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Biocultural diversity in the Javanese *gunungan wayang kulit purwo* and its role in biodiversity conservation

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Abstract. *Fahrudin D, Suciati, Indriyanti NY, Muzzazinah. 2026. Biocultural diversity in the Javanese* gunungan wayang kulit purwo *and its role in biodiversity conservation. Asian J Ethnobiol 9 (1): y090119. https://doi.org/10.13057/asianjethnobiol/y090119.* Biocultural diversity bridges biological diversity and cultural diversity. The *gunungan wayang kulit purwo*, a Javanese culture in Java, Indonesia, can encode conservation values that can be an alternative way to biodiversity conservation. This study aims to analyze biocultural diversity and conservation values reflected in *gunungan wayang kulit purwo*. This study uses a qualitative approach through ethnographic methods and symbolic interpretation in anthropology. Data collection was conducted through semi-structured interviews, literature reviews, and content analysis, which were then analyzed using spiral analysis followed by triangulation for data validation. Informants were selected through purposive sampling, including a puppeteer (*dalang*), a Javanese scholar, a *gunungan wayang kulit puwo puppet* maker, and a biodiversity expert. The results of the study show that the *gunungan wayang kulit purwo* depicts the biocultural diversity of Javanese society both structurally and symbolically. The *gunungan wayang kulit purwo* contains three abiotic components (soil, air, and *joglo* house) and 14 biotic species: two flora (*Ficus* sp., grass) and twelve fauna (*Pavo muticus*, *Gallus varius*, Sciuridae, *Nisaetus bartelsi*, *Malayopython reticulatus*, *Rhyticeros undulatus*, *Macaca fascicularis*, *Bos javanicus*, *Panthera tigris sondaica*, *Rattus argentiventer*, *Tor tambroides*, and *Rhyothemis* sp.). This representation symbolizes the preservation of biodiversity through the depiction of key species and ecological concepts such as food chains, food webs, keystone species, and seed dispersal. This study concludes that the *gunungan wayang kulit purwo* embodies systematically structured biodiversity symbols with ecological conservation meanings, affirming its role as a biocultural resource for learning and cultural preservation.

Keywords: Biocultural diversity, biodiversity conservation, ethnography method, *gunungan wayang kulit purwo,* Javanese culture

INTRODUCTION

Environmental degradation, species extinction, and erosion of local culture are two major problems faced in the modern world (Ulicsni et al. 2019; Taylor et al. 2024). Excessive exploitation of natural resources without consideration for environmental balance accelerates ecosystem degradation and species extinction (Lampert 2019). So far, research and conservation actions have been direct, such as species preservation, ecosystem restoration, and protected area management (Benayas et al. 2009; Gatti 2025). Javanese culture in Java, Indonesia, is rich in meaning and symbols that reflect harmony and balance with nature, and can be an alternative solution to the problem of biodiversity loss, and protected area conservation (Mukarromah et al. 2024; Septhia et al. 2024).

Biocultural diversity is a concept that bridges the realms of biological diversity and cultural diversity. This concept recognizes that the loss of biological diversity often coincides with the erosion of traditional knowledge, language, and cultural expression, especially in indigenous and local communities (Maffi 2005; Pretty et al. 2009). The disclosure of cultural symbols that combine elements of biodiversity, such as flora and fauna embedded in traditional artifacts, rituals, or visual arts, not only helps restore intangible heritage but also raises ecological awareness and biodiversity conservation (Essien et al. 2025). This dual implication offers a strategic entry point for raising awareness about biodiversity conservation and cultural preservation.

The *gunungan wayang kulit purwo* is one of the traditional artifacts that has important visual elements in shadow puppet performances. The *gunungan wayang kulit purwo* serves as a symbol of time in shadow puppet performances. The visual structure of the *gunungan wayang kulit purwo* consists of several elements that depict the universe, forests, mountains, and the creatures that live in them (Bridgewater and Rotherham 2019). Based on the contents of these elements, the *gunungan wayang kulit purwo* serves as a symbol of lightning, fire, and water in wayang kulit performances. The *gunungan wayang kulit purwo* is made by *wayang* makers or *tukang sungging*, who sometimes have several versions of different shapes and symbols, but there are still certain rules or regulations. The richness of biodiversity symbols found in the *gunungan wayang kulit purwo* has the potential to serve as a symbol

of biocultural diversity-based biodiversity conservation. In addition to its noble values, the meaning revealed can become a message of conservation for the biodiversity found in the *gunungan wayang kulit purwo*.

Several studies related to *gunungan wayang kulit purwo* have been conducted from various scientific perspectives. In the field of education, Junaidi et al. (2024) developed puppet shadow-based learning media to instill character education in elementary school students, demonstrating the potential of this cultural symbol as a powerful educational tool. Meanwhile, Sunyoto and Angge (2016) explored the use of *gunungan wayang kulit purwo* motifs in jewelry design, showing how traditional symbols can be adapted in the context of modern applied arts as a form of cultural revitalization. An in-depth study by Pramana et al. (2007) highlights Sufi values in the visuals of the *gunungan wayang kulit purwo* Surakarta style, including the spiritual and ecological interpretations attached to the *gunungan* element. From an ethnobiological perspective, two studies analyze the relationship between puppetry and ethnobiology. First, Muhajirin (2015) examined the symbolic transformation of *gunungan wayang kulit purwo*, which developed from the concept of the tree of life or *Kalpataru* in Javanese Hindu culture into *kayon* in *wayang kulit* performances. This study emphasizes the shift in symbolic meaning along with the process of cultural acculturation and the importance of preserving the cosmological values contained therein. Second, Fahrudin et al. (2023) placed the *gunungan wayang kulit purwo* in the context of science education by mapping the environmental conservation messages contained therein and proposing it as an interdisciplinary learning medium in the science curriculum.

