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# Short Communication: Diversity of fauna and local wisdom of Somopuro Cave, Pacitan District, East Java, Indonesia

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[2]Program of Biology Education, Universitas Kuningan. Jl. Cut Nyak Dhien No. 36 A, Kuningan 45511, West Java, Indonesia
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**Abstract.** *Sholiqin M, Mahendra AS, Waskito DN, Fathoni MFM, Maheswara VD, Indrawan M, Junaedi E, Setyawan AD. 2024. Short Communication: Diversity of fauna and local wisdom of Somopuro Cave, Pacitan District, East Java, Indonesia. Intl J Trop Drylands 8: 114-125.* Karst is an area that has a remarkable landscape and hydrological pattern that is formed from a combination of rock properties that have a high level of solubility and well-developed secondary porosity. This research aims to determine the diversity of fauna and local wisdom in the Somopuro Cave karst area, Pacitan, East Java, Indonesia. The sampling was conducted in December 2023. The method used was direct observation and interviews regarding animals and the local wisdom of the local people. The fauna sampling technique and local wisdom are combining hand collection with trap method, direct count and in-depth interviews with Somopuro Cave sources. Data analysis used the formulas for the Shannon Wiener diversity, Evenness Index, Dominance Index, Species Richness Index, and local wisdom analysis through interviews with residents. The animal species obtained includes Actinopterygii (*Barbodes binotatus, Poecilia reticulata, Barbonymus gonionotus*, and *Channa striat*a), mammals (*Eonycteris spelaea* and *Limnogonus bonaparte*), crustacea (*Cardisoma carnifex* and *Paneaus merguiensis*), arthropods (*Limnogonus fossarum*, *Phrynus exsul*, and *Diestrammena heinrichi*), Amphibians (*Fejervarya cancrivora*), and Mollusca (*Faunus ater*). The calculation results obtained a Diversity Index value of 1.26 in the medium diversity category, Evenness Index (0.45) in the medium evenness category, Dominance Index (0.44) in the low dominance category, and Species Richness Index (2.46) in the low species richness category. The value of fauna species diversity is still low in the community, and low dominance indicates balanced competition between fauna populations. The local wisdom found in Somopuro Cave is *Tapa Mangsa* which means meditating in a special month and makes the cave considered sacred and mystical. This action aims to gain peace, maintain the surrounding environment, and preserve the ecosystem so that it is not exploited or damaged by humans. The development of the modern era has made the community's analogy towards this belief decline so that currently, there is a lot of use of fauna resources in the cave by the community.

**Keywords:** Culture, environment, karst, species

## INTRODUCTION

Karst is formed from a combination of a special hydrological system against limestone that undergoes a karstification process to form natural features in the form of valleys, hills, caves, and dolines (Wang et al. 2019). Biogeochemical processes in karst ecosystems are both temporally and spatially heterogeneous (Li et al. 2021). The upper part of the karst area allows for a long delay in the flow of rainwater into underground rivers (Goldscheider 2019). The karst ecosystem also acts as a carbon catchment area, capturing twice as much carbon as forests (Widyaningsih 2017). Karst ecosystems regulate the terrestrial carbon cycle and potentially mitigate climate change. However, rocky desertification has emerged as one of the most serious environmental problems in karstic areas because of long-term overexploitation (Tang et al. 2022).

As an ecosystem, karst has various important values that must be preserved, including the biodiversity in karst environments (Haryono et al. 2022). Karst ecosystems are diverse; several terrestrial fauna also live and adapt to karst environments. Examples of terrestrial fauna that can adapt to karst include the Araneae, Coleoptera, and Hymenoptera families (Hongbo et al. 2018). Biodiversity plays an important role in conservation efforts, which karst also contributes to, and karst is the basis for the continuity of biodiversity (Veress 2022). The function of karst can cause the diversity of fauna that live in karst ecosystems as a safe habitat for rare fauna species, as well as limestone, which regulates the water flows, maintaining the endokarst groundwater basin where the womb and life chain of living things are (Konradus 2021). However, the threat of natural greening, urbanization, and unsustainable waste management are significant and affect biodiversity in karst environments (Breg et al. 2018).

Caves are one of the characteristics of subsurface karst, developing when acidic water begins to break down the bedrock near cracks (Zhu et al. 2019). Because caves are characterized by darkness, low to moderate temperatures, high humidity, and limited nutrients, they can be discriminated from land surface substrates. In the absence of sunlight, microorganisms in cave habitats cannot photosynthesize and are forced to rely on alternative primary production strategies to compensate for the lack of an exogenous carbon source (Zang and Chai 2019). Microorganisms are important in nutrient regulation and strengthening karst conservation and restoration (Xiao et al. 2022). Karst ecosystem recovery likely relies on the persistence of soil functions at the microbial scale where soil remains between the exposed rocks (Xue et al. 2020). Populations found in karst areas have received more attention due to the origin and diversification of high biodiversity, which has caused great ecological and evolutionary value and priority of karst areas (Yang et al. 2021).

Extensive research has been conducted on fauna diversity, including in karst ecosystems. Species that can live in karst caves have special characteristics that help them adapt to the existing environment. This is why only adaptable species can survive (Suhendar et al. 2018); fauna with karst cave habitats must have distinctive physical characteristics (Poerwanto et al. 2020). Studies of the causes and impacts of biodiversity differences between communities require appropriate species richness and diversity measurements. These measurements include the number of individuals of a species in a community and are a function of the relative frequencies of different species (Omayio and Mzungu 2019). Research conducted by Salas et al. (2005) showed that the Sangkulirang peninsula in East Kalimantan province is home to high levels of diversity for snails, insects, birds, and bats. Additionally, several new animal species were discovered, including what may be the world's largest cave cockroach (*Blattella asahinai*) and a very small blind crab (*Gandalfus yunohana*). Another karst region in southwest China, one of the largest continuous karsts in the world, is known for its unique landscape and rich biodiversity. However, karst ecosystems are very vulnerable to damage due to human activities (Wang et al. 2019). It's in this delicate balance that human activities, guided by local wisdom, play an important and respectful role in the survival of fauna. Prabowo (2011) explains that local wisdom is a culture or habit of local people that is useful for maintaining the environment, which is implemented in the form of local customs. Good local wisdom will bring life to the environment, and harmful human activities can threaten the life of existing fauna, such as in the Mojokerto area, which has preserved conservation with local wisdom that can protect water sources, flora, and fauna (mahogany, sengon, pine, teak, and fauna such as monkeys, wild dogs, and wild boar (wild boar) can easily be found. (Lestari et al. 2021).

Karst ecosystems, with their unique features, are known for their diverse fauna. This manuscript will specifically explore the diversity of fauna species in the Somopuro Karst cave and the local wisdom of the surrounding community in their efforts to preserve this diversity. Our primary goal is to uncover the extent of fauna diversity in Somopuro Cave and to highlight the local practices that are instrumental in protecting and nurturing the ecosystem. We believe that this research has the potential to not only enhance our understanding of cave ecosystems but also to serve as a valuable tool for identifying and preserving fauna diversity in other caves.

