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Ecotypological Assessment of Mangrove ecosystem in Tropical Estuarine: Case study in Segara Anakan Estuarine, Cilacap, Central Java

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Abstract

The purpose of this paper is to evaluate the condition of ekotypology the mangrove ecosystem in Segara Anakan Estuarine. covering broad estimates, the distribution of mangroves and vegetation typology. Wide estimation and distribution of mangrove approximated with spatial analysis of vegetation index using unsupervised classification and normalized difference vegetation index (NDV) I, while the mangrove vegetation typology using transect quadratic single method swath on 3 replications.

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Data were analyzed to obtain the value of the relative density, relative dominance, relative frequency, importance value, diversity and distribution patterns. Research has also found that extensive mangrove decreased by 2.550,69 ha 62,02 % over the previous year. Mangrove vegetation composed by 27 species, including 17 species of trees, 2 types of shrubs, two types of climbers, three kinds of nails ferns/palm, and 3 types of herbaceous ground. Abundance of species ranges between 13-12475 ind/ha. Typology of vegetation around the zone belonging to the low diversity (H '<2) where the eastern zone dominated kind Rhizopora apiculata (IVI = 97.62 to 154.99%), in the middle zone kind R. apiculata, Agiceras .corniculatum, and N. fruticant INP range from 58.97 to 67.09%, while the western zone of S. caseolaris and A. marina (IVI 46.80 to 148.02). The pattern of spread of the type forming an irregular pattern, except on the type of R. apiculata and S. caseolaris spread group (clumped).

Keywords: ecotypological assessment; mangrove; estuarine; segara anakan

1. Introduction

The mangrove forest is a formation of specific plant, generally is found to grow and thrive in protected coastal areas in tropical and subtropical regions. The word of mangrove comes from the blend of Portuguese language, namely is mangue, and English is grove. The word of mangrove used for individual plant species, and the word mangal used for forest communities consisting of individuals mangrove species [1]. In this regard, various terms are used to give the title to the mangroves, among other coastal woodland, mangal and tidalforest [1,2]. In general, [3] gives the sense that the mangrove forest as a forest formation is influenced by the presence of tidal sea water, with the anaerobic soil conditions. While [4] defines the mangrove well as plants that grow in the area as well as the tidal community. The most fundamental and important to understand is that mangroves are able to grow and thrive in coastal environments of extreme salinity, water saturated, anaerobic and less stable soil conditions.

Segara Anakan Estuarine is one of the potential estuary in Indonesia. The area is a meeting place of freshwater from 8 large river with the sea water of the Indian Ocean, making the region immediately puppies as unique and important habitat for a variety of aquatic biota. This area is largely dominated by mangrove forest, which is suspected to be the largest mangrove forest in Java [5]. At this time mangrove forests in Segara Anakan continue to decline rapidly extents. Informed by the Department of Public Works [6], in 1930 mangrove forest area in Segara Anakan estuarine is 35,000 hectares with very good conditions, but currently lives of 12,000 hectares and about 5,600 hectares in disturbed conditions. The decline in mangrove forest also was followed lossing of some types of mangrove because felled by the community around there. The rapid decline in the extent caused by the switching function of land into farms and agricultural land would also change the structure of the population and the existing mangrove distribution patterns. These conditions are compounded by high rates of sedimentation that may have an impact on changes in the distribution pattern of seed and recolonization rate [7].

The importance of information about the state of mangroves in relation to the ecological functioning and development of the area, then the purpose of this paper is to get an idea of the condition of ecotipology in the

mangrove ecosystem in Segara anakan Estuarine, covering broad estimates, the distribution of mangroves and vegetation typology.

2. Methodology

2.1 Location, Materials and Devices Research

Location of research covering all areas of estuarine, set out in Regulation Distric of Cilacap in Perda Kab.No. 23, tahun 2000, which is located at the coordinates S 07^o: 34’ 29.42” to 07^o 47’ 32.39” and E 108^o 46’ 30” – 109^o 03’ 21.02” and covers an area of 34018.62 ha (Figure 1). Satellite data used were Landsat satellite imagery 8 Path 121/Row 065 acquisition date of May 31, 2013 which has been corrected geometric and radiometric. The tools used for field data validation include: Garmin 3, DSLR cameras, boats, rool meters, plastic bag, thermometer, refractometer, pH meters, paper labels and stationery, as well as software Er Mapper 6.4, and ArcGIS 9.0 is used as means of processing, and interpretation of data.

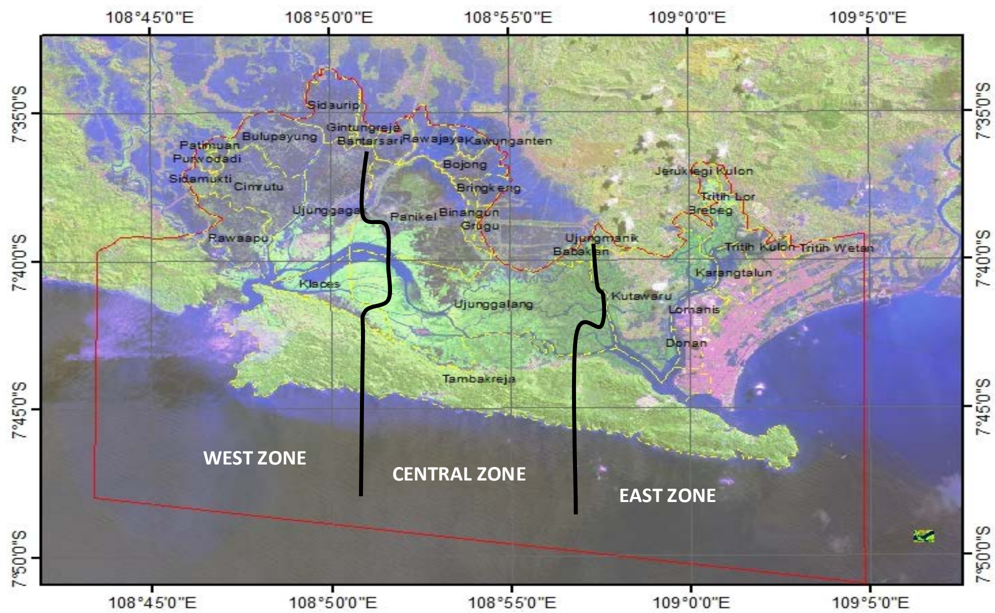

Figure 1. Map location of research

2.2 Method of Data Collection and Analysis

Identification of mangrove forest on Landsat satellite imagery 8 used composite RGB 564 where three bands are included in the range of the visible spectrum and infrared - near to having a wavelength corresponding to the wavelength band 4, band 5 and band 3 on satellite images of Landsat 7 ETM +. To get a broad distribution of mangrove forests with mangrove vegetation index value approach, the band ratio method is used *infrared* (NIR) and *red bands* (red) [8]. in [9]:

