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Type and Abundance of Macrozoobenthos as A pollution Indicator in ken Dedes river at singosari Subdistrict malang regency, east java, Indonesia

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----------ABSTRACT----------
Ken Dedes river was located at Singosari Subdistrict in Malang Regency. It was originally only used as waste water from bath but it has been used for agriculture, tourism, public toilet, settlements, rearing of fish tilapia waste, sandal industry, welding workshop and tofu industry. The waste water can cause problems of habitat destruction of macrozoobenthos that was in water. The aim of this research was to study the type and abundance of macrozoobenthos, and determine the level of water pollution based on macrozoobenthos so that the river can be utilized by the public. The research was carried out by methods of survey and on observing variable of macrozoobenthos, current velocity, type of substrate, temperature, pH, dissolved oxygen, total organic matter, hardness and ammonia. Analysis of macrozoobenthos using PCA software, BMWP-ASPT and abundance index. Macrozoobenthos found during research consisting of 10 classes which divided into 12 order and 44 species. The result analysis of PCA showed medium and heavy polluted category, while of BMWP-ASPT index showed categories heavily polluted with abundance index varied from moderate to high. This river belong to quality standard grade two where water sources and flow can still be used for activity of agriculture, tourism, settlements and rearing of freshwater fish.

Keywords: *river pollution, macrozoobenthos, Ken Dedes River, quality standard*

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I. INTRODUCTION

The development of population activities in waterhed such as agricultural, residential, industrial activity and households can affect water quality, because resulting waste dumped directly into river. The faster development of industry will cause onset of problems because entry of industrial and domestic waste into environment watershed. The input of dissolved materials produced by activities of inhabitants of waste around watershed until within certain limits can be lowered water quality of river. It will be a serious problem occurred, that is water pollution, which can negatively affect to aquatic biota on lives and health of residents who take advantage of river. River pollution also occur in Ken Dedes River that is a tributary of Brantas River (Subekti, 2009), where river has begun to experience a change of agricultural function, tourism, public toilet (shower, toilet, washing), settlements, rearing of fish tilapia, sandall industry, welding workshop and tofu industry which may cause problems habitat destruction of existing macrozoobenthos in water.
The aim of this research was to study type and abundance of macrozoobenthos, and determine level of water pollution based on macrozoobenthos so that river can be utilized by public.

II. MATERIALS AND METHODS

Research Location

Ken Dedes River was located at Singosari Subdistrict in Malang Regency, with altitude 487 m above sea level with an average temperature of 22-32°C and a rainfall average of 349 mm per year. Extensive land use 11.374 ha which are exploited as farming areas and plantations, as seen in Figure 1.

Research Variables

The measured of water quality variables included current velocity, substrate, temperature, pH, dissolved oxygen, total organic matter, hardness, ammonia and macrozoobenthos.
The methods used in this research was survey method (Cooper and Pamela, 2003), conducted by observing human activity around river.

