved and flown into the river water in Sengkaling and Malang which is followed by the abundance of this species.

# The role of plankton-periphyton in biodiversity and their economic aspects

Phytoplankton are highly important as primary producers in aquatic environment. In the food chains they play an important role in providing food for many aquatic animals such as zooplankton, herbivorous fishes, macroinvertebrates, etc.

Because of their photosynthetic activities, they have a role as primary energy source. During daylight they are oxygenating the water in their immediate vicinity, from which are needed by aquatic animals for its respiration and development.

The role of plankton, especially blue green algae, in nitrogen fixation has been known. They fix nitrogen from the air, from this level they can be utilized as a source of nitrogen to fertilize poor nutrient environment.

On the view of their economic aspect, certain species can be monocultured for many purposes. Spirulina can be an excellent substitute for animal protein (Wagener et al, 1987), because of its high nutritive value this species may also have a great future in developing country. Other species such as Chlorella has been known as a supplement or as health food in pharmaceutic industries. The commercial interest in Dunaliella for production of Betha-carotene (Richmond, 1987)is more recent. It may be used as a vitamin A substitute, as an animal feed and as a food colorant.

### Problem and solution

The paragraphs above have cited some roles and beneficial uses of plankton. Not all have a positive aspect, there are also negative aspects that should be solved.

### 1. Algal blooms

Stagnant water in the reservoirs, lakes, ponds or in a very sluggish river which are ample of nutrients (i.e. nitrate, phosphate, etc) may support rich algal blooms. Blooming of alga ussually followed by the rise of oxygen demand for its respiration. Euthophication is a term to the process where lakes are enriched by nutrients naturally or non by human activities. Eutrophic lakes in general are indicated by a low diversity (few species but abundantly). In the 🖉 Brantas Basin, Karangkates represented reservoir can be regarded as an example, has a lower diversity of plankton during the dry season of 1997.

Certain species, when present in a large concentration, produce disagreable tastes and odours (Palmer, 1985). This may cause disagreable taste to drinking water. Algal deposits originated from blooming of alga may provide further sources of nuissance. Further problem of the rise of oxygen demand from algal blooms, is, this may cause fish mortality.

Eutrophication can be reduced by a better water quality management in the reservoirs. Algal blooms may be reduce physiologicaly by treatments of "unprefered" substance. Some

species have certain "prefered" or "unprefered" nutrients and condition. Further field and laboratory researches are needed.

### 2. Inflicted plankton

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Some species has been known produce toxins, especially red microalga, Dinoflagellate. The toxins could be produced by microalgae when blooms occur and then be concentrated by filtering bivalves or be found in other molluscs or fish. At this level in the food chain that these toxins represent a danger for man. Red microalgal bloom or red tide in general occur in the coastal area seasonaly. In the river environment this may reach the estuarine or brackish water area.

There is in general no information or study concering this subject in Indonesia and especially in East Java. For the time being, this is not a main problem which is faced by the Brantas River Estuary.

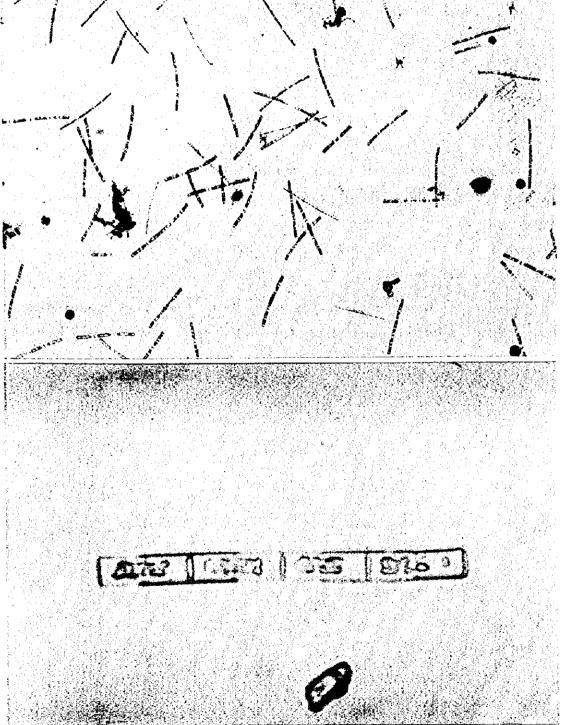
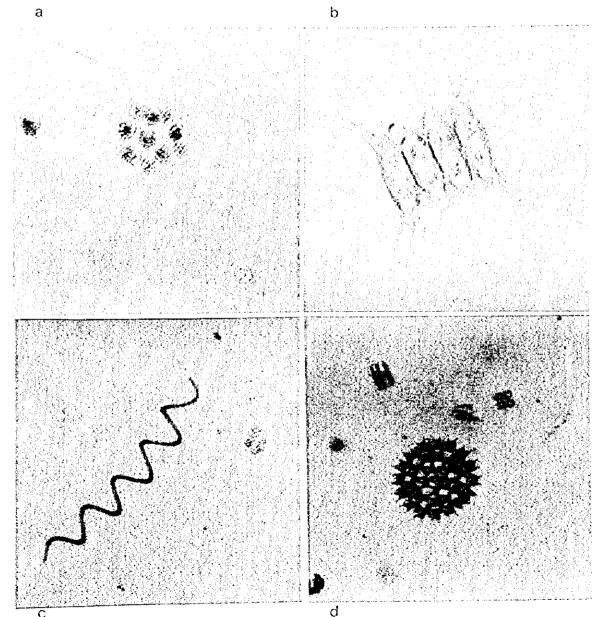


Figure 18. Domination of a species in Karangkates reservoir by Chorhormidium (A). Closed view of Chorhormidium (B). (Photo: YR) B

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d Figure 19. Some of phytoplankton commonly found in the water surface of the Brantas River. A. Microcystis, B. Scenedesmus, C. Spirulina, D. Pediastrum. (Photos: YR)

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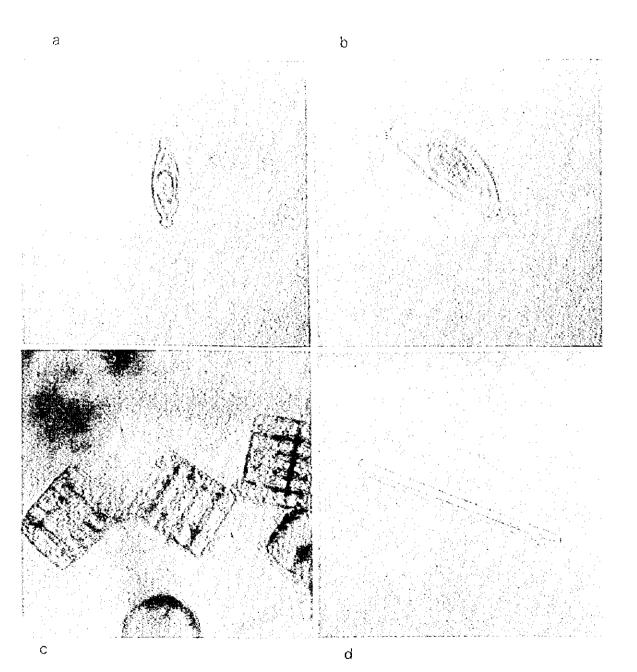


Figure 20. Some of periphyton commonly attached in the stones of the Brantas River. A. Anomoeneis, B. Cymbella, C Tabellaria, D. Synedra. (Photos: YR)

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### PLANT COMMUNITIES

The important of vegetation

Plants including all flora existed along the river have many ecological functions. Forest loss is the most serious threat to the habitats they occupy. Although many functions of plants, in general forest, aquatic plant and mangrove, have already been describe, it may be useful to summarize them here.

1. Dead leaf production to the surrounding bodies of water.

The continuous input of dead materials provides the basic of food chain in the environment. Many species are dependent directly or indirectly on these materials. The omnivore, herbivore fishes and some invertebrate feed directly on leaves which fall into the water. Plankton and macrophyte depend on nutrients such as nitrate and phosphate which is obtained indirectly from material organic decomposition.

2. Production of oxygen and carbondioxide fixation by aquatic plant.

Aquatic plants provide oxigen which is needed by all aquatic organismes for their respiration, contrarely, they fix carbondioxide which is dissolved in the water for their photosyntese process. During the night, aquatic plants do not photosynthesize and oxygen content can fall rapidly to a lesser level required by certain species. This can affect fishes mortality.

3. Reduction of temperature.

The rise in temperature is associated with decreased shading from vegetation. The higher temperature in the water, the greater metabolic rate of fishes and other aquatic animals, and the greater their demand for oxygen. Plant shadows can reduce the rise of water temperature.

4. Prevention of soil erosion.

Silt from poorly protected soil runs to river may cause soil erosion and may increase turbidity. This sedimentation will reduce the depth and will expand the width of the river, and for the later condition can smother eggs and spawning ground. The plant roots are useful for fixing river banks and for the prevention of soil erosion.

5. Feeding sites and nursery areas for aquatic animals. Many aquatic species including fishes, shrimps and prawns depend on mangrove roots and aquatic plants as feeding sites and nursery areas.

6. Supporting the productivity and the diversity in aquatic environment.

Terrestrial forest and mangrove create habitat diversity in their environment. This will increase the productivity of the associated aquatic environment.

### The existed species and the family composition

From the survey it has been collected 174 plant species along the Brantas River, including terrestrial plants, aquatic plants and mangrove species. The species, the relative abundance and the distribution are listed on annexes. These plants consist of 60

families (Table 14) which distribute along the Brantas river, and can be classified as mentioned below:

- 1. The highest number of taxa per family is Graminae which having 35 species.
- 2. Families which having taxa amount between 10 and 20 are Compositeae (16), Convolvulaceae (12), Cyperaceae (19), Leguminoceae (18), Malvaceae (15), Mimosaceae (10), Moraceae (10), Euphorbiaceae (14).
- 3.Families which having taxa amount between 3 and 9 are Acanthaceae (3), Amaranthaceae (9), Asclepiadaceae (4), Asteraceae (7), Bombaceae (5), Brasicaceae (3), Caricaceae (3), Componulaceae (4), Labiateae (5), Marsiliaceae (3), Musaceae (3), Myrtaceae (4), Onagraceae (4), Papilionaceae (4), Polypodiaceae (5), Rubiaceae (4), Salviniaceae (5), Solanaceae (4) and Verbenaceae (6).

Families which only consist of 1 or 2 taxa are Annonaceae (1), Apoccynaceae (2), Araceae (2), Araliaceae (1), Avicenniaceae (2), Bignoniaceae (1, Boraginacea (2), Butomaceae (1), Caryophyllaceae ´(l), Comelinaceae Cyatheae (2), (1), Casuariaceae (1), Lannaceae (1), Gleichenniaceae (1), (2), Elaecarpaceae Marchantiaceae (1), Meliaceae (1), Nyctagenaceae (1), Oxalidaceae (2), Palmae (2), Passifloraceae (1), Pinnaceae (1), Polygonaceae (1), Polystrychaceae (2), Ponteridaceae (2), Portulacaceae (2), (2), Sapindaceae (1), Rhomnaceae Rhizophoraceae (1), Sellaginellaceae (1), Tiliaceae (1), Typhaceae (1).

Family	Higher	Middle region 1	Middle region 2	Delta region	Total of taxa per	
	αιτιτικα	. Ug . U. I		-	family	
1. Acanthaceae				3	3	
2. Amaranthaceae	2	2	2	3	9	
3. Annonaceae			1		1	
		1	1		2	
4 . Apoccynaceae 5 . Araceae			1	1	2	
6. Araliaceae	1				1	
7. Asclepiadaceae	-		2	2	4	
8. Asteraceae	1	5	1		7	
9. Avicenniaceae	-	-		2	2	
10.Bignoniaceae				1	1	
10.Bighoniaceae		1	2	2	5	
			1	1	2	
12.Boraginaceae	1	1	1		3	
13.Brasicaceae	+	-		1	1	
14.Butomaceae		1	1	1	3	
15.Caricaceae	1	±	-		1	
16 Caryophyllaceae					1	
17.Casuariaceae	1		1	1	2	
18.Comelinaceae		2	1	1	4	
19.Componulaceae		2	5	3	16	
20.Compositeae	1	3	5	4	12	
21.Convolvulaceae	-	.5		•	1	
22.Cyatheae	· 1	3	6	7	19	
23.Cyperaceae	3	2	1	1	2	
24.Elaecarpaceae		c	4	4	14	
25.Euphorbiaceae		6	4	-1	1	
26.Gleichenniaceae	1		14	10	35	
27.Gramineae	4	7		2	5	
28.Labiatae		2	1	2	1	
29.Lannaceae		1	0	5	18	
30.Leguminoceae		5	8	5	15	
31.Malvaceae	_	4	5	0	10	
32.Marchantiaceae	1	-	-	r	3	
33.Marsiliaceae		1	1	1	3 1	
34.Meliaceae		-	1	ъ	10	
35.Mimosaceae		3	4	3		
36.Moraceae		3	5	2	10 3	
37.Musaceae		1	1	1		
38.Myrtaceae	2		1	1	4	
39.Nyctagenaceae		1	_	· .	1 4	
40.Onagraceae	1	1	1	1		
41.Oxalidaceae	2		-	-	2	
42.Palmae			1	1	2 2	
43.Palystrychaceae	2		-			
44.Papilionaceae		1	2	1	4	
45.Passifloraceae				1	1	
46.Pinaceae	1				1	
47.Polygonaceae			1		1	
48.Polypodiaceae	2	3			5	
49.Ponteridaceae			1	1	2	
50.Portulacaceae			1	1	2	

Table 14. The plant family composition along the Brantas river.

