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IDENTIFICATION OF MACROZOOBENTHOS IN THE UPSTREAM OF THE BRANTAS RIVER, BLITAR

IDENTIFIKASI MAKROZOOBENTOS PADA HULU SUNGAI BRANTAS, BLITAR

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ABSTRACT

Macrozoobenthos are animals that settle at the bottom of the waters with limited movement and are sensitive to changes in water quality so that they can be used as bioindicators of water quality. Examples of macrozoobenthos are snails, crabs, clams, shellfish, and insect larvae. Not much research has been done on macrozoobenthos, especially in the upper reaches of the Brantas River, so it is necessary to identify macrozoobenthos that can be used as bio-indicators of pollution levels in the upper reaches of the Brantas River. Macrozoobenthos sampling was carried out by kicking and jabbing techniques. Ready samples were then observed with the help of a stereo microscope and identified up to the family level. 24 families of macrozoobenthos (Parathhelpusidae, Palaemonidae, Tubificidae, Dugesiidae, Erpobdellidae, Thiaridae, Physidae, Gomphidae, Hydropsychidae, Chironomidae, Perlidae, Scyomizidae, Amphipterygidae, Baetidae, Tipulidae), 6 orders (Lumbricullidae, Epheroptera, Diptera,Planaria, Coleoptera, Trichopteran), and 4 classes (Malacostraca, Citellata, Gastropods, and Insects).

Keywords: *Blitar; Brantas River; Macrozoobenthos; Upstream*

ABSTRAK

Makrozoobentos adalah biota yang menetap di dasar perairan dengan gerakan yang terbatas dan sensitif terhadap perubahan kualitas air sehingga dapat digunakan sebagai bioindikator kualitas air. Contoh makrozoobentos adalah hewan jenis siput, kepiting, kerang, shellfish, dan larva serangga. Penelitian mengenai makrozoobentos khususnya pada wilayah hulu Sungai Brantas belum banyak dilakukan sehingga identifikasi makrozoobentos yang dapat dijadikan bioindikator tingkat pencemaran di wilayah hulu Sungai Brantas perlu dilakukan. Pengambilan sampel makrozoobentos dilakukan dengan teknik *kicking* dan *jabbing*. Sampel yang sudah siap lalu diamati dengan bantuan mikroskop stereo dan diidentifikasi hingga tingkat Family. Makrozoobentos yang ditemukan sebanyak 24 famili (Parathhelpusidae, Palaemonidae, Tubificidae, Dugesiidae, Erpobdellidae, Thiaridae, Physidae, Gomphidae, Hydropsychidae, Chironomidae, Perlidae, Scyomizidae, Amphipterygidae, Baetidae, Tipulidae), 6 ordo

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(Lumbricullidae, Epheroptera, Diptera, Planaria, Coleoptera, Trichopteran), dan 4 kelas (Malacostraca, Citellata, Gastropoda, dan Insecta).

Kata Kunci: Blitar; Hulu; Makrozoobentos; Sungai Brantas

INTRODUCTION

Macrozoobenthos are animals that settle on the bottom of the waters with limited movement and are sensitive to changes in water quality so that they can be used as bioindicators of water quality (Rachman et al., 2016). Macrozoobenthos are macro-sized invertebrates that live at the bottom of the waters. Macrozoobenthos can also be defined as invertebrate animals that live in sediments or substrates. Examples of macrozoobenthos are snails, crabs, clams, shellfish, and insect larvae. Macrozoobenthos organisms have a very important role in the cycle of nutrients in the waters. Răescu et al. (2011) explained that macrozoobenthos are the main source of nutrition in aquatic ecosystems. Macrozoobenthos also helps break down various types of materials at the bottom of the waters (Vyas et al., 2012).

Macrozoobenthos of each species show different levels of tolerance to different contaminants. Macrozoobenthos is used as an environmental indicator because its response can predict various types of anthropogenic disturbances (Yunita et al., 2018). Macrozoobenthos animals are sensitive to changes in environmental conditions where they live so their living environment greatly influences their composition and abundance. The macrozoobenthic diversity index shows the condition of the river waters (Pelealu et al., 2018). Several types of macrozoobenthos such as macrozoobenthos from the orders Ephemeroptera, Plecoptera, and Trichoptera live in environments with high DO values (Darojat et al., 2020). The abundance of macrozoobenthos can also be used as an indicator of water quality. The preferred living habitat for each type of macrozoobenthos also influences the distribution of diversity and abundance (Hakim et al., 2020). Several studies have proven that the existence of macrozoobenthos in an ecosystem is closely related to the surrounding environmental conditions. For example, in a study conducted by Cai *et al.* (2012), dissolved oxygen concentration is closely related to the community structure of macrozoobenthos in China's Cao Chu River. Not much research has been done on macrozoobenthos, especially in the upper reaches of the Brantas River, so it is necessary to identify macrozoobenthos that can be used as bio-indicators of pollution levels in the upper reaches of the Brantas River.