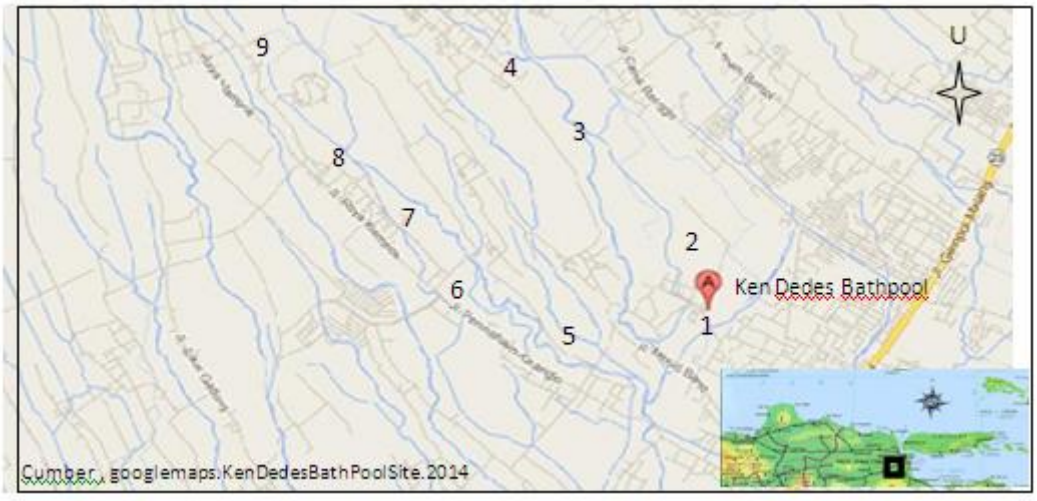

Figure 1. Location of Ken Dedes River

Collecting Samples

Methods used for samples of macrozoobenthos was kick sampling, with use of set net with mesh size 500, used in shallow water (Sudaryanti *et al*., 2001). Observation stations were determined based on land use of watershed and obtained 9 stations i.e. Station 1 was entering source of water that flow into Ken Dedes River. Station 2 was the flow of Bathpool Ken Dedes. Station 3 was station, where river flow of station 1 and 2. Station 4 received entering water from station 3. Station 5 lead to DAM Klampok. Stations 6 was residential, farms and railroad. Station 7 was Sumber Banyon, public toilet and rearing of fish tilapia. Station 8 was area before area DAM Klampok. Station 9 was river flow from DAM Klampok before entering Mondoroko River that will lead to Bango, watershed of Brantas River and flew into Brantas River.

Data Analysis

Data analysis using Principal Component Analysis (PCA), was to know relation of environment variables, in this research is a factor of water quality with macrozoobenthos (Gunadi and Pongsitanan, 2001). Biological Monitoring Working Party-Average Score Per Taxa (BMWP-ASPT) index, for considering sensitivity of macrozoobenthos in responding to pollution (Abdullahi and Suleiman, 2011). Abundance index, was to know of macrozoobenthos found (Riyanto *et al*., 2011).

III. RESULTS AND DISCUSSION

Macrozoobenthos

Macrozoobenthos found consisting of 10 classes (Gatropoda, Arthropods, Bivalves, Insecta, Tricladida, Olygochaeta, Hirudina, Polychaeta, Crustacea and Collembola) divided into 12 order (Decapoda, Argyronetta, Ephemeroptera, Diptera, Trichoptera, Coleoptera, Plecoptera, Odonata, Lepidoptera, Megaloptera, Hemiptera, Pulmonata) which consists of 44 species. The lowest taxa found at station 7 (located in Candirenggo Subdistrict) with macrozoobenthos found i.e of Atydae, Sundhatelpusidae, Baetidae, Thiaridae, Elmidae, Lumbricullidae (Larva), Caenidae, Chironomidae, Chironomini, Orthocladinae, Heptagenidae, Argyronetta. The observed water quality : current velocity 24 cm/sec was categorized as fast current with substrates of gravel and sand, temperature 26°C which is normal category, pH 7 was ideal category, dissolved oxygen 4.9 mg/l was normal category, total organic matter 98 mg/l was high category, hardness 238 mg/l was very hard category and ammonia 0.294 mg/l was high category, where human activity among others, public toilet, rearing of fish tilapia and Sumber Banyon with vegetation around the river exist bush and clumps of bamboo. The presence of a water Sumber Banyon on this station 7 as indication that there are still ground water that can be used by local residents and found macrozoobenthos type Atydae, where this macrozoobenthos is found in area which was still clean and close to source of water with vegetation around river there are still many shade. It is agreed with Pratiwi (2008), who proposed that Atydae found on a source area that not yet polluted with condition around river still natural which has many trees with a soft substrate it consisted of a mixture mud and sand and live beneath stones. If it is rated by quality of the water this station still support the life species. This agreed with Asthma *et al* (2013)., where water quality of Atydae life with the temperature range 26-30°C, pH 6.7-7.8 and dissolved oxygen >3–5 mg/l.