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51.Rhizophoraceae	· · · · · · · · · · · · · · · · · · ·			1	1
52.Rhomnaceae				1	1
53.Rubiaceae		1	2	1	4
		3	2	2	5
54.Salviniaceae		-	2		2
55.Sapindaceae			•	1	2
56.Selaginellacea	e 1			1	4
57.Solanaceae	1	2	1		
58.Tiliaceae		1		_	1
59.Typhaceae				1	1
60.Verbenaceae	1	1	2	2	6
Higher altitude: Middle region 1: Middle region 2:	Sengkaling - Sengquruh - N	Sengguru Mojokerto	h /Lengkong	ł	
Lower region :	Surabaya & Po	orong riv	ver - esti	aries	

## Zonation of Macrophyte along the Brantas river

Macrophyte communities appear to be governed by climate, geology and soil type and low or high altitude stream, thus, different specific zones will have specific macrophytic vegetation. The distribution of macrophyte along the Brantas River can be classified based on the different habitat of the macrophyte as mentioned below.

### • Terrestrial plants (excluding Mangrove)

Terrestrial plants which only inhabit in very high altitude such as at Sumber Brantas and Junggo and which are not found in the other region are Celosia argentea, Cemara, Cyathea sp, Cyperus brevivolius, Datura metel, Drymaria cordata, Eucalyptus alba, Eugenia cumini, Gleichenia sp., Lantana camara, Nephrolepis cordifolia, Nothopanax quincifolia, Osmunda sp, Oxalis acetofolia, Oxalis carniculata, Polystrichum commune, Pinus merkusii, and Selaginella sp.,

Terrestrial plants only inhabit in the lower part of the Brantas river from Surabaya river to the river mouth such as Abutilon indicum, Claris barbata, Delonix regia, Dolichandron spathacea, Enterolobium saman, Fimbristylis, Passiflora paetida, Phaseolus fulgaris, Phyllanthus reticulatus, Pithecellobium dulce, Portulaca sp, Ricinus communis, and Zizyphus mauritania.

Other mcrophytes, as can be seen in the annexe, grow sparsely or abudantly between upper and lower part of the Brantas river. These species may have a wide or a narrow distribution.

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Aquatic Plants

Marchantia polymorpha from the Family of Marchantiaceae is the only aquatic plant which is found in the upperstream part of the Brantas River.

Aquatic plant such as Cyperus pilosus, Limnocharis flava (rare), Marsilia aquatica (many) and Typha angustipholia grows in the lower part of the river from Surabaya river to the river mouth.

The others inhabit and distribute widely along the Brantas River. These species include Ipomoea aquatica, Salviniaceae and their derived, Marsilia crenata, Eichhornia crassipes, Jussiena repens, and Spenoclea zeylanica

#### Mangroves

The mangrove forest often exhibit a very complex zonation pattern. Many studies of zonation schemes or pattern have been done by some authors. The schemes is generaly based on the existed frequency, or on the dominant species.

Mangrove refers to complex of plant communities fringing sheltered shores. In the Brantas Delta this communities occupy the riverine area of the estuary, coastal area and pond areas. At least there are 8 mangrove species in the Brantas delta which are dominated by Avicenia marina, Avicenia officinalis, Acanthus ilicifolius and Exoecaria agallocha. Other species such as Nypha

fructicans and Xylocarpus sp, distribute moderately. Rhizophora and Derris sp. are found rarely.

The zonation pattern among these species shows heterogen, it means that there is no specific pattern which is separated by ecological characteristic such as tide and soil-water salinity. Mangrove plants are associate together with epiphytes, few lianes, grasses and other higher plants.

This pattern is not the same with other mangrove forest located in other area in East Java like in Curah Sawo, which is dominated by Rhizopora and showing zonation of certain species. In the Brantas delta, water salinity is very high, especially in many ponds which can reach more than 40 promil. This reason indirectly makes specific communities of mangrove species which is shown by the abundance of Avicenia. These plants are dominant in the Brantas delta because of their high adaptation to environment such as salinity and partly anaerobic soil.

### Indicator species

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> Macrophytes have some important advantages as indicator species: they are stationary and visible to the naked eye. Until relatively present their responses to pollutants were not well documented, but attempts have now been made to provide schemes for assessing environmental damage (Harding, 1981; Haslam, 1982; *in* Hellawell, 1986).

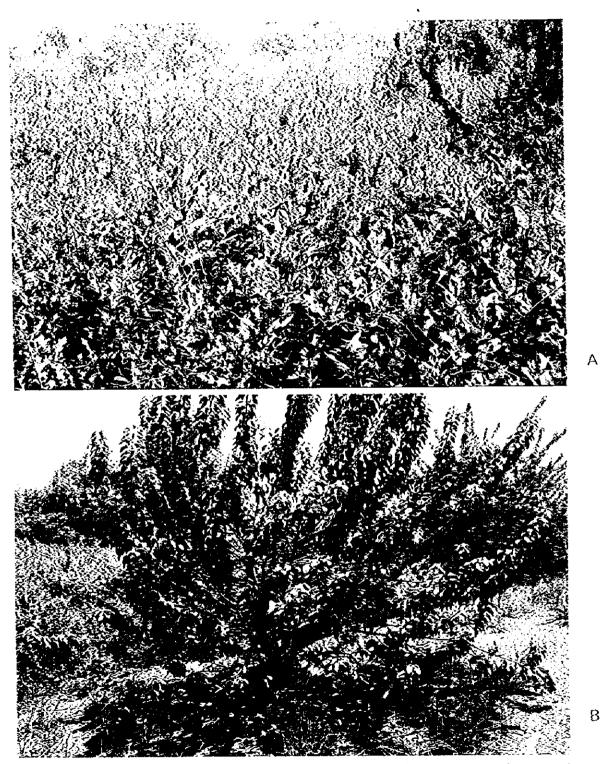


Figure 21. Some of mangrove species which inhabit in many quantity at the Brantas delta. A. The sapling of Acanthus; B. Exoecaria.

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Until present, the study concerning the use of terrestrial plant for ecological indicator is very lack, but many studies have been done for the use of aquatic plants as indicator of water quality. Water hyacinth, *Bichhornia crassipes* is known can accumulate some pollutants such as cadmium, lead, mercury (Chigbo et al, 1982), and detergent (Akhyaar, 1996). Thus, this aquatic plant can be recomended as an indicator species for water quality.

Other species can also be considered as pollutant indicator based on their habitat in the Brantas river, they are Cyperus pilosus, Marsilia aquatica and Typha angustipfolia which are found in many quantity from Surabaya river to the river mouth. The only species inhabit in Sumber Brantas or Junggo, Marchantia polymorpha, may be considered as indicator of clean water. Further study concerning the use of macrohyte as indicator of water quality is needed to understand their physiological characteristic of pollutant accumulation and to manage river environment.

### Mangrove and fisheries in the Brantas delta

The important of mangrove in providing nutrient for aquatic animal and as nursery areas has long time been recognized. A variety of fish species and herbivorous animal feed in the mangrove forests.

In relation to their function as a nursery area for many species, mangrove has a role in supporting prawn migration for the completion of its life cycle. Knox *et al.*, (1984) stated that the freswater prawn, *Macrobrachium*, is dependent on the brackish-water environtment. Pregnant female migrate from freshwater rivers and lakes to the mangrove swamps along the coasts, where the eggs hatch into free swmming larvae. After completion of the pelagic larval stage, the larvae metamorphose to a benthic stage and crawl back upstream to fresh water. On the other hand, marine species spawn in

the shore, the newly larvae migrate to the mangrove swamps and stay until they reach the juvenil stage then migrate offshore.

Mangrove in the Brantas delta, especially in Wonokromo river, facing some problems.

1. Mangrove conversion to other land uses.

Mangrove area has been changed to aquaculture ponds or tambak since 1962. There are approximately 200 hectars of tambak which are managed traditionaly for milk-fish and shrimp culture (Yazid and Amar, personnel communication). In the future, the area will be converted to a settlement area.

2. Mangrove cutting.

Mangrove forests are exploited by local people for a source of firewood. Ohter reason, some local people cut the old trees as a preventive action from pest and desease.

3. Lacking of silvofishery management.

Based on the survey on the last of November 1997, the most pond areas has very high salinity (38-42 promil). It is the fact that Wonorejo area has no fresh water resources, it is only from the rainfall during the rainy season the ponds obtain the freshwater. On this condition, Penaeus and adult milk fishes (more than 2 kg of weight) die, only white shrimps and the juveniles adapted in these ponds.

### The Problems and the solutions

1. Aquatic plant problem.

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It has been long time known that the Brantas River facing problem of water hyacinth, *Eichornia crassipes* (Eceng Gondok). This aquatic plant grows and covers surface water of river and reservoirs rapidly. Commonly it inhabit densely in stagnant water or in slugish flowing water. Our observation shows that the plants cover about 25 percent of river area at Porong in the dry season (August 1997) and in November the river had been covered by almost 100 percent of the surface area.

2. Forest loss is the most serious threat to the habitat they occupy. This include forest conversion to other land uses, cutting of trees, etc.

3. The aquatic plants can be used as water quality indicator and they have many functions for aquatic animals. The uncontrolable of sand and stone mining can vanish aquatic plants, which then influence biodiversity.

Solutions for these problems can be proposed:

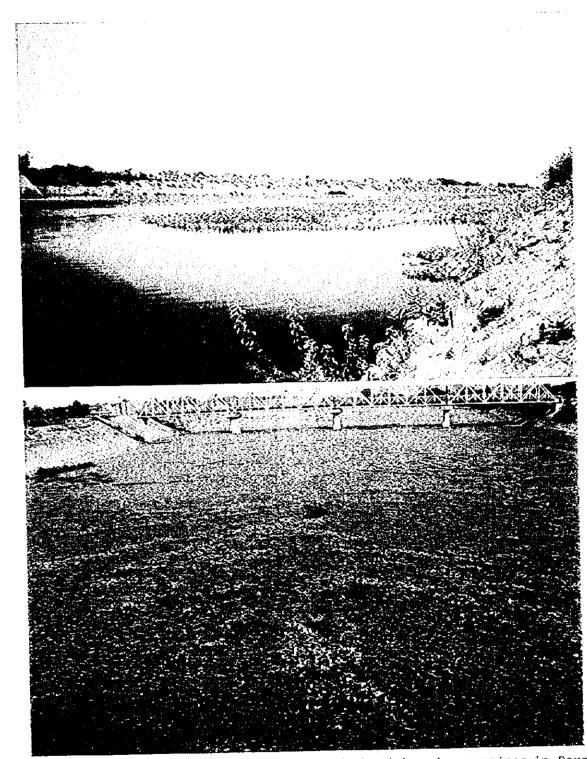
1. Cleaning water hyacinth by machines, chemist or others such as by prevention of direct sunlight. Local people and NGO can also be involved to clean this plant. Monitoring is needed to control their growth.

2. Forest loss due to conversion to other land uses such as aquaculture ponds can not be avoided. On the other hand the multiple use system of pond and mangrove can be applied. This system is called "tambak tumpang sari" (Sukardjo, 1988) or

"silvofishery" (Anonyme, 1997) because it embraces multiple land use practice involving joint production of mangrove forestry and fishery crops. This concept may provide traditional fishery products and may save the existing mangroves.

3. Giving information and guidance to the people or inhabitants near the forest sites. Involving LKMD, LSM, local people to support reforestation. <u> </u>

4. Increasing the supervision of forest and excecuting law enforcement.



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Figure 22. Aquatic plant, the water hyacinth Eichornia crassipes in Porong during the dry season, August 1997 (A). The species covers approximately 100 % of the total area in the beginning of the rainy season December 1997 (B). (Photos: SS & YR).

### OTHER FAUNA

Although this observation is not focused for the terrestrial animals, some terrestrial animals which were found coincidentally during the survey of the Brantas River in 1997 were taken also into the note.

Some other terrestrial fauna were found during the survey in 1997 commonly consist of some livestocks from a small-scale animal husbandries or from local people inhabit in the Brantas River. Some aquatic birds such as ducks and gooses are found in Malang Regency. Some poultries such as free-range chickens are also found in the river banks, especially in the sites which have a dense population. These animals were raised by the local people. Some goats and sheeps were raised in the area where many graminae grows in an important quantity in the river banks.

Some wild animals were found coincidentally in the delta of the Brantas river. The wild animals exist here are some wild monkeys which hid on mangrove area near the Brackish-water fishery ponds.

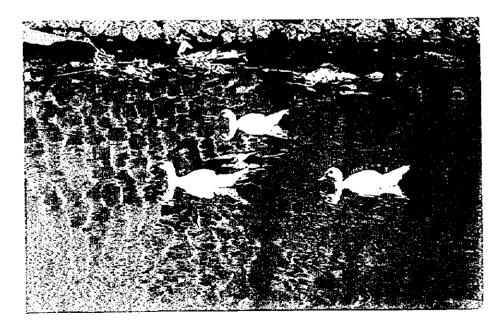


Figure 23. Some aquatic birds of the Brantas river.

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### GENERAL CONCLUSION

The Brantas river has a very important role as water resources for agraricultural demand, domestic, industries and many other functions. Based on ecological data, especially dissolved oxygen and BOD, the water quality of the Brantas River has a range from clean to dirty water. These ecological factors appear to restrict the spatial distribution of biological communities.

