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Potential Biodiversity from Ethnozoology of Enggano Island: Utilization, Quantitative Analysis, List of Animals Conserved by Local People, and Application of Research Findings Empowering Species Literacy in Biology Student Teachers

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ABSTRACT

This study aims to identify the utilization of animals, conduct an ethnozoology quantitative analysis, describe animal conservation by local people on Enggano Island, and apply the research results to empower species literacy in biology student teachers. Data collection in this study is in-depth semi-structured interviews, observations, participant observations, questionnaires, and tests. Based on the study results, 64 species of animals are used for ten categories. According to the quantitative analysis, Chelonia mydas has the highest CI index (1.071) and RFC index (1.00). Based on these indices, Chelonia mydas was identified as the most important species for local people in Enggano island. The ethnozoology textbook developed from the results of ethnozoology research on Enggano Island is valid, practical, and effective to can increase species literacy in biology student teachers. In the control class, the adjusted mean of species literacy was 63.91, while the adjusted mean of species literacy in the experimental class was 71.87.

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1. INTRODUCTION

The unique ecology of an area determines biodiversity, including the diversity of animals (Vale *et al*., 2023; Yang *et al*., 2021). Animals provide ecosystem services and help local people survive (Gouwakinnou *et al*., 2019). Local people have preserved and transmitted traditional knowledge about animals through their culture and traditional practices (Alves & Souto, 2015). Interactions between humans and animals include social and natural sciences, fundamental and practical knowledge, and integrating anthropological information into a social-ecological approach (Guerrero-Gatica *et al*., 2020). As part of ethnobiology, ethnozoology provides a way to link local knowledge about animals with scientific knowledge (Ludwig & El-Hani, 2020). Ethnozoology includes studying animal use, species diversity, ethnotaxonomy, and animal conservation by local people (Bello-Román *et al*., 2023; Solís & Casas, 2019). By offering policymakers information and solutions on biodiversity-related concerns, ethnozoology studies play a critical role in promoting efforts to attain sustainable development goals (Alves, 2012). Studying ethnozoology can also mediate knowledge about species and educational strategies from a conservation perspective (Rêgo *et al*., 2021; Tom *et al*., 2019).

Indonesia has the highest number of ethnobiological publications in Southeast Asia, including a study on ethnozoology (Hidayati *et al*., 2015). Previous study shows that tribes in Indonesia use animals for various purposes, such as food, traditional medicine, domestication, hunting, mystical practices, folklore, and traditional ceremonies (Mulyanto *et al*., 2020; Sawaki *et al*., 2022; Supiandi *et al*., 2023; Yuniati *et al*., 2020). Tribes in Indonesia also have local wisdom regarding animal conservation and management strategies (Permana *et al*., 2019). However, ethnozoology studies in Indonesia are still in the early stages, so it is possible to carry out further studies in other local people (Mardiastuti *et al*., 2021).

Enggano Island is in the Indian Ocean. This island is inhabited by local people, namely the Enggano tribe. According to its geological history, Enggano Island is an oceanic island because it was formed from an oceanic rift and was never connected to the Sumatran mainland. Islands classified as oceanic islands have a diversity of ecosystems, an abundance of plant and animal life, and endemic species (Cortés, 2012; Kienle *et al*., 2022). Based on previous studies, the relationship between local communities and animals on Enggano Island includes using animals as medicine and traditional ceremonies (Patrick & Rahman, 2024; Tambunan *et al*., 2021). Even though this tradition has received much opposition from various parties, the people of Enggano Island have attitudes, perceptions, and a high level of participation in managing conservation areas and protecting biodiversity, including sea turtles (Firdiansyah *et al*., 2020; Nurhidayah, 2017). Based on the explanation, Enggano Island offers significant potential for exploration due to its geographical location and distinctive culture.

In ethnobiology studies, local people's knowledge about species varies greatly (Reyes-García *et al*., 2006). As part of the ethnobiology field, ethnozoology study results in quantitative and qualitative data (Ávila-Nájera *et al*., 2018). Quantitative analysis has been widely used in ethnobotanical studies (Albuquerque *et al*., 2006; Shaheen *et al*., 2017; Rohman *et al*., 2021) but is still limited in ethnozoology studies (Borah & Prasad, 2017). Publications regarding ethnozoology studies are dominated by qualitative data, such as descriptions of animal use and conservation efforts by local people (Hou *et al*., 2020; Ulfa *et al*., 2023). In this study, we also collected data regarding the number of ethnozoological studies on the Scopus database. As shown in **Figure 1**, research in ethnozoology started in 1979 based on the Scopus database, which shows the importance of this study.