The highest taxa found at station 2 (located near Ken Dedes pool site), with macrozoobenthos found i.e 26 species of Tipulidae, Tricladida, Glossiphonia, Elmidae, Lumbricullidae (L,Pupa,Adult), Baetidae, Caenidae, Hydropsychidae, Chironomini, Chiromidae (P), Sundathelphusidae, Thiaridae, Planorbidae, Philopotamidae, Simulidae, Hirudina, Argyronetta, Psepenidae, Muscidae, Platycnemididae, Corydalidae, Gerridae, Hydrobiosidae. The water quality observed : current velocity 65 cm/sec was fast current category with substrate of pebbles and sand, temperature 26°C normal category, pH 7 ideal category, dissolved oxygen 5.1 mg/l normal category, total organic matter 157.3 mg/l is high category, hardness 96 mg/l is moderate category and ammonia 0.055 mg/l normal category, where human activity was agriculture and parking area with vegetation around river in form of banana trees, shrubs and cherry trees. The agricultural activity contributes to waste in form of fertilizer run-off used by farmers and if this take place continuously then it will bring up macrozoobenthos are tolerant on these condition. According to literature studies by Agustiningsih *et al* (2012)., agricultural activities to use fertilizers and pesticides will affect river water quality through wastewater from agricultural land into water bodies and will bring up organism that sensitive to those conditions. Discovery of macrozoobenthos species Lumbricullidae, Muscidae and Chironomini indicates that there has been a change macrozoobenthos habitat of a bit sensitive for some macrozoobenthos become tolerance for several macrozoobenthos.

The lowest species was found at station 3 (located in Candirenggo Subdistrict) found a spesies of Noctuidae and station 8 (located in DAM Klampok) found a species of Phyralidae. Water quality station 3 : current velocity 70 cm/sec was fast current category with substrate of pebbles and sand, temperature 26°C normal category, pH 7.2 ideal category, dissolved oxygen 5.3 mg/l normal category, total organic matter 55,6 mg/l normal category, hardness 335 mg/l was very hard category and ammonia 0,278 mg/l was high category, where human activity was agriculture and vegetation surrounding public graveyard with clumps of bamboo, bushes and banana trees. While water quality station 8 : current velocity 35,6 cm/sec was medium-sized category with substrate gravel, temperature 26°C normal category, pH 7 ideal category, dissolved oxygen 5.3 mg/l normal category, total organic matter 63.2 mg/l normal category, hardness 110 mg/l was hard categories and ammonia 0.116 mg/l normal category, where human activity in form of residential and sandal industrial with vegetation around river in form of clumps of bamboo and bushes. The state of being station 3 and 8 site that are found of kind of Lepidoptera which is Noctuidae and Pyralidae. Macrozoobenthos this type of many associated with leafage around river in rainy season and even though there are human activity in form of sandal industry and settlements so that this type found only in inconsiderable quantity. It agreed with Robbins and Busby (2009), who argued that local Lepidoptera likes there are many shrubs and trees around river rich in foodstuffs and found most often in rainy season.

The highest species found at station 6 (located in Wonorejo Village), where found macrozoobenthos species Thiaridae as many as 2.048 ind/m^2. The water quality observed : current velocity 51 cm/sec was fast current category by a substratum mud, temperature 26°C normal category, pH 7 ideal category, dissolved oxygen 5 mg/l normal category, total organic matter 79.6 mg/l normal category, hardness 72 mg/l was moderate category and ammonia 0.054 mg/l normal category, where human activity in form of farm and settlements with vegetation around river there are slight shrubs. The quality of water at station was very life support macrozoobenthos type Thiaridae, in form of mud, where a substrate organic material, hardness and ammonia high that found this type in the condition of being abundant. According to Reese and Voshel (2002), Thiaridae lived in running water with a substrate that was smooth and hardness of being moderate and according to Marwoto and Nurinsyah (2009), snails serves to predict pollution level a water.

Water Quality

Water quality measurements obtained include current velocity 24-92.5 cm/sec was very fast-flowing category, substrate was combination of pebbles, boulders, sand and less silt, pH 6.7-7.2 was ideal category for life macrozoobenthos, dissolved oxygen 4.3-5,5 mg/l was appropriate category for life macrozoobenthos, total organic matter 35.3-157.3 mg/l was high category, hardness 58-438 mg/l was high category and ammonia 0.034-0.0294 mg/l was high category.

