

The Study of Dragonfly (Odonata) Diversity as Bioindicator of Water Quality in Science Techno Park Spring-Beleknehe Village

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Abstract: Dragonflies are bioindicator insects for the quality of the aquatic environment, especially springs. This study aims to determine the types of dragonflies that live in the Science Techno Park (STP) spring, Beleknehe village, Nekemese sub-district, Kupang District. STP is owned by Widya Mandiri Catholic University. This research was conducted in September 2022. Data collection consisted of dragonfly samples and abiotic factors. Dragonfly samples were obtained using insect nets and hand sorting, while abiotic factor measurements included physical (Conductivity, TDS) and chemical (hardness, iron, sulfate, Mn, NO₃, NO₂) parameters. The results of the study revealed that there were four types of dragonflies namely *Neurothemis stigmatizans*, *Coenagrion lunulatum*, *Megalagrion* sp., and *Orthetrum pruinosum*. The four dragonflies found showed that the quality of the Science Techno Park spring was still in good condition.

Keywords: bioindicator; dragonfly; spring; science techno park

Introduction

Springs are a vital hydrological element of rivers and have significant ecological value as a habitat with unique and naturally stable environmental conditions, and inhabited by unique fauna (Semiun & Boli Duhan, 2021). Springs are groundwater that appears to the ground and naturally becomes a source of clean water for the community (Semiun et al., 2020). Springs have a role as a habitat for various plants, animals, and microorganisms, one of which is dragonflies (Odonata).

There found in Indonesia are around 750 species (Yudiawati, E., & Oktavia, 2020). This insect has six legs, wings, compound eyes, and an abdomen (stomach) with 8-10 segments (Fitriana, 2016). Dragonflies undergo incomplete metamorphosis consisting of egg, nymph, and imago stages. Dragonfly eggs can be seen attached to plants around the water, while the nymphs always live in the water.

Dragonflies have an important role in maintaining the balance of the food chain in ecosystems (Laily et al., 2018), as predators of

small insects, and as bioindicators in an aquatic environment (Rizal & Hadi, 2015). Dragonfly nymphs will not live in polluted water or rivers where there are no plants (Triyanti & Arisandy, 2021). As indicators, ordonates offers some advantages i.e. provide knowledge of the ecological requirement of a large number of species and their distribution and seasonality, easy to observe and identify, and well dependent on the ecological conditions of the environment.

The study was conducted at the Science Techno Park spring, Widya Mandira Catholic University, Kupang. This spring is still very natural and has not been touched by human activity. Around the spring there are tall trees and other plants that are important in maintaining the existence of water sources around them. This area is still storing good diversity of flora and fauna, starting from low-level plants to high level plants. Many plants grow along the water bodies which adds freshness to the springs. The preliminary study revealed that this spring is far from residential areas with topography under a hill that can receive rainwater flow and be accommodated so

that it forms like a lake near the spring. This study aimed at determining the types of dragonflies found in STP springs, and as initial data for STP development.

Material and Method

Time and location

This study was located in STP spring, Beleknehe Village, Nekamese sub-district, Kupang district (Figure 1). Then, the samples

were identified at Biology laboratory of Widya Mandira Catholic University.

Technique of data collection

The samples were collected by using insect nets and hand sorting (Semiun & Mamulak, 2021). The obtained dragonfly samples were then photographed and put in a labeled sample bottle. Measurement of abiotic factors includes conductivity, TDS, iron, hardness, sulfate, manganese, nitrate, and nitrite.