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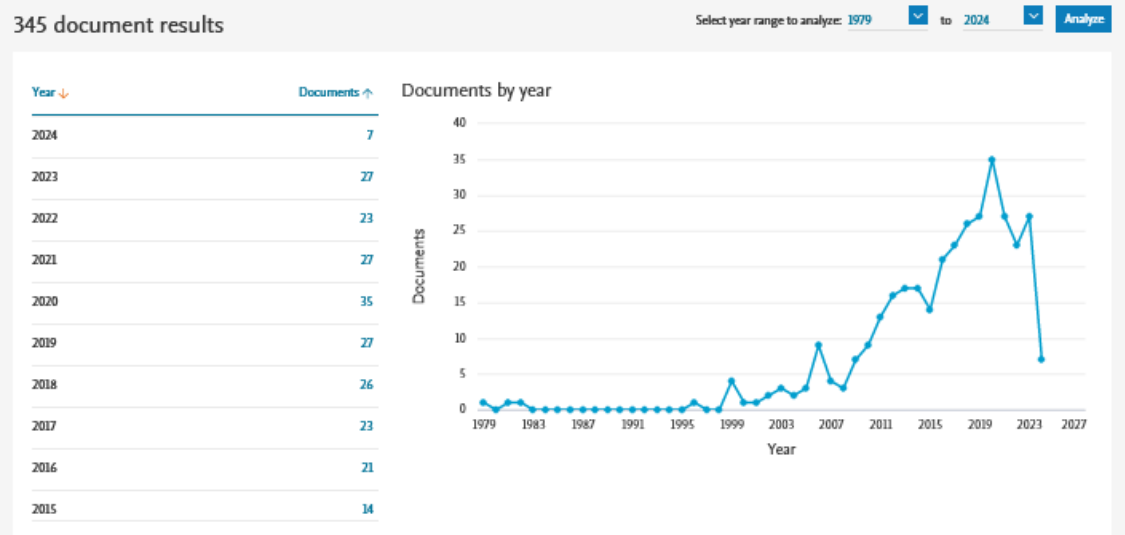

Figure 1. Publication in Scopus database, taken on June 2024, using keyword ethnozoology.

Figure 1 shows that there were 345 documents of ethnozoological research in the Scopus database from 1979 to 2024. The average ethnozoological research has increased from year to year, but it tends to decrease from 2020 to June 2024. The results of bibliometric analysis on journal databases will produce important information regarding the number of publications, networks between authors and countries, research topics, publication year, citations, and so on. Detailed information for how to use the data is explained elsewhere (Rochman *et al*., 2024; Azizah *et al*., 2021; Al Husaeni & Nandiyanto, 2022).

By using data obtained from interviews, each species used by local people can determine the Use Value, Frequency of Citation, Relative Importance Index, Cultural Value Index, and others (Leonti, 2022). Data obtained from quantitative analysis will be beneficial in determining which species are considered the most important in a local community (Faruque *et al*., 2018). Quantitative data in the ethnozoology study also plays an essential role in knowing the priority of species for conservation and protection due to human use. In ethnozoology studies, it is necessary to conduct a quantitative analysis of variations in individual knowledge regarding the use of animals for consumption, traditional ceremonies, magical-religious, decorative purposes, and other uses (Ávila-Nájera *et al*., 2018).

Exploration of ethnozoology studies results contains knowledge that can be developed to empower species literacy (Baptista & Araujo, 2019). The results of ethnozoology studies contain information regarding species diversity, species use, species conservation status, local people knowledge about species, taxonomy, and other species concepts (Alves & Souto, 2011). Species literacy includes broad knowledge and in-depth knowledge of species. Broad knowledge about species is related to the ability to identify species. In contrast, in-depth knowledge is related to more specific knowledge about species, such as food, habitat, behavior, conservation status, species benefits, and others (Hooykaas *et al*., 2019). Species literacy can shape a person's awareness, caring attitude, and biodiversity conservation behavior (Mohneke *et al*., 2016; Melis *et al*., 2021). Species literacy is needed for decision-making in utilizing resources by prioritizing a balance between economic, social, and environmental aspects (Palmberg *et al*., 2017).

Species literacy is related to the main issue of Education for Sustainable Development (ESD) because of its role in achieving the SGDs goals of preventing species extinction and preserving biodiversity (Wolff & Skarstein, 2020). In line with this, teachers play an essential role in providing education regarding global and local issues regarding biodiversity (Wanchana *et al*.,

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2020). Teachers act as agents of change in developing students' attitudes, awareness, and behavior in the future that align with sustainable development principles (Raus, 2017). The teacher's species literacy abilities will significantly influence the success of teaching species (Almeida *et al*., 2018; Robles-Moral *et al*., 2022). For educators, species literacy can motivate them to increase professionalism in teaching about natural resource conservation and carry out learning innovations related to biodiversity issues (Skarstein & Skarstein, 2020; Kaasinen, 2019; Scharenberg *et al*., 2021).