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## MATERIALS AND METHODS

### Study area

The research was conducted in December 2023 at Somopuro Cave, Bungur Village, Tulakan Sub-district, Pacitan District, East Java, Indonesia. The research survey was conducted on 2 December 2023 and sampling at the research location was from 8 to 10 December 2023. Tulakan, Pacitan District, is located between 200 and 700 meters above sea level, approximately 25 km eastern of Pacitan capital district, and is classified as a topography dominated by highlands, karst mountain areas, and lime-stone mountain areas. The geographic coordinates of Somopuro Cave are 8°10'44"S and 111°16'53" E (Figure 1).

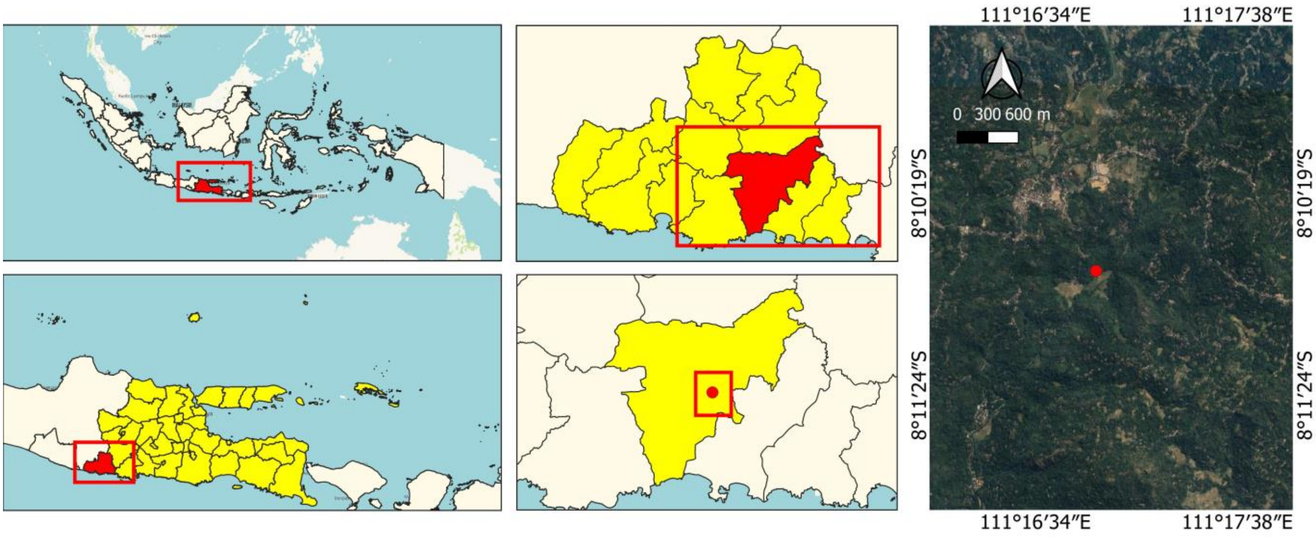


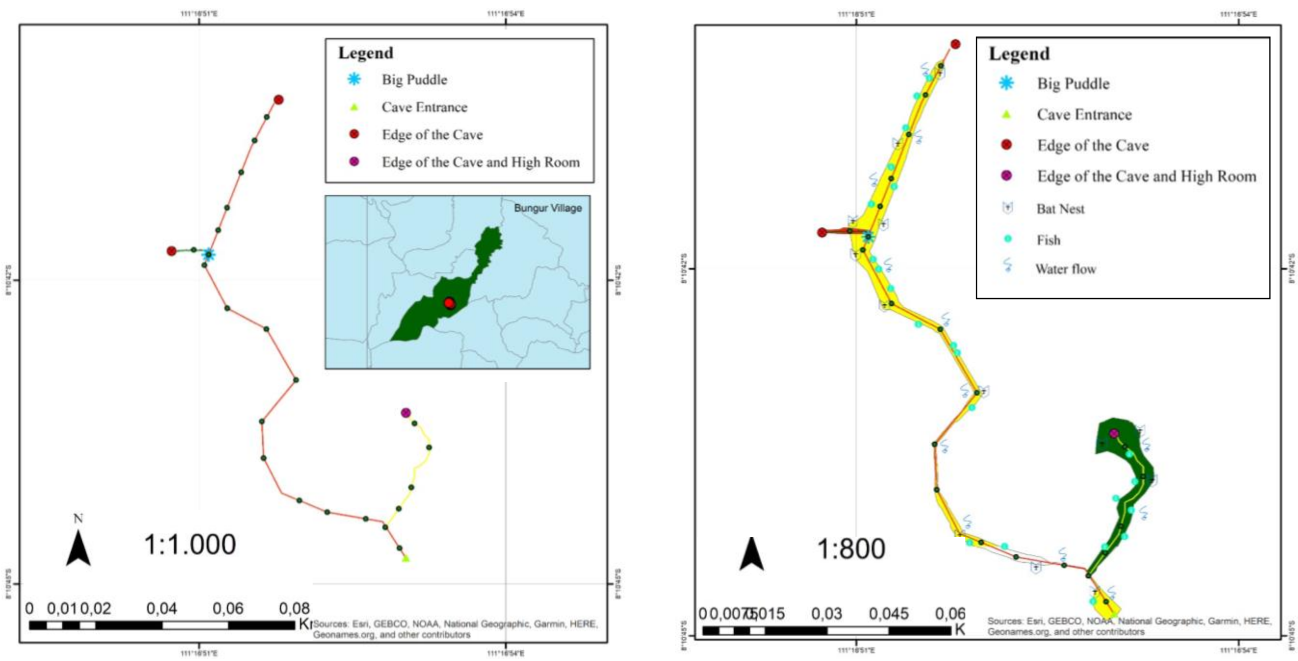

**Figure 1**. Map of Somopuro Cave, Bungur Village, Tulakan Sub-district, Pacitan District, East Java, Indonesia

**Figure 2.** Front gate of Somopuro Cave, Bungur Village, Tulakan, Pacitan District, East Java, Indonesia

Several abiotic, biotic, and cultural factors in Somopuro Cave are always related to form a balanced karst environmental composition. Sompuro Cave is one of the karst natural features whose abiotic factors are in the form of karst hills, air from rivers, and karst springs with relatively sufficient light intensity. Somopuro Cave is a type of elongated horizontal cave (Figure 3.A). The mouth of the cave faces southeast, with a width of 8.34 meters. This cave has two directions of corridors that are divided into two separate parts (Figure 4.B). The left cave corridor has a water source and passes through an underground river and is a habitat for air and land fauna. At the same time, the right corridor has no water source and is usually used by the community for traditional ceremonies. The left corridor system has a length of 184 meters, with the cave walls relatively damp and slippery. In this left corridor system, many stalagmites, stalactites, and fauna are found in it. In addition, there is no light intensity at all in the inside of this corridor. The river flow at the entrance to the left cave corridor has a depth of up to 187 cm, but the flow after it towards the water source is at a depth of 35 - 47 cm. Researchers managed to explore the deepest end of the cave until they found a source of flowing water at the end of the cave, which then flowed into the water body of the Somopuro Cave. Meanwhile, the right corridor is dominated by quite large stalactites and stalagmites, but the distance between the mouth of the cave and the inside reaches 42.6 meters. The fauna found in the right passage is not that much and is usually used by residents for meditation. Local residents meditate on the highest karst rocks towering to the roof of the cave, approximately 7-8 meters. Hence, the position of meditation is quite close to the roof of the Somopuro Cave in the right passage system (Figure 4). In addition, the soil conditions are relatively fertile, resulting in many plants and animals being able to grow and develop around the cave. This potential creates an opportunity for local communities to cultivate their land for agricultural, plantation, and livestock sectors.

**Procedures**

The methods used in the study are descriptive, quantitative, and qualitative. Field data search by means of observation. The sampling technique used is a combination of data collection with trapping methods and direct calculations. Local wisdom information is obtained through interviews with sources or caretakers (*juru kunci*) of Somopuro Cave directly. The interview method used is the In-depth interview technique in order to obtain information from participants and informants that the researcher has determined. Then, the interview was conducted in a semi-structured manner by asking questions about the objects and data needed by the researcher to the informant. The indicator data studied include abiotic factors, aquatic fauna, terrestrial fauna, and local wisdom.




A B

**Figure 3.** Somopuro Cave, Pacitan District, Indonesia. A. Schematic map, B. Corridor system and sampling points

*Environmental factor sampling technique*