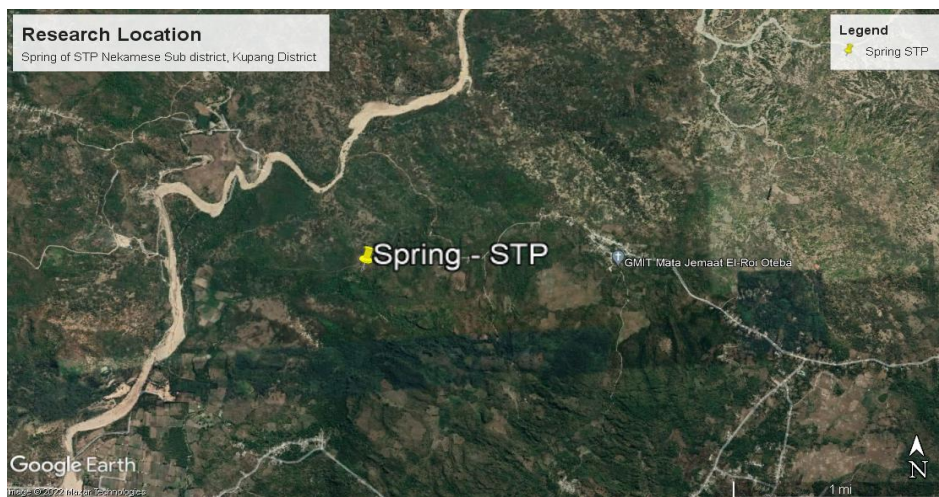


Figure 1. The odonata sampling locations

Dragonfly identification

The samples were identified in Biology Laboratory. The identification process was done by using identification guidance books (Borror *et al.*, 1992; Borror & White, 1970; Siwi, 2006) and internet browsing on the related websites.

Data analysis

The obtained data were the data of types of dragonflies, physics parameter data, and chemistry data of water quality. Those data were analyzed descriptively and presented in pictures and tables.

Results and Discussion

Dragonfly species found on STP spring

The data revealed that there are four types of dragonflies that consist of three families i.e. Libellulidae, Coenagrionidae, and Libelluloidea. The four species are *Neurothemis stigmatizans*,

Coenagrion lunulatum, *Megalagrion* sp., and *Orthetrum pruinosum*. *Neurothemis stigmatizans* species are categorized in Libellulidae family that are generally found in swamp and pond areas. Libellulidae vary greatly in length from 20-75 mm, and many species have wings marked with spots or bands (Borror *et al.*, 1992). Its special feature (Figure 2) is that at the top end of its wings it has a red dot, and a quarter of the wing tips are slightly transparent at the base. It has a blackish-red color. The upper part of the abdomen is dominated by a red heart, and there is a black straight line right in the middle. The classification of *Neurothemis stigmatizans* is presented next.

Kingdom : Animalia
Phylum : Arthropoda
Class : Insekta
Ordo : Odonata
Family : Libellulidae
Genus : Neurothemis
Species : *Neurothemis stigmatizans*



a. Observed data



b. Comparison data

Figure 2. *Neurothemis stigmatizans*

Coenagrion lunulatum is a species from Coenagrionidae family. This species is found in habitats such as lakes, swamps, oligotrophic to mesotrophic ponds, with an acidic to slightly acidic pH. This is in accordance with the pH of the water measured at the location of the spring which is classified as slightly acidic. The pH is acidic because there are mosses and ferns around the springs, as well as fallen plant leaves in the springs. The habitat of this species is adjacent to forests, where there is no or minimal anthropogenic activity. The dominant body color is blue, while the top of the head, thorax, and abdomen are dominated by black (Figure 3). On all four wings, there is a point which is located at the top end. The classification of *Coenagrion lunulatum* is as follows:

Kingdom : Animalia
 Phylum : Arthropoda
 Class : Insekta
 Ordo : Odonata

Family : Coenagrionidae
 Genus : Coenagrion
 Species : *Coenagrion lunulatum*



a. Observed data



b. Observed data

Figure 3. *Coenagrion lunulatum*

Megalagrion sp. belongs to the Coenagrionidae family. Most of the narrow-winged Coenagrionidae family are small and slender with long abdomens. Body colors include red, green, blue, purple, orange, or yellow. They have thin, transparent wings which they hold vertically above the body when at rest. Adult dragonflies are most often found near the ground, perched on rocks, sticks, or low-growing vegetation. The dominant body color of this dragonfly is red, with slightly yellow legs. At the tip of the wing, there is a reddish mark (Figure 4). Classification of *Megalagrion* sp. is as follows:

Kingdom : Animalia
 Phylum : Arthropoda

Class : Insekta
 Ordo : Odonata
 Family : Coenagrionidae
 Genus : Megalagrion
 Species : *Megalagrion* sp.