Based on previous studies, the symbolic and artistic aspects of *gunungan wayang kulit purwo* have been widely discussed. However, the biodiversity symbols and geometric structures represented in its visual composition and their ecological interpretations have not been systematically analyzed from an ethnobiological perspective. This study contributes to ethnobiological research by systematically mapping biodiversity symbols embedded in the *gunungan wayang kulit purwo* and interpreting their ecological conservation meanings. The findings provide insights for interdisciplinary studies in cultural arts, design, ethnobiology, and biodiversity conservation, highlighting that the *gunungan* is not only an aesthetic cultural artifact but also a symbolic representation of biodiversity and ecological values embedded in Javanese cultural knowledge.

MATERIALS AND METHODS

Study area

This research was conducted from February 2024 to July 2025, in five different locations in Central Java and Yogyakarta, Indonesia (Figure 1). The research locations in Central Java, include: (i) Radya Pustaka Museum/A1, (ii) Pusat Unggulan Iptek (PUI) Javanologi Universitas Sebelas Maret (UNS)/A2, (iii) Museum Wayang Indonesia, Wonogiri/A3, and (iv) Animal Taxonomy Laboratory - Building D11 Faculty of Mathematics and Natural Sciences Universitas Negeri Semarang (UNNES)/B. Then, (v) Sonobudoyo Museum Unit II/C1 in Yogyakarta. The first location, PUI Javanologi UNS, has developed into an institute engaged in Javanese Cultural, Language, and Literary Studies. This location was chosen because it supports information on the development and intensity of studies on Javanese culture. The informant from this location is a puppeteer who is an expert in Javanese culture. The second location was the Radya Pustaka Museum. The informant from this location was a philologist who was an expert in ancient manuscripts related to *gunungan wayang kulit purwo*. The third location was the Museum Wayang Indonesia. At this location, there were *gunungan wayang kulit purwo* that were different from the collection at the Radya Pustaka Museum, so confirmation or comparison could be made. The fourth location was the Animal Taxonomy Laboratory at UNNES, where an analysis of *gunungan wayang kulit purwo* symbols was conducted together with an informant, a professor who is an expert in biodiversity and fauna conservation in Central Java. The fifth location was the Museum Sonobudoyo Unit 2. At this location, no informants were interviewed, but only a comparison of *gunungan wayang kulit purwo* from the two previous museums was conducted.

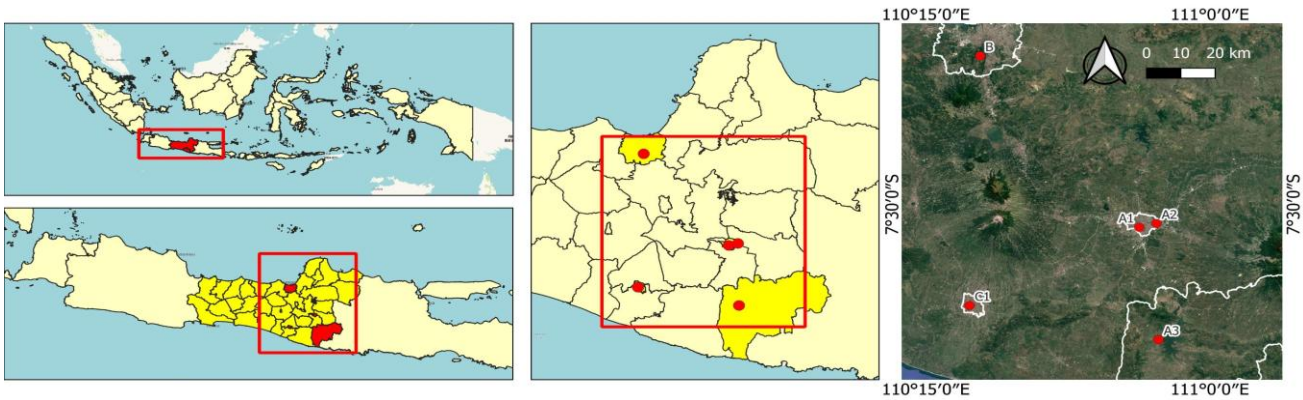

Figure 1. Map of research locations in Central Java (A1-A3 and B) and Yogyakarta (C1), Indonesia. A1 (-7.56844, 110.81445), A2 (-7.55717, 110.8598), A3 (-7.9074, 110.86532, B (-7.05148, 110.39417), C1 (-7.80446, 110.3661)

Data collection

Data collection was conducted using a multi-source ethnographic method, including observation, traditional and academic literature studies, and interviews. Observations were conducted at three locations: Museum Sonobudoyo in Yogyakarta, Museum Wayang Indonesia Wonogiri, Central Java and Museum Radya Pustaka in Surakarta, Central Java. In-depth visual observations were made on the structure, shape, and ornaments of *gunungan wayang kulit purwo*, and the data produced consisted of symbolic elements such as trees, animals, and geometric structures of *gunungan wayang kulit purwo.* The researchers observed all symbols of the *gunungan* and selected those that represented biodiversity symbols that were different from the others. The observation was stopped when no new biodiversity symbols were found (de Medeiros et al. 2008; Coe and Gaoue 2020).

Traditional and academic literature studies include analysis of journals related to *gunungan wayang kulit purwo* and videos of puppeteers discussing *gunungan* uploaded to YouTube. The data obtained consists of the initial symbolic meaning and geometric structures meaning of *gunungan wayang kulit purwo,* as well as information on the involvement of community data in mapping the relationship between culture and the meaning of biodiversity and ecology (Otamendi-Urroz et al. 2025).