Moreover, the data collection on water quality with parameters Total Dissolved Solids (TDS) (ppm), water temperature (°C), Dissolved Oxygen (DO) (%), and pH are calculated using the TDS meter, pH meter, and DO meter. TDS measurements are carried out by dipping the TDS meter into the solution to be measured to a depth of 2-3 cm. The final value can be read quickly, and the number is stable. The TDS and temperature readings are collected from these meters (Wang 2021). pH measurements are carried out by inserting a pH meter into the water in Somopuro Cave. Monitoring water pH is important to determine whether water quality is good or bad. Water with poor quality can have a negative impact on the health of aquatic biotas and cause various diseases (Rahmanto et al. 2020). The DO measurement refers to Uddin et al. (2014). All results are recorded and then compiled for analysis. The pH meter correlates with physical, chemical, and biological water factors to closely relate to water quality (Supriatna et al. 2020). Water quality is important to measure because it can affect life in the area (Astuti 2014).

*Aquatic and terrestrial fauna sampling technique*

The research's specification method combines hand collection with trap methods and direct count (Setiawan et al. 2018). The fauna in Somopuro Cave was captured using trap nets, and then data on numbers was collected (Safitri et al. 2016). Sampling was conducted from 08.00 am to 1.00 pm which was conducted 3 times in 3 days of research. The number of teams involved in this research was 5 researchers and 1 caretaker who accompanied the data collection. Of the 5 people, 1 of them made observations regarding cave conditions and abiotic parameter measurements. At the same time, 4 of them focused on sampling aquatic and land fauna using nets, and each person was equipped with a headlamp. The technique used in this sampling was to combine hand collection with trap and direct count methods, where the fauna found was directly captured, and the number of individuals was counted at that time. The tools used in capturing aquatic fauna species use nets with a width of 25 cm, meshes with holes of 1 and 2 mm accompanied by a 1.5 m pole for the handle, a headlamp as a light when capturing species, a 100 mL sample bottle, and a 108-megapixel cellphone camera. Aquatic and land fauna found directly were captured using nets and documented. Each sample was put into a sample bottle with 4% formaldehyde in water that had been brought for further identification. The search for animals using nets was carried out directly on all river flows in the cave and the bottom, sediment, walls, and ventilation, which were documented with a camera. Complementary data regarding existing fauna and strong local wisdom were obtained by conducting direct interviews with the caretaker of the cave. In addition, collecting data using the exploratory method involves observing or taking samples directly from the observation location (Gunarno 2021).

Identification of aquatic and terrestrial fauna in the Actinopterygii class refers to Kottelat and Whitten (1996) and Tamsil et al. (2021), while the crustacean class refers to Zupo (2022), in the mollusca class using Graham (1988), the amphibian group is identified refer to MEF & IIS (2019), bats group is identified refer to Taylor (2019) and the arthropod group is identified with Thorp (2009).

*Local wisdom sampling technique*

Information regarding the local wisdom of Somopuro Cave was obtained through in-depth interviews directly (using the Focus Discussion Group/FDG scheme) with the five key informants, one of whom is Somopuro Cave's senior caretaker. The other informants had been determined by the researcher as suggested by the head of the community to represent the area used for research. Then, the interview was conducted in a semi-structured manner by asking questions about the objects and data needed. Key informants become a source of information in helping the research process. This FDG is an interview scheme with a model of gathering together and asking questions about Somopuro Cave, both from history, abiotic, biotic, cultural elements, fauna species found, and local wisdom around the cave. This is done using the local language (Javanese) to create a clearer and more communicative language and easier for informants to understand. The interview was conducted at the key informant's house and the cave. Then, the research team recorded and documented all local wisdom information in Somopuro Cave. The results of the interview were identified to be more communicative and analyzed, then published based on the permission given by the informants when the interview was conducted.

**Data analysis**

*Environmental factor analysis (abiotic parameters)*

Water quality parameters, including TDS, temperature, DO, and pH, were tested on the underground river water of Somopuro Cave and then analyzed using the Government Regulation of the Republic of Indonesia Number 22 of 2021 concerning the Implementation of Environmental Protection and Management. The results of river water measurements are compared to these regulations so that their compliance with the applicable river water quality standards in Indonesia can be determined.