The result of the dry and the rainy seasons survey of Biological diversity of the Brantas river reveals that the river has an abundance of species and the richness of species illustrates found river biodiversity. It has been importance of the approximately 50 fishes species from the river, among of them 18 river. This the Brantas of indigenous fishes species are observation shows that the amount of indigenous species decrease approximately to less than 30 % of the total species in 1962. The decrease of indigenous fishes are caused by the decrase of biodiversity of vegetation and other plant communities as primary producers in the lower food chains. These are also caused by the change of habitat or others as shown in the Fig. 24.

Fish distribution pattern shows a higher number of species in the middle part of the Brantas river between the three big Ngembul and Kademangan. can be It reservoirs in Sengguruh, concluded that reservoirs or dams may be a good habitat for fishes but it may limit the behavior of their movement. Because fishes tend to migrate from a place to another place for spawning, breeding and for feeding, so, dams building without fishes passage may change living behavior of potamodromous fishes (fishes inhabit in running water) become lacustrine fishes. The higher diversity is shown also in Ngunut and Papar but tend to decrease in the lower The lower diversity is influenced by water pollution part.

especially in Surabaya Regency, and only some tolerance species inhabit here.

From this study, it can be classified some indicator fishes based on their presence in clean or polluted water. Cyprinus, Nemacheilus and bekepek are clean water species; other species such as Suckermouth, Clarias, Mystus micracanthus, A. panchax, Poecilia, Tilapia and M. albus are polluted water species.

Pangasius macronemus or wakal is popular in the Brantas river, this is the keystone species. Other species such as M. aculeathus, I. carce, seren, areng-areng, blancer and sengkaring are found rarely. While the endemic species in the middle part are .N. fasciatus, K. lawak, L. siamensis, and G. platypogon. Many other species in the Brantas river have economic and ecological important roles.

Macroinvertebrate communities have an important role as energy transfer in the food chains, in self purification and as a good indicator to monitor water quality. The observation reveals that macroinvertebrate communities have a higher taxa amount from the upperstream to the middle part of the Brantas river, either in the dry and in the rainy season.

Macroinvertebrates are immobile and have a long life cycle, so their presence in the stream may reflect their environment. Some different groups from the Brantas river have been identified as indicator species: member of Plecoptera are sensitive to pollution, member of Hydropsychidae are moderate group and Tubificidae derived from Oligochaeta are tollerant to water pollution. This is shown by different communities inhabits from the upperstream to the lowerstream. Tubificidae are abundant in Surabaya river to the estuary where many pollutions occur here.

Plankton show a domination of one species in some area. During the dry season Karangkates is dominated by Chorhormidium (87%) and other species, Oscillatoria is dominant in Lengkong

reservoir (80%) and in Wonokromo (71%), while Spirulina shows abundant in Surabaya river (71,5%). In the beginning of the rainy season the communities changes in the reservoirs, it means that there is no domination of a species. The domination of species only occurs in sluggish-flowing water as shown by Microcystis (72%) in Surabaya river.

Domination of Periphyton are shown by Tabellaria (70%) at Ngunut during the dry season and Ulothrix (72%) at Sengkaling in early of rainy season.

The domination of a species is related to diversity value (index) and in general indicate a lower diversity. Plankton are applicable to estimate the environmental condition in stagnant water, and periphyton are usable for running water. Based on diversity index, Sumber Brantas and Junggo have a higher diversity which indicate a good environmental condition, and in contrast the lower value has reached to the upperstream part such as in Sengkaling and Malang. This is due to nutrient enrichment i.e. nitrate, which is high in these sites, and it also has been polluted by organic materials which dissolved into the water.

Plants existed along the Brantas river have many ecological functions such as: dead leaves production which provides the basic of food chains in the environment, production of oxygen and carbondioxyde fixation, reduction of temperature, prevention of soil erosion, feeding sites and nursery areas for aquatic animals and these may support the productivity and the diversity in aquatic environment. Plant vegetation which has been sampled from upper to lower Brantas indicates a great variability of species along the river. From the survey has been collected 174 species of 60 families, including terrestrial plants, aquatic plants and some mangrove species. Some terrestrial plants have a different zone from only inhabit in a very high altitude to species of the lower altitude.

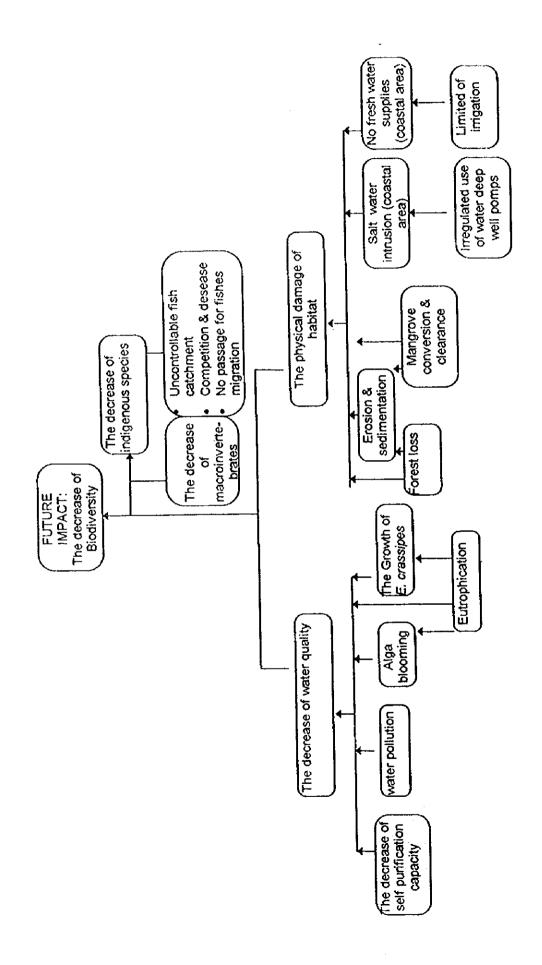


Fig. 24. The interrelated problems of the Brantas river in the connection with biological diversity.

Mangrove only inhabit in the lower part of the Brantas river. In the Brantas Delta this communities occupy the riverine area of the estuary, coastal area and pond areas. At least there are 8 mangrove species in the Brantas delta which are dominated by Avicenia marina, Avicenia officinalis, Acanthus ilicifolius and Exoecaria agallocha. Other species such as Nypha fructicans and Xylocarpus sp, distribute moderately. Rhizophora and Derris sp. are very rare.

Macrophytes have some advantages as indicator species because they are immobile and visible to the naked eye. Water hyacinth, E. crassipes can accumulate some pollutants, so, this aquatic plant can be recomended as pollutant indicator. Other species are good for pollutant indicator such as Cyperus pilosus, Marsilia aquatica and Typha angustifolia. The indicator of clean water is Marchantia polymorpha. Further study of macrophyte as indicator for water quality is needed to know their physiological pollutant accumulator and to manage the river environment.

Biodiversity in the Brantas river is very important to be conserved but the river facing some problems in relation to the issue of biodiversity. The interelated problems of the Brantas river can be seen on the Fig. 24; which shows that the negative aspects of each "branch" may bring other problem in the future such as the lowness of biological diversity. These problems which indicated by negative (-) ecological impact can be formulated in present feature with the action should be taken or program listed on the fourth collumn, for a better condition in the future, as shown on this scheme. On the other hand, the positive impact (+) of the present feature should be maintained or developped for the sake of natural conservation. The general target should be reached in the connection of this subject is a higher biological diversity in the Brantas river.

Aspect	Present feature	impact	program	
	Water pollution	-	• Improvement of waste water treatment for domestic and industrial waste	Â
			<ul> <li>Monitoring habitat &amp; law enforcement</li> </ul>	U
			• Cooperation with industry in waste treatment management	
	Sedimentation	-	<ul> <li>Sand digging monitoring &amp; law regulation</li> </ul>	
Fish communities	Higher diversity in the middle part	+	• Decide priority area (in the middle part) for biodiversity conservation,	
	Dams construction without fishes passages	_	<ul> <li>Create a mini renovation of fish passage at dams for fishes migration</li> </ul>	
	Decrease of	-	• Habitat improvement	
	indigenous species		<ul> <li>Culture assay of indigenous fishes, especially endangered species</li> </ul>	۲
			<ul> <li>Fish cathcment monitoring</li> <li>Decreasing pollutant source</li> </ul>	
	Reservoirs function not for fish culture yet	-	<ul> <li>Recommendation of floating net fish culture or "karamba" system</li> </ul>	
			• TOR for fishery management	
	Lack of information of fish ecological characteristic & their behaviour	-	• Research recomendation	
Macroinverte -brate communities	the change of substratum due to the removing of sand, stone, gravel	-	• Controlling sand digging and improvement of habitat	
	higher diversity in the upperstream to the middle area (means higher variety of fish "food")	÷	• Conservation of habitat in the related area	
	lower diversity in the downstream part	-	• Decreasing of pollutant source regularly	

Planktonic communities	higher diversity, stabil, higher variety of fish food,	ł	<ul> <li>Conservation of habitat in the related area</li> </ul>
	lower diversity, domination of a species or algal blooming	-	• Create a better water quality management
Plants communities	Forest loss		<ul><li>Forest supervision</li><li>Law enforcement</li></ul>
	Mangrove cutting	-	• idem
	Mangrove conversion to other land use	-	<ul> <li>Strategy of multy-used system, i.e. tambak tumpang sari/silvofishery, etc.</li> <li>Regulation and TOR</li> </ul>
	Lack of silvofishery management	-	<ul> <li>Guidance to the local people, cooperation with other related institutions</li> </ul>
	Disturbance of <i>E</i> . <i>crassipes</i> in the slow flowing/stagnant water	-	• Cleaning E. crassipes, Monitoring their growth
	Increase of CO <sub>2</sub> in the water by the aquatic plant during the night	-	• Water quality management & Airation
	Reduction of macrophyte caused by uncontrollable sand mining.	_	• Supervising of sand mining & law enforcement

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## ANNEXES

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Annex 1. Dissolved Oxygen, BODs, Nitrate, Phosphate and pH.

Region	No	Sampling Site	DO	BOD <sub>5</sub>	NO	PO	рН
			mg/l	mg/l	(mg/1)	(mg/1)	
Upper	1	Sumber Brantas	5.45	2.69	1	0.23	5.0
	2	Junggo	8.29	2.75	4	0.25	5.5
	3	Sengkaling	10.56	5.24	7	0.79	6.5
	4	Malang	7.07	4.22	7	1.03	6.0
	5	Sengguruh Res.	5.37	2.93	2	0.35	7.0
	6	Karangkates	2.9	2.33	2	0	6.8
	1	reservoir					
Middle	7	Kademangan	8.14	5.99	5	0.37	6.6
	8	Ngunut	6.83	5.83	3	0.06	6.5
	9	Papar	6.3	4.6	2	0.08	6.5
	10	Ploso	6.5	0.32	3	0.21	6.0
	11	Padangan	7.48	7.09	2	0.28	6.5
Lower	12	Lengkong			-	-	
	13	Porong	2.09	6.09	nd	nd	nd
	14	Porong Estuary	1.71	8.1	3	0.42	6.5
	15	Canggu	6.08	6.59	2	0.23	6.5
	16	Petekan	1.33	6.57	1	1.24	6.3
	17	Gunungsari	2.28	6.83	3	0.31	6.0
		(Surabaya river)	·				
	18	Hulu Wonokromo	-	-	1	1.06	6.2
	19	Wonokromo Estuary	-	-	2	0.76	6.0
			ļ				

rainy season 1997

## Dry season 1997.

Region	No	Sampling Site	DO	BOD5	NO <sup>3-</sup>	PO	рН
			mg/l	mg/l		(mg/l)	
Upper	1	Sumber Brantas	7.6	2.8	23 mmol/m <sup>3</sup>	0.6	9.0
	2	Junggo	8,1	2.75	6 mg/l	0.8	9.0
	3	Sengkaling	7.8	3.55	12 mg/1	1.7	6.5
	4	Malang	8.4	3.20	7 mg/l	4.3	6.0
	5	Sengguruh	6.76	1.92	$17 \text{ mmol/m}^3$	1.0	6.5
	6	Karangkates	-	3.70	S mg/l	0.3	
		reservoir			-		
Middle	7	Kademangan	7.43	5.96	33 mmol/m <sup>3</sup>	0.3	6.5
	8	Ngunut					
	9	Papar	9.12	4.60	3 mg/1	2.14	6.5
	10	Ploso	8.31	0.90	2 mg/1	0.25	
	11	Padangan	4.28	12.96	2 mg/1	0.33	7.0
Lower	12	Lengkong	2.23	7.16	1 mg/l	0.46	6.5
	13	Porong river	-	6.90	17 mmol/m <sup>3</sup>	0.65	6.5
	14	Porong Estuary	2.64	12.20	1 mg/l	0.69	
	15	Canggu	6.42	5.62	2 mg/1	0.27	7.5
	16	Petekan	2.57	7.90	2 mg/l	0.62	
	17	Gunungsari (Surabaya river)	3.38	5.40	1 mg/l	0.33	
	18	Hulu Wonokromo	3.31	6.40	1 mg/l	0.4	
	19	Wonokromo Estuary	6.89	4.90	3 mg/1	0.71	6.5