Interviews were conducted with five informants using semi-structured interview techniques. This technique is in line with ethnographic practices that emphasize the importance of local narrators' perspectives in understanding cultural diversity (Gilmore and Young 2012). Research informants were selected using purposive sampling. The five informants were chosen to represent key knowledge holders from different domains related to *wayang* culture and biodiversity, enabling this study to examine the *gunungan wayang kulit purwo* from complementary perspectives on its cultural function, symbolic meanings, and ecological interpretations. Researchers determined the criteria for informants. Biodiversity experts were selected based on the following criteria: (i) lecturers in the field of biodiversity, (ii) 10 years of experience in biodiversity research, and (iii) holding the title of Professor in the field of biodiversity. Javanology experts with the following criteria: (i) working in a Javanology institution, (ii) holding a master's degree, (iii) researchers and lecturers in the field of Javanology with ten years of experience. *Dalang* with the following criteria: (i) holding a bachelor's degree in Javanese cultural studies or *dalang*, (ii) having 10 years of experience as a *dalang*. Puppet maker with the following criteria: 15 years of experience as a puppet maker. Philologist with the following criteria: (i) holding a bachelor's degree, (ii) working in a museum, (iii) having 20 years of experience. All informants participated voluntarily and gave their consent prior to the interview.

Data analysis

All data were analyzed using spiral analysis (Creswell and Poth 2018), which applies interactive and holistic interpretation of qualitative ethnobiological data. All data, including field notes, interview transcripts, photographs of *gunungan wayang kulit purwo*, and literature citations, were compiled and organized using ATLAS.ti 25 software. Each source was tagged based on type (artifact, oral, textual) and origin (museum site or informant). The analysis process used four recursive phases, namely open coding (initial coding), axial coding, selective coding/theme construction, and data interpretation; as well as the addition of one phase, namely visual construction and triangulation (Denzin 2017).

Open coding (initial coding)

Researchers examined photographs, field notes, and artifact descriptions of *gunungan wayang kulit purwo* to identify initial meaning units. Each visual motif was documented and described based on its morphological characteristics, including shape, structural composition, and ornamental patterns. Symbols representing flora, fauna, and abiotic elements were identified and coded as preliminary biodiversity motifs. Descriptions obtained from expert informants (puppeteers and puppet makers) were used to support the initial interpretation of these symbolic elements.

Axial coding

During axial coding, the initial codes were grouped into broader analytical categories linking visual motifs with cultural and ecological meanings. Symbols representing flora, fauna, and geometric structures were compared with representations of sacred flora and fauna documented in Javanese artistic traditions, cultural literature, and oral explanations from expert informants. The symbolical

Species identification symbol followed a contextual ethnobiological approach consisting of four steps Figure 2. First, each visual motif was described based on morphological characteristics such as shape, structural features, and ornamental patterns found in the *gunungan*. Second, these characteristics were compared with representations of flora and fauna commonly recognized in Javanese cultural symbolism and artistic traditions, supported by explanations from expert informants (Mulyanto et al. 2025). Third, the motifs were matched with corresponding biological taxa using resource of biodiversity and taxonomic references. Fourth, species identification was guided by correspondence from biodiversity expert, Javanology expert and supporting by ecological and cultural criteria, including the occurrence of the species in the Javanese region, its endemic or historically documented presence in Java, and its symbolic Javanese cultural traditions. Taxonomic verification and conservation status were cross-checked using biodiversity databases such as the International Union for Conservation of Nature (IUCN) Red List.

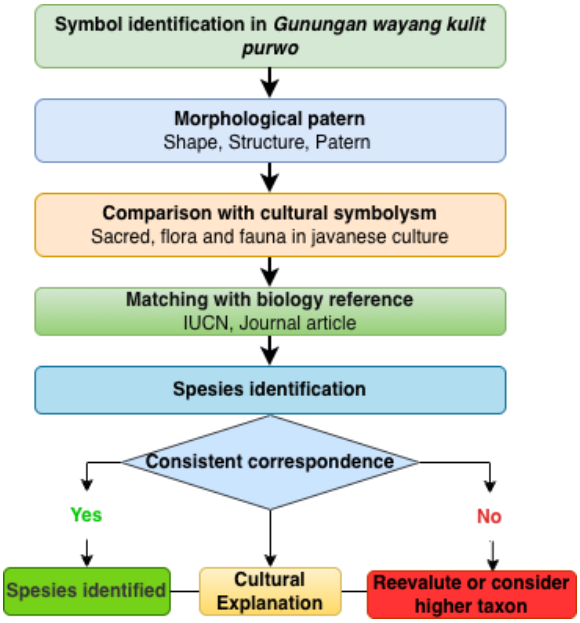

Figure 2. Symbols identification process in *gunungan wayang kulit purwo*

Selective coding / theme construction

In the selective coding stage, categories derived from axial coding were synthesized into broader interpretative themes that addressed the research questions. These themes included *gunungan wayang kulit purwo* as a symbolic of biodiversity, ecological ethics embedded in geometric structure, and conservation messages reflected in Javanese cultural knowledge (Staller 2022).

Data interpretation

In this phase, the identified themes were interpreted to construct higher level meanings related to the ecological and cultural significance of biodiversity symbols in *gunungan.* Interpretations were iteratively checked against the original data sources to ensure coherence, credibility, and consistency with ethnobiological theory. Peer discussions and constant comparison techniques were used to refine the interpretation of symbolic meanings and minimize interpretive bias.

Visual construction and triangulation

Finally, the identified biodiversity symbols and their corresponding species representations were organized into visual constructions and frequency tables to illustrate relationships between symbolic elements and ecological concepts. To enhance analytical reliability, source triangulation was conducted by cross-checking findings across three main data sources: artifact observations, interview narratives, and literature references. Interpretations were further validated through discussions with expert informants from different disciplinary backgrounds, including puppeteers, cultural scholars, philologists, and biodiversity experts. This triangulation process ensured that the final interpretation of biodiversity symbols reflected both ecological knowledge and traditional cultural understanding (Staller and Krumer-Nevo 2013).