PCA Analysis

Macrozoobenthos

Quadrant A (see Figure 2) consists of stations 3,5,7 (located in Candirenggo Subdistrict), station 8 (located before DAM Klampok) and station 9 (located after DAM Klampok) was macrozoobenthos i.e Nereidae, *Branchiura* sp., *Chironnomous thummi*, Lumbricullidae, Tricladida, Planorbidae, Atydae, Lampiridae, Hirudina, Limnephilidae, Chironomidae (P), Ortocladinae, Tubificidae, Pyralidae. Environmental factors : current velocity 24-70 cm/sec with substrate a combination of pebbles, sand and a little great stones,

temperature 26°C, pH 7, dissolved oxygen 4.3-5.3 mg/l, total organic matter 35.3-98 mg/l, hardness 110-438 mg/l, ammonia 0.027-0.294 mg/l with in form of agriculture, settlements, public toilet, rearing of fish tilapia, sandal industry, welding workshop and Sumber Banyon with vegetation around river in form of a clumps of bamboo, shrubs and banana trees

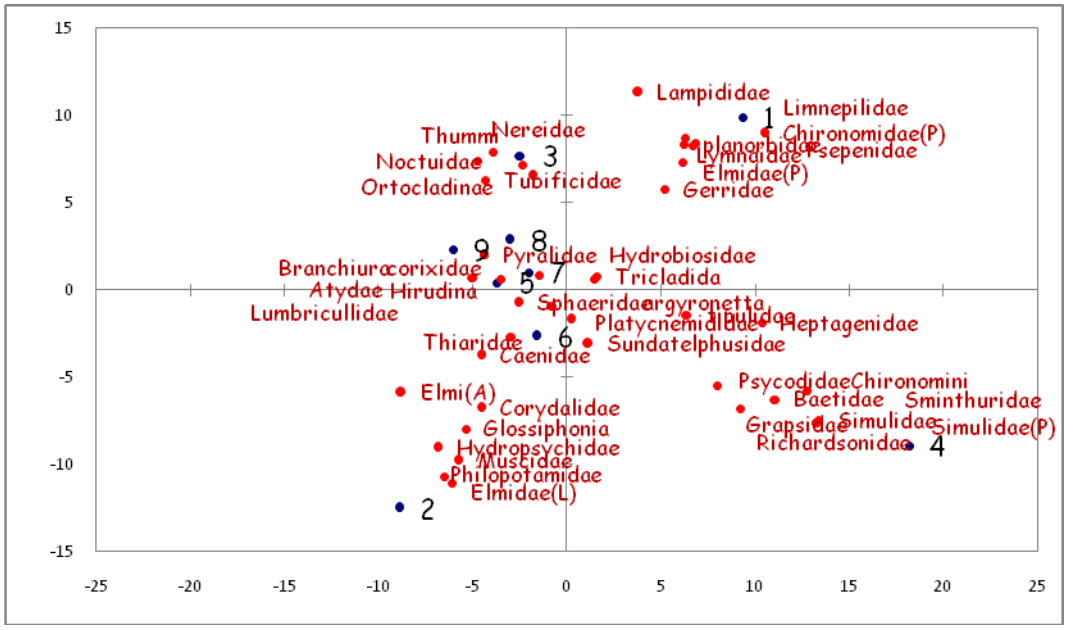

Figure 2. PCA Results Analysis to Macrozoobenthos

` Species of Nereidae, *Branchiura* sp., *Chironnomous thummi*, Lumbricullidae, Chironomidae (P), Ortocladinae, Tubificidae was found at downstream with slow current velocity, mud substrates where existence of little oxygen and rich in organic matter. According to Bat and Akbulut (2001), *Chironnomous thummi* was an organism that very tolerant pollution because of these organism have gills which are at the end of the tail. The function was to kept oxygen and conform to habitats that are anoxic. Nereidae and *Branchiura* sp. have cilia around his body that functions same as gills at *Chironnomous thummi*.

Quadrant B (see Figure 2) at station 2 (located in Ken Dedes pool site) and station 6 (located in Wonorejo Village) found macrozoobenthos species i.e Hirudina, Glossiphonia, Elmidae (P,L,A), Sundatelphusidae, Richardsonidae, Grapsidae, Sminthuridae, Psycodidae, Corydalidae, Baetidae, Platycnemididae, Tipulidae, Hydrobiosidae, Caenidae, Philopotamidae, Tricladida. Environmental factors : current velocity 51-65 cm/sec with substrates combination of gravel, sand and mud, temperature 26°C, pH 7, dissolved oxygen 5-5.1 mg/l, total organic matter 79.6-157.3 mg/l, hardness 72-96 mg/l, ammonia 0.054-0.055 mg/l where human activity among others agriculture and settlements with vegetation around the river in form of banana trees, little shrub and cherry trees. Tipulidae and Psycodidae life under to passage of still water and was decomposting organic matter (Wenn, 2008). So as to be said quadrant B get in category polluted being because there were Tipulidae and Psycodidae tolerant against pollution characterized by a substratum muddy although there are macrozoobenthos of a species that sensitizes namely Atydae and Philopotamidae. It was similar to opinion Urbanik *et al* (2005)., who said that Philopotamidae was macrozoobenthos of the order of Trichoptera which suggest that if there are macrozoobenthos this species of water can then be said to be suffered pollution being.