Macroinvertebrate					Sa	mplin	g sit	.e					
	1	2	3	4	5	6	7	8	9	10	11	12	13
Ariidae								5					
Atydae					1								
Baetis sp 1		56			1			3		I			
Branhiura sp				10					4	6	10		
Brotia sp			19					124					
Caenis sp							10						
Centroptilum			74					42	44	64			
Chaeborus		•••••	3						1				
Chironomidae	193	48	32	330	77	1	97	15	14	5			
Chironomus thummi			6	15	2		1		1	•••••			1
Chouborus			3										1
	• • • • • • • • • • • • • • • • • • • •	•••••			••••••		12		1				1
Coleoptera sp 1 Corithidae cingulata												2	
Corividae sp 1					25		84						68
Corixidae sp 1		• • • • • • • • • • • • • • • • • • •				c	89		·		••••		
Corixidae sp 2 Crab	1		1		1						•••	1	
			17	,			4						
Dicranota sp 1		•••••	16					•			•••••	····-	1
Diptera sp 16	2	ļ	10		10		31	-				·	1
Dixa sp	2				10	·····	25			1			
Dytistidae						95	2.5	·				•••••	··
Ecdyonurus sp		<u>ļ</u>				95			15			<b>!</b>	
Gyrinus sp.		2					ļ		10	<b>.</b>			
Halipidae		2			ļ							<u> </u>	
Heptogenia						ļ	1			<b>.</b>		<u> </u>	
Hydrophilidae			Į			5	Į						
Hydropsyche		168	117	33		106	5						
angustipennis					ļ	<u></u>							
Lepidoptera sp 1		. <u>.</u>	<b>_</b>		Į	1							
Lepidostomatidae			19		ļ					<b>.</b>			
Limnaea spl		<u>.</u>	176	<u> </u>	ļ	Į			. <b>İ</b>	<u> </u>			4
Limnaea sp2		1	240				12		. <b>i</b>				
Lymnea columella	1		1				1						
Melanoides granifera						1		51		3	1	1	
Melanoides	[	1	1	1				10	3	15		1	
tuberculata		1					<u>.</u>		<u> </u>			<u> </u>	
Melanoides rustica			ļ			]	2	1					
Mesovelidae		l	1									<u>.</u>	1
Micronectinae	1	Î			1	1							1
Naididae		1								1	108	1	
Pedicia sp	1	1			1	-	23		I				
Philopotamidae	1	1	1			1	16		Ī		1	I	
Physa fontinalis		2				Ī	1		Ī			Î	1
Planaria	15	97		1			-		1		1	1	1
Planorbidae	···}····	1	1		1	1					T	1	
Procloen sp		99	9				8		·		-		
Psychomyiidae									2		•		

# Annexe 2a : The abundance of Macroinvertebrate of the Brantas River during the dry season in 1997.

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Rhapidolabis				1		<u> </u>	-						
Sericostomatidae						2							
Simulium	80	55	13			<b>1</b>							<b>.</b>
Sipholonuridae									4				
Sphaeriidae							11		4				<b>]</b>
Sphaerium							69	1	5				<u>.</u>
Syncera javana						[		32	1				<u> </u>
Syrphidae						1		ļ	<u>.</u>				
Tipulidae		12	15			1	38	2				Į	<u> </u>
Tipula spl	1					1		<u> </u>	İ.				<u> </u>
Tipula sp2	2								1			<u>.</u>	
Thiaridae spl									73	I		<b>İ</b>	<u>.</u>
Thiaridae sp2				1	l	ļ	1		19			]	
Tubificidae				25		Ĩ			1	7	895		
<ol> <li>Sumber Brantas;</li> <li>Kademangan; 7. Pap</li> <li>Wonokromo estuary;</li> </ol>	ar; 8.	Plos	; 3. ;; 9	Sen . Car			4. M Gunu				enggu Pete		

Macroinvertebrate					5	Sampli	ng s				<i></i>		
	1	2	3	4	5	6	?	8	9	10	11	12	13
Anentoma helena					4,						<u> </u>	<u> </u>	
Baetis spl	115	360	20			162						Į	
Bellamya javanica		1									11	1	
Branchiura													2
Brotia spadicea											4	1	3
Brotia testudinaria										9			
spp.2													
Bulimidae			15										
Caenis sp.						1		20	13				
Caenis sp. Centroptilum			28				187						
Ceratopogonidae		10											
Chimarra sp.								1	8				
Chimarra sp. Chironomidae	267	347	10			2		2	10			.]	
Chironomus thummi	1	Í		14							1	6	ļ
Coenagriidae		1	•••••		1								
Coleoptera spp.5	1	1					2						
Crab			1										l
Dysticidae					-	1	1						
Dixa sp		1				1	7		1				1
Gyrinus		10			-	1	1						
Glossiphonidae sp.1			3										1
Glossiphonidae sp.2				1	3								
Heptogenia			1			120							
Hydropsyche	•••••••••••••	256	12	T		24	1	1	4				l
angustipenis													
Ilybus sp.	2	3					Ĩ						
Lepidoptera sp.7		}	5			8	1	1	7				
Lepidostomatidae	21	76	34			5	1	1					
Lumbriculidae			5	10		1	1			1		55	
Lymnaea sp.			<b>.</b>	-			1					1	
Melanoides sp.		1	<b>]</b>	1	1		1					Ī	
Melanoides javanica			İ				1				6		
Melanoides		1					1					1	1
tuberculata													
Naididae		1	1				Î			1	1	3	
Physa fontinalis			1	1			Í	Î			1	1	
Planaria	57	121	4	1									
Platambus	47	Ĩ	1			1	Ī					ļ	
Procloeon sp.		25	Î	1				43	6				
Prosobranchiata spl	1		15	1			1			1			
Prosopristoma		1	1	Ì	1			1	1			Ī	
Psichodidae	1			2									
Rhithrogenia		1	1	1		1	1	1	···· è···	-		1	
Seriscotomatidae	1		· •				····						
Simulium sp.	138	360	· [			1							
Spaniotoma	27			13	3	1			3	Ī		1	

# Annexe 2b : The abundance of Macroinvertebrate of Brantas river during the rainy season in 1997.

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Sphaeridae								1			 
Sphaerium					4	1	2	2			
Stratiomyiidae	1										
Syncera javana spp. 1			7		14			5			
Syncera javana spp. 2			20								
Telmatoscorpus			••	4							
Thiara scabra		Ĩ	1		 					2	
Tipula sp				2	 						
Tipulidae (Antocha)	20	1	1		1						
Tubificidae		·····		29	 				437	609	

Brantas source; 2. Junggo; 3. Sengkaling; 4. Malang; 5. Karangkates;
 Kademangan; 7. Papar; 8. Ploso; 9. Canggu, 10. Gunung Sari;
 Petekan; 12. Wonokromo river; 13. Porong.

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Annex 3a : Plant species identified from sampling sites of the Brantas river.

2	opecies induce	raunty	Local Name								1100	sampling sues	0110							
				- -	3	4	5	6 7	7 8	6	2	Ξ.	2	13	: 14	15 16		8	61	12 02
$\uparrow$	Abutilon indicum Sw	Malvaceae	Cemplak														٩			1
6	Acalypha indica	Euphorbiaccae			٩	م														
	Acalypha marginata	Euphorbiaceae									م									
4	Acalypha wilkesiana MA.	Euphorbiaceac				م														٦
Ī	Acanthus ilicifolius	Acanthaceae	Daruyu														e	e	,,, ,,	đ
Ī	Acasia	Leguminoceae	Orak-arik				٩													
1	Achiranthes aspera L.	Amaranthaceae	Jarong			م										0		3		
	Adiantum	Polypodiaceae	Suplir		σ	٩			Ť								-			
<u> </u>	Ageratum conizoides L.	Composiae	Wedusan		υ			ር ይ	р р	٩	٩	م	م			ο				
10	Albisia falcata Back	Mimosaceae	Sengen laut				م	υ												
11	Alysicorpus vaginalis DC.	Leguminnaceae	Brobos		م															
12	Amaranthus sp.	Amaranthaceae	Bayam		٩										1	1				
13	Amaranthus spinosus	Amaranthaceae	Bayam duri					ىد م	م م					٥	ـــــــــــــــــــــــــــــــــــــ	٥ ٥				
4	Amarantus tricolor L.	Amaranthaceae	Bayam		۹ م				٥							<u>م</u>				
5	Andropagon nardus	Gramineae	Sere						o											
16	Annona muricata L.	Annonaceae	Nangka sabrang				ci.	a,												
17	Arachis hypogaea L.	Leguminoceae	Kacang tanah					σ												
8	Artocarpus	Moraceae	Nangka				م													
10	Artocarbus communis	Malvaceae	Kluwih		م		a	م								е 	U			
	Artocarpus	Moraceae	Nangka			হ		•••••••	<u>.</u>		•••••		•••••••				•••••••			
;	neterophytu Lumh	Arrenniscese	Am-30		<u> </u>	ļ	ļ		ļ	ļ			,				¢	0		v
11	Avicenta marine to	Avicenniaceae	Api-api														0	<u>ہ</u>		U

Sumber Brantas, 2. Junggo, 3. Sengkaling, 4. Malang, 5. Kademangan, 6. Blitar, 7. Ngunut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 12. Lengkoi
 Surabaya river, 14. Upper course of Wonokromo river, 15. Gunung sari, 16. Porong river, 17. Wonokromo estuary, 18. Wonokromo Brackish water, 19.
 Porong estuary, 20. Porong Brackish water, 21. Gisik river estuary.
 a. Very rare, b. Rare, c. Moderate, d. Many, e. Abundant

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Annexe 3b : Plant species identified from sampling sites of the Brantas river.

°Z	Species Name	Family	Local Name							လိ	unplu	Sampling Sites	S								
			<b>-</b>	1	5	4 5	9	2	× ×	9 10	11	2	13	4	15	16	17		61	12	
23	Bambusa arndinoceae (RFTZ)	Gramineae	Bambu ori		٥ د	•					0							.,			
	Willd																				
24	Bambusa sp.	Gramineae	Bambu apus	٩		σ		σ	σ					<u>0</u>							T
25	:	Gramineae	Bambu ori						σ												
26	:	Asteraceae	Ajeran		q																
27	Bougenvillea	Nyctagenaceae	Bugenvil		٩		<i></i>				•••••										
	spectabilis Willd																				1
58 73	Brasica sp.	Brasicaceae						٥							7					-	
29	Calocasia sp.	Araceae	Talas				ס								0						
30	Calotropis gigantea	Asclepiadaceae										٩									-
31	Calotropis gigantea	Asclepiadaceae							o	с.	۵							•••••	• • • • •		
	Burn								Ì												
32	Calotropis gigantea	Asclepiadaceae	Biduri								u U		ø			o			ະ ຍ	 D	
	Dryent																				1
33	Capsicum frutescens L.	Rubiaceae	Lombok							υ											
8	Carica papaya L.	Caricaceae	Pepaya			م م	٩		٩								ļ		٥		Ī
35	Cassia siamea Lamk	Leguminoceae	Johar					م	م												
36	Cassia sp	Leguminnaceae			م																
37	Cassita filiformis	Lannaceae	Tali putri			0															
38	Cuba petandra	Bombaceae	Randu			a P	<u>م</u>	م			••••			· <b></b> -					 മ		•
. :	Gaertn									ľ				•				Ĩ			
39	Cuba petandra L.	Bombaceae	Randu						۵					٥							- [-
<del>6</del>	Celosia argentea L	Amaranthaceae	Baroco	<u>ہ</u>																	1
41	Cemara	Casuariaceae	Cemara	م م																	]
Z																					

Sumber Brantas, 2. Junggo, 3. Sengkaling, 4. Malang, 5. Kademangan, 6. Blitar, 7. Ngunut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 12. Lengkong, 13. Surabaya river, 14. Upper course of Wonokromo river, 15. Gunung sari, 16. Porong river, 17. Wonokromo estuary, 18. Wonokromo Brackish water, 19. Porong estuary, 20. Porong Brackish water, 21. Gisik river estuary.
 a. Very rare, b. Rare, c. Moderate, d. Many, e. Abundant

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Annexe 3c : Plant species identified from sampling sites of the Brantas river.

°Z	Species Name	Family	Local Name							27	mdur	sampling siles	ß							
<u> </u>				1	£	4 5	9	2	8	9   10	0 11	12	13	14	15	16 1	17   18	11	ន្ត	ដ
1	C1.1 . 1 1	Cominana	Rummit					σ		   							•••••	۵		
74	Chioris paroaia					••••				••••										• • • •
	Swartz		kemoang						••••		•••••					•••••				
			goyang										2.							
43	Claris barbata	Gramineae																		1
44	Clitoria ternatea	Leguminnaceae	Empik-		م					ন্য ন্য	•							•••••		
		•	empikan																<u>.</u>	
45	Clotalaria striaca	Papilionaceae	Orok-orok	•••••			<b></b>		م	••••••		••••••					• • • • •			
	DC.						Ī													
46	Cocos nucifera L	Palmae	Kelapa			σ	م 1													. <b>.</b>
47	Commelina nudiflora	Comelinaceae	Geworan					۵		 م		7				ب				
48	Crotalaria striaca	Leguminoceae			U					 				•		>	•••••			
	DC .																		-	
40	Cvathea sp.	Cyatheaceae	Paku tiyang	6						ľ	- fr				7	 T	٦			+
	Cynodon dactylon	Gramineae	Rumput		τ	σ	U	••••		 е	ຍ ບ		8		3	<b>)</b>		•		
			grinting													1				1
51	Cyperus brevifolius	Cyperaceae	Teki	م							•••••				•					
	(Rottb) Hassk.		· · · · · · · · · · · · · · · · · · ·															<u> </u>		
52	Cyperus compressus	Cyperaceae	**********************************					<b>0</b> 4								0			<b>.</b>	
53	Cyperus diformis	Cyperaceae	Teki sawah					٥	0			-								<b>.</b>
54	Cyperus distan L.	Cyperaceae	++++++++++++++++++++++++++++++++++++++	a														ļ		1
55	Cyperus flabelliforms	Cyperaceae			e	o										4			-	1
56	Cyperus iria L.	Cyperaceae	Teki	٥	o			ပ	U		D D							ł	-	1
57	Cyperus pilosus	Cyperaceae	***********************************									•								
04	I on the second s	Constrant	Tela			 م				 V		2								

a. Very rare,

 Sumber Brantas, 2. Junggo, 3. Senglealing, 4. Malang, 5. Kademangan, 6. Blitar, 7. Ngunut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 12. Lengkong, 13. Surabaya river, 14. Upper course of Wonobromo river, 15. Gunung sari, 16. Porong river, 17. Wonobromo estuary, 18. Wonobromo Brackish water. 19. Porong estuary, 20. Porong Brackish water, 21. Gisik river estuary. c. Abundant d. Many, c. Moderate, b. Rare,

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Annexe 3d : Plant species identified from sampling sites of the Brantas river.