RESULTS AND DISCUSSION

Respondent demographics

In this study, five key informants were obtained from five locations in Central Java Province and Yogyakarta. The informants represented diverse professional backgrounds with 10 to 33 years of experience. All informants had a high level of expertise in their respective fields, providing a specific information comprehensive biocultural perspective on the symbolism of *gunungan wayang kulit purwo* and its relevance to biodiversity conservation. The informant's background expertise and interpretive role can be seen in Table 1.

Table 1 shows the diversity of expertise and experience backgrounds. It indicates that the research data was obtained from competent and multidisciplinary sources, thereby supporting the depth of analysis of the meaning of biodiversity conservation and ecological conservation in wayang puppetry.

Thematic analysis of *gunungan wayang kulit purwo* symbolism

The spiral analysis process produced three main themes: (i) symbols of biodiversity meaning on the *gunungan wayang kulit purwo*, (ii) symbols of ecological meaning on the *gunungan wayang kulit purwo*, and (iii) conservation ethics embedded in geometric structures. These themes emerged from triangulation between coded visual artifacts, interview data, and ethnobiological literature. These findings are presented through a combination of Table 2.

Table 2 represents the process of conceptualizing the symbolic meaning of *gunungan wayang kulit purwo* through qualitative coding stages that produced three main themes, namely biodiversity, ecology, and conservation ethics. Flora and fauna symbols were analyzed not only as visual representations of species, but as narratives about biological diversity in the Javanese forest landscape, which were then categorized as biodiversity.

Symbols of biodiversity meaning on *gunungan wayang kulit purwo*

This study compares the symbols of flora and fauna on the *gunungan wayang kulit purwo* at three Museum. Each museum has two types of gunungan wayang kulit purwo, namely *blumbangan* and *gapuran*. *Gapuran* is named as such because it has a gate in its visual structure, while *blumbangan* has a pond in its visual structure. The results of observing biodiversity symbolism in the entire museum collection yielded three collections of *gunungan wayang kulit purwo* after no other biodiversity symbols were found in the entire museum (Figure 3).

Based on visual inspection and confirmatory interviews with puppeteers, Javanese experts, and biodiversity experts and literature review, 14 biodiversity symbols were identified on the *gunungan wayang kulit purwo* (Table 3).

Table 1. Demographic data of Informant participating in the research

Code name	Profession	Expertise and interpretive role	Experience
DL	Dalang	National level puppeteer, provides information about the gunungan wayang kulit purwo from the perspective of its function in puppetry. The puppeteer also assists in the initial identification process of existing biodiversity and its ecological meaning and values.	10 years
Ph	Philologist	Have a bachelor's degree and experience working in a cultural heritage museum, provides information about the history and meaning of gunungan wayang kulit purwo based on ancient Javanese texts or manuscripts, both visually and structurally, as well as their interpretation of ecological and conservation values.	20 years
Je	Javanologi expert	Holds a master's degree and teaches courses in Javanology and local wisdom-based conservation Javanology experts, provide information from an academic perspective regarding symbolic meanings and help identify and help identify advanced levels regarding the relationship between the biodiversity found in gunungan wayang kulit purwo with real biodiversity and its relationship to the life and culture of Javanese society.	30 years
Pm	Puppet maker	Experienced in making wayang for generations, provide perspective on what animals or plants are actually being symbolized by the puppet makers and where they get their inspiration for the symbolized biodiversity.	32 years
Be	Biodiversity expert	Holds the title of expert Professor in biodiversity conservation and help interpret biodiversity symbols, evaluate initial interpretation findings, validate identified biodiversity conservation status and help validate the symbolism of ecological concepts	33 years