NDVI = $\underline{(NIR – red)}$ .... (1)

(NIR + red)

Spesification:

NDVI = *Normalized Difference Vegetation Index*

NIR = Near-Infrared, (0,845-0,885 μm), 30 m

Red = Red (0,630-0,680 μm), 30 m

Where, NDVI> 0, vegetation, and NDVI <0, no vegetation

Identification of vegetation typology is done at every level of growth that is: (1) seedlings, i.e germination up to a height of 1.5 m, (2) Sapling, is trees with height between 1.5 m and a diameter of <10 cm, (3) tree, i.e trees with diameter> 10 cm, [10]. The method used is the method of least 3 repetitions single plot, where the technique of making sub-plot follows the growth stage. Observations included the number of pole/tree, sapling and seedling each plot, the diameter of the pole/tree number of species present in the plot, and the identification of the type carry out by observing the shape of the leaves, flowers, fruit, stem, and root system refer to [7,11] ; and [4]. Analysis data to determine the vegetation typology, the pattern spread of species, and the Important value index (IVI) is determined based on the formula IVI [12]. in [13]:

a. Wide sample plots

$$\text{Wide} = \frac{wide\ plot\ X\ number\ of\ plot}{10.000m2} \quad \text{.....(2)}$$

b. Density of a species (D)

$$\text{Density} = \frac{\Sigma\ individu\ of\ a\ spesies}{Wide\ sample\ plots} \quad \text{..... (3)}$$

c. Relative Density of a Species (DR)

$$\text{DR} = \frac{Density\ of\ a\ species}{Density\ of\ all\ species} \text{ x } 100\% \quad \text{.....(4)}$$

d. Frequency of a kind (F)

$$\text{F} = \frac{\Sigma\ Sub\ plot\ discovered\ a\ species}{\Sigma\ All\ of\ sub\ sample\ plot} \quad \text{..... (5)}$$

e. Dominance of a species (D_p)

$$D_P = \frac{LBDS}{Wide\ sample\ plots} \quad \text{..... (6)}$$

$$\text{LBDS} = 1/4\ \pi\ D^2 \quad \text{..... (7)}$$

Spesification:

LBDS = Broad Field Elementary

D = diameter rod

f. Relative dominance of a spacies (D_pR)

$D_pR = \frac{Dominance\ \ of\ a\ species}{Dominance\ \ of\ all\ species}$ x 100% .....(8)

g. Relative frequency of a species (FR)

$FR = \frac{frequency\ \ of\ a\ species}{frequency\ \ of\ all\ species}$ x 100% .....(9)

h. Important Value Index (IVI)

$IVI_{stadium\ of\ tree} = DR + FR + D_pR$ ..... (10)

$IVI_{stadium\ of\ seedling} = DR + FR$ .....(11)

Shannon-Wiener index used for the calculation of diversity and uniformity, similarity and disimilarity of community between the zones follow in [14]. The pattern of spread of the type analyzed using Morishita Index [15].

$$IS = \frac{Q \sum_{i=1}^{n} Xi\ (X1-1)}{T\ (T-1)} \quad \text{.....(12)}$$

Specification:

IS = Morishita Index

Xi = Number of individuals of species X in the plot, (i = 1,2,3, ... q)

Q = Total number of plots

T = Total number of individuals of all plots

If, IS = 1, the type of a random distribution

IS < 1, the type of irregular deployment

IS > 1, the type of deployment group

3. Results

3.1. Validation Distribution of mangrove

Validation was conducted to determine the level of accuracy distribution of mangroves in the study area through field survey. This process gained 30 points scattered in the area of mangrove forest (Figure 2). Research objects are grouped into 2 (two) on the mangrove and non-mangrove forest covering mixture, ground

vegetation/moor, vacant land, farms, fields, water, shelter. Of the 30 points was obtained suitability as much as 96.2% of mangrove object, and to objects as much as 87.4% non-mangrove.

The analysis also obtained conditions of any object that is not as mangrove class. This condition is suspected because of the influence of the tide, where the spectral condition flooded mangrove object has different characteristics from the flooded mangrove object. This is corroborated by previous studies [16] which states that the spectral characteristics are not only influenced by the chlorophyll content but also by the surrounding environment such as water and soil.