Empowerment of species literacy can be directed at the context of species that exist around students' local environment, with the hope of connecting the diversity of life of people in various regions to expand broad support for conservation (Hooykaas *et al*., 2020). We also conducted a bibliometric analysis using VOSviewer with Publish or Perish program from the Google Scholar database to find global ethnozoology research trends and how they relate to education. Bibliometric analysis is a popular analysis used to determine and map trends in a research topic (Al Husaeni *et al*., 2024; Nandiyanto *et al*., 2023). Based on the results of this bibliometric analysis, there is no connection between ethnozoology research and research in the field of education, especially regarding species literacy.

In this study, the potential for animal diversity as a source of natural life on Enggano Island will be explored further. This study aims to identify the uses of animal species, conduct quantitative analysis to determine the cultural importance of these species for local people and identify animal conservation techniques by the local people of Enggano Island, which are essential for animal management practice. After getting data from the field, it will be developed as learning and teaching materials to empower biology student teachers' species literacy.

2. METHODS

2.1. Study Area of Etnozoology in Enggano Island

This study was conducted on Enggano Island, Enggano District, North Bengkulu Regency, Bengkulu Province, Indonesia, at coordinates 50 38' South Latitude and 1020 25' East Longitude. A map of ethnozoology study on Enggano Island is in **Figure 2**. Enggano Island has an area of 400.6 km^2, approximately 100 nautical miles from Pulau Bai Harbor, Bengkulu City. Around 35.89% of the Enggano Island area is forest area, while 64.11% is residential, agricultural, and plantation areas. Enggano Island boasts a shoreline of 106.7 kilometers, with its maximum elevation reaching 281 meters above sea level. The Enggano District has six villages, each with its own area: Banjarsari (125.50 km^2), Meok (60.90 km^2), Apoho (1.35 km^2), Malakoni (40.21 km^2), Kaana (87.01 km^2), and Kahyapu (85.65 km^2). Enggano Island has the highest seismological activity among all the islands in Sumatra. Enggano Island's climate is tropical, with substantial annual precipitation ranging from 1,000 to 2,000 mm. The island has five types of ecosystems, namely mangrove, coastal, riparian, lowland forest, and freshwater swamp ecosystems.

The native people of Enggano Island are the Enggano tribe. The Enggano tribe has six sub-tribes, namely Kaahoao, Kaitora, Kaarubi, Kaharuba, Kauno, and Kaamay tribes. The Kaamay tribe is intended for immigrants from outside Enggano Island, while the other five tribes are native tribes from Enggano Island. These six sub-tribes have the same customary rules in traditional and social life (Arios, 2018). Each sub-tribe has a chief called *Ekap'u*. Every matter related to customs and government is facilitated by a coordinator called *Pa'abuki*.

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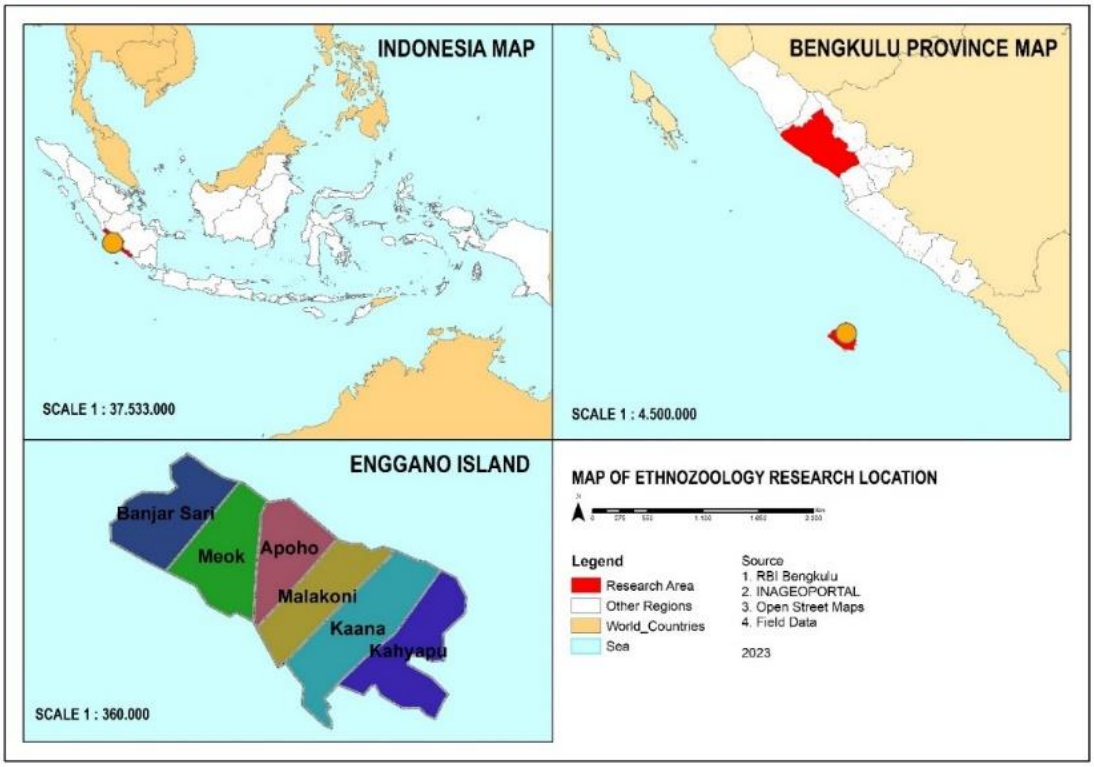