Relations Beetwen Macrozoobenthos and Water Quality

The result analysis using software PCA got that water quality affect lives of macrozoobenthos was current velocity, as seen from Figure 3.

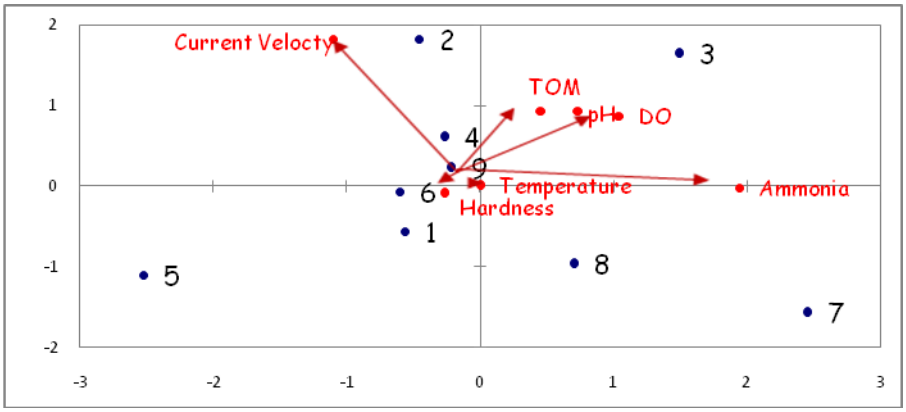

Figure 3. PCA Analysis Results for Water Quality Relationships With Macrozoobenthos

In this area are found macrozoobenthos species i.e Hydropsychidae, Baetidae and Simulidae which has adaptation to fast current velocity. Simulidae having adaptation to current velocity form catch or inhalator, caddiesfly larvae of Hydropsychidae from the order of Trichoptera, that body on substrate attach rocks. The order of EpHemeroptera, species Baetidae has a flattened body as its adaptation to fast current velocity. It agreed with Maharaj and Alkins-Koo (2007), in which some kind of macrozoobenthos have power to defend itself in adaptation of current velocity : permanent inherent in a firm substrate e.g. caddiesfly, hooks or suction e.g. Simulidae, body flattened e.g stonefly nymph. While result water quality observed, standards on the government regulation number 82/2001, this river belong to quality standard grade two where water sources and flow can still be used for activity of agriculture, tourism, settlements and rearing of freshwater fish.

BMWP-ASPT Index

This river category polluted heavy with macrozoobenthos found during research of Ken Dedes River to downstream namely species *Chironomous thummi*, *Branchiura* sp. and Nereidae. The species of macrozoobenthos found indicated that the river has had a heavy pollution due to variety of complex human activities. It was agreed with Kustiasih (2011), that water which receives waste from complex human activity increasingly would bring them to an organism that tolerant of change this condition. Nereidae include into class Polychaeta, where this species have cilia around his body that serves as adaptation to conditions poor oxygen, organic matter and high ammonia by making a hole in mud and buries itself under surface of substrate (Correa *et al*., 2008). *Branchiura* sp. was macrozoobenthos of a class of Oligochaeta, where this species have cilia on tail that serves as adaptation to condition of being destitute of oxygen and usually found in downstream area or human activity industrial (Poly, 2008). *Chironomous thummi* spread on downstream and industrial activity where this species of many researched because their bodies storing hemoglobin much so often called blood worm. Hemoglobin it served to power adaptation to anoxic state of his life in place where exixtence oxygen are few and high content organic matter (Gurvey *et al*., 2001).

Abundance Index

The results obtained by using abundance index was obtained by moderate to high category, with lowest abundance was found at station 2 was 1,7 and highest abundance was found at station 6 was 3,7.