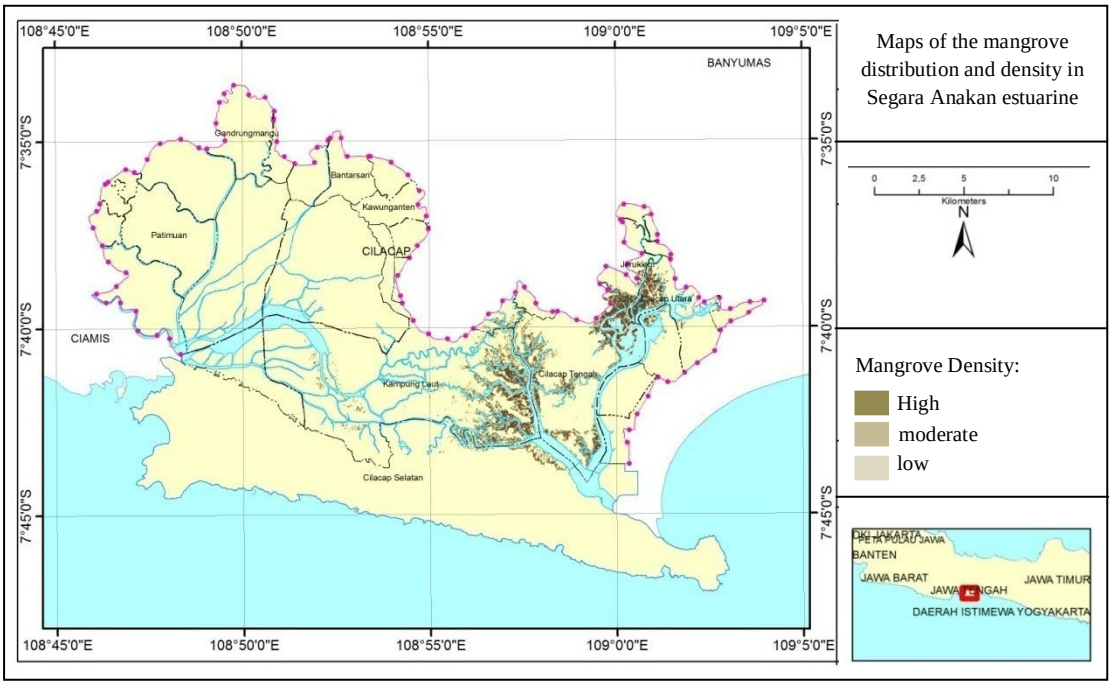

Figure 2. Distribution and interpretation of the results of mangrove forest area

Landsat TM8

3.3 Broad distribution of mangrove

The results of spatial analysis to estimate the extent of mangrove forests in Segara Anakan amounted to 2.550,69 hectare. This widespread decline compared to previous years, which in 2012 and 2013 respectively still has an area of 8,000 ha [17] , and 6.716 ha [18]. Development of mangrove forest area over a period of 84 years (1930 -2014) are presented in figure 3. Potency of mangrove are scattered throughout the region of estuaries, namely along the western and northern side of the river flow Donan (eastern zone), along the Kembang Kuning river include the area around Klaces, Motean and Cikiperan, Dangal River, Ujung Alang river, and around the Nusakambangan Island, south side along streams Sapuregel (Central Zone), around the west side of the lagoon and Muara Dua (west zone), and. Suspected of natural factors and human activities cause the degradation rate of mangrove ecosystems in the ocean puppies. Field observations indicate that the rate of sedimentation to form new lands at the mouth of the river is a barrier in the mass circulation of water in the estuary, illegal logging

activities and land use change into farms and settlements, the more narrow the mangrove forests in the immediate tillers.

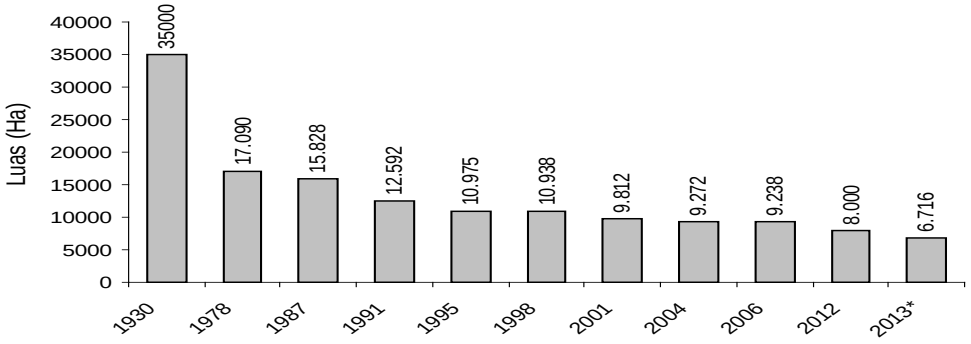

Figure 3. The development of mangrove forest area in segara anakan

3.3. Typology of mangrove vegetation

a. Number of species and abundance of vegetation

Observation of mangrove vegetation, at the moment still found 27 mangrove species that make up the population of mangroves in Segara Anakan Estuarine, includes 17 species of trees, 2 types of shrubs, two types of liana / climber, 3 types of nail ferns / palm, and 3 types of herbaceous ground (Table 1). These are the types of *Acanthus ebracteatus, A. ilicifolius L, Acrosticum aureum, Aigiceras corniculatum, Avecinnia marina, A. alba, A.officinalis, Atalantia trimera oliv, Bruguiera cylindrica, B. gymnorhiza, Cerbera manghas linn, Ceriop tagal, Corypha Uton, Derris trifolliate, Dolichaudrone spathacea, Excoecaria agallocha, Ficus retusa, Finlaysonia maritima, Heritera litoralis, Hibiscus tiliaceus, nyipa fruticant Sonneratia caeseolaris, S. alba, Rhizophora apiculata, R.mucronata, Xilocarpus granatum,* and *Terminalia cattapa*. Several types previously identified but not found at the time of the study, among others, *B. parviflora, X. Mollucensis*, and *Premna obtusifolia* [5].

The results of the abundance vegetation analysis, it is known that the central zone has the highest number of species, they are such of 18 types are dominated by *R. apiculata* and *Ceriop tagal*, as well as the eastern zone. While the western zone dominated by *A. marina, S. alba* and *S. caseolaris*. The types of *A. marina* preparing zoning front (near the sea), followed by *S. caseolaris* and *S. alba.* The same was found by [19]. in his research along the coast of Malay, and [20] in the Gulf Birik South Sumatra, explains that the edges are dominated by *Avicennia* and *Sonneratia*, which the subtrat form of mud sedimentation. Furthermore, [21]. explains that the area formed from the new sedimentation generally have low levels of fertility and organic matter content were little and vegetation is dominated by *Avicennia. Avecinnia spp* is a kind of pioneer in the front overlooking the sea and can tolerate salinity to 35 ppt. After zoning *A. marina* further formed zoning *S. caeseolaris.* This is presumably because the smaller salinity towards the mainland as well as the flow of the river. It is as stated by [22,7] that *S. Caeseolaris* can grow well in low salinity areas with freshwater stream. On the inside of this zone, most of the mangrove area covered by mangrove associations and types of *Acanthus sp* and *Heritera littoralis*,

which indicates the condition of degraded mangrove. The number of types (abundance) in each zone are presented in Figure 4.