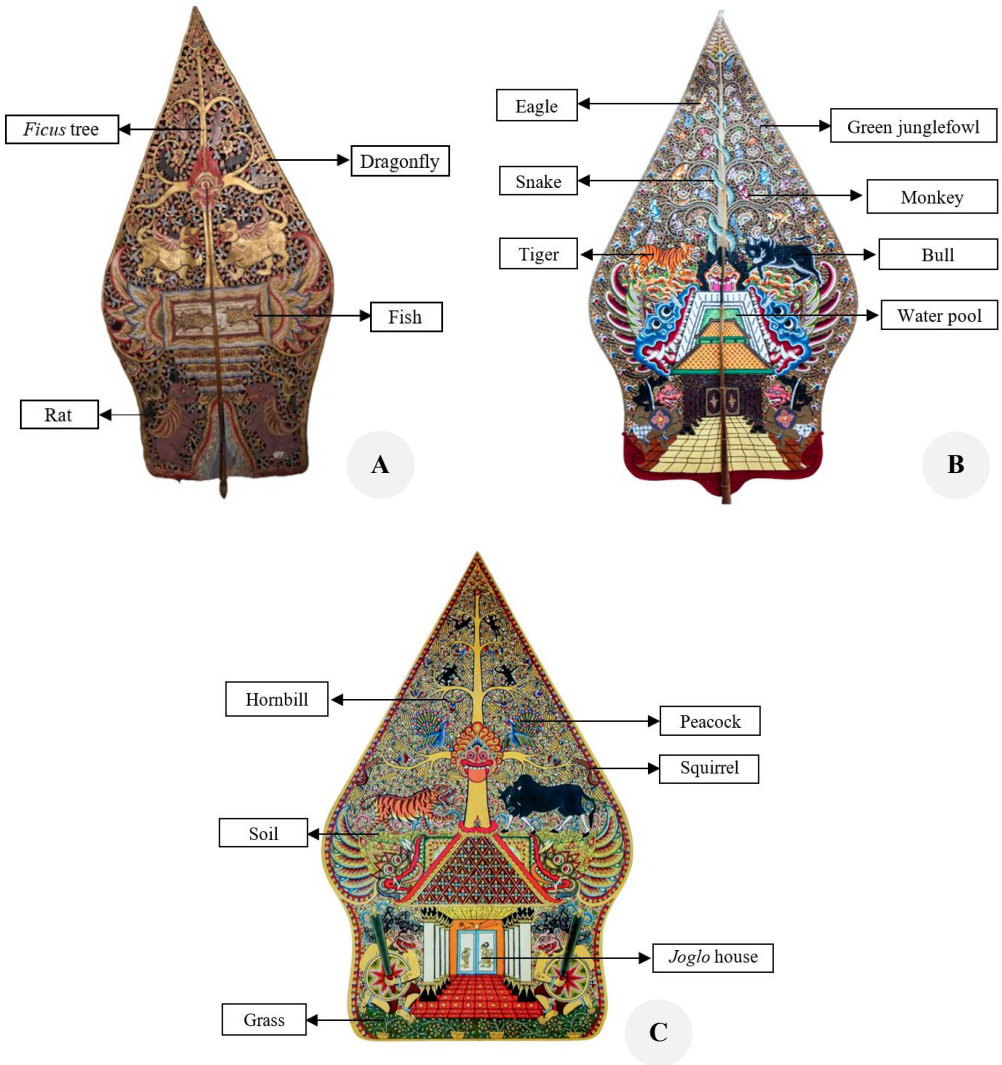

Figure 1. *Gunungan wayang kulit purwa* from Indonesia. A. *Gunungan blumbangan* (Museum Sonobudoyo in Yogyakarta), B. *Gunungan blumbangan* (Museum Radya Pustaka in Central Java), C. *Gunungan gapuran* (Museum Wayang Indonesia Wonogiri in Central Java). Sources: Personal documentation by the authors (2025)

Table 2. Qualitative coding results from analysis

Open codes (Initial)	Axial categories	Selective themes
Representations of diverse flora and fauna including flora, tiger, bull, snake, bird, fish etc.	Biodiversity in Javanese forest	Theme 1: Symbols of biodiversity meaning on *gunungan wayang kulit purwo*
Metaphor for the forest and mountain, water, soil, *joglo* house, interaction biotic and abiotic.	Ecosystem	Theme 2: Symbol of Ecological meaning on *gunungan wayang kulit purwo*
Messages of balance, harmony narratives, restriction on exploitation	Conservation ethics and ecological balance values embedded in symbolic structure	Theme 3: Embedded conservation ethics on geometric structure

Table 3. Biodiversity, symbolic meaning, and conservation status

Category	Symbol/Image	Binomial nomenclature (Family/Genus/species)	IUCN status	Location		
				A1	A3	C1
Flora	Grass	Poaceae	-	√	√	√
	Ficus tree	*Ficus* sp.	-	√	√	√
Fauna	Javan tiger	*Panthera tigris sondaica*	Extinct (EX)	√	√	-
	Bull	*Bos javanicus*	Critically Endangered (CR)	√	√	√
	Monkey	*Macaca fascicularis*	Endangered (EN)	√	√	√
	Hornbill	*Rhyticeros undulatus*	Vulnerable (VU)	-	√	-
	Python	*Malayopython reticulatus*	Least Concern (LC)	-	√	√
	Javan hawk-eagle	*Nisaetus bartelsi*	Endangered (EN)	√	√	√
	Peacock	*Pavo muticus*	Endangered (EN)	√	√	√
	Green junglefowl	*Gallus varius*	Least Concern (LC)	√	√	√
	Squirrel	Sciuridae	Least Concern (LC)	-	√	-
	Rat	*Rattus argentiventer*	Least Concern (LC)	-	-	√
	Fish	*Tor tambroides*	Data Deficient (DD)	-	-	√
	Dragonfly	*Rhyothemis* sp.	-	-	-	√

Note: Conservation status follows the IUCN Red List Categories and Criteria (IUCN 2025)

Table 3 shows the identification of flora and fauna symbols found on the *gunungan*, along with their scientific taxonomic equivalents, conservation status according to the IUCN, and distribution of their appearance in several parts of the symbol location (A1, A3, C1). Not all biodiversity symbols appear in every *gunungan wayang kulit purwo.* The biodiversity that appears in the three locations shows that this biodiversity is a standard or norm of what is called *gunungan wayang kulit purwo*. Not all flora or fauna names can be perfectly identified due to the limitations of the visual objects symbolized, which are often not representative of the real world. Researchers and biodiversity experts examined additional sources to substantiate biodiversity related claims. For instance, in identifying the fish species, the researchers conducted a literature review on sacred fish in Java. Based on a comprehensive analysis, the findings indicate that the depicted fish is morphologically similar to *Tor tambroides*, a species regarded as sacred by Javanese communities (Budi et al. 2025). The same approach was also applied to identify and validate other species represented in the study. The flora component is dominated by common vegetation such as grass and *Ficus* trees, which represent the basic structure of a tropical forest ecosystem. Meanwhile, the fauna component includes various trophic levels, ranging from large mammals (Javan tigers, bulls), primates (long-tailed monkeys), birds (hornbills, Javan hawk-eagles, peacocks), reptiles (pythons), to small organisms such as fish and dragonflies. The presence of species with high conservation status, such as *Panthera tigris sondaica* (Extinct), *Bos javanicus* (Critically Endangered), *Nisaetus bartelsi* (Endangered), and *Pavo muticus* (Endangered), shows that the *gunungan wayang kulit purwo* symbol not only represents biodiversity in general, but also reflects the importance of biodiversity in the Javanese ancestors' awareness of important and iconic animals in the Javanese ecosystem. Informants consistently described these components as metaphors for the forest ecosystem and natural regeneration.