MATERIAL AND METHODS

This research was conducted from April 2023 to May 2023. The sampling location was determined in the upper reaches of the Brantas River which includes the Blitar Regency. Identification of macrozoobenthos was carried out at the Anatomy and Aquaculture Laboratory, Faculty of Fisheries and Maritime Affairs, Airlangga University. The research design to be carried out is sampling at 5 stations which are included in the upstream area of the Brantas River. Each station has 3 sampling points with 3 repetitions so the total number of samples studied is 30 samples.

The equipment that was used in this study included hand nets with a diameter of 45 cm with a net mesh of 50, boots, buckets, basins, plastic clips, sample tubes or bottles, coolboxes, stationery and cameras, label paper, stereo microscopes, tweezers, rulers, cups. petri, lup, secchi disk, pH meter, DO meter, measuring flask, Winkler bottle, heater, Erlenmeyer, and lup (Violando et al., 2023). The materials used in this study were macrozoobenthos samples, 4% formalin, and identification books.

Macrozoobenthos sampling was carried out by kicking and jabbing techniques. The substrate (sediment and gravel) that enters the net is sorted and then cleaned in a plastic basin. The macrozoobenthos attached to the substrate were taken as samples. The sorted macrozoobenthos samples were transferred into sample plastic which had been labeled based on station points and given 4% formalin solution to preserve the macrozoobenthos to be identified. In the laboratory, samples of macrozoobenthos taken from the field were then removed from the sample plastic to be rinsed by washing under running water. Ready samples were then observed with the help of a stereo microscope and identified up to the family level. Identification of samples using books Sabelli (1979), Dharma (2005), Edington and Hildrew (1981), Hawking and Smith (1997), Quigley (1977), and using websites from WoRMS (World Register of Marine Species), Waterbugkey, and Bugguide.

RESULT AND DISCUSSION

Macrozoobenthos Identification

The results of the identification of macrozoobenthos in this study found 4 classes (Malacostraca, Citellata, Gastropods, and Insects), and are members of 9 orders (Decapoda, Tricladida, Arhynchobdellida, Pharyngobdellae odonatan, Trichopteran, Diptera, Plecoptera, Ephemeroptera), and 13 families (Parathelpusidae, Palaemonidae, Tubificidae, Dugesiidae, Erpobdellidae, Thiaridae, Physidae, Gomphidae, Hydropsychidae, Chironomidae, Perlidae, Baetidae, Tipulidae). Substrate types at all stations are large rocks, gravel, and a little sand. According to Morley et al., (2008), differences in substrate affect the level of stability of the macrozoobenthos composition of a particular species. Macrozoobenthos from the families Ephemeroptera and Tricoptera are more stable in populations in coarse sediments such as rocks and gravel. Previous results showed 42 native freshwater fishes from Brantas river, which also existed in this study (Hasan et al., 2022).

Table 1. Macrozoobenthos Found Around the Upstream of Brantas River in Blitar Regency

Family	Station

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Parathelpusidae	4th station 5th station
Palaemonidae	1st station
Tubificidae	2nd station 3rd Station
Dugesiidae	1st station 3rd station
Erpobdellidae	2nd station
Thiaridae	1st station 2nd station 3rd station 4th station 5th station
Physidae	1st station
Gomphidae	1st station
Hydropsychidae	1st station 3rd station 5th station
Chironomidae	1st station 5th station
Perlidae	2nd station 3rd station 5th station
Baetidae	2nd station 3rd station
Tipulidae	3rd station 4th station

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Figure 1: Macrozoobenthos Found Around the Upstream of Brantas River in Blitar Regency (A) Parathelpusidae; (B) Palaemonidae; (C) Dugesiidae; (D) Erpobdellidae; (E) Thiaridae; (F) Physidae; (G) Gomphidae; (H) Hydropsychidae; (I) Chironomidae; (J) Perlidae; (K) Baetidae; (L) Tipulidae

Key Identification for Parathelpusidae consists of A spine near the far end of the upper border of the merus of the chelipeds. Parathelpusidae described by Arlock (1910) that it is unusual for the abdomen of the adult male to be regularly triangular; it is far more usual for its distal half to be narrowed, the narrowing beginning suddenly at the 5th or 6th segment. Whether this contraction is marked or not, the 6th segment is never broad, its length almost always being equal to, and not unseldom exceeding, its distal breadth; and the 7th segment is never broadly triangular, but is narrowly semi-elliptical, or tongue-shaped, or at least elongate. The mandibular palp is of a peculiar pattern; the first two joints are not separately distinguishable—they certainly have no movement independent of one another; and the terminal joint is divided from the base into two lobes —a dorsal and a ventral. It is unusual for any distinct gap to exist between the lower border and the outer upper angle of the orbit.