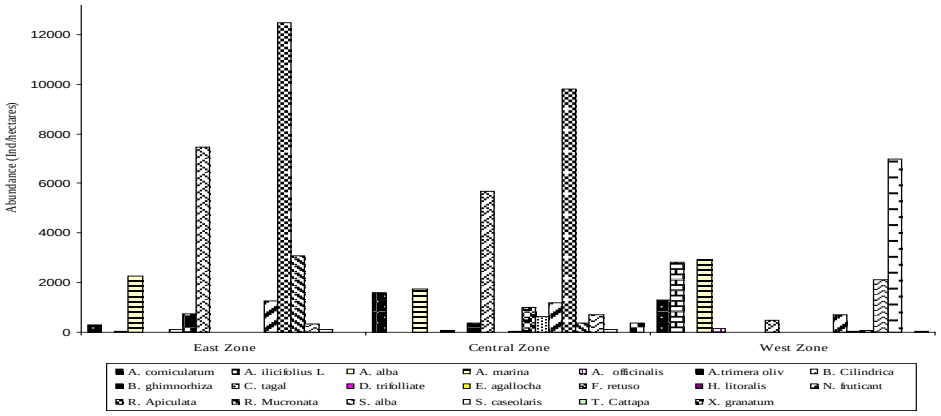

Figure 4. Histogram abundance of mangrove species in eeach zone

Table 1. Types of mangroves are found in Segara Anakan Estuarine

No	Latin name	Local Name	Station												Spesification
			I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
	Group of Trees:														
1.	*Avicennia alba*	api api	*	-	-	-	-	-	-	-	-	**	-	-	True mangrove
2.	*Avicennia marina*	api api	*	** *		**	** *	*	-	-	-	-	**	** *	True mangrove
3.	*Avicennia officinalis*	api api	-	-	-	-	*	-	-	-	-	-	-	** *	True mangrove
4.	*Bruguera cilindrica*	tanjan putih	-	*	*	-	-	-	-	-	-	-	-	-	True mangrove
5.	*Bruguera ghimnorhiza*	tancang	-	**	**	-	-	-	-	-	-	-	-	-	True mangrove
6.	*Ceriop tagal*	tingi	-	** *	** *	** *	-	-	-	-	-	-	-	** *	True mangrove
7.	*Dolichaudrone spathacea*)*	tingi/jarangan	-	-	-	-	-	-	-	-	-	-	-	-	Assosiation
8.	*Heritera litoralis*	dungun	-	-	*	-	-	-	** *	-	-	-	-	-	True mangrove
9.	*Hibiscus tiliaceus*)*	waru kuning	-	-	-	-	-	-	-	-	-	-	-	-	asosiasi
10.	*Rhizopora Apiculata*	bakau	** *	** *	** *	** *	-	*	-	** *	-	**	-	-	True mangrove
11.	*Rhizopora Mucronata*	bakau	*	** *	-	-	*	-	-	-	-	-	-	-	True mangrove
12.	*Soneratia alba*	bogem/perep	-	**	-	-	**	-	-	**	*	**	**	**	True

2.		at														mangrove
1	*Soneratia*		*	-	*	-	-	-	-	**	**	**	**	-		True
3.	*caseolaris*	bogem merah								*	*	*	*			mangrove
1	*Xilocarpus*		-	-	-	-	-	-	**	-	-	-	-	**		True
4.	*granatum*	nyirih							*							mangrove
1	*Terminalia*		-	-	-	-	-	*	-	-	-	-	-	-		
5.	*cattapa*)*	ketapang														asosiasi
1	*Cerbera manghas*		-	-	-	-	-	*	-	-	-	-	-	-		
7.	*linn*)*	bintaro														asosiasi
	Group of shrubs:															
1	*Atalantia trimera*		-	-	-	-	-	-	*	-	-	-	-	-		
8.	*oliv*	jerukan														asosiasi
1	*Excoecaria*	panggang/but	-	-	-	-	*	-	*	-	-	-	-	-		True
9.	*agallocha*	a buta														mangrove
	Group of liana/climber															
2		kambingan/g	-	-	*	*	**	**	**	**	**	**	**	**	*	
0.	*Derris trifolliate*	adelan						*	*	*	*	*	*			asosiasi
2	*Finlaysonia*		-	-	-	*	-	-	-	-	-	-	-	-		
1.	*maritima*)*	basang siap														asosiasi
	Group of fern and palm															
2		warakas/paki	-	-	-	-	-	**	-	-	-	-	-	-		True
2.	*Acrosticum aureum*	s laut														mangrove
2			-	-	*	-	*	*	-	-	-	-	-	-		
3.	*Corypha uton *)*	gebang														asosiasi
2			-	*	**	-	-	**	*	-	**	**	-	*		True
4.	*Nyipa fruticant*	nipah			*											mangrove
	Group of herb															
2	*Acanthus*		-	-	-	-	**	**	**	**	-	**	**	*		True
5.	*ebracteatus*	jeruju putih						*	*	*		*	*			mangrove
2	*Acanthus ilicifolius*		-	-	-	-	**	**	**	**	-	**	**	*		True
6.	L	drujon						*	*	*		*	*			mangrove
2	*Aigiceras*		-	**	**	-	**	-	-	**	-	**	-	**		
7.	*corniculatum*	gedangan					*					*				asosiasi

b. Important Value Index (IVI), Index Diversity (H') and Uniformity Vegetation Index (e)

Important Value Index (IVI) is a quantity that indicates the position of a kind to another kind in a community. IVI is derived from the relative density (DR), the relative frequency (FR) and relative dominance (D_pR) of the types that make up the observed community (Tabel 2). Snadakker grouped of IVI into three categories: high, medium and low [23] . In the eastern zone is seen that *R. apiculata had* the highest IVI at each stage of growth than other types so that it can be said this type of control of their habitat. As revealed by [23] that the type which

has a density, the higher the spread and dominance usually excel in the use of resources and (adjust to local environmental conditions). After *R. apiculata,* followed *R. mucronata* and *A. Marina* at level of tree, and *C. tagal* on stage saplings and seedlings. As well as the eastern zone, *R. apiculata* is a type that has a high IVI at every level of growth in the middle of the zone, but it appears the spread of other types are quite evenly on *N.fruticant, A. Marina* and *S. Alba* at the stadium tree with IVI range 30, 25 to 67.09. While on stage saplings and seedlings dominated by *A. Corniculatum, C. tagal, X. granatum, S. caseolaris* with IVI range (30.43 to 66.89). In the western zone, *S. caseolaris* and *A. Marina* are two types that dominate typology of vegetation at every level of growth with IVI range from 47.78 to 135.18 (tree stage) and from 46.80 to 148.02 (seedling stage), and 51.47 to 95.30 (seedling stage). Other types of controls habitat west zone *S. Alba* and *N. Fruticant* on tree stage, *A. Corniculatun* and *C.tagal* on sapling stage, and *A. Illicifolius* at seedling stage.