Symbol of ecological meaning on *gunungan wayang kulit purwo*

The ecological meaning of the *gunungan* is based on the interpretation of the ecological function of each biotic component/biodiversity that has been identified in the *gunungan wayang kulit purwo*, which has been validated by biodiversity experts and supported by various sources. Table 4 presents the identification of symbols found on the mountain along with their scientific nomenclature equivalents, ecological functions, and frequency of appearance at three observation locations (A1, A3, C1). The classification of ecological functions includes the role of organisms in the ecosystem structure, such as producers, primary consumers, secondary consumers, apex predators, and abiotic components that act as sources of nutrients and habitat. Frequency of appearance is used to indicate the visual dominance and level of emphasis of certain symbols in *gunungan wayang kulit purwo.*

The differences in the frequency of symbol appearance at locations A1, A3, and C1 indicate that the visual composition of the *gunungan* is not uniform, but rather represents different ecological meanings in each part of the structure. The concept of the relationship between biotic components and between biotic and abiotic components also reinforces the interpretation of the ecological conservation value of the *gunungan wayang kulit purwo*. High-frequency symbols, such as monkeys (*Macaca fascicularis*), indicate an ecological role that is considered important in the ecosystem narrative, particularly as primary consumers and seed dispersal agents that contribute to forest regeneration. Conversely, low-frequency symbols such as the Javan tiger (*P. t. sondaica*) or other predators tend to represent higher trophic positions in the ecosystem hierarchy, thus appearing less frequently visually but carrying strong symbolic meaning as guardians of the natural balance. Differences in frequency between locations may also reflect symbolic ecological zoning, where certain parts highlight specific biotic components (e.g., herbivorous fauna or birds), while others feature abiotic elements or organisms of different trophic levels. Thus, frequency variations not only reveal aesthetic aspects but also indicate an organized ecological narrative structure that depicts trophic relationships, population balance, and interactions between ecosystem components within a single symbolic in *gunungan.*

The abiotic elements identified in the *gunungan* are limited to the water pond and *joglo* shaped structure, which serve as fundamental environmental components that support biological symbols. Water symbolizes the source of life and ecological renewal, soil symbolizes fertility and habitat stability, while the *joglo* shape marks the cultural-ecological boundary between the human world and nature. This pattern emphasizes vegetation and forest ecology as the primary ecological landscape underlying the interpretation of Javanese cosmology. The symbols of biodiversity on the *gunungan* represent a relatively complete trophic structure of the ecosystem, ranging from producers (*Ficus* trees), primary herbivorous and omnivorous consumers (bull, monkeys, birds), to secondary consumers and apex predators (pythons, Javanese eagles, Javanese tigers). The presence of abiotic components such as water and soil reinforces the representation of interactions between biotic and abiotic factors in an ecological system. Symbolically, this shows that traditional craftsmen encoded ecological knowledge into the visual symbolism of *gunungan*. For example, birds such as hornbills and eagles symbolize guardianship, spiritual messengers, and the connection between heaven and earth (Fahrudin et al. 2023). Tigers are consistently interpreted by biodiversity experts as symbols of apex predators that maintain trophic balance, while birds symbolize the vitality and regeneration of forests. The complete trophic structure of the ecosystem in the *gunungan wayang kulit purwo* can be interpreted as a symbol of mutually beneficial relationships and their impact on ecosystem conservation, such as the concepts of food chains and seed dispersal (Figure 3).

Figure 4.A clearly shows that there are two simple ecological concepts regarding the relationship between biotic components that form the food chain. Food chain concept 1 involves fig trees as producers, squirrels as primary consumers, snakes as secondary consumers, and eagles as tertiary consumers or apex predators. In the second food chain concept, grass acts as a producer, bulls as primary consumers, and tigers as apex consumers. Food chains play an important role in maintaining forest sustainability. Through trophic interactions between producers and consumers, food chains play a role in maintaining population dynamics in forests by preventing population explosions of certain species (Pollierer et al. 2021; Rivera 2024). The concept of food chains can help identify key species that are essential for ecological sustainability. An intact food chain is an indicator of forest ecosystem health; the loss of one trophic level, such as a top predator or decomposer, can signal ecological degradation due to human pressure. The symbolism of the food chain concept in the *gunungan wayang kulit purwo* has provided an understanding of the food chain that can form the basis of forest conservation strategies (Rivera 2024).

Figure 4.B shows a schematic diagram of the mutualistic symbiotic relationship between the *Ficus* tree, hornbills monkeys, and squirrel. The *Ficus* tree provides fruit as food for hornbills and monkeys, which are then dispersed to various areas in the mountains by hornbills and monkeys, ensuring the sustainability of their populations (Butler and Johnson 2022). Biodiversity experts say that because of this behavior, monkeys and hornbills are referred to as forest farmers, "*Hornbills and monkeys are common keystone species that we often refer to as forest farmers because of their ability to disperse fig seeds to various locations in the forest, allowing fig trees to regenerate naturally*".

In ecological terms, keystone species can be defined as species that play a very important role in their ecosystem within their habitat. The extinction of keystone species can cause ecological changes and the loss of biodiversity in their habitat (Russo et al. 2024). The symbolism of keystone species in the *gunungan wayang kulit purwo* is a message and reminder deeply rooted in Javanese culture regarding forest conservation, through the conservation of various keystone species in the *gunungan wayang kulit purwo*. Ethnobiological studies of the *gunungan wayang kulit purwo* show that traditional knowledge systems recognized the ecological functions of these species long before they were scientifically defined, contributing to biodiversity conservation and ecological resilience (Jessen et al. 2022). This is also supported by interviews with puppeteers, Javanese experts, and Javanese manuscript philologists, who stated that "*The gunungan wayang kulit purwo is a symbol of the forest; to preserve the forest, all species symbolized within it must be preserved*." This understanding further reinforces the symbolic meaning contained in it, which implicitly conveys a message of forest conservation. The *gunungan wayang kulit purwo*, as a representation of natural culture, embodies the harmony between humans and their environment, emphasizing an

ethnobiological perspective in which nature and culture are inseparable dimensions of ecological wisdom (Nabhan and Martinez 2012; Robinson et al. 2021).