The lowest abundance at station 2 where macrozoobenthos found only one species of Muscidae, the water quality observed: current velocity of 65 cm/sec was fast current category with substrate of pebbles and sand, temperature 26°C normal category, pH 7 ideal category, dissolved oxygen 5.1 mg/l normal category, total organik matter 157.3 mg/l was high category, hardness 96 mg/l was moderate category and ammonia 0.055 mg/l normal category, where human activity among others agriculture and parking area with vegetation around river in form of banana trees, shrubs and cherry trees. It contains order Diptera species Muscidae, live on susbstrat which is rich organic matter and tropics collector level takes some particles are suspended from water, took organic substances from bacteria and algae that live apart from substrate (Johanson and Espeland, 2010). We can conclude that invention macrozoobenthos only one kind of at station 2 due to difference response habitats at any species of macrozoobenthos, besides caused by drifting factor caused by rain on day before sample.

The highest abundance at station 6 where found macrozoobenthos species of Thiaridae with water quality observed : current velocity 51 cm/sec was fast current category with substrate of mud, temperature 26°C normal category, pH 7 ideal category, dissolved oxygen 5mg/l normal category, total organic matter 79.6 mg/l normal category, hardness 72 mg/l was moderate and ammonia 0.054 mg/l normal category, where human activity among others agriculture and settlements with vegetation around river is little bush. Domestic waste such as

discarded use of shampoo, bath soap and detergent can increase hardness of river waters that bring up organism like this condition. It agreed with Effendi (2003), where hardness of water closely related to ability of water to form lather if hardness of water bigger and soap difficult due to form precipitation and foam will not formed before all cation shaper of hardness settles known with a softening or hardness by soap decline. Hardness was also closely related to formation of mollusca shell in particular and will be many types of shellfish.

IV. CONCLUSION

Macrozoobenthos was found in Ken Dedes River by a kind there are 10 classes which divided into 12 order consisting of 44 species. The results obtained by abundance index varied from moderate to high category. The pollution that occurs in river belonging to category of heavily polluted due to tolerant macrozoobenthos found species i.e *Chironomous thummi*, *Branchiura* sp. and Nereidae. However, if seen from water quality, this river belong to quality standard grade two where water sources and flow can still be used for activity of agriculture, tourism, settlements and rearing of freshwater fish.

V. SUGGESTION

Governments and communities around this river should begin to build waste dump away from this river and indirect discharged into river and made a prohibition to make people do not throw trash in river. The government should begin drafting village planning integrated river management to maintain sustainability of river so that macrozoobenthos are sensitive to pollution was still there.

REFERENCE

[1]. Abdullahi and Suleiman. 2011. Biological Assessment of Water Quality: A Study of Challawa River Water Kano, Nigeria. Journal of Pure and Applied Science, Bapojas VOL.4 No.2 p:121-127

[2]. Agustiningsih, D., S. S Sasongko and Sudarno. 2012. The Water Quality Analysis and Pollution Loads Based On Land Use In The River Dwastrict Blukar. Proceedings of The National Seminar On Natural Environmental Management. Diponegoro University. Semarang

[3]. Asma, S., K. Lengka and M. Kolopita. 2013. Lobster Aquaculture Techniques (*Cherax quadricarinatus*) In Freshwater Aquaculture Hall (BBAT) Tatelu. Journal of Aquaculture. VOL.1 No.1 p:15-21

[4]. Bat, L and M. Akbulut. 2001. Studies On Sediment Toxicity Bioassays Using *Chironomus thummi K*., 1911 Larvae. University of Ondokuz MayÝs, Sinop Fwasheries Faculty, Divwasion of Basic Sciences, 57000 Sinop-Turkey. Journal of Science VOL.3 No.5 p:87-93

[5]. Cooper, D and S. Pamela. 2003. Business Research Methods. International Edition. Mc Grow Hill. Boston

[6]. Correa, M and V.S Uieda. 2008. Composition of The Aquatic Invertebrate Fauna Associated To The Mangrove Vegetation of A Coastal River, Analyzed Through A Manipulative Experiment. Journal Of Aquatic Sciences VOL.3 No.1 p:23-31

[7]. Effendi, H. 2003. Study of Water Quality For The Management of Resumbers And The Aquatic Environment. YogyakartA:Kanwasius Publwasher