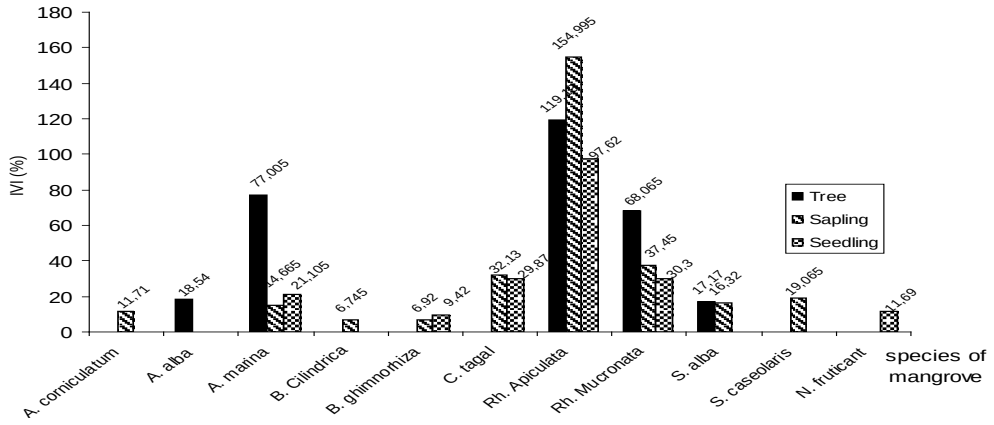

Figure 5. IVI Mangrove species on growth of trees level in the east zone

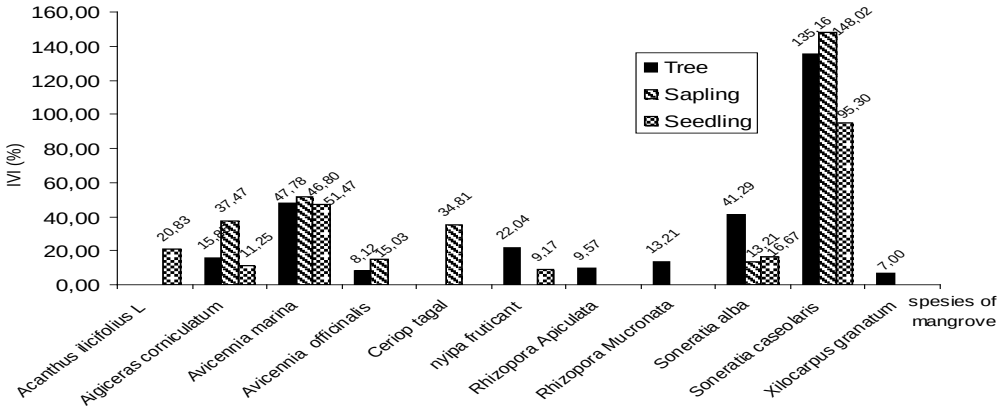

Figure 6. IVI mangrove species on growth of trees level in the central zone

Value of diversity index (H ') ranged from 1,519 to 1,834 and the value of uniformity index (E) ranged from 0,635 to 0,718 (Table 3). Medium value of similarity and dissimilarity index between stations, each ranging between 18.28 to 76.82 and 23,18 to 81,72 (Table 4). Diversity index value in the entire zone <2, showing the diversity of vegetation in the study area is relatively low, as dictated by [24], that the value of H 'ranges from 0-

7, so that H' <2, expressed as a condition of low diversity, or it can be said that the current compiler mangrove forest vegetation in Segara Anakan Estuarine are not too varied. Nevertheless, the middle zone has the highest diversity of vegetation types in other zones appeal.

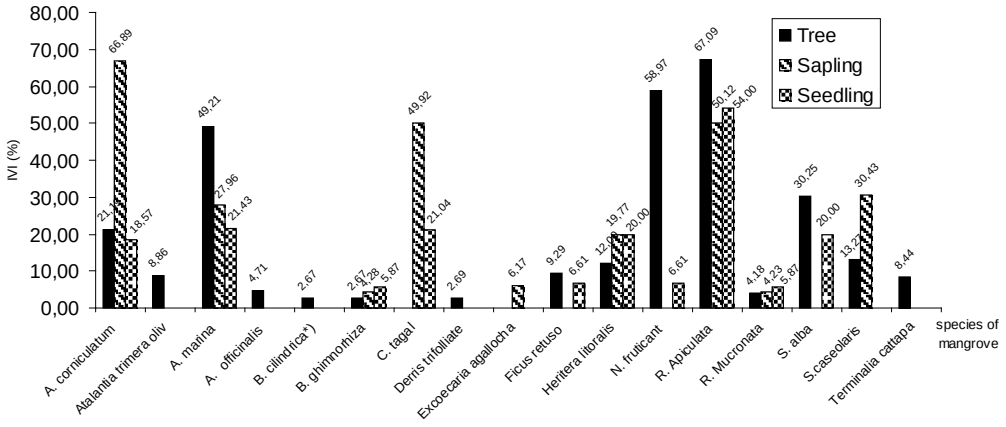

Figure 7. IVI mangrove species on growth of trees level in in the west zone

the eastern and central zones have reached the level of 76,82 % vegetation similarity (similarity index). This is possible because the two zones have similar substrate tipolologi conditions where most of the area is dominated by *sandy silt clay* substrate. Different conditions in comparison with the western zone where the value of the index is only 18,28%. It is thought to be caused by differences adanyaa beberapaa influence of environmental factors such as water supply, salinity, nutrient supply and stability of the substrate, as a major factor that greatly determines the survival of mangrove growth [25]. Substrates that dominate the form of mud with a dominant fraction sandyslit and siltysand. The observation of environmental conditions is presented in Table 5.

Table 2. Number of stands, relative density, relative frequency, relative dominance and importance value index (IVI) in stage of growth

	Number of Stand (ind/hectares)			Relative Density (%)			relative frequency (%)			Relative Dominance (%)		Important Value Index (IVI)		
Name of Species	Trees	Sapling	Seedling	Trees	Sapling	Seedling	Trees	Sapling	Seedling	Trees	Sapling	Trees	Sapling	Seedling
West Zone: Muara Donan (Desa Donan)														
Avicennia	1	0	0	8,33	0,00	0,00	20	0,00	0,00	8,75	0,0	3	0,	0,

alba											0	7,00	0,00	00
Avicennia marina	1	0	0	8,33	0,00	0,00	20	0,00	0,00	7,45	0,00	7,91	0,00	0,00
Rhizopora Apiculata	9	41	8	75,01	97,62	72,73	40	66,67	66,67	73,71	97,58	8,71	1,87	13,39
Rhizopora Mucronata	1	0	3	8,33	0,00	27,27	20	0,00	33,33	10,09	0,00	8,42	0,00	60,61
Soneratia alba	0	0	0	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Soneratia caseolaris	0	1	0	0,00	2,38	0,00	0,00	33,33	0,00	0,00	2,42	0,03	8,13	0,00
number	**12**	**42**	**11**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**
Muara cigintung (Desa Tritih/Talun)														
Aigiceras corniculatum	0	3	0	0,00	7,69	0,00	0,00	8,33	0,00	0,00	7,40	0,01	23,40	0,00
Avicennia marina	6	2	3	46,15	5,13	13,64	20,00	16,67	28,57	52,08	7,53	8,11	29,32	42,21
Bruguera cilindrica	0	1	0	0,00	2,56	0,00	0,00	8,33	0,00	0,00	2,60	0,03	1,36	0,00