Key identification for Palaemonidae consists of the claws of the pereiopod small; Rostrum not finely serrated, with big teeth, in general, less than 10. Without supraorbital spine. The chela from the second pair of pereiopods is bigger than that of the first pair of pereiopods, and neither has a tuft of setae apically. Palaemonidae is described by Oscoz (2011) as small shrimp (up to 60 mm total length). They have an elongated, laterally compressed body, with developed pleopods modified for swimming. The carpus of the two first pairs of legs is distally excavated and the claw inserts laterally on the internal angle of the excavation. The first pair of pereiopods ends in a small claw. The second pair ends in a larger, sturdier claw. The last three pairs end in claws and are shorter

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than the second pair. The telson is long and triangular, apically ending in a sharp angle, and with four spines on its margin (two short external and two longer and internal), among which there is a variable number of long and feather-like setae.

Key identification for Dugesiidae consists of: One pair of eyes anteromedially located; Head triangular (lanceolate) or spatulate, in which case the distance between the eyes is greater than the distance to the edge of the body. Dugesiidae is described by Oscoz (2011) as unsegmented and usually small (between 1 and 2 cm long) free-living freshwater flatworms. Their main external characteristic is a triangular (sometimes rounded) head with two eyes in the middle, although occasionally they can present supernumerary eyes.

Key identification for Erpobdellidae consists of: Four pairs of eyes, pharynx without jaws; Eyes in two segments, each segment containing two pairs of eyes. Erpobdellidae is described by Oscoz (2011) as slender, slightly flattened leeches with an indistinct anterior sucker and eight eyes arranged in two transverse rows. Like all the members of the order Pharyngobdellae, this family has a weak muscular pharynx with no jaws or teeth but is capable of swallowing whole prey. Salivary glands secreting digestive enzymes open into the pharynx, which is followed by a tube-like crop. Unlike other leech families, the crop in Erpobdellidae lacks lateral caeca. After the crop, the intestine leads to the anus. In predatory species, the crop and the intestine are used for digestion and absorption, while in sanguivorous leeches only the intestine has those functions. Coloration varies between reddish-brown and greyish-brown, and sometimes they have a black-and-yellow pattern superimposed on their basic pigmentation.

Key identification for Thiaridae consists of: With operculum; mantle opening directed more or less forward (operculate snails); Shell medium-sized (more than 10 mm high), with well-developed or, generally, high spire. Thiaridae is described by Pan American Health Organization (1968) as ovoviviparous snails. It already has an apical whorl. The cephalopod mass has a foot with a flat sole and a mouth in front, both of which are applied to the substrate when the snail crawls. Labial palps are absent in the Thiaridae. In many prosobranchs, the front end of the head is distinctly separated from the foot and forms a proboscis. Prosobranchs in Thiaridae, the gono- duct, or vas deferens, do not lead to an external appendage called the penis, or verge. This structure is variously located in different families. Some female prosobranchs of the Thiaridae are ovoviviparous, they retain the fertilized eggs inside the body until they hatch.

Key identification for Physidae consists of: With just one shell; Operculum absent; Shell spirally coiled; Shell aperture to the left (facing the opening). Physidae are described by Oscoz (2011) as species that have a fragile, semi-transparent shell with an aperture on the left side (levogyre or sinistral). The shell does not bear operculum or umbilicus, but it does have a pointy apex. In some species, the mantle can have finger-like extensions that go over the shell

Key identification for Gomphidae consists of Abdomen ending in five short, spinous appendages; Antennae with four segments, the third one usually longer than the sum of the other three. Tarsi of prothoracic and mesothoracic legs with two segments, tarsi of metathoracic legs with three segments. Gomphidae is described by Oscoz (2011) as dorsoventrally flattened. They have a flat mask that, while at rest and similarly to Aeshnidae, does not cover other mouthpieces. Unlike Aeshnidae, Gomphidae has short and stout antennae with only four segments (the third one longer than the remaining three combined). Their morphology is dictated by their peculiar burrowing behavior, head first into the substrate. This causes a decrease in the number of antennal segments and the engrossment of the antennae. Besides, they have spurs on the tibiae to help them dig, and they have shorter and sturdier tarsi than other families.