[8]. Gunadi, K.R and S. Pongsitanan. 2001. Making of Face Recognition Software Using Principal Components Analysis. Journal of Informatics VOL. 2 No. 2 p:57-61

[9]. Gurvey, V., I. Makarevitch., A. Blinov and J. Martint. 2001. Phylogeny of The Genus Chironomus (Diptera) Inferred From DNA Sequences Of Mitochondrial Cytochrome B and Cytochrome Oxidase I. ournal Molecular Phylogenetics and Evolution. VOL.19 No.1 p:9–21

[10]. Googlemaps. 2014. Location Ken Dedes River. Accessed 13 January 2014

[11]. Government Regulation Number 82/2001 About Water Quality Management And Water Pollution Control

[12]. Johansen, K.A and M. Espeland. 2010. Description of New Chimarra (Trichoptera: Philopotamidae) Species From The Solomon Waslands. Journal Zootaxa VOL.2 No.6 p:25–43 ISSN 1175-5334

[13]. Kustiasih, T. 2011. Determination of The Chemical Oxygen Demand of Wastewater by Considering The Uncertainty Factor Incase of Wastewater Treatment Plant at Research Institute For Human Settlements. Journal of Settlement VOL.6 No.3 p:121-128

[14]. Maharaj, L.D and M. Alkins-Koo. 2007. Use of Benthic Macrozoobenthoss To Assess Anthropogenic Impacts In The Rivers of Trinidad and Tobago. Department of Life Sciences. University of The West Indies St. Augustine Trinidad and Tobago

[15]. Marwoto, R. M and A.S. Nurinsiyah. 2009. The Diversity of Freshwater Snail Genus Filopaludina In Indonesia And The Taxsonomi Status (Gastropod:Viviparidae). Proceeding of The National Seminar on Mollusca 2. Bogor, 11-12 February p:202-213

[16]. Poly, W.J. 2008. Global Diversity of Fwashlice (Crustacea, Branchiura, Argulidae) In Freshwater. Journal Hydrobiologia VOI.10 p:209–212

[17]. Pratiwi, R. 2008. The Aspect of Important Biology Shrimp Economically. Journal Oseana VOL.33 No.2 p:15-24 ISSN 0216-1877

[18]. Reese, J and Voshel, Jr. 2002. A Guide To Freswater Invertebrates of North America. Mc Donald & Woodward Publwashing Co. Blacksburg, VA. Maryland

[19]. Riyanto, S. Herlinda, C. Irsan and A. Umayah. 2011. Abundance And Diversity Predator Insect Species And Parasitoid *Aphwas gossypii* In South Sumatra. Journal HTP Tropica VOL.11 No.1 p:57-68 ISSN 1411-7525

[20]. Robbins, R and R.C Busby. 2009. Updated Phylogeny, Taxonomy, and Diversification of Janthecla Robbins & Venables (Lycaenidae, Theclinae, Eumaeini). Journal of Research on Lepidoptera. VOL.41 p:5-13 ISSN 0022 4324

[21]. Subekti, E. 2009. Water Resumbers Management In Watershed. Delivered at a National Seminar on Apliksi Technology Infrastructure Areas of ITS Surabaya 29 July 2009. The Department of Workers General Directorate General of Public Hall Water Resumbers Brantas Watershed

[22]. Sudaryanti, S., Y. Trihadiningrum, B. Hart, P.E Davies., C. Humprey., R. Norrwas., J. Simpson and L. Thurnell. 2001. Assessment of The Biological Health of The Brantas River, East Java, Indonesia Using The Australian River Assessment System (AUSRIVAS) Metodology. Journal Aquatic Ecology. Kluver Academic Publishers. Printed In The Netherland. VOL.35 p:135–146

[23]. Urbanic, G., M.J Toman and C. Krusnik. 2005. Microhabitat Type Selection of Caddwasfly Larvae (Insecta: Trichoptera) In A Shallow Lowland Stream. Journal Hydrobiologia VOL.3 p:1–12

[24]. Wenn, C.L. 2008. Do Freshwater Macrozoobenthoss Reflect Water Quality Improvements Following The Removal of Point Sumber Pollution From Spen Beck, West Yorkshire. Journal of Earth and Environment VOL.3p:369-406