	$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	l	Species Name	Family	Local Name								Sar	aplin	Sampling Sites	ŝ								
Cypertue SR.       Cypertue SR.       Cypertue SR.       Contract (L)       Solumaccese       Texin Kentung       Defonition       Solumacces       Kentung       b       d       c       d       d       c       d       d       c       d       d       c       d       d       c       d <th>Cyperner SR     Cyperate SR</th> <th></th> <th></th> <th></th> <th></th> <th>-</th> <th></th> <th>-</th> <th>2</th> <th>9</th> <th></th> <th>1</th> <th>1</th> <th></th> <th></th> <th>13</th> <th>1 1</th> <th>1 1</th> <th>· · · ·</th> <th>l i</th> <th></th> <th></th> <th>i i</th> <th>ត</th>	Cyperner SR     Cyperate SR					-		-	2	9		1	1			13	1 1	1 1	· · · ·	l i			i i	ត
Dynamics Str.       Cyperaes Str.       Cyperaese       Tela         District meteric       Semescene       Farenbyran       Semescene       Farenbyran         District meteric       Legnintocese       Farenbyran       Legnintocese       Farenbyran         District meteric       Legnintocese       Farenbyran       Eventuation       Farenbyran         Dynamics outling       Caryophyla-       Makti burn       c       d       d       d       d         Dynamics outling       Caryophyla-       Makti burn       c       d       d       d       d       d       d         Dynamics outling       Caryophyla-       Makti burn       c       d	Cyperate Sp.:       Cyperates Sp.:       Cypera						-						ľ	<b> </b>							م	••••		
Diature metel L.         Solancesee         Keeubung         b         <	Diamar meter L       Sojanescee       Keeubung       b       b       b       b       b       b       b       d       <	ې ئۇ	Cyperus sp.	Cyperaceae	Teki								1						Ť	Ī	<b>.</b>			
Determer regic         Legenitiocese         Flamboran           Doublematoree         Bignoniaceae         Ki Jatani           Doublematoree         Bignoniaceae         Ki Jatani           Domaria conditacia         Caryophyllas         Jukut Iburi         c         c         c         c         a         d           Dynamic oracity sch         Bignoniaceae         Ki Jatani         c         d         d         d         d         d         d         d         d         d         d         d         d         d         d         d         d         d         d         d	Ditionancegic         Legenuisoccee         Filamborian           Doliohundence         Bignoniaccee         Ki Jaran           Doliohundence         Bignoniaccee         Ki Jaran           Donarras cordua (L)         Carophylia-         Jukut Ibun         c         d         c         c         c         c         c         c         c         d	ŝ	Datura metel L.	Solanaceae	Kecubung	م											4							
Doi/schandome     Bignoniaceae     Ki laran       Spothocca (LP) sch     Caryophylta:     Jukut hunn       Wield arreas     Caryophylta:     Jukut hunn       Wield arreas     Carophylta:     Jukut hunn       Wield arreas     Carophylta:     Jukut hunn       Kield arreas     Carophylta:     Jukut hunn       Kield arreas     Point arreasipes     Point arreasipes       Binns     Eichhorn a reassipes     Point arreasipes     Point arreasipes       Binns     Eichhorn arreasipes     Point arreasipes     Point arreasipes       Doint arreasipes     Eichhorn arreasipes     Point arreasipes     Point arreasipes       Distribution arreasi     Eichhorn arreasipes     Point arreasipes     Point arreasipes       Distribution arreasi     Eichhorn arreasipes     Point arreasipes     Point arreasipes       Distribution arreasipes     Eichhorn arreasipes     Point arreasipes     Point arreasipes       Distribution arreasipes     Distributi <td>Dolichiandrone         Biggnoniaceae         Xi Jaran           Spothacea (L.F) seth         Expondiaceae         Xi Jaran           <i>Producea (L.F) seth</i>         Caryophylia-         Jukut Ibun         c         d         c         c         c         c         a         d         d           <i>Producea (L.F) seth</i>         Caryophylia-         Jukut Ibun         c         d         c         c         c         c         c         c         a         d</td> <td>32</td> <td>Delouix regio</td> <td>Leguminoceae</td> <td>Flamboyan</td> <td></td> <td>D</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>- In</td> <td></td>	Dolichiandrone         Biggnoniaceae         Xi Jaran           Spothacea (L.F) seth         Expondiaceae         Xi Jaran <i>Producea (L.F) seth</i> Caryophylia-         Jukut Ibun         c         d         c         c         c         c         a         d         d <i>Producea (L.F) seth</i> Caryophylia-         Jukut Ibun         c         d         c         c         c         c         c         c         a         d	32	Delouix regio	Leguminoceae	Flamboyan												D						- In	
synthaccar (L, P) schi       Carcyophylta-       Jukut Ibun       c       d       c       c       c       c       d       d       d         Dynamic acordiant (L)       cease       Eleusiti excissions       Foundational consistents       Foundational consistent consistent       Eleusiti excission       d       c       c       c       c       c       c       c       d </td <td>spatilacea (L.7) scin         Caroophylla- Wienia cordara (L)         Undut ibun         c         d         c         c         a         d         d         c         a         d</td> <td>62</td> <td>Dolichandrone</td> <td>Bignoniaceae</td> <td>Ki Jaran</td> <td></td> <td></td> <td>•••••</td> <td></td> <td>,</td> <td></td>	spatilacea (L.7) scin         Caroophylla- Wienia cordara (L)         Undut ibun         c         d         c         c         a         d         d         c         a         d	62	Dolichandrone	Bignoniaceae	Ki Jaran			•••••															,	
Dynamic conface (L)       Caryophylla- cee       Mont Ibun       c       d       c       c       c       d       d <i>Nielid carCis Ceens Ceens Cens</i>	Dynamic cordiate (L)       Caryophylla- cease       Unkut Ibut       c al       al       al       al         Rieid texclas       Fournencessors       <		spathacea (L.F) sch											ļ										
Mutual sectors       Decide       Decide       Element       Concertification       Element       Concertification       Concenertification       Concertification       Conce	Bitementant     Contractant     Enter accessions     Contractant     Enter accessions     Contractant     Content     Contractant     Contractant <t< td=""><td>63</td><td></td><td>Caryophylla-</td><td>Jukut Ibun</td><td><del>د</del></td><td>ರ</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	63		Caryophylla-	Jukut Ibun	<del>د</del>	ರ																	
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Gaenth     Lataig     Islang       Emilia sonchylolia (L)     Asteraceae     Prath kemudi     d       Enterolobium saman     Trembesi     Trembesi     a       Pratir     Enterolobium saman     Trembesi     d     d     d       Enterolobium saman     Frankis     Trembesi     a     a       Pratir     Enterolobium saman     d     d     d     d     a       Pratir     Enterolobium saman     a     d     d     d     d     a       Pratir     Eveletitar     Gramiteae     Emprit-     d     d     d     d     a       DC     Valeranobia (Wail)     DC     Valeraceae     b     b     b     a     a     a       DC     Eventitar     Asteraceae     D     b     b     b     a     a     a       Eventitar     Eventitar     Nytraceae     D     b     b     b     b     b     b       Eventitar     Eventitar     Compositie     b     b     b     b     b     b       Eventitar     Mytraceae     D     b     b     b     b     c     c     d     c       Eventitar     Evenotitar     Contracte	Gaerth     Mange       Emilia somehylolia (L)     Asteraceae       Emilia somehylolia (L)     Asteraceae       Enterolobium saman     Trembesi       Erechtiter     Trembesi       Eventitier     Asteraceae       Doct     C       Eventitier     Asteraceae       Doct     Asteraceae       Eventitier     Asteraceae       Eventitier     Asteraceae       Eventitier     Asteraceae       Eventitier     Asteraceae       Eventitier     Asteraceae       Doc     C       Eventitier     Asteraceae       Doc     b       Euphorbia (Wall)     Compositie       Doc     b       Euphorbia (Wall       Compositie     Ki Paliti       L     Euphorbia (Wall       L     Euphorbia (Wall       Euphorbia (Wall     C       Euphorbia (Wall     C       Euphorbia (Wall       Euphorbia (Wall       Eupho	22	Elevene indica (1.)	Gramineae	Rumput		م			v				• • • • • •	•	<b>U</b>	٥	Ď	<b>J</b>					
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L.         Description         Euphorbiaceae         Katemas         b         d <th< td=""><td>Euphorbia geniculata         Euphorbiaceae         Katemas         b         d         c         d</td><td>73</td><td>Eupatorium odoratum</td><td>Compositae</td><td>Ki Pahit</td><td>U С</td><td>v</td><td></td><td><u>م</u></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>	Euphorbia geniculata         Euphorbiaceae         Katemas         b         d         c         d	73	Eupatorium odoratum	Compositae	Ki Pahit	U С	v		<u>م</u>															
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	L. L. Romber 2 Innoroo 3. Senekaling, 4. Malang, 5. Kademangan, 6. Blitar, 7. Ngunut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 12. Lengkong, 1 Cumber Promps 2 Innoroo 3. Senekaling, 4. Malang, 5. Kademangan, 6. Blitar, 7. Ngunut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 12. Lengkong, 1 Cumber Promps 2 Innoroo 3. Senekaling, 4. Malang, 5. Kademangan, 6. Blitar, 7. Ngunut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 12. Lengkong, 1 Cumber Promps 2 Innoroo 3. Senekaling, 4. Malang, 5. Kademangan, 6. Blitar, 7. Ngunut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 12. Lengkong, 1 Cumber Promps 2 Innoroo 3. Senekaling, 4. Malang, 5. Kademangan, 6. Blitar, 7. Ngunut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 12. Lengkong, 1 Cumber Promps 2 Innoroo 3. Senekaling, 4. Malang, 5. Kademangan, 6. Blitar, 7. Ngunut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 10. Padangan, 10. Padang	26	Excocaria agallocha	Acanthaceae	Kayu Wuto					•••••		•••••	••••			,				د	<u>,</u>		,	

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13. Surabaya river, 14. Upper course of Wonokronno river, 15. Gunung sari, 16. Porong river, 17. Wonokromo estuary, 18. Wonokromo Porong estuary, 20. Porong Brackish water, 21. Gisik river estuary.
a. Very rare, b. Rare, c. Moderate, d. Many, e. Abundant

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Annexe 3c : Plant species identified from several sampling sites of Brantas river.

~	Species Name	Familia	Local Name							ני	N I I I	some gundninge								
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_	Firms honvamina	Moraceae	Beringin						ผ		Ĭ			લ						
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1	Ficus sentica Burn	Moraccae	Awar-awar			٩	0		م											Ī
1	Ficus sp.	Moraceae	Awar-awar	,	ъ Р															
4	Filicium desipiens Thw	Sapindaceae				ם												ъ	70	
1	Fimbrishis	Cyperacea	Mendong									1				7	ļ		Ī	υ
<u>' ~``</u>	Fimbristylis annua R &	Cyperaceae/	Bulu Mata Mundino					ပ		0		5								
		Gleichenisceae	Paku zarou	<b>p</b>		ļ														
	Gliricidae sepium (jacq)	Leguminoceae	Gliriside			ъ	م	٩							٥					
	Kunthexwalp								2					q				••••		
	Heliotropium Indicum L.	Boraginaceae	Tusuk Konde		····	T	1	T	<b>.</b>			1	4	T	ء.	ļ	٦	٩		v
1	Hibiscus filiaceus L.	Malvaceae	Waru		م	م م	<u>0</u>	σ	<u>.</u>			0		1	···	<u> </u>	<u> </u>			
1	Hyperic Surveolens Poir	Labiatae	Lampesan		و ا				d	<b>0</b>										Ī
1	In section to the section of the sec	Mimosaceae			v							Ì								
1	Imperata cylindrica	Gramineae	Mang-alang		טי				6		ט	•••••		d		<u>ب</u>				
	Beaw						<b>۳</b>	2		٦	ح	٩	р Р						υ	
<u>;                                    </u>	Imperata cylindrica L.	Gramineae	Alang-alang	0			3	-1		s   c						م			ত	م.
<u>.                                    </u>	Indigofera sumatrana Gaertn	Papileonaceae	Daun Tom (Tarum)							\$		(			٦					
+ •	Ipomoea aquatica Econoli	Convolvulaceae	Kangkung			م.	<u>v</u>	م	۵			υ	·····		2					
	Lowoon aduation L.	Convolvulaceae	Kangkung								۵		 ۵							
+	Lomou agained a	Convolvulaceae	Ubi Jalar			م	٩									· · · • • • · ·	-	4	1	
	Ipomoea crassicaulis Poh	Convolvulaceae	Krangkungan		e		υ	G.	ט		v	σ		ρ	Ø			<b>.</b>	<b>5</b> r	
+	Tromoed SD.	Convolvulaceae	Krangkungan		σ					<b>0</b>							-		,	
-		:	Jarak Pagar			 2														

Sumber Brantas, 2. Junggo, 3. Sengkaling, 4. Malang, 5. Kademangan, 6. Blitar, 7. Ngunut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 12. Lengkoi
 Surabaya river, 14. Upper course of Wonokronno river, 15. Gunung sari, 16. Porong river, 17. Wonokronno estuary, 18. Wonokronno Brackish water, 19.
 Porong estuary, 20. Porong Brackish water, 21. Gisik river estuary.
 a. Very rare, b. Rare, c. Moderate, d. Many, e. Abundant

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Annexe 3f : Plant species identified from several sampling sites of Brantas river.