Embedded symbolical conservation ethics on Geometric structure

The *gunungan wayang kulit purwo* exhibits a hierarchical geometric structure consisting of four main sections: *palemahan*, *lengkeh*, *genukan*, and *pucukan* The symbolism of this geometric structure is visually evident in Figure 5. The lower sections (*palemahan* and *lengkeh*) are represented by rectangular forms, the middle section (*genukan*) by a rounded structure, and the upper section (*pucukan*) by a triangular from. This layered geometric composition organizes the placement of symbolic elements within the *gunungan*, including biodiversity symbols, environmental features, and cultural representations. The structured arrangement reflects an integrated system that visually connects different symbolic components within a unified composition. The geometric structure of the *gunungan wayang kulit purwo* serves as a symbolic framework that bridges the real world and the metaphysical realm, where shapes and proportions are deliberately constructed to convey spiritual balance and ecological order as well as the principle of sustainability. This symbolism is not only metaphysical but also ecological: the layered and symmetrical arrangement reflects the interdependence of natural elements, emphasizing that harmony in the cosmos cannot be separated from balance in the environment. The shapes of *palemahan, lengkeh,* and *genukan* represent the material world and concrete, orderly human life (Pugersari 2024). This reflects stability, balance, and existential foundations, where humans live the dynamics of daily life horizontally in a structured social and moral space (Sabdho 2014). Above it, the cone or isosceles triangle pointing upwards symbolizes the direction of transcendence the journey of the soul towards spiritual perfection. This cone refers to the symbol of the Mountain in Hindu-Javanese cosmology, which is seen as the connecting axis between the lower world, the middle world, and the upper world. At the same time, the triangular shape also evokes the image of a forested mountain, with a layered ecosystem ranging from the soil and vegetation at the base to animal life and celestial elements at the summit. Thus, the visual structure of the *gunungan* functions not only as an artistic composition or spiritual metaphor, but also as a cosmology of ecological order, in which human welfare depends on maintaining a balance between the material world, the natural environment, and the divine cosmos (Sedyawati 2006; Muhajirin 2015).

The theme of biodiversity symbolism affirms that the representation of flora and fauna reflects the species richness of Java's forest ecosystems, while the theme of ecological meaning demonstrates an understanding of biotic and abiotic interactions, trophic structures, and ecosystem balance. The theme of conservation ethics embedded in the geometric structure reveals a normative dimension in the form of the value of harmony between humans and nature and restrictions on resource exploitation. Integratively, these findings reinforce the view that traditional cultural artifacts contain implicit ecological knowledge that is passed down across generations through symbols and cosmological narratives. This perspective is in line with cultural anthropological studies that place symbols in Javanese tradition as a medium for transmitting the values of human-nature (Smith 1963; Nakamura 2020), as well as international recognition that puppet is a cultural heritage that contains moral and philosophical values of life, including harmony with the environment (United Nations Educational, Scientific and Cultural Organization (UNESCO) 2021). Thus, the *gunungan wayang kulit purwo* can be understood as an educational medium that integrates messages of biodiversity conservation and ecology within the framework of local wisdom.

Table 4. Ecological functions and frequency of biodiversity symbols represented in *gunungan*

Symbol/Image	Binomial nomenclature (Family/Genus/species)	Ecological function	Frequency		
			A1	A3	C1
Ficus tree	*Ficus* sp.	Producer	1	1	1
Grass	Poaceae	Producer	1	1	1
Javan tiger	*Panthera tigris sondaica*	Peak Consumer / Carnivore	1	1	0
Bull	*Bos javanicus*	Primary Consumer / Herbivore	1	1	4
Monkey	*Macaca fascicularis*	Primary Consumer / Pollinator	12	4	4
Hornbill	*Rhyticeros undulatus*	Primary Consumer / Pollinator	0	6	0
Python	*Malayopython reticulatus*	Secondary Consumer / Predator	1	0	2
Javan hawk-eagle	*Nisaetus bartelsi*	Peak Consumer / Predator	2	0	3
Peacock	*Pavo muticus*	Primary Consumer	0	2	0
Green junglefowl	*Gallus varius*	Primary Consumer	3	0	2
Squirrel	Sciuridae	Primary Consumer / Pollinator	0	2	0
Rat	*Rattus*	Secondary Consumer	0	0	2
Fish	*Tor tambroides*	Secondary Consumer	0	0	2
Dragonfly	*Rhyothemis* sp.	Secondary Consumer	0	0	2
Water pond	-	Source of nutrition for producers	0	0	1
Soil	-	Source of nutrition and habitat	1	1	1
Joglo house	-	Human Habitation	1	1	0

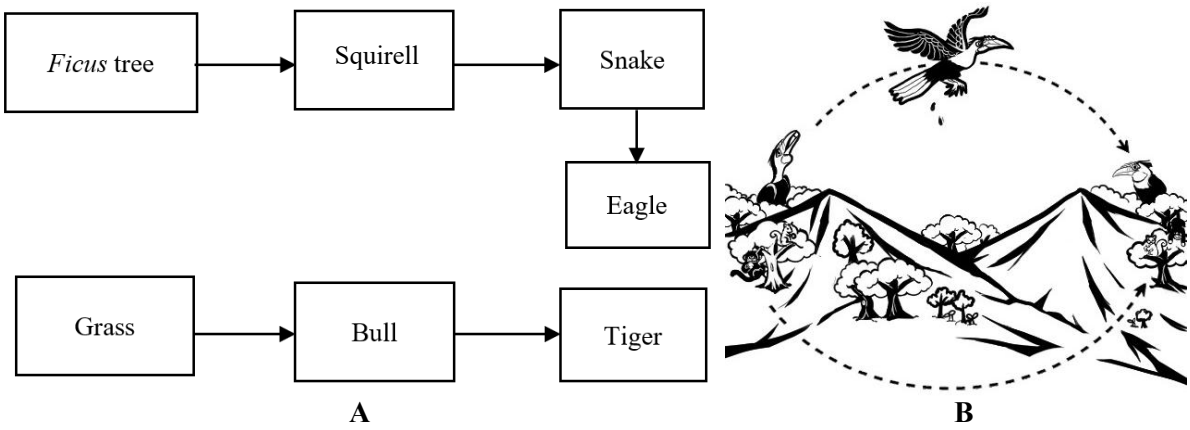

Figure 2. A. Representation of food chain interactions and B. Seed dispersal processes in the symbolism of *gunungan wayang kulit purwa*