Figure 2. Map of ethnozoology study locations on Enggano Island, North Bengkulu Regency, Bengkulu Province, Indonesia.

2.2. Data Collection

We conducted in-depth research and attempted to obtain data regarding local knowledge about animals on Enggano Island, then comprehensively applied it to empower the species literacy of biology student teachers. For this reason, we carried out two main stages, namely ethnozoology studies on Enggano Island and empowering species literacy among biology student teachers.

2.2.1. Ethnozoology study of local people on Enggano Island

The ethnozoology data collected in this study includes the utilization, management, and conservation of animals by the local people of Enggano Island. Data collection uses semi-structured interviews, observations, and participant observation (Abebe *et al*., 2022; Tongco, 2007). Respondents were selected using purposive and snowball sampling techniques (Yuniati *et al*., 2020). The selection of key informants considered their expertise related to animals, such as tribal chiefs, animal hunters, fishermen, traditional healers, traditional medicine experts, fish traders, and livestock breeders. Determining key informants also uses snowball sampling to obtain a larger sample size. The respondents for this study consisted of 28 key informants, six women and twenty-two men, aged 35–75 years.

2.2.2. Study of species literacy in biology student teachers

In this research, empowering species literacy will be encouraged through the Enggano Island Ethnozoology textbook and Problem-based Learning (PBL). We developed the book by involving four experts as validators. The four experts assessed the textbook before it was implemented to empower species literacy. We chose PBL learning because this learning directs students to carry out activities of finding, studying, evaluating, and applying new

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information to solve problems in real-world situations (Liu *et al*., 2012). We use a quasi-experimental two-group pretest-posttest design to empower species literacy in biology student teachers. **Table 1** shows the quasi-experimental design that will be implemented.

Table 1. Quasi experimental design.

Group	Pretest	Treatment	Posttest
Experimental class	O_1	X1 (PBL+ Enggano Island Ethnozoology Textbook)	O_2
Control class	O_3	X2 (PBL+ General Ethnozoology Textbook)	O_4

Data collection regarding species literacy of biology student teachers was carried out on 5th-semester students taking an ethnobiology course. The number of students in class X1 is 24, while those in class X2 are 21. There are 13 types of animals asked about in this species literacy test, namely *Bubalus bubalis, Gallus gallus domesticus, Channa striata, Sus scrofa, Varanus salvator, Hemidactylus frenatus, Python reticulatus, Chelonia mydas, Gracula religiosa, Psittacula longicauda, Charonia tritonis, Canis lupus familiaris*, and *Manis javanica*. Species literacy data collection was carried out using species literacy instruments. Species literacy indicators consist of broad knowledge about species and in-depth knowledge about species (Hooykaas *et al*., 2019). The species literacy instrument to measure species literacy in biology student teachers has previously been validated by experts, and pilot tests have been performed. Hence, the instrument used is valid and reliable. Each species consists of 8 short questions. The first question relates to broad knowledge about species, where students are asked to identify species based on the picture of the species displayed. Questions 2 and 8 relate to in-depth knowledge about species. After identifying the species, students are asked to write down their knowledge about the habitat, food, position of the species in the food pyramid, conservation status according to the IUCN Redlist, predators, behavior, and benefits or role of the species for local people.