Ordo : Odonata
 Family : Libelluloidea
 Genus : Orthetrum
 Species : *Orthetrum pruinorum*



a. Observed data



b. Comparison data

Figure 4. *Megalagrion* sp.

Orthetrum pruinorum belongs to the Libelluloidea family. *Orthetrum pruinorum* is usually found at an altitude of 200 -300 m (Janra et al., 2021). However, in this study, it was found at an altitude of 152 m asl. Members of this group are very large in number, many are found around ponds and swamps. This species has an irregular flying habit. From the head to the thorax it is black, and the abdomen is bright red (Figure 5). The classification of *Orthetrum pruinorum* is as follows:

Kingdom : Animalia
 Phylum : Arthropoda
 Class : Insekta



a. Observed data



b. Comparison data

Figure 5. *Orthetrum pruinorum*

STP spring dragonfly status in nature

The status of the STP dragonfly in nature refers to The International Union for Conservation of Nature (IUCN) Red List. The IUCN Red List is a valuable indicator for assessing biodiversity health that provides information on species distribution, population size, habitat, ecology, uses, and threats. The IUCN Red List classifies species into nine categories i.e. Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern, Data Deficient, and Not Evaluated. Species that fall into the Vulnerable, Endangered, and Critically Endangered categories are considered to be endangered species. The four types of dragonflies are classified as Least Concern (Table 1) which indicates stable nature conditions. The location is far from settlements so anthropogenic disturbances are minimal.

Table 1. STP dragonfly species status on the IUCN Red List

NO	Dragonfly Species	IUCN Red List
1	<i>Neurothemis stigmatizans</i>	LC (Least Concern)
2	<i>Coenagrion lunulatum</i>	LC (Least Concern)
3	<i>Megalagrion</i> sp.	-
4	<i>Orthetrum pruinosum</i>	LC (Least Concern)

Water quality of STP spring

This study also collected data on water quality parameters presented in Table 2. Table 2 reveals the water quality in STP springs is still in good condition because it meets the quality standards according to the Minister of Health of the Republic of Indonesia No. 32 of 2017. It also states that the four types of dragonflies found can be used as bio-indicators of good water quality for springs. Odonates are characterized as excellent habitat indicators of present and past

(long-term) environmental conditions in aquatic habitats. As habitat quality changes, odonates also exhibit changes in their diversity and distribution due to their sensitivity to structural habitat quality and these have made them much easy tools in the monitoring and evaluation of habitat quality. Research conducted by (Jacob et al., 2017), revealed types of dragonflies that can be used as bioindicators of water quality. One of which is from the genus *Orthetrum*. This is consistent with the data found in STP springs.

Table 2. Physical and chemical parameters of STP spring water quality

Parameters	Value	Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygienic Purposes (Permenkes RI No 32 of 2017)	Notes
Physics			
Conductivity	488µS	Not required	
TDS (Total Dissolve Solid)	277 mg/L	1.500 mg/L	Meet quality standards
Chemical			
Hardness	304 mg/L	500 mg/L	Meet quality standards
Iron	0,083 mg/L	1,0 mg/L	Meet quality standards
Sulfate	0 mg/L	400 mg/L	Meet quality standards
Mn	0,002 mg/L	0,5 mg/L	Meet quality standards
NO ₃	1 mg/L	10 mg/L	Meet quality standards
NO ₂	3 mg/L	1,0 mg/L	Meet quality standards

Conclusion

Four types of dragonflies were found at STP consisting of *Neurothemis stigmatizans*, *Coenagrion lunulatum*, *Megalagrion* sp., and *Orthetrum pruinosum*. The presence of these dragonflies can be used as a bioindicator of water quality for hygiene and sanitation purposes.

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