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2 2	Species Name	ramy						ŀ	t	ľ	c	11 - 01 -	11 112	2 : 13	3 5 14	115	16	117	18	61	2	E.
					3	4	<u> </u>	<u>ہ</u>	<u> </u>	ά		Ł	1	1	1			ļ		<b> </b>		
8	Jathropa	Euphorbiaceae	Jarak Merah																			
	Gossypifolia		Ктета	0	τ			٩			٩	٩	٩	U		đ	9					. <b>İ</b>
100	Jussiena repens L.	Onagraces	Tambelikan		đ					ĺ												Ļ,
- 1	Lantana camara L.	Veroenaceae			ß											•••••	••					
102	Laurenta longifiora	Companya								,						7	1		-	<u>, o</u>	ļ	ļ
	(L) Peter		Volomento	<u>.</u>		ļ						م	ار م		٥	- 1		د			-	· • · · · ·
103	Leersia hexandra	Grammeae			ď	<u>م</u>	٩	م			م			 								• +
104	Leucaena glauca Bth	Mimosaceae	Nemanouyan			Ť	1	1	Ą	م		م	– ਹ	 م	<b>0</b>					•••••		••••
105	Leucaena		Lamtoro		•••••									******			•		•			
	leucocepala (Lam.)				•••••																ļ	
	de Wit									•••		•••••			••••	• • - • • •	d 					+ • -
106	Limnocharis flava	Butomaceae	l center					•••••														1.
	Buch	1 ************************************				2																1
101	Monorfera indica L.	Malvaceae	Mangga			<u>.</u>		٦			Į				م							
	Manibot esculenta	Euphorbiaceae	Pohong			<b>ب</b> يد 	~															
ŝ	(Crontz)	•	***************************************												 				•••			
100	Marchantia	Marchantiaceae	Lumut Hati	ರ -	o	••			•				••••									Į.
\$	polymorpha						-			ļ	ļ						υ					
0	Marsilia aquatica	Marsiliaceac	·····								u							•••••		•••••		
111		Marsileaceae	Semanggi		•••••	U.																1
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12	Mimosa pudica L.	Mimosaceae									6	••••				م						
	112 Morinda citrifolia L	Rubiaceae	Pace							7	2		σ	v	م	σ	ц Ч	ہ م		<u>0</u>		1
	Muse paradistaca L.	Musaceae	Pisang			Ť	0 0		<u>ار</u>	s			0		<b>0.</b>	a a				5		<u>ا</u>
		[ Electronic 29	Kersen			•••						-		ļ								

Sumber Brantas, 2. Junggo, 3. Sengkaling, 4. Malang, 5. Kademangan, 6. Blitar, 7. Ngunut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 12. Lengkot
 Surabaya river, 14. Upper course of Wonokromo river, 15. Gunung sari, 16. Porong river, 17. Wonokromo estuary, 18. Wonokromo Brackish water, 19. Porong estuary, 20. Porong Brackish water, 21. Gisik river estuary.
 a. Very rare, b. Rare, c. Moderate, d. Many, e. Abundant

Annexe 3g : Plant species identified from several sampling sites of Brantas river.

											ame	Sampling Sites	ites								
9Z	Species Name	Family	Local Name							-	1	)							- 1	- I.	
	_			-	6	4	5 6	2	8	٩	10	=	12 13	5 1	15	9	5	<u>e</u>	5	2	
911	Nastrutium monta	Brassicaceae	Sawi Tanah	<u>م</u>		٩		,													
2													1								
117	<u> </u>	Sapindaceae	Rambutan	•••••••				4													
118	L. Nephrolepis	Polypodiaceae	Paku Sepat	م م	٩																
						1				<u>.</u>											
611	Nephrolepis sp.	Polypodiaceae	Paku Sepat			đ	<b>,</b>														
120	1	Araliaceae	Ponco Sudo		63								·····					0	U	U	
	guncijolia												••••	•••				) 			
121	Nypha fruticans Wurmh	Palmae	urediu																		
122	+-	Labiatae	Remujung			م															
			** ** *** *** *************************							-			2		.,	••••					
123		Labiatac	Klampes																		
124	┿	Polypodiaceae		σ						1			1					. •••••			
100	+-	Oxalidaceae			0									<u></u>							
126	<u> </u>	Oxalidaceae	Semanggi Gunung	ç																	
		······································							• • •	. •	م							, in the second s	-		-
127	Palygonum sp.	Polygonaceae	NEKAWAHAII																		
128	<u></u>	Palystrychaceae		ບ 	5																
	commune		T AMMINTONO		Ģ	q q													4		1
129		Cramneae															<u> </u>		<u>.</u>		
130	1.	Passifloraceae	Namtang								ļ	ļ							م		
15	+		Kacang Tolo												٩						
132	1	Euphorbiaceae	Ketupel Besi		••••										{						
	reticulatus Poir																		,		
Note	Vote : Vo	vo 3 Senekaling.4	. Malang, 5. Kademangan , 6. Blitar, 7. Ngnnut, 8. Papar, 9. Ploso , 10. Padangan, 11. Canggu , 12. Lengkong,	emang	an , 6.	Blitar,	7. Ng	unut,	7. Ngnnut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 12. Lengk	9. 9. 19. 19.	Ploso	10.	Padau W	Tage of the second		Brack	a, 12 cish v	. Len vater.	19. 19.	-6	
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 Surabaya river, 14. Upper course of Wonokromo river, 15. Gunung sari, 16. Porong river, 17. Wonokromo estuary, 18. Wonokromo
 Surabaya river, 14. Upper course of Wonokromo river, 15. Gunung sari, 16. Porong river, 17. Wonokromo estuary, 18. Wonokromo
 Surabaya river, 14. Upper course of Wonokromo river, 15. Gunung sari, 16. Porong river, 17. Wonokromo estuary, 18. Wonokromo
 Surabaya river, 14. Upper course of Wonokromo river, 15. Gunung sari, 16. Porong river, 17. Wonokromo estuary, 18. Wonokromo
 Forong estuary, 20. Porong Brackish water, 21. Gisik river estuary.
 a. Very rare, b. Rare, c. Moderate, d. Many, e. Abundant

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Annexe 3h : Plant species identified from several sampling sites of Brantas river.

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4 4	Physaus minima 4.		Pink	<u>م</u>	q	,										4			
lu	Pinus merkusu											•••••				<u>.</u>			
 ``	Pithecellobium dulce	Mimosaceae	Asam Jonno																
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136	Pityrogramma	Folypoundwar					,									0	10		
127	Physica indica Less	Compositae	Beluntas	, in the second se	σ				4										
	Plumeria acuminata	Apoccynaceae	Kamboja						>										
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130	Politrias polymorsa	Gramineae	Kekeratan									1							
140	Polystrichum	Polystrichaceae	Lumut Daun	U	5	••••••													
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141	Portulaca oleracea	Portulacaceae	Krokot						· •										d
142	Portulaca sp.	Portulacaceae	Krokot				4	4							م				
143	Psidium guajava	Myrtaceae	Jambu Jawa					ב סיר			þ		σ		م				
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145	Rhizophora	Rhizophoraceae	Jangker	-												р Р	†	o	0
146	Ricinus communis L.	Euphorbiaceae	Jarak Jepang							q				م		<del>ه</del>	<u>,0</u>	0	ດ
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149	Salvinia sp.	Salviniaceae	***************************************								<b> </b>								
150		Selaginellaceae	***************************************	0	0			2						, .					rd.
151		Leguminoccae	inut				ন 	,,,											

Ş Sumber Brantas, 2. Junggo, 3. Sengkaling, 4. Malang, 5. Kademangan, 6. Blitar, 7. Ngunut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 12. Lengkon 13. Surabaya river, 14. Upper course of Wonokcomo river, 15. Gunung sari, 16. Porong river, 17. Wonokcomo estuary, 18. Wonokcomo Brackish water, 19. Porong estuary, 20. Porong Brackish water, 21. Gisik river estuary.
 a. Very rare, b. Rare, c. Moderate, d. Many, c. Abundant