*Aquatic and terrestrial fauna analysis*

The Shannon-Wiener formula was used to calculate the diversity index by analyzing the abundance and distribution of species found in Somopuro Cave. According to Jhingran (1989), the formula and value of the Shannon-Wiener diversity index are as follows:

$$H' = -\sum_{i=1}^{s} \left(\frac{ni}{N}\right) ln\left(\frac{ni}{N}\right)$$

Where:
H': Diversity Index Pi: ni/N
ni: Number of species i
N: Total number of individuals
S: Number of all individuals

The categories of the results of the diversity index are as follows:

H'<1: Low diversity

1<H'<3: Medium diversity
H'>3: High diversity

Apart from the diversity index, the Evenness Index is also calculated using the formula made by Shannon-Wiener (Heip 1974):

$$E = \frac{H'}{LnS}$$

Where:
E: Evenness Index
H': Diversity Index
S: Number of all species

Categories from the results of the evenness index (evenness) are as follows:
0<E≤0.4: Low evenness
0.4<E≤0.6: Medium evenness
0.6<E≤1: High evenness

Calculation of the dominance value of the species found is calculated and analyzed using the formula made by Simpson (Zuhry et al. 2020; Merly et al. 2022):

$$C = \sum \left(\frac{ni}{N}\right)^2$$

Where:
C: Dominance Index
ni: Number of individuals of the i-th species in each plot
N: Number of individuals of species i in all plots

The categories of species dominance index results are as follows:

| | |
|---|---|
| C<0.5 | : Low dominance |
| 0.5<C<0.75 | : Moderate dominance |
| 0.75<C<1 | : High dominance |

The species Richness Index is calculated and analyzed using the formula made by Margalef (Latumahina et al. 2020; Mulya et al. 2021):

$$R = \frac{S-1}{Ln\ N}$$

Where:
D: Species Richness Index
S: Number of all species
N: Number of individuals of species i in all plots

The categories of the species richness index results are as follows:
D<2.5: Low species richness
2.5>D>4: Medium species richness
D>4: High species richness

*Local wisdom analysis*

The results of the Somopuro Cave local wisdom interview (through the Focus Discussion Group scheme) by surrounding people were analyzed by abstracting raw information into more general insights (Rachmawati 2007). Then, the data was presented descriptively.

## RESULTS AND DISCUSSION

### Abiotic factor in Somopuro Cave

The water quality parameters checked in Somopuro Cave River, i.e: TDS, temperature, DO, and pH. Based on Table 1, TDS parameter shows 224 ppm or 223.74 mg/L with a range (1,000-2,000 mg/L); the water temperature parameter shows 18.9°C with a range (15-28°C); the Dissolved Oxygen (DO) parameter shows 18% or 1.67 mg/L with a range (1-6 mg/L); and the pH parameter shows 7.02 with a range (6-9). The water quality in Somopuro Cave is then compared with the Government Regulation of the Republic of Indonesia Number 22 of 2021 concerning the Implementation of Environmental Protection and Management. It is known that the quality standards for Somopuro Cave in TDS are included in classes 1-3 with a quality standard limit of 1,000 mg/L. The temperature parameter has a range between 15-28°C or follows a standard deviation of 3. DO class 4 with a minimum quality standard limit of 1 mg/L and a pH acidity level of class 1-4 with a quality standard limit of 6-9.

### Aquatic and terrestrial fauna in Somopuro Cave

The total number of individuals found at the location reached 438 individuals. Some animals that, according to respondents, live in this cave but were not found in this study are *Anguilla celebene*, *Tachysurus fulvidraco*, and *Lutrinae bonaparte*. Specifically, *L. bonaparte* only found its tracks in this study. The presence of animals in Somopuro Cave can be caused by parameter factors such as water quality, which can support species living in the cave (Khatri and Tyagi 2015), as well as human disturbance. No animals were found in the cave due to the community's excessive exploitation that indirectly threatened the species living in it (Veress 2020). These findings underscore the need for further research to understand the dynamics of the cave ecosystem fully.

Table 2 shows the species found in Somopuro Cave which consist of several animal families including Cypirinidae, Poeciliidae, Channaidae, Palaemonidae, Gecaricinidae, Pachychilidae, Dicroglossidae, Vespertilionidae, Rhaphidophoridae, Gerridae, Dicroglossidae, and Phrynidae. This family of animals falls into the categories of actinopterygii, crustaceans, molluscs, amphibians, mammals, and anthropods. Mammals in the form of bats, actinopterygii, crustaceans, and molluscs dominate the presence of animals in Somopuro Cave. Based on the results of the research, the species found in the Actinopterygii class are *Wader* (*Barbodes binotatus*); *Cethol* (*Poecilia reticulata*); *Bader* (*Barbonymus gonionotus*); Snakehead (*Channa striata*), in the Crustacea class are *Jerbung* Shrimp (*Penaeus merguiensis*); Brown Land Crab (*Cardisoma carnifex*), in the Mollusca class are *Sumpil* clam (*Faunus ater*), in the Amphibia class are Field frog and Tadpole (*Fejervarya cancrivora*), in the Mammals class are Bat (*Eonycteris spelaea*), in the Arthropods class are Cave-Cricket (*Diestrammena heinrichi*), Whip Spider (*Phrynus exsul*) and Water Striders (*Limnogonus fossarum*). The highest number of individuals belonged to the *Eonycteris spelaea* species, with 278 individuals, while the fewest species were *Chana striata*, *Cardisoma carnifex*, and *Fejervarya cancrivora*, with only 1 individual found each.

**Accumulation of fauna diversity values in Somopuro Cave**

Based on the results of the fauna research in Somopuro Cave, it was then analyzed using the ecological diversity value consisting of the diversity index, evenness index, dominance index, and species richness index. The diversity index (H') shows a value of 1.26, which indicates the medium species diversity category (Ren et al. 2021). The evenness index (E) shows a value of 0.45, which indicates medium species evenness (Ren et al. 2021). The dominance index (C) shows a value of 0.44, which indicates a low dominance category (Ren et al. 2021). The Species Richness Index (D) shows a value of 2.46, which indicates low species richness (Wahyuningsih et al. 2019). Therefore, various unique species are found in Somopuro Cave because the water parameters mutually support each other species in the cave.

**Table 1.** Water quality parameters in Somopuro Cave

| TDS | | DO | | Temperature | pH |
|---|---|---|---|---|---|
| **(ppm)** | **(mg/L)** | **(%)** | **(mg/L)** | **(°C)** | |
| 224 | 223.74 | 18 | 1.67 | 18.9 | 7.02 |

**Table 3.** Species calculation diversity in Somopuro Cave

| Diversity Index | Evenness Index | Dominance Index | Species Richness Index |
|---|---|---|---|
| 1.26 | 0.45 | 0.44 | 2.46 |