Key identification for Hydropsychidae consists of Metanotum fully sclerotized; Abdominal ventral gills present. Hydropsychidae is described by Oscoz (2011) as having all three thoracic segments dorsally covered by sclerotized plates. The posterior margins of the meso and metanotal sclerites are lobate. The abdomen is cylindrical and slender. The hydropsychids are easily recognized because the abdomen and the last two thoracic segments bear ventral branched gills and a tuft of many long stiff setae on each anal proleg. Instars I–II lack gills and they can be misidentified as Hydroptilidae or Ecnomidae. They can be differentiated from the latter due to their tuft of setae on the anal proleg and the posterior margins of the thoracic segments. The body is covered with dark-colored spicules. Anal claws form a stout hook apically.

Key identification for Chironomidae consists of a Head capsule usually well-defined and sclerotized, separated from the thorax; a Head capsule without protuberances and not perpendicular to the body. Thoracic prolegs in pairs, although sometimes they might be fused at the base and so close together that they may appear as one. Without opened spiracles. Chironomidae is described by Oscoz (2011) as having very diverse color patterns. They are characterized by having a well-developed cephalic capsule with a multi-segmented antenna (retractile or not), and a cylindrical body that has two pairs of prolegs, the first one situated on the thoracic area and the second pair on the anal area. The pair of thoracic prolegs can be reduced to a transversal pad with thin denticulations. Pupae have different morphologies depending on the subfamily or tribe to which species belong, although in general, they all present a flat anal lobe at the tip of the abdomen. Over the dorsum of the thoracic region, there is a pair of respiratory processes of variable morphology.

Key identification for Perlidae consists of Glossae smaller than paraglossae; Thoracic gills present. Perlidae described by Oscoz (2011) with the main diagnostic character that defines Perlidae nymphs is the presence of thoracic tufted tracheal gills, although in some species there is also an anal tuft. Nymphs can reach considerable sizes (more than 3 cm in some Spanish species when mature). They also have dark and light contrasting colors that form characteristic patterns. The body is dorsoventrally flattened, with a slightly convex dorsum. The pteropthecae diverge and legs have wide femurs and many swimming setae. Tarsal segments I and II are short, while segment III is long.

Key identification for Baetidae consists of Cerci with setae only on their inner margins; the Posterior end of the last abdominal segments is not pointy. Antennae long (more than three times the head width). Baetidae are described by Oscoz (2011) as species that have a fusiform, subcylindrical body, although some species show a degree of both lateral and dorsoventral compression. The eyes are dorsolateral and the antennae are longer than the head. The labrum is subquadrangular, with a medial notch on the distal margin. Maxillary palpi with 2–3 segments. The lobes of the labium (glossae and paraglossae) are narrow and elongated, with a rounded tip. Labial palpi with three segments. Usually, they have seven (sometimes six) pairs of abdominal gills that can be uni or bilamellar. Cerci only bear setae on their inner margin and they are longer or at least similar in length to the terminal filament (paracercus). They are very similar to Siphonuridae, but they do not have posterior spines on the lateral margins of the last abdominal segments.

Key identification for Tipulidae consists of a Head capsule not well defined, possibly retracted into the thorax; a Spiracular disc with six lobes on the anal region. Tipulidae described by Oscoz (2011) with the first larval instar of Tipulidae species is different from the rest and only described for a few species. Larvae (Fig. 3.20l–n) are hemicephalic, with the head markedly withdrawn into the prothorax. The body is elongated, with eight abdominal segments. The anal segment is frequently truncated and divided into a dorsal spiracular field and an anal ventral field where three to four finger-like papillae are present. They are metaplastic.

CONCLUSIONS

The results of the identification of macrozoobenthos in this study found 4 classes (malacostraca, citellata, gastropoda, and insecta), and are members of 9 orders (decapoda, tricladida, arhynchobdellida, pharyngobdellae odonatan, trichopteran, diptera, plecoptera, ephemeroptera), and 13 families (Parathhelpusidae, Palaemonidae, Tubificidae, Dugesiidae, Erpobdellidae, Thiaridae, Physidae, Gomphidae, Hydropsychidae, Chironomidae, Perlidae, Baetidae, Tipulidae). Substrate types at all stations are large rocks, gravel, and a little sand.

SUGGESTION

More detailed pictures from a more advanced microscope are needed to verify the identification of each macrozoobenthos. Further investigations on each species could help determine the water quality for the upstream area of the Brantas River in the Blitar Regency.

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