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s vante Fattivy Lorat vante 1 2 3 4 5 6 7 8 9 10 11 23 13 16 17 18 19 20 11 12 19 20 11 10 12 19 19 20 11 10 10 11 10 10 11 10 11 10 10 11	State rhoub/folia L.     Ratting     Latat Nature     1     2     3     6     7     8     9     10     13     13     15<	Anne.	ADDEXE 21 : Flatti Species Austituted Aviit several sampare area		T and Mane								San	Sampling Sites	Sites		,						
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56       Sonchrac arvenses L.       Campositie       b       <	56       Sanchus arvense L.       Compositie       b <th< td=""><td>155</td><td></td><td>Solanaceae</td><td>Tekokak</td><td></td><td>م</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>ľ</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th<>	155		Solanaceae	Tekokak		م								ľ								
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38       Sperioritez zeylanica       Componila-       Ganda (Paert       c       d       b       c       d       b         39       Gaera       vertemia       wit)       b       b       c       d       b       b       b       b       b       b       b       b       b       b       b       b       b       c       b<	38     Spanocitez zeylanica     Componula- caesa     Ganda (Paer     c     d     b     b     c     b       30     Garriz     Varbenaese     eain     b     b     c     b     b     b       60     Swietenia molegorii     Weitheneese     Mahonii     b     b     c     b     b     b       61     Swietenia molegorii     Mellacese     Mahonii     b     d     d     b     b       63     Swietenia molegorii     Mellacese     Mahonii     b     d     d     b     b       63     Swietenia molegorii     Mellacese     Mahonii     b     d     d     d     d       63     Terevita     Sontenia grandis L     Vertenaese     Jaina     b     d     d     d     d       64     Theorita     Sponta     Kembang     c     b     d     d     d     d     d       65     Trinoria diversifolia     Composities     Kembang     c     b     d     d     d     d     d       66     Trinoria diversifolia     Composities     Kembang     c     b     d     d     d     d     d       67     Trinoria diversifolia	57	Sonchus arvensis L.	Aseraceae		٩	٩																
Gateration     Cateration     cease     still       59     Sizohyuzpheta     Verbenseese     Mahoni     b     b       60     Swietminsnistychi     Meltacese     Mahoni     b     b       61     Swietminsnistychi     Meltacese     Mahoni     b     b       61     Swietminsnistychi     Meltacese     Mahoni     b     b       61     Swietminsnistychi     Meltacese     Mahoni     b     b       61     Smeatrella rediffora     Asteracese     Gleitangan     b     d       63     Thermedia granitea     F     Verbensecese     Jati       64     Thermedia granitea     Asportanta     Asportanta     Asportanta       65     Thermedia granitea     F     Verbensecese     Jati       66     Thermedia granitea     Crampetite     F     d       70     Merr     Asportanta     Asportanta     Asportanta       66     Thermedia granitea     Crampetite     F     d       70     Uniferentia granita     Asportanta     A     d     d       67     Thermedia granita     Asportanta     Asportanta     d     d     d       68     Thermedia granita     T     T     d <t< td=""><td>Gateration     Gateration     cese     strip       59     Sizohyumpheta     Vertoenseese     Pecut Kuda     b     b       60     Switteminensis/Soni     Meliascese     Mahoni     b     b       61     Switteminensis/Soni     Meliascese     Mahoni     b     b       61     Switteminensis/Soni     Meliascese     Mahoni     b     b       61     Switteminensis/Soni     Meliascese     Mahoni     b     b       61     Switteminensis/Soni     Meliascese     Mahoni     b     b       63     Trevetal grants     Kenan     Asteracese     Bain     a       64     Thevatia     Sportan     Kenan     c     b     c     b       65     Tithonia aljerarjolia     Composite     Mahoni     c     c     d     d       66     Tithonia aljerarjolia     Composite     Kenan     c     c     d     d       66     Tithonia aljerarjolia     Compositie     Sumen     c     c     d     d       67:0y     Tithonia aljerarjolia     Compositie     Sumen     c     c     d     d     d       68     Tithonia aljerarjolia     Compositie     Sumen     c     d</td><td>58</td><td>Spenoclea zevlanica</td><td>Componula-</td><td>Gunda (Pacar</td><td>•••••</td><td>v</td><td></td><td>•</td><td></td><td></td><td>م</td><td></td><td></td><td></td><td></td><td></td><td>•</td><td></td><td></td><td></td><td><u>.</u></td><td><i></i></td></t<>	Gateration     Gateration     cese     strip       59     Sizohyumpheta     Vertoenseese     Pecut Kuda     b     b       60     Switteminensis/Soni     Meliascese     Mahoni     b     b       61     Switteminensis/Soni     Meliascese     Mahoni     b     b       61     Switteminensis/Soni     Meliascese     Mahoni     b     b       61     Switteminensis/Soni     Meliascese     Mahoni     b     b       61     Switteminensis/Soni     Meliascese     Mahoni     b     b       63     Trevetal grants     Kenan     Asteracese     Bain     a       64     Thevatia     Sportan     Kenan     c     b     c     b       65     Tithonia aljerarjolia     Composite     Mahoni     c     c     d     d       66     Tithonia aljerarjolia     Composite     Kenan     c     c     d     d       66     Tithonia aljerarjolia     Compositie     Sumen     c     c     d     d       67:0y     Tithonia aljerarjolia     Compositie     Sumen     c     c     d     d     d       68     Tithonia aljerarjolia     Compositie     Sumen     c     d	58	Spenoclea zevlanica	Componula-	Gunda (Pacar	•••••	v		•			م						•				<u>.</u>	<i></i>
39     Stachytarpheta     Vertemacese     Pecut Kuda     b     b     c       10     Swetenia mohagoni     Maliacesa     Mahoni     b     b     c       10     Swetenia mohagoni     Maliacesa     Mahoni     b     c     b       11     Systemia mohagoni     Maliacesa     Mahoni     b     c       12     Stracenta redulfora     Asteracese     Gletangan     b     d       13     Tectora grandis LF     Verbenscese     Jati     c     b     d       16     Theretia grandis LF     Verbenscese     Jati     c     b     d       16     Theretia grandis LF     Verbenscese     Jati     c     b     d       16     Theretia grandis LF     Verbenscese     Jati     c     b     d       16     Marcetia grandis LF     Verbenscese     Jati     c     b     d       16     Marcetia grandis LF     Verbenscese     Jati     c     b     d       16     Marcetia grandis LF     Verbenscese     Jati     d     d       16     Marcetia grandis LF     Verbenscese     Jati     d     d     d       17     Rob     F     b     c     d     d	39     Stackyumphera     Vertemedes     Pectr Kuda     b     b     c       60 <i>jomaticensis Vali</i> Maliacea     Maliacea     Maliacea     Maliacea       61 <i>Sinatenia andnageni</i> Maliacea     Maliacea     Maliacea     Maliacea       61 <i>Sinatenia andnageni</i> Antiacea     Maliacea     Maliacea       63 <i>Sinatenia andnageni</i> Antiacea     Maliacea     Maliacea       64 <i>Teamada Sgenta</i> Accentea     a     a       65 <i>Teamada Sgenta</i> Accentea     a     a       66 <i>Threata pervirana</i> Accentea     Am     a       66 <i>Tithonia directifolia</i> Composite     Kambang     c     a       67 <i>Tithonia directifolia</i> Composite     Kambang     c     c     d       66 <i>Tithonia directifolia</i> Composite     Kambang     c     c     d     d       67 <i>Tithonia directifolia</i> Composite     Kambang     c     c     d     d     d       66 <i>Tithonia directifolia</i> Composite     Kambang     c     c     d     d     d       67 <i>Tithonia directifolia</i> Composite     Kambang     c     c	2	Gaertz	Ceae	air)										Ť								
jameteensis Vahl     jameteensis Vahl       60     Swietenia mahagonii     Mahonii       61     Joaderla rodujiora     Mahonii       62     Testenia mahagonii     Mahonii       63     Thereia mahagonii     Mahonii       63     Thereia grandis LF     Verbeneese       63     Thereia grandis LF     Verbeneese       63     Thereia grandis LF     Verbeneese       64     A     b     c       65     Thereia gravitata     Asteratese       66     Thoma aljeeroloita     Composties     Kenbang       66     Thoma aljeeroloita     Composties     Kenbang       66     Thoma aljeeroloita     Composties     Strueth       66     Thoma aljeeroloita     Composties     Strueth       66     Theoretha pervirata     A     A       67     Theoretha gravitatio     Composties     Strueth       68     Thoma aljeeroloita     Composties     Strueth     A       69     Dybha angustifolia     Thoma     A     A       69     Dybha angustifolia     Composties     Lingungkepm     A     A       69     Dybha angustifolia     Mahases     Lingungkepm     A     B       71     Materia     Dombk<	jamatcensis Yahl     jamatcensis Yahl       60     Svieternia mainagoni     Malauni       61     Graeteria     Malauni       61     Graeteria     Aretraceae       62     Teatoria grandis LiF     Varbanaceae       63     Teatoria grandis LiF     Varbanaceae       64     Terretia     Canton grandis LiF       7     Terretia pervicana     Sectoria grandis LiF       65     Therretia pervicana     Compositae       65     Thorna differsifolia     Compositae       66     Thorna differsifolia     Compositae       67     Thorna differsifolia     Compositae       68     Thorna differsifolia     Compositae       69     Tridonia differsifolia     Compositae       60     Tridonia differsifolia     Compositae       61     Tridonia differsifolia     Compositae       62     Tridonia differsifolia     Compositae       63     Tridonia differsifolia     Compositae       64     d     d       65     Tridonia differsifolia     Tridonia       66     Tridonia differsifolia     Tridonia       67     Urrena lobula     Tridonia       68     Tridonia     Tridonia       69     Tridonia     Compositae	159	Stachytarpheta	Verbenaceae	Pecut Kuda		ą	م			v	•••••				<b></b>					o		
60     Swaterina maltagori     Meliacesa     Mahoni       61     Synedretla rodifjora     Atteracesa     Gletangan     b     d       61     Synedretla rodifjora     Atteracesa     Gletangan     b     d       62     Tarlos Strantis     L     Verbenscese     Jati       63     Therneda grantis     L     Verbenscese     Jati       64     Therneda grantis     Grantiseas     Rumput Gajah     c     d     b     e       63     Therneda grantis     Grantiseas     Rumput Gajah     c     d     b     e       64     Therneda grantis     Apocyma-     Kenati     b     c     d     d       65     Therneda grantis     Apocyma-     Kenati     b     d     d       66     Therneda grantis     Compositiae     Kembang     c     c     d       66     Therneda adversifolia     Compositiae     Kembang     c     c     d     d       66     Therneda adversifolia     Compositiae     Kembang     c     c     d     d     d       67.09     Therneda adversifolia     Compositiae     Simbang     c     c     d     d     d     d       66     Therneda adversi	60     Sweternia mohagoni     Meliaeese     Mahoni       61     Synedretia rodiflora     Asteracease     Gietangan       63     Terretia rodiflora     Asteracease     Jati.       63     Terretia grandis LF     Verbenacease     Jati.       63     Therretia grandis LF     Grantinese     Ramper Gatal       64     Therretia pervirana     Apocyna-     Remat       65     Thomia difersifolia     Compositie     Bulan       66     Tithomia difersifolia     Compositie     Bulan       66     Tithomia difersifolia     Compositie     Suntern       6700     Gray     C     C     C       700     Urrena diversifolia     Compositie     Suntern     C     C       6700     Thiffar procumbers L     Compositie     Suntern     C     C       68     Trinifat procumbers L     Compositie     Suntern     C     C       700     Urrena diobata     Malvaesa     Pultitan     C     C     C       70     Urrena diobata     Malvaesa     Pultitan     C     C     C       71     Walvaesa     Malvaesa     Malvaesa     Malvaesa     Malvaesa       70     Urrena diobata     Malvaenda     C     C		iamaicensis Vahl																				
61       Synedretila rodifilora       Anteraceae       Gletangan       Li       Anteraceae       Gletangan         62       Tectiona grandits LF       Vartienese       Ramper       Ramper       Ramper         63       Tenencia perviana       Kenati       Anteraceae       Ramper       Ramper         64       Trevencia perviana       Apocynas-       Remain       Ramper       Ramper         64       Tithonia difersifolia       Compositie       Kenati       C       D       A         65       Tithonia difersifolia       Compositie       Kenabang       c       C       D       A         66       Tithonia difersifolia       Compositie       Kenabang       c       C       D       A       C       D       A       C       D       A       C       D       A       C       D       A       C       D       A       A       C       D       A       A       C       D       A       A       A       C       D       A       A       A       A       A       A       A       A       A       A       A       C       D       A       A       A       A       A       A       A	(51)       Synedrella rodiffora       Asteracese       Gletangan       b       d       d         (10)       Gaerta       Verbenacese       Jati       Sectora       Sectora       Verbenacese       Jati         (63)       Tremedia grandis L       Verbenacese       Bati       Bati       Sectora       =""><td>160</td><td>Swietenia mahagoni</td><td>Meliaceae</td><td>Mahoni</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	160	Swietenia mahagoni	Meliaceae	Mahoni																		
(I.) Gaerti       (I.) Gaerti         (3.) Thermeda giganitea       Gamineas       Rumput Gajah       c       b       a         (4) Thevetia perviata       Compositie       Gamineas       Rumput Gajah       c       b       c       b       c         (5) Tithonia dijerst/olia       Compositie       Kembang       c       b       c       b       c       b       d	(2)       General       Science       Jati       A         (3)       Theretia pervisata       Gramineae       Jati       C       b       c       c       c       d	161	Synedrella rodiflora	Asteraceae	Gletangan		م								•••••		•••••						•••••
<ul> <li>(3) Tectoria grandis LF Verbenaceae lati.</li> <li>(4) Theretia grandis LF Verbenaceae lati.</li> <li>(5) Themeda grantea Gramineae Rumput Gajah c d b c b e d</li> <li>(6) Themeda grantea Gramineae Rumput Gajah c d b c b e d</li> <li>(7) Theoria diversifolia Compositae Kembang c c d d d d d d d d d d d d d d d d d</li></ul>	(3)       Tectoring grandes L/F       Verbenseese       Jait         (3)       Thereda grgantes       Graminese       Rumour Gajah       c       d       d         (4)       Theretiz pervizata       Apocyna-       Kenahi       c       d       d       d         (5)       Theretiz pervizata       Apocyna-       Kenahi       b       c       d		(L) Gaertu																				
G3       Themeda gigantea       Rumput Gajah       c       d       e       d         64       Theretia perviana       Apocyna-       Kenati       b       c       b       c       d       d         65       Tithonia difersifolia       Compositae       Kenbang       c       d <t< td=""><td>G3       Themeda gigantea       Gramineae       Rumput Gajah       c       d       e       d         (A       Thevelia perviana       Apocyna- ceae       Kembang       Kembang       b       c       b       c       d       d         (5       Tithomia dijerstjolia       Compositae       Kembang       c       c       d</td><td>162</td><td>Tectona grandis L.F</td><td>Verbenaceae</td><td>Jati</td><td></td><td></td><td></td><td></td><td>4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>e<b>1</b> .</td><td></td></t<>	G3       Themeda gigantea       Gramineae       Rumput Gajah       c       d       e       d         (A       Thevelia perviana       Apocyna- ceae       Kembang       Kembang       b       c       b       c       d       d         (5       Tithomia dijerstjolia       Compositae       Kembang       c       c       d	162	Tectona grandis L.F	Verbenaceae	Jati					4												e <b>1</b> .	
64     Theretia perviana     Apocyna- cese     Kenati     b       65     Tithonia difersifolia     compositae     Kenati     b       65     Tithonia difersifolia     Compositae     Kenati     b       66     Tithonia difersifolia     Compositae     Kenbang     c     c     d       66     Tithonia diversifolia     Compositae     Kembang     c     c     d     d       66     Tritoria diversifolia     Compositae     Sranen     d     d     d     d       66     Tritoria diversifolia     Compositae     Sranen     d     d     d     d       67     Tritor     Compositae     Sranen     d     d     d     d     d       68     Triunfetto bortranta L     Titlaceae     Pultutan     c     d     d     d       69     Dypta angestripoira     Typbaceae     Long     d     d     d       70     Urena lobata     Malvaceae     Jonnbok     d     d     d       71     Widelia oblora     DC     Compositee     Long     d     d       73     Zea mors L.     Gramineeae     Jagung     d     d     d     d	64     Theretia perviana     Apocyna- cese     Kentari     b     h       Merr     cese     Kentari     cese       Merr     cese     Kentari     cese       65     Tithonia difersifolia     Compositae     Kentbang     c     d       66     Tithonia difersifolia     Compositae     Kentbang     c     c     d       66     Tithonia diversifolia     Compositae     Srunen     d     d     d     d       67     Triargeno combens L.     Compositae     Srunen     d     d     d     d     d       68     Trimyterio bentromic L.     Tiliaceae     Pulutan     c     d     d     d     d       69     Dpha angustifolia     Typaceae     Tripa     c     d     b     f       70     Urena lobota     Malvaceae     Palutan     c     d     d     d       71     Widelia biflora DC     Compositae     Lamis     d     d     d     d       71     Widelia biflora DC     Compositae     Lamis     J     d     d     d       73     Ziororpus sp.     Malvaceae     Jonok     d     d     d     d       73     Ziororpus sp.     Malvaceae<	163	Themeda vigantea	Gramineae	Rumput Gajah						σ												
Merrceae65Tithonia difersifoliaCompositaeKembangcdd700RobDulanCompositaeKembangccddd66Tithonia diversifoliaCompositaeKembangccdd<	Merr       cese       cese       cese         65       Tithonia difersifolia       Compositae       Kembang       c       d       d         66       Tithonia diversifolia       Compositae       Kembang       c       c       d	2	Therefia perviana	Apocyna-	Kenari		م															• • • • • •	
65Tithonia difersifoliaCompositaeKembangcd700RobBulanCompositaeKembangcdddd66Tithonia diversifoliaCompositaeKembangccdd<	65       Tithonia dijersifolia       Compositae       Kembang       c       d		Merr	CE30														_		·····			
RobRob66Tithonia diversifoliaCompositaeKembangccddd	Rob       Rob         (67       Tithomia diversifolia       Compositae       Kembang       c       c       d	165	Tithonia difersifolia	Compositae	Kembang		<u>с</u>			ש										• •			
66       Tithomia diversifolia       Compositate       Kembang       c       d	66     Tithonia diversifolia     Compositae     Kembang     c     c     d <t< td=""><td></td><td>Rob</td><td></td><td>Bulan</td><td></td><td></td><td></td><td>÷</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>		Rob		Bulan				÷														
GrayGrayBulanBulan(67)Triangeto bertromic L.CompositaeSrunenddd <td< td=""><td>Gray         Gray         Bulan         d         <th< td=""><td>166</td><td>Tithonia diversifolia</td><td>Compositae</td><td>Kembang</td><td></td><td>0</td><td></td><td></td><td> TJ</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>••••</td><td></td><td></td><td></td><td></td><td></td></th<></td></td<>	Gray         Gray         Bulan         d <th< td=""><td>166</td><td>Tithonia diversifolia</td><td>Compositae</td><td>Kembang</td><td></td><td>0</td><td></td><td></td><td> TJ</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>••••</td><td></td><td></td><td></td><td></td><td></td></th<>	166	Tithonia diversifolia	Compositae	Kembang		0			 TJ								••••					
67     Triac procumbens L.     Compositise     Srunen     d	67     Triangetto borronnia L.     Composities     Srunen     d		Gray		Bulan													1			7		
68     Triumfetta bartramta L.     Tiliaceae     Pulutan     c       69 <i>Лpha angustifolia Iyphaceae Ipa</i> 60 <i>Npha angustifolia Iyphaceae Ipa</i> 70 <i>Urena lobata Malvaceae Pulutan</i> 71 <i>Widelia biflora DC</i> Composiae     Langlangkepan       73 <i>Zea mojs L.</i> Gramineae     Jagang       74 <i>Zisphus mawitania</i> Rhomnaceae     Widoro	68     Triumfetta bartramta L.     Tiliaceae     Pulutan     c       69 <i>Typha angustifolia</i> Typhaceae     Pulutan       60 <i>Urena lobata</i> Typhaceae     Pulutan       70 <i>Urena lobata</i> Malvaceae     Pulutan       71 <i>Widelia biflora DC</i> Compositae     Langlangkepan     d       72 <i>Xylocorpus sp.</i> Meliaceae     Jombok     d       73 <i>Zea mojs L.</i> Gramineae     Jagung       74     Zizpphus mawitanta     Rhomnaceae     Widoro       75 <i>Lunk</i> S. Postor, 11. Canggu, 12.	167	Tridax procumbens L.	Compositae	Srunen		q	σ		0		<b>v</b>	U	U	Ø				Ì				
<ul> <li>(69) <i>Typha angustifolia</i> Typhaceae Tipa</li> <li>(70) <i>Urena lobata</i> Malvaceae Pulutan</li> <li>(71) <i>Widelia biflora DC</i> Compositae Langlungkapan</li> <li>(72) <i>Xylocarpus sp.</i></li> <li>(73) <i>Zea majs L.</i></li> <li>(74) <i>Zisphus mauritania</i> Rhomnaceae Widoro</li> <li>(74) <i>Lamk</i></li> </ul>	69     Typha angustifolia     Typhaceae     Tipa       70     Urena lobata     Malvaceae     Pulutan       71     Widelia biflora DC     Compositae     Langlangkapan       72     Xylocorpus sp.     Meliacease     Jombok       73     Zea mors L.     Graminese     Jagang       74     Zipphus mawitanta     Rhomnaceae     Widoro       7.4     Zipphus mawitanta     Rhomnaceae     Widoro	168	Triumfetta bartramía L	Tiliaceae	Pulutan		v																
70     Urema lobata     Matvaceae     Pulutan       71     Widelia biflora DC     Composite     Langlungtapun       72     Xylocarpus sp.     Meliacaae     Jombok       73     Zea mojs L.     Gramineae     Jagung       74     Zizpphus mauritanta     Rhomnaceae     Widoro	70     Urema lobata     Matvaceae     Pulutan     c       71     Widelia biflora DC     Composite     Langinugtapun     d     b       72     Xylocarpus sp.     Meliaceae     Jombok     d     d       73     Zea moys L.     Gramineae     Jagung       74     Zispphus mauritanta     Rhomnaceae     Widoro     6. Blitar. 7. Ngunut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 12.	169	Typha angustifolia	Typhaceae	Tipa															Ī			
Midelia biflora DC     Composiae     Lenglengtepen     d     b       (72     Xylocarpus sp.     Meliaceae     Jombok       (73     Zea moys L.     Gramineae     Jagung       (74     Zizyphus mauritanta     Rhomnaceae     Widoro	Widelia biflora DC     Composiae     Langlangtepan     d     b       72     Xylocarpus sp.     Meliaceae     Jombok       73     Zea moys L.     Graminese     Jagung       73     Zea moys L.     Graminese     Jagung       74     Zizyphus mauritanta     Rhomnaceae     Widoro       7     Lamk     Senstraina     6. Blitar. 7. Ngunut, 8. Papar, 9. Ploso, 10. Padangan, 11. Canggu, 12.	70	Urena lobata	Malvaceae	Pulutan				0														
(72     Xylocarpus sp.     Meliaceae     Jombok       (73     Zea mays L.     Graminese     Jagung       (74     Zizyphus mauritania     Rhomnaceae     Widoro	(72     Xylocarpus sp.     Meliaceae     Jombok       (73     Zea mars L.     Graminese     Jagung       (74     Zizyphus mauritanta     Rhomnaceae     Widoro       (74     Zizyphus mauritanta     Rhomnaceae     Widoro       (75     Zeanot 3     Sanotesting 4     Malang 5, Kademangan 6, Blitar, 7, Ngunut, 8, Papar, 9, Ploso , 10, Padangan, 11, Canggu , 12.	12	Widelia biflora DC	Composiae	Langlangkapan		σ	٩							I								
(73     Zea mays L.     Graminesse     Jagung       (74     Zizyphus mauritania     Rhomnaceae     Widoro	(73     Zea mays L.     Graminesse     Jagung     d       (74     Zizyphus mauritarita     Rhomnacease     Widoro	12	Xylocarpus sp.	Meliaceae	Jombok																		
Zizyphus mauritania Rhomnacease Widoro	Zizypius mauritaria Rhomnacese Widoro Lamk 	173	Zea mays L.	Gramineae	Jagung					7			_						Ì	Ţ.			
	5. Kademangan , 6. Blitar, 7. Ngunut, 8. Papar, 9. Ploso , 10. Padangan, 11. Canggu , 12.	174	Zizyphus mawitania	Rhomnaceae	Widoro															-1+4 1/4			•
	5. Kademangan , 6. Blitar, 7. Ngunut, 8. Papar, 9. Ploso , 10. Padangan, 11. Canggu , 12.		Lamk				_	_			-	-		ļ	]		- °  ;						