**Table 2.** Fauna species found in Somopuro Cave

| Local name | Family | Scientific name | Category | Total individuals |
|---|---|---|---|---|
| *Wader* (*Ikan Wader*) | Cyprinidae | *Barbodes binotatus* (Valenciennes 1842) | Actinopterygii | 84 |
| *Cethol* (*Ikan Cethol*) | Poeciliidae | *Poecilia reticulata* (Peters 1859) | Actinopterygii | 11 |
| *Bader* (*Ikan Bader*) | Cyprinidae | *Barbonymus gonionotus* (Bleeker 1849) | Actinopterygii | 3 |
| Snakehead (*Ikan Gabus*) | Channidae | *Channa striata* (Bloch 1793) | Actinopterygii | 1 |
| *Jerbung* Shrimp (*Udang Jerbung*) | Palaemonidae | *Penaeus merguiensis* (De Man 1888) | Crustacea | 19 |
| Brown Land Crab (*Kepiting Darat Coklat*) | Gecarcinidae | *Cardisoma carnifex* (Herbst 1796) | Crustacea | 1 |
| *Sumpil* clam (*Kerang Sumpil*) | Pachychilidae | *Faunus ater* (Linnaeus 1758) | Mollusca | 14 |
| Field frog (*Katak Sawah*) | Dicroglossidae | *Fejervarya cancrivora* (Gravenhorst 1829) | Amphibia | 5 |
| Bat (*Kelelawar*) | Vespertilionidae | *Eonycteris spelaea* (Dobson 1871) | Mammals | 278 |
| Cave-Cricket (*Jangkrik Gua*) | Rhaphidophoridae | *Diestrammena heinrichi* (Ramme 1943) | Arthropods | 9 |
| Water Striders (*Anggang- Anggang Air*) | Gerridae | *Limnogonus fossarum* (Fabricius 1775) | Arthropods | 10 |
| Tadpole (*Kecebong*) | Dicroglossidae | *Fejervarya cancrivora* (Gravenhorst 1829) | Amphibians | 1 |
| Whip Spider (*Laba-Laba Cambuk*) | Phrynidae | *Phrynus exsul* (Harvey 2022) | Arthropods | 2 |
| Totals | | | | 438 |

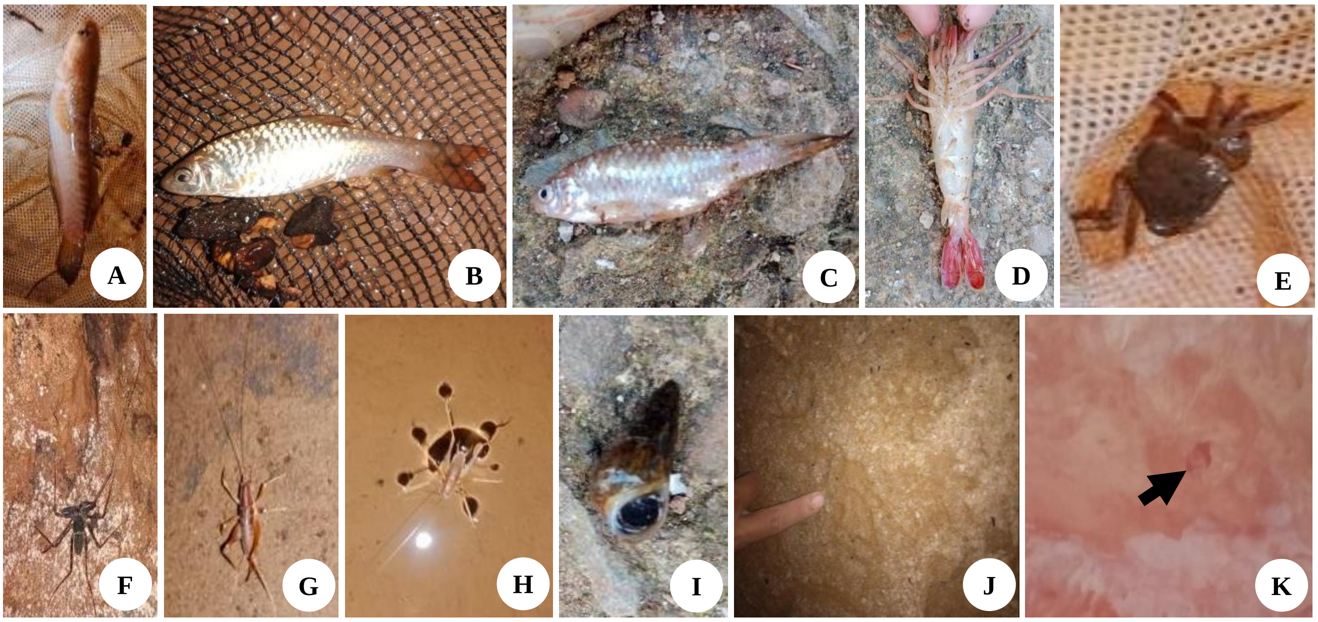



**Figure 5.** Some documentation of animals found in Somopuro Cave, Pacitan District, Indonesia. A. Snakehead (*C. striata*), B. Bader Fish (*B. gonionotus*), C. Wader Fish (*B. binotatus*), D. Jerbung Shrimp (*P. merguiensis*), E. Brown Land Crab (*C. carnifex*), F. Whip Spider (*P. exsul*), G. Cave-Cricket (*D. heinrichi*), H. Water Striders (*L. fossarum*), I. Sumpil Clam (*F. ater*), J. Otter Tracks (*L. bonaparte*), K. Bat (*E. spelaea*)