												0	5	
													2	
													1	
Bruguera												0,	3,	18
ghimnorhiz							0,0				2,9	0	8	,8
a	0	1	1	0,00	2,56	4,55	0	8,33	14,29	0,00	5	0	4	3
													6	
												0,	4,	59
Ceriop						45,4	0,0				25,	0	2	,7
tagal	0	12	10	0,00	30,77	5	0	8,33	14,29	0,00	16	0	7	4
												4	4	
												9,	8,	55
Rhizopora						27,2		16,6			16,	5	1	,8
Apiculata	2	6	6	15,38	15,38	7	20	7	28,57	14,16	07	4	2	4
												9	7	
												7,	4,	
Rhizopora								16,6			30,	8	8	0,
Mucronata	4	11	0	30,78	28,22	0,00	40	7	0,00	27,11	01	8	8	00
												3	3	
												4,	2,	
Soneratia								16,6			8,2	3	6	0,
alba	1	3	0	7,69	7,69	0,00	20	7	0,00	6,65	8	5	4	00
												0,	0,	23
nyipa							0,0				0,0	0	0	,3
fruticant	0	0	2	0,00	0,00	9,09	0	0,00	14,29	0,00	0	0	0	8
													3	
													0	
											10	**3**	**0,**	**20**
					100,0	**100,**	**100**	**100,**	**100,0**		**0,0**	**0**	**0**	**0,**
number	**13**	**39**	**22**	**100,00**	**0**	**00**	**,00**	**00**	**0**	**100,00**	**0**	**0**	**0**	**00**
Central Zone: Parid (Desa Kotowaru)														
												1		
Aigiceras												6,	2	
corniculatu							11,	14,2			2,6	1	0,	0,
m	1	1	0	3,33	3,57	0,00	11	9	0,00	1,67	5	1	5	00
												1		
												6,	0,	
Bruguera							11,				0,0	0	0	0,
cilindrica	1	0	0	3,33	0,00	0,00	11	0,00	0,00	1,56	0	1	0	00
Bruguera	1	1	1	3,33	3,57	4,35	11,	14,2	25	1,56	3,5	1	2	29

ghimnorhiza							11	9			3	6,01	1,39	,35
Ceriop tagal	0	4	0	0,00	14,29	0,00	0,00	28,57	0,00	0,00	15,440	0,01	8,30	0,00
Derris trifolliate	1	0	0	3,33	0,00	0,00	11,11	0,00	0,00	1,72	0,00	6,17	0,00	0,00
Heritera litoralis	1	0	0	3,33	0,00	0,00	11,11	0,00	0,00	1,94	0,00	6,38	0,00	0,00
Rhizopora Apiculata	14	21	21	46,67	75,00	91,3	22,22	28,57	50	24,04	74,423	92,93	7,992	141,33
Rhizopora Mucronata	0	1	1	0,00	3,57	4,35	0,00	14,29	25	0,00	3,97	0,01	21,83	29,35
Soneratia caseolaris	1	0	0	3,33	0,00	0,00	11,11	0,00	0,00	1,56	0,00	6,01	0,00	0,00

	Number of Stand (ind/hectares)			Relative Density (%)			relative frequency (%)			Relative Dominance (%)	Important Value Index (IVI)		
Name of Species	Trees	Sapling	Seedling	Trees	Sapling	Seedling	Trees	Sapling	Seedling	Trees	Sapling	Trees	Sapling	Seedling
nyipa fruticant	10	0	0	33,33	0,00	0,00	11,11	0,00	0,00	65,94	0,00	110,38	0,00	0,00
jumlah	**30**	**28**	**23**	**100,00**	**100**	**100**	**100,00**	**100,00**	**100**	**100,00**	**10,00**	**300,00**	**0,00**	**20,00**

														0
Sapuregel-kembang kuning (Ujung Alang)														
Avicennia marina	4	2	0	33,33	8,33	0,00	50	25	0,00	35,6	2,71	11 8,9	13 6,05	0,00
Ceriop tagal	0	16	15	0,00	66,67	65,22	0,00	50	40	0,00	74,63	19 0,0	1,29	10 5,22
nyipa fruticant	0	0	3	0,00	0,0	13,04	0,00	0,00	20	0,00	0,00	0,0	0,0	33,04
Rhizopora Apiculata	8	6	2	66,67	25	8,7	50	25	20	64,34	22,66	18 1,0	7 2,6	28,7
pohon meranggas	0	0	3	0,00	0,0	13,04	0,00	0,00	20	0,00	0,00	0,0	0,0	33,04
												30	**30**	
jumlah	**12**	**24**	**23**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**10 0,00**	**100,00**	**0,0**	**0,0**	**20 0,00**
cikiperan (Desa Ujung Alang)														
Aigiceras corniculatum	3	10	3	18,75	62,5	42,86	28,57	40	50	13,35	62,88	16 0,67	16 5,37	92,86
Avicennia officinalis	1	0	0	6,25	0,0	0,00	14,29	0,00	0,00	7,74	0,00	2 8,28	0,0	0,00

												13	10	
										54		3,	3,	10
Avicennia					31,	57,1	28,5			,6		1	7	7,
marina	8	5	4	50	25	4	7	40	50	1	32,51	8	6	14
													3	
												0,	0,	
Excoecaria					6,2					0,		0	8	0,
agallocha	0	1	0	0,00	5	0,00	0,00	20	0,00	00	4,61	0	6	00
												2		
												5,	0,	
Rhizopora					0,0		14,2			4,		0	0	0,
Mucronata	1	0	0	6,25	0	0,00	9	0,00	0,00	54	0,00	8	0	00
										19		5	0,	
Soneratia					0,0		14,2			,7		2,	0	0,
alba	3	0	0	18,75	0	0,00	9	0,00	0,00	6	0,00	8	0	00
												3	**3**	
												0	**0**	
										10		**0,**	**0,**	**20**
	1				**100**	**100,**	**100,**		**100,**	**0,**		**0**	**0**	**0,**
jumlah	**6**	**16**	**7**	**100,00**	**,00**	**00**	**00**	**100,00**	**00**	**00**	**100,00**	**0**	**0**	**00**
Ujung alang (Desa Ujung Alang)														
												4		
												8,	0,	
Avicennia					0,0					8,		0	0	0,
marina	1	0	0	14,29	0	0,00	25	0,00	0,00	77	0,00	6	0	00
												1		
												5		
												5,	0,	
nyipa					0,0					73		8	0	0,
fruticant	4	0	0	57,14	0	0,00	25	0,00	0,00	,7	0,00	4	0	00
												4		
												4,	0,	
Rhizopora					0,0					5,		4	0	10
Apiculata	1	0	3	14,29	0	50	25	0,00	50	19	0,00	8	0	0
												0,	0,	
Soneratia					0,0					0,		0	0	10
alba	0	0	2	0,00	0	50	0,00	0,00	50	00	0,00	0	0	0
Terminalia					0,0					12		5	0,	0,
cattapa	1	0	0	14,29	0	0,00	25	0,00	0,00	,3	0,00	1,	0	00