Surabaya river, 14. Upper course of Wonokromo river, 15. Gunung sari, 16. Porong river, 17. Wonokromo estuary, 18. Wonokromo Brackish water, 19. Porong estuary, 20. Porong Brackish water, 21. Gisik river estuary.
 a. Very rare, b. Rare, c. Moderate, d. Many, e. Abundant

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Annex 4a. Size of fish which was caught from the Brantas river. Valus in each collumn are average value (varied between 1-10 individus). Specimens having no size data are fishermen's information from the Brantas river.

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No	Latin name	Local name	Weight	Total Length	St. Length	Depth	rs/ds
1	Achrochordonichthys	Jogoripo	-	-	•	-	-
;	rugosus						
2	Ambasis nalua	Pengkih	-	-	-	-	-
3	Anabas testudinieus	Betik, betok	43.6	12.5	9.75	3.55	rs
4	Aplocheilus panchax	Kepala timah	1.6	4.3	3.2	0.42	rs-ds
5	Channa striata	Kutuk	24.18	12.62	10.26	2.02	rs
	(Channa lucius)		66.3	21.1	17.9	3.1	ds
6	Chanos chanos*	Bandeng	50.5	13.5	10.30	2.7	rs
7	Clarias batrachus*	Lele lokal	34.1	15	13.1	2.1	ds
			31	15.5	13.48	1.86	rs
8	Clarias gariepinus	Lele dumbo	107.6	25.5	23	2.8	ds
9	Cyclocheilichthys	Wader,	25.1	12.2	11.6	3.2	ds
	enoplos*	· ·	9.05	9.02	7.2	1.92	rs
10	Cyprinus carpio	Tombro	23.7	19.5	16.0	5.5	ds
11	Fam. Cobitidae	Seren	-	] -	<b>i</b> -	-	-
12	Glyptothorax platypogon	Tapel watu	7.3	8.8	7.2	12	ds
13	Hampala macrolepidota*	Palung	59.56	13.56	8.9	3.36	rs
			70.7	16.9	13.42	3.9	ds
14	Helostoma temmincki	Keprek,	27.57	11.49	8.98	3.34	rs
		Tambakan					
15	Ichthyocampus carce	Sogoprono	0.75	5.05	3.96	0.7	rs
16	Labeo chrysophekadion*	Areng-areng	-	-	-	-	-
17	Labeobarbus siamensis	Sengkaring	23.9	14.4	12.2	3.3	ds
18	Macrognathus aculeatus*	Sili	9.1	15	14.1	1.6	ds
			43.2	20.83	19.8	2.23	rs
19	Macrones gulio*	Baung	169	30	26	4.8	ds
	(Mystus gulio)						
20	Macrones microcanthus*	Keting	80.5	18.5	14.7	3.3	ds
<b>.</b> .	(Mystus micracanthus)						
21	Macrones pogulia	Berot	-	-	-	~	-
22	Macrones sp. (M. nemurus )	Lenger .	-	-	-	-	-
23	Monopterus albus*	Welud, Welut,	18.2	25.7	25.7	1.0	ds
		Belut	24.9	29.1	29.0	1.0	rs
24	Mystacoeleucus marginatus	Bekepek	-	-	-	-	-
25	Mystus nigriceps*	Bekel	20.2	12.4	10.1	1.9	rs
26	Nemachilus fasciatus*	Uceng	0.9	6.1	5.0	0.6	rs
27	Ophiocephalus gachua HB. Channa gachua	Kotes, Gabus	30.5	14	11.3	2.4	rs

\* : indigenous fish

ds: dry season

rs: rainy season

### Annex 4b. continued

28	Ophiocephalus	Bekes	61.27	17.02	14.15	2.37	rs
	melanopterus						
	(Channa melanopterus)						
29	Osphpronemus goramy	Gurame	19.8	10.1	8.7	3.4	ds
30	Osteochilus haseltii*	Milem, Nilem,	16.62	10.12	8.17	2.4	rs
		Bader muntu,					
		mangut					
31	Osteochilus spilurus		8.27	8.17	6.27	1.67	rs
32	Pangasius djambal	Jambal	1.0	3.9	3	0.3	ds
33	Pangasius micronemus*	Jendil/Wakal	95.7	22.1	19.1	3.9	ds
			37.85	16.05	13.4	3.25	rs
34	Pangasius nasutus	Mengkreng	-	-	-	-	-
35	Poecilia reticulata	Ikan seribu	1.5	4.1	3.0	0.4	ds
			1.3	3.9	2.8	0.3	rs
36	Puntius binotatus*	Cakul, Gathul	1.5	4.2	3.2	0.68	ds
			1,85	4.79	3.62	0.8	rs
37	Puntius bromoides*	Bader bang	83.9	15.7	12.3	4.7	ds
	(Barbodes balleroides)		63.01	15.16	12.24	4.26	rs
38	Puntius javanicus (Blkr)*	Tawes, Putian	46.7	14.7	11.2	4.0	ds
	(Barbodes gonionatus)						
39	Puntius lawak*	Lawak	-	-	-	-	-
	(Kalimantania lawak)						
40	Rasbora argyrotaenia *	Wader pari	6.7	8.0	20.4	1.65	ds
			6.8	8.8	7.0	1.7	rs
41	Sukhermouth catfishes	Suckermud,	37.2	21.5	15.1	3.4	ds
		Cakarmut	71.33	18.1	12.9	2.3	rs
42	Tilapia mossambica	Mujair	43.4	13.5	10.5	4.3	ds
	(Oreochomis mossambicus)		38.55	12.9	10.15	3.65	rs
43	Tilapia nilotica	Nila	67.5	13.3	11	4.7	ds
	(Oreochomis niloticus)		79.12	14.15	11.35	4.9	rs
44	Trichogaster trichopterus	Sepat	12.2	8.6	7.0	3.0	ds
			13.8	8.5	6.4	3.0	rs
45	nd	Blancer	-	-	-	-	-
46	nd	Garingan	15.45	11.45	9.3	1.65	rs
47	nd	Benculing	50.1	14.0	12	2:7	ds
48	nd	Kebogerang	-	-	-	-	-
49	nd species1	nd	0.9	3.0	2.4	0.9	rs
50	nd species2	nđ	60	15.2	13.4	4.0	ds
51	nd species3	nđ	10.5	6.5	5.2	2.1	rs
* :	indigenous fish				•	• • • • • • •	

\* : indigenous fish ds: dry season

rs: rainy season

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