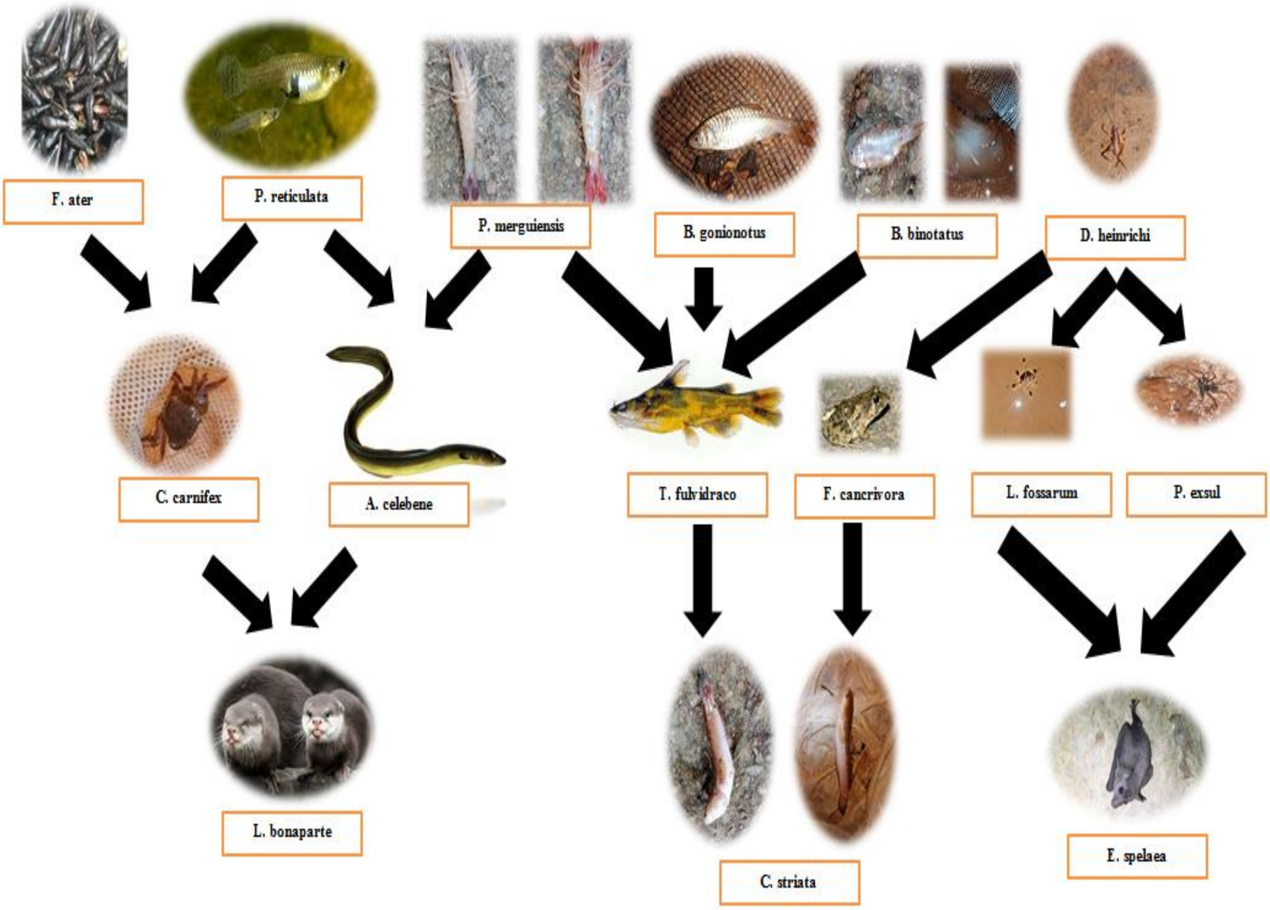



**Figure 6.** The composition of the aquatic and terrestrial fauna food chain in Somopuro Cave, Pacitan District, Indonesia

## Discussion

*Karst Somopuro Cave in Pacitan*

Karst is the result of the weathering process of limestone material from the activity of groundwater flows in the Earth so that over a long period, up to millions of years, large holes were created (Goldscheider et al. 2020). The dissolution process is called true karst (Singh et al. 2020). The similar ecosystems formed by lava flows are called pseudokarst (Wood et al. 2023). Somopuro Cave is a type of horizontal cave that has a river flowing in it. This cave describes two directions at once, as seen in Figure 4. The left cave passage, or the one with the water source and passed by the underground river flow, is a place for aquatic and land fauna to live. While the right passage does not have a water source and is usually used by the community for traditional ceremonies and only a few terrestrial faunas are found at this point, when the research was carried out, animal footprints were also found, such as *L. bonaparte*. According to Veress (2020), karst is a form of the Earth's surface with closed features and caves. Somopuro Cave is formed from karst rock type material, carbonate rock type from the dissolution process. On the other hand, the Somopuro Cave ecosystem is muddy; there are lots of small rocks, slippery rocks, rivers, and dark and no light entering the cave. Somopuro Cave is used as a habitat for several animals, especially bats. Similar research by Sasmito et al. (2019) states that the bats use the cave as their nest. Somopuro Cave has an underground river; part of Tikung River flows upstream to downstream of Gede River. Somopuro Cave has two common types of mineral formations, i.e., stalactites with a pointed shape, such as ice on the cave ceiling, and stalagmites rising from the cave floor. Karst material has a health benefit for making toothpaste because it contains calcium carbonate (Solang et al. 2021). Apart from the types of rocks such as limestone and dolomite stone, 13 species were found in Somopuro Cave, and 3 additional species were obtained from interviews with local people. Of the many animal species in Somopuro Cave, there are not too many except for *wader* fish (*B. binotatus*), *jerbung* shrimp (*P. merguiensis*), *sumpil* clam (*F. ater*), *cethol* fish (*P. reticulata*),, and bats (*E. spelaea*). Animals can adapt quickly to new environments, with minimal genetic diversity, as in cave environments (Carneiro and Lyko 2020); therefore, their color is white because they are not exposed to sunlight from the outside. Research by Straka et al. (2020) states that the color change in animals when they are inside the cave and outside is due to exposure to reflected light from the sun or lighting. In the cave, a flow path is directly connected to an underground river, and they experience differences with animals outside the cave. The water inside the cave will increase, leaving traces of water flowing on the cave floor and seeping into the walls while raining. Various animal species were raised when the water increased due to the absorption process from tree roots, and they entered the various holes of Somopuro Cave. The form of the food chain in Somopuro Cave is *wader* fish (*B. binotatus*), *jerbung* shrimp (*P. merguiensis*), *sumpil* clam (*F. ater*), *cethol* fish (*P. reticulata*), tadpole (*F. cancrivora*), Cave-Cricket (*D. heinrichi*) and *bader* fish (*B. gonionotus*). There are many predatory levels as follow: (level I producer) → yellow catfish (*T. fulvidraco*), field frog (*F. cancrivora*), brown land crab (*C. carnifex*), *Sidat* fish (*A. celebene*), water striders (*L. fossarum*) and bats (*E. spelaea*) (level II producer) → snakehead fish (*C. striata*), otter (*L. bonaparte*) and Whip Spiders (*P. exsul*) (level 1 predator). Predators such as snakehead fish are dangerous for other animals because they are carnivores, so the existing animals' birth rate will be drastically reduced to their juveniles (Rahayu et al. 2021). Even so, Somopuro Cave is a place whose ecosystem is still preserved due to the local wisdom of the local community.