										4		6	0	
												2		
												3		
												0		
										10		**0,**	**0,**	**20**
					0,0	**100,**	**100,**		**100,**	**0,**		**0**	**0**	**0,**
jumlah	**7**	**0**	**5**	**100,00**	**0**	**00**	**00**	**0,00**	**00**	**00**	**0,00**	**0**	**0**	**00**
Benteng (Desa Ujung Alang)														
												5		
												3,	0,	
Atalantia					0,0					5,		1	0	0,
trimera oliv	7	0	0	28	0	0,00	20	0,00	0,00	14	0,00	4	0	00
												5	9	
										17		7,	8,	
Heritera					16,					,6		6	8	10
litoralis	5	5	1	20	67	50	20	50	50	4	32,2	4	7	0
												1		
												0		
										58		6,	0,	
nyipa					0,0					,1		1	0	0,
fruticant	7	0	0	28	0	0,00	20	0,00	0,00	2	0,00	2	0	00
													2	
												2	0	
												7,	1,	
Xilocarpus					83,					3,		3	1	10
granatum	1	1	1	4	33	50	20	50	50	34	67,8	4	3	0
												5		
										15		5,	0,	
pohon					0,0					,7		7	0	0,
meranggas	5	0	0	20	0	0,00	20	0,00	0,00	6	0,00	6	0	00
												3	**3**	
												0	**0**	
										10		**0,**	**0,**	**20**
	2				**100**	**100,**	**100,**		**100,**	**0,**		**0**	**0**	**0,**
jumlah	**5**	**6**	**2**	**100,00**	**,00**	**00**	**00**	**100,00**	**00**	**00**	**100,00**	**0**	**0**	**00**

	Number of Stand (ind/hectares)			Relative Density (%)			relative frequency (%)			Relative Dominance (%)		Important Value Index (IVI)		
Name of Species	Tre	Sapling	Seedling	Trees	Sapling	Seedling	Trees	Sapling	Seedling	Trees	Sapling	Tree	Sapl	Seedli

	es											s	ing	ng
Motean (Desa Ujung Alang)														
Aigiceras corniculatum	2	1	0	18,18	50	0,00	25	50	0,00	9,39	47,82	52,57	147,83	0,00
Rhizopora Apiculata	4	0	0	36,39	0,00	0,00	25	0,00	0,00	40,54	0,00	10 1,97	0,00	0,00
Soneratia alba	2	0	0	18,18	0,00	0,00	25	0,00	0,00	36,69	0,00	79,88	0,00	0,00
Soneratia caseolaris	3	1	0	27,27	50	0,00	25	50	0,00	13,37	52,17	65,64	152,17	0,00
jumlah	**11**	**2**	**0**	**100,00**	**100,00**	0,00	**100,00**	**100,00**	0,00	**100,00**	**100,00**	**300**	**300**	0,00
East Zone: Utara Pulau 3 (Desa Ujung Gagak)														
Avicennia marina	0	0	1	0,00	0,00	20	0,00	0,00	33,33	0,00	0,00	0,00	0,00	53,33
Soneratia alba	1	0	0	5	0,00	0,00	33,33	0,00	**0,00**	3,91	0,00	42,24	0,00	0,00
Soneratia caseolaris	19	7	4	95	100	80	66,67	100	66,67	96,09	100	257	300	146,67

												7,76	0	67
												30	**30**	
												0,00	**0,00**	**20**
jumlah	**20**	**7**	**5**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**0**	**0**	**0,00**
Panikel/Muara dua (Desa Panikel)														
Aigiceras corniculatum	1	5	3	4,17	55,55	25	10	40	20	9,26	54,31	23,43	149,86	45
Avicennia marina	2	1	1	8,33	11,11	8,33	20	20	20	13,89	13,22	42,23	44,33	28,33
nyipa fruticant	1	0	2	4,17	0,00	16,67	10	0,00	20	9,88	0,00	24,05	0,00	36,67
Rhizopora Apiculata	2	0	0	8,33	0,00	0,00	10	0,00	0,00	19,94	0,00	38,27	0,00	0,00
Rhizopora Mucronata	1	0	0	4,17	0,00	0,00	10	0,00	0,00	9,88	0,00	24,05	0,00	0,00
Soneratia alba	2	0	0	8,33	0,00	0,00	20	0,00	0,00	12,35	0,00	40,67	0,00	0,00
Soneratia caseolaris	15	3	6	62,5	33,33	50	20	40	40	24,87	32,47	101,73	105,81	90
jumlah	**24**	**9**	**12**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**330**	**330**	**20 0,00**

												0,0	**0,0**	**00**
Muara Cibereum (Desa Ujung gagak)														
Avicennia marina	5	3	2	31,25	15,79	22,22	40	25	33,33	6,06	20,09	7 7,3 1 4	6 0,8 7 5	55 ,56
Soneratia alba	2	3	0	12,5	15,79	0,00	20	25	0,00	14,63	12,07	7, 1 3 1 7	2, 8 6 1 8	0, 00
Soneratia caseolaris	9	13	7	56,25	68,42	77,77	40	50	66,67	79,31	67,84	5, 5 6 **3 0**	6, 2 7 **3 0**	14 4, 44
jumlah	**16**	**19**	**9**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**100,00**	**0,0 0**	**0,0 0**	**20 0,00**
Klaces (Desa Klaces)														
Acanthus ilicifolius L	**0**	**0**	**9**	0,00	0,00	**50**	0,00	0,00	**33,33**	0,00	0,00	0,0 0 3	0,0 0 0	**83 ,33**
Aigiceras corniculatum	8	0	0	18,18	0,00	0,00	14,29	0,00	0,00	7,5	0,00	9, 9 6 3 2, 4 9 7 1, 5 7	0, 0 0 6 0, 1 0 0, 6 0	0, 00
Avicennia officinalis	5	2	0	11,36	11,11	0,00	14,29	33,33	0,00	6,84	15,69			
Avicennia marina	14	6	3	31,82	33,33	16,67	14,29	33,33	33,33	25,47	33,99			