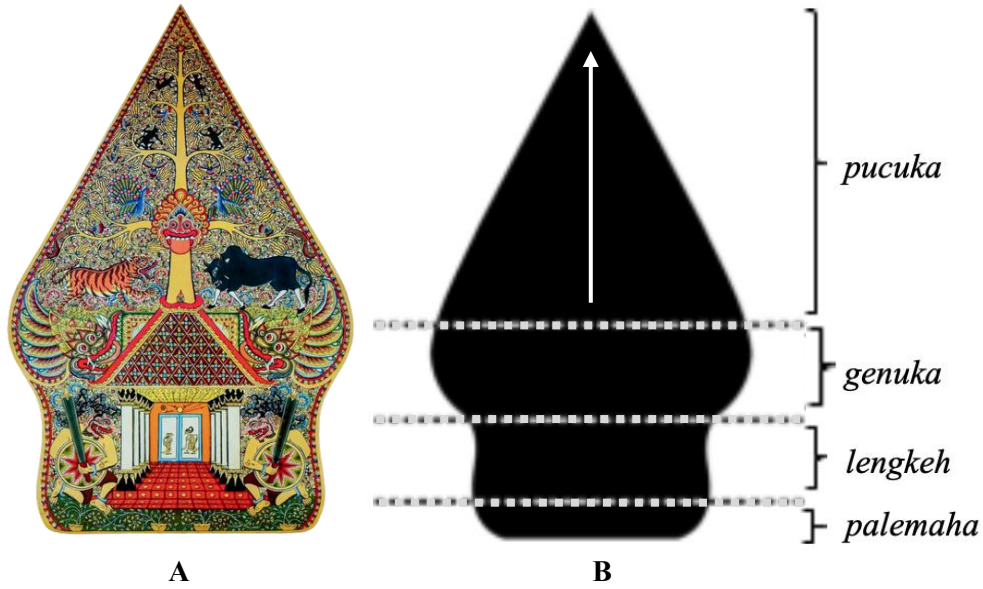

Figure 3. Meaning of geometric structure of *gunungan*. Source: A. Personal documentation by the authors, B. Pugersari (2024)

In the past, the meaning and noble values of local culture in *wayang* performances were symbolized and interpreted independently by the audience. The *golek* dance, which means searching, became a symbol for seeking the implied meaning contained in the *wayang* performance (Cahya et al. 2012). The results of this research have become one of the interpretive materials that yielded three important and beneficial findings in various aspects, both in terms of education, conservation, and cultural preservation. In the aspect of education, the findings of biodiversity symbols and ecological concepts can serve as innovative learning resources and teaching media based on biocultural principles. The integration of symbol *gunungan wayang kulit purwo* in environmental education, both formal and informal, can be contextual and support the development of science and cultural literacy, environmental awareness, and critical thinking skills among students through a contextual approach based on local wisdom. Furthermore, the use of cultural artifacts as learning media is also in line with the embodied cognition approach, where the understanding of concepts is built through direct interaction with concrete and culturally meaningful representations (Zhang et al. 2025).

In the aspect of biodiversity and ecological conservation, this finding shows that the symbols in the *gunungan* not only have esthetic and philosophical value but also contain implicit ecological knowledge that can strengthen public awareness of the importance of maintaining ecosystem balance. The representation of species, including those with certain conservation statuses, increasingly opens the public's understanding of ecological narratives that can be used as a medium for culture-based conservation education. This biocultural approach can serve as an alternative strategy to enhance concern for

biodiversity preservation, especially through more contextual education and public communication channels. Meanwhile, in the context of cultural preservation, these findings can be used as interpretative educational media in museums and cultural centers. This research also emphasizes the importance of revitalizing the symbolic meanings in the *gunungan wayang kulit purwo* as part of intangible cultural heritage. Reinterpreting these symbols from the perspective of education and conservation can strengthen the relevance of traditional culture amidst the challenges of modernization (Turner et al. 2022). This also opens up opportunities for the integration of formal education and local cultural practices, so that the younger generation not only recognizes but also understands the philosophical and ecological values contained within them. Theoretically, this research contributes to the development of biocultural studies by demonstrating how cultural artifacts can serve as a medium for the transmission of ecological knowledge across generations (Rinto et al. 2023; Leonti 2024). This study expands the perspective that conservation is not solely based on modern scientific approaches but can also be strengthened through local knowledge systems internalized in cultural symbols and practices.

In conclusion, this study concludes that the *gunungan wayang kulit purwo* embodies systematically structured biodiversity symbols that reflect coherent ecological meanings aligned with principles of ecological conservation. The findings demonstrate that these symbolic representations are not merely artistic expressions, but constitute a form of embedded ecological knowledge within Javanese cultural traditions. By systematically mapping and interpreting these symbols, this study reveals the potential of the *gunungan* as a biocultural medium for transmitting ecological understanding across generations. Furthermore, this study affirms the relevance of the *gunungan wayang kulit purwo* as an innovative biocultural resource for education, particularly in fostering scientific literacy, ecological awareness, and contextual learning grounded in local wisdom. At the same time, it highlights its strategic role in strengthening cultural preservation by recontextualizing traditional artifacts within contemporary educational and conservation frameworks. Overall, this research bridges the gap between ethnobiology, cultural studies, and science education, offering a novel perspective that positions cultural artifacts as epistemic resources for biodiversity conservation and sustainable cultural continuity. Future studies are recommended to explore the implementation of this biocultural approach in educational practices and its impact on learners' environmental awareness and conservation attitudes.

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