*Abiotic factors found in the underground river of Somopuro Cave Pacitan*

The underground river in Somopuro Cave is the outlet river leading downstream (Septiasari et al. 2021), formed from springs, water droplets from cave rocks, and upstream of the river. The streams connect with the Tikung River to the downstream Gede River. In the middle of Somopuro Cave, a branching river leads to villages and agricultural land. The water quality of the underground river in Somopuro Cave has a Total Dissolved Solid (TDS) parameter of 224 ppm or 223.74 mg/L, a water temperature of 18.9°C, the Dissolved Oxygen (DO) content is 18% or 1.67 mg/L, and the pH acidity level is 7.02 (Table 1). Somopuro Cave materials such as limestone and dolomite stone possibly pollute the water quality because limestone contains iron, manganese, magnesium, and lead, while dolomite is a carbonate of calcium and magnesium (Lamare and Singh 2016); if the water contains a lot of calcium and magnesium, it will impact negatively on health if drunk (Bouderbala 2017) and also animal feces can risk contaminating the water quality and introducing pathogens (White et al. 2016). Comparison of data on the water quality of the Somopuro Cave underground river with river water quality standards based on Government Regulation of the Republic of Indonesia Number 22 of 2021, it is known that the river water quality standard limits that follow the data are TDS including class 1-3 with a quality standard limit of 1000 mg/L. The mixing of rainwater also influences the high TDS value in the Somopuro Cave river water. This is because the research was conducted during the rainy season. So the results will affect the high and low TDS values, DO including class 4 with a minimum quality standard limit of 1 mg/L, and pH acidity levels are class 1-4 with a quality standard limit of 6-9. The underground river water of Somopuro Cave has the characteristics of lower water temperatures due to the lack of sunlight and its location in the highlands; low DO is influenced by calm water currents, low levels of aquatic plants, and relatively high levels of aquatic animals; water pH is influenced by water temperature and dissolved oxygen levels in the water (Khatri and Tyagi 2015), while TDS is influenced by runoff from the soil, rock weathering, and anthropogenic influences (Rinawati et al. 2016). The advantage of Somopuro Cave's underground river compared to ordinary river water is that it is able to accommodate groundwater and store rainwater; limestone correlates with small to medium continuity of underground water and limited availability of underground water; slow underground water flows can store water reservoirs for three to four months after the rainy season (Aprilia et al. 2021). The absence of sunlight results in no evaporation of the water, as well as providing a habitat for unique living creatures to live. Apart from that, the water quality of the underground river at Somopuro Cave is clear. Still, suspended solids such as sediment, sand, clay, and mud are in large quantities and large masses in river beds. Similar Research by Piccini et al. (2019) showed that Apuan Alps Karst Aquifers had suspended solids like fine sands and mud.

*Diversity of aquatic and terrestrial fauna*

The results of identifying the types of animals found in Somopuro Cave have significant implications for our understanding of biodiversity and cave ecosystems. The findings are divided into 5 groups: Actinopterygii, Mammals, Crustaceans, Arthropods, Amphibians, and Molluscs (Table 2). In the Actinopterygii class, it is known that there are *wader* fish (*B. binotatus*), *cethol* fish (*P. reticulata*), *bader* fish (*B. gonionotus*), snakehead fish (*C. striata*), eel fish (*A. celebene*), yellow catfish (*T. fulvidraco*). Types of crustaceans are brown land crabs (*C. carnifex*) and *jerbung* shrimp (*P. merguiensis*). Animals belonging to the Arthropod class in Somopuro Cave are Water Striders (*L. fossarum*), Whip Spiders (*P. exsul*), and Cave Crickets (*D. heinrichi*). Amphibians are animals that can live in water and on land. The animal class found was frogs (*F. cancrivora*). Mammals are all animals that suckle (Francis 2019). These mammals are bats (*E. spelaea*) and otters (*L. bonaparte*). Mollusks are soft-bodied, non-segmented animals; their bodies consist of muscular legs, a head, a visceral mass containing organ systems, and a fleshy mantle that secretes a calcareous shell (Pyron and Kenneth 2015). The class of mollusks found in Somopuro Cave are *sumpil* clams (*F. ater*). These species also have an important role in freshwater quality because they are often used as bioindicators of water pollution so that pollutant substances enter and automatic changes in water quality occur (Lige et al. 2022). According to research by Xu et al. (2021), animals that live in caves and then are consumed will risk developing diseases in their bodies due to gene differences between animals inside and outside the cave. Genetic changes in several animal birth rates are smaller in the living habitat in a cave. Species in Somopuro Cave experience changes in body color when exposed to light because the sensory nerves in their bodies respond to receiving light (Souto-Neto et al. 2023). According to research by Kurniawati et al. (2022), the habitat of various animals in the cave has an average temperature parameter of 18-38°C and a pH of 7.

*The diversity index of aquatic and terrestrial fauna*

The research results of Ren et al. (2021) show that the calculation of the diversity index ranges from 1.03 to 2.13, which is included in the medium species diversity category. On the other hand, various species are also found in it. The large number of species that live in caves can be due to environmental quality parameters that are still supportive. The analyses of the results of diversity calculations using the Shannon-Wiener formula show 16 total animal species and 6 classes, including Actinopterygii, Mammals, Crustaceans, Arthropods, Amphibians, and Mollusca. The most dominant animals are bats, with 278 species (Table 3). However, there are *B. binotatu*s (84), P. *reticulata* (11), *B. gonionotus* (3), C. *striata* (1), *P. merguiensi*s (19), *C. carnifex* (1), *F. ate*r (14), *D. heinrich*i (9), *L. fossaru*m (10), *F. cancrivor*a (5), *P. exsul* (2) and *F. cancrivora* (1). Animal species that were not found include *A. celebene*, *T. fulvidraco*, and *L. bonaparte*. *E. spelaea* is often found in Somopuro Cave because it has become its habitat. *A. celebene* and *T. fulvidraco* were discovered through interviews with local people who had caught the animal. *L. bonaparte* is known through footprints on the cave floor in muddy conditions during the research. But, in calculating the diversity index value, it is not included quantitatively. The H' value is a diversity index value to determine the high level of diversity of a species in the area to be studied. The diversity index obtained from Somopuro Cave included moderate diversity with a value of 1.26 (Table 3). There is moderate diversity in Somopuro Cave because it was once used as a tourist attraction by the local community, so over time, when it was no longer a tourist attraction, various animal species entered Somopuro Cave. According to research by Syukri et al. (2018), animals' movement into caves was due to places that were no longer used, such as tourist attractions, and were far from human activity. Compared to Ren et al. (2021), the Somopuro Cave ecosystem is still relatively good and well-maintained.

The evenness index (E) is the composition of the mixture of each species contained in one community. The calculation results show that the evenness index in Somopuro Cave is 0.45, categorized into medium evenness (Table 3). Therefore, compared to Ren et al. (2021), the average value per cave is 0.42 to 0.77 and is included in the medium and high categories; these values still have similarities with the results of the evenness calculation values in Somopuro Cave. The balance of species distribution in a community can be determined through the results of the evenness index so that the results will be inversely proportional to the results of the diversity index (Sirait et al. 2018). However, the diversity index and evenness index values in Somopuro Cave tend to be moderate because there are several species whose existence is threatened due to human hunting. Interviews with local people show that some of the animals that are often hunted are *D. heinrichi*, *G. bimaculatus*, *B. binotatu*s, *T. fulvidraco*, *A. celebene*, *P. merguiensi*s, *P. reticulata*, and *B. gonionotus*. Therefore, several animal species were not found or had been hunted during data collection. The results of this analysis, compared by Ren et al. (2021), show that the evenness index is medium in Somopuro Cave when the ecosystem conditions are quite good, and the distribution of individuals of each species is relatively even. Therefore, the high or low evenness index results are more influenced by physicochemical and biological parameters, including temperature, pH, and dissolved oxygen. Species behavior also influences things such as adaptation to environmental conditions.