												5		
												1		
												3		
											0,	9,		
Ceriop											50,3	0	2	0,
tagal	0	10	0	0,00	55,56	0,00	0,00	33,33	0,00	0,00	3	0	2	00
												6		
											4,	0,		
nyipa				13,6			14,2			36,1		0	0	0,
fruticant	6	0	0	4	0,00	0,00	9	0,00	0,00	6	0,00	9	0	00

	Number of Stand (ind/hectares)			Relative Density (%)			relative frequency (%)			Relative Dominance (%)		Important Value Index (IVI)		
Name of Species	Trees	Sapling	Seedling	Trees	Sapling	seedling	Trees	Sapling	Seedling	Trees	Sapling	Trees	Sapling	Seedling
												2		
												8,	0,	
Rhizopora							14,2					7	0	0,
Mucronata	4	0	0	9,09	0,00	0,00	9	0,00	0,00	5,4	0,00	8	0	00
												3		
												5,	0,	66
Soneratia						33,3	14,2		33,3			1	0	,6
alba	3	0	6	6,82	0,00	3	9	0,00	3	14	0,00	1	0	7
												2		
												8,	0,	
Xilocarpus							14,2					0	0	0,
granatum	4	0	0	9,09	0,00	0,00	9	0,00	0,00	4,63	0,00	1	0	00
												3	**3**	
												0	**0**	
												0,	**0,**	**20**
	4			**100,**	**100,0**	**100,**	**100,**		**100,**	**100,**	**100,**	**0**	**0**	**0,**
jumlah	**4**	**18**	**18**	**00**	**0**	**00**	**00**	**100,00**	**00**	**00**	**00**	**0**	**0**	**00**

Table 3. Values Diversity (H') and Uniformity Index (e)

Indeks	Zona		
	East	Central	West
H'	1,519	1,834	1,723
e	0,659	0,635	0,718

Table 4. Value of similarity and dissimilarity index

Dissimilarity Index	Zona	Similarity Index		
		East	Central	West
	East	-	76,82	18,28
	Central	23,18	-	25,13
	West	81,72	74,87	-

Table 5. Parameters environment in each zone, June 2014

Indeks	Zona		
	East	Central	West
Temperature (^{o}C)	28,93 – 30,46	29,86 – 31,00	28,58 – 30,62
	(29,73)	(30,11)	(29,68)
Salinity ($^{0}/_{00}$)	8,40- 14,30	7,64 – 13,70	3,80- 14,20
	(12,46)	(9,33)	(6,39)
Substrat	*Silty clay*	*Sandy silty Clay*	*Silty Sand*

3.4. The Spread Pattern of Mangrove Vegetation

The survival and growth of mangrove determined by three main factors: the supply of fresh water and salinity, nutrient supply and substrate stability. Based on the index calculation Morishita at various mangrove growth rate zones based on the location of the study, it can be mentioned that most of the vegetation distribution patterns have a regular pattern (*regular / uniform*) because the value of the IS <1 (Table 5), this pattern reflects the existence of a negative interaction between individuals such as competition for space nutrients and sunlight. Only two types namely *R. apiculata* mangrove saplings and seedlings, and *S. caseolaris* on all stadia have clustered distribution patterns (*clumped*), where the value of the IS > 1.

Table 5. Results Calculation of the Index Morishita on any type of vegetation by zone

Types of mangrove	Indek Morishita (IS)								
	East Zone			Central Zone			West Zone		
	Trees	Sapling	Seedling	Trees	Sapling	Seedling	Trees	Sapling	Seedling
Aigiceras corniculatum	0	0,003	0	0,027	0,208	0,014	0,047	0,051	0,022
Acanthus ilicifolius L	0	0	0	0	0	0	0	0	0,266

Avicennia alba	0	0	0	0	0	0	0	0	0
Avicennia marina	0,282	0,001	0,028	0,139	0,066	0,027	0,274	0,229	0,155
Avicennia officinalis	0	0	0	0,00	0	0	0,013	0,005	0
Atalantia trimera oliv	0	0	0	0,037	0	0	0	0	0
Bruguera cilindrica	0	0	0	0	0	0	0	0	0
Bruguera ghimnorhiza	0	0	0	0	0	0	0	0	0
Ceriop tagal	0	0,083	0,387	0	0,600	0,475	0	0,229	0
Derris trifolliate	0	0	0	0	0	0	0	0	0
Excoecaria agallocha	0	0	0	0	0	0	0	0	0
ficus retuso	0	0	0	0,018	0	0,014	0	0	0
Heritera litoralis	0	0	0	0,028	0,032	0	0	0	0
nyipa fruticant	0	0	0	0,374	0	0,014	0,027	0	0,007
Rhizopora Apiculata	0,731	1,368	0,568	0,625	1,108	1,469	0,001	0	0
Rhizopora Mucronata	0,134	0,070	0,026	0	0	0	0,013	0	0
Soneratia alba	0	0,004	0,009	0,018	0	0,004	0,037	0,015	0,111
Soneratia caseolaris	0	0	0	0,011	0	0	1,180	1,285	1,006
Terminalia cattapa	0	0	0	0	0	0	0	0	0
Xilocarpus granatum	0	0	0	0	0	0	0,009	0	0

4. Conclusion

Currently Segara Anakan Estuarine still have 2.550,68 ha of mangrove forest area, or decreased 62,02% over the previous year. Considerable potential for preservation of mangrove estuaries are scattered through out the region, namely along the western and northern side of the River Donan (eastern zone), along the Kembang Kuning River include the area around Klaces, Motean and Cikiperan, Dangal River, Ujung Alang River, and around the Nusakambangan island, south side along Sapuregel river (Central Zone), around the west side of the lagoon and Muara Dua (west zone). Mangrove vegetation in Segara Anakan Estuarine composed by 27 species, including 17 species of trees, 2 types of shrubs, two types of climbers, three kinds of nails ferns / palm, and 3 types of herbaceous ground. Abundance of species ranges between 13-12475 ind / ha. Mangrove species which has a density, the spread and dominance of R. apiculata (IVI = 97.62 to 154.99%) in the eastern zone, *R. apiculata*, *A.corniculatum*, and *N. fruticant* with IVI range from 58.97 to 67, 09% (central zone), and *S. caseolaris* and *A. marina* (west zone) with IVI 46.80 to 148.02. Results of analysis of variance showed that the entire zone vegetation typology groups considered in the low diversity (H '<2). Distribution patterns of mangrove species form a regular pattern (regular / uniform) except on the type of *R. apiculata* and *S. caseolaris* spread group (clumped).

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