The results of calculating species dominance using the Simpson formula there are 16 animal species, with 5 species from the most individuals, i.e., *E. spelaea* with 278 individuals, *B. binotatu*s with 84 individuals, *P. merguiensi*s with 19 individuals, *F. ater* with 14 individuals, and *P. reticulata* with 11 individuals. Based on individual data, it can be known that *E. spelaea* has a very high number of 278 individuals, followed by *B. binotatus*, which has 84 individuals. However, the dominance of species in an ecosystem can be determined after calculating the dominance index using the Simpson formula. Based on Table 3, it is known that the dominance index (C) value is 0.44. The dominance level influences competition between species that depend on the same ecological and management principles (Adeux et al. 2019). The dominance level in Somopuro Cave between species is low to maintain ecosystem balance. Similar research by Núñez-Novas et al. (2016) about studying Simpson's species dominance index at some caves during the wet and dry seasons showed that the total species dominance index in the rainy and dry seasons in Honda de Julián is 0.27, La Chepa is 0.26, Los Patos 0.41, and Pomier #4 is 0.36 which are all in the low dominance category.

Species richness often focuses on the quantity of animal species in a community, so the quantity in the field will determine the size of the richness index (Baderan et al. 2021). The species richness index is carried out by dividing the number of species by their natural function, where the number of species is inversely proportional to the increase in the number of individuals. The results of calculating the richness of animal species using the Margalef formula showed that there were 16 animal species, with the total number of animal species found in Somopuro Cave being 438 individuals. Table 3 shows that the species richness index (R) value is 2.46. Indicating a low species richness category. Based on this statement, a low species richness index indicates a low number of species in the community (Wahyuningsih et al. 2019). Comparing the species richness by Cardoso et al. (2020) shows that the results are high because environmental conditions are mutually supportive, and there is still no interference from outside. However, in Somopuro Cave, species richness is low because, when conducting interviews with local people, it was once a tourist spot for residents; after it was abandoned, new species entered Somopuro Cave, affecting their richness.

*Local wisdom of value*

Somopuro Cave in Tulakan Village, Pacitan, has the potency of historical, cultural, and local wisdom. According to Nurbaiti (2021), there are four versions of the Somopuro Cave story, including one like the one we got when interviewing the caretaker, that during the Dutch era around 1830 (after Java/Diponegoro War), Somopuro Cave was a place used to hide from Dutch pursuit. It is also told that Somo Adipuro, a descendant of royalty from Yogyakarta, the Islamic Mataram Kingdom, discovered the cave. Somo Adipuro fled from Dutch pursuit and then found a cave, which is now called Goa Somopuro, to hide and meditate in the cave for years. After leaving the cave, Somo Adipuro mingled with the community around the cave, namely Tulakan Village, and taught knowledge, including how to grow crops; therefore, the main local community's livelihood is farming and gardening. Then, the name Somopuro Cave was given to the cave discovered by Somo Adipuro because of the people around the cave's respect for Somo Adipuro (then summarized into Somo Puro or Somopuro). Until now, some people in the Somopuro Cave area believe in ancient traditions, namely carrying out the ritual of "*penance*" in Somopuro Cave.

According to Prabowo (2011), Javanese society at large gets to know the related attitudes of life with initiation in the form of asceticism. In the interview, the caretaker of Somopuro Cave informed that there is no rain while it is being used for meditation. Apart from *penance*, people usually do "*tapa mangsa*," which means meditating in a particular month (the sacred month, *Suro*, the first month of the Javanese calendar) to achieve their desired goals, called asceticism. This act of *'tapa mangsa'* is usually carried out within 40 days and 40 nights or, in most Javanese, called "*ngebleng*," meditating without lighting or crowds and eating in moderation. In this hermitage, a meditating person performs acts of worship to God, which they believe are a form of concern for a servant. A hermit will pray to remain peaceful for all their wishes, individual wishes, life, and the environment. Therefore, because of the local community's beliefs regarding Somopuro Cave, many people who enter the cave are more ethical and careful in their behavior. This is evidenced by the order from the caretaker, who requires every visitor who enters the cave to be prayed for and permitted by the caretaker first and is strictly prohibited from speaking badly and causing damage in Somopuro Cave. It has the same goal as conservation efforts in the karst environment in Somopuro Cave, namely to maintain the ecosystem and biodiversity found there. It is related to the local wisdom of Somopuro Cave. However, many local people still engage in these ascetic activities and think that they are normal. Therefore, many residents freely access the cave and utilize resources such as fish, shrimp, and other animals. The advancement of the times and the way people think logically about their respective religions have led to a decline in people's beliefs in local wisdom. This has caused the implementation of local wisdom to shift and has had an impact on the community being freer to explore and utilize the wealth of food sources in Somopuro Cave.

Furthermore, the existence of the Somopuro Cave-dwelling species is decreasing due to community activities that utilize these resources for food needs. It is indicated by the decline in species richness in the underground river of Somopuro Cave. People's habit of too many taking fauna from the cave freely has resulted in a decrease in the fauna. There are no special rules for residents not to exploit the cave's fish, shrimp, and other fauna. The local wisdom applied above will only limit the movement of people outside the area to exploit the Somopuro Cave but not inhibit the local people's activities. Steps that can be taken to increase the richness of species and diversity of fauna in the Somopuro Cave environment include providing a special ban on excessive exploitation of fauna in the cave, making the fauna of Somopuro Cave a local icon that is prohibited from being hunted, working with the relevant government to make this location a conservation site so that it is better managed, and there is continuous monitoring from both the caretaker, the community and the local government to keep Somopuro Cave sustainable and rich in the diversity of its fauna species.

In conclusion, the fauna found in Somopuro Cave consists of 13 species with as many individuals as possible of 438. The results of identifying animal species found in Somopuro Cave are divided into 6 groups, i.e., actinopterygii, mammals, crustaceans, arthropods, amphibians, and mollusca. The diversity index in Somopuro Cave is 1.26, which is included in the medium diversity. The evenness index (E) in Somopuro Cave is 0.45, which, according to the criteria, indicates medium. This dominance index (C) in Somopuro Cave is 0.44, which, according to the criteria, indicates low dominance). Furthermore, the diversity index for species richness (D) in Somopuro Cave is 2.46, which is in the category of low species richness. Based on these results, it can be concluded that a low level of dominance between species indicates that ecosystem balance is maintained. Apart from that, a low species richness index also indicates that the number of species in the community tends to be low. Many parameters cause this, such as local wisdom carried out by the surrounding community starting to decrease. The decreasing *tapa mangsa* or *ngebleng* culture is also an indicator that causes many residents to access the cave and freely carry out activities to exploit the resources within it. The low species richness is because there is no special prohibition for local people to take fish and shrimp in the cave so that the community can exploit the wealth of fish in the cave. Public trust in Somopuro Cave has the potential to increase visitor ethics and caution, supporting the goals of ecosystem and biodiversity conservation goals.

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