2.3. Data Analysis

2.3.1. Data analysis of ethnozoology study on Enggano Island

The local people's relationship with animals in Enggano Island was analyzed quantitatively and qualitatively. Qualitative data includes species use, animal-catching techniques, and animal conservation by the Enggano tribe. The utilization of animals by the Enggano tribe is classified into ten categories based on a study conducted by Ávila-Nájera *et al*. (2018). These categories include consumption, traditional medicine, traditional ceremonies, decorative purposes, breeding, pets, trade, hunting, mythology, and tools. The animals used by the Enggano tribe were analyzed for their conservation status and population trends using data from the IUCN Red List of Threatened Species.

Quantitative analysis in ethnobiology studies evaluates how the importance of the cultural value of certain species in local communities (Faruque *et al*., 2018; Leonti, 2022). Quantitative analysis includes calculating basic values and indices for each species (ethnospecies) (Oza *et al*., 2022; Shaheen *et al*., 2017). The basic values in this study include Use Report (UR), Number of Uses (NU), and Frequency of Citation (FC). The indices in this study include the Relative Frequency of Citation (RFC) index, the Relative Importance (RI) index, the Cultural Importance (CI) index, and the Cultural Value (CV) index. The index calculation results for each species are then sorted based on their ranking to determine which species have the highest and lowest index. Correlation analysis (*Pearson*) was also done using SPSS software to determine the correlation value between basic values and indices. The formula used to calculate the basic value and indices can be seen below:

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(i) **Use Report (UR) per species.** Use report per species (UR_s) is a fundamental and essential calculation to determine the total number of uses of a species (ethnospecies/species s) by all informants in each use category. According to Prance *et al*. (1987), calculating URs is in Eq. (1).

$$UR_S = \sum_{u=u_1}^{u_{NC}} \sum_{i=i_1}^{i_N} UR_{ui} \quad (1)$$

(ii) **Number of Uses (NU) per species.** The number of uses per species (NUs) is the total number of use categories (NC) for a species in a study. According to Prance *et al*. (1987), calculating NUs is in Eq. (2).

$$NU_S = \sum_{u=u_1}^{u_{NC}} UR_u \quad (2)$$

(iii) **Frequency of Citation (FC) per species.** The frequency of citations per species (FCs) is the number of informants who mentioned a citation for the species. According to Prance *et al*. (1987), calculating FCs is in Eq. (3).

$$FC_S = \sum_{i=i_1}^{i_N} UR_i \quad (3)$$

(iv) **Relative Frequency of Citation (RFC) Index per species.** According to Tardío & Pardo-De-Santayana (2008), the formula for calculating RFCs is in Eq. (4). In this formula, FCs is the frequency of citation (FC) of species (ethnospecies), while N is the total number of informants in the study.

$$RFC_s = \frac{FC_S}{N} \quad (4)$$

(v) **Relative Importance (RI) Index per species.** The formula for calculating the relative importance index per species (RIs), according to Tardío & Pardo-De-Santayana (2008), is in Eq. (5).

$$RI_s = \frac{RFC_{s(max)} + RNU_{s(\max)}}{2} \quad (5)$$

The following formula determines RFCs(max); the relative frequency of citation for the species over the maximum is in Eq. (6).

$$RFC_{s(max)} = \frac{FC_S}{Max\ FC} \quad (6)$$

FC_s are the frequency of citation values for species, while max FC is the maximum value of frequency of citation for the most versatile species in the study. The formula for calculating the relative number of use categories per species over the maximum is seen in Eq. (7).

$$RNU_{s(\max)} = \frac{NU_S}{Max\ NU} \quad (7)$$

NU_s is the number of uses for species, while max NU is the maximum value of the number of uses for the most versatile species in the study.

(vi) **Cultural Importance (CI) Index per species.** The cultural importance index per species (CI_s) is the same as the use value index per species (UV_s) because it starts by adding up the total number of use reports across all use categories for species (UR_s), then dividing it by the actual number of informants in study (N). Calculating CI values, according to Tardío & Pardo-De-Santayana (2008), is seen in Eq. (8).

$$CI_S = \sum_{u=u_1}^{u_{NC}} \sum_{i=i_1}^{i_N} \frac{UR_{ui}}{N} \quad (8)$$

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(vii) **Cultural Value (CV) Index per species.** The formula for calculating the cultural value index per species (CVs), according to Reyes-García *et al*. (2006), is in Eq. (9).

$$CV_S = \left[\frac{NU_S}{NC}\right] \times \left[\frac{FC_S}{N}\right] \times \left[\sum_{u=u_1}^{u_{NC}} \sum_{i=i_1}^{i_N} \frac{UR_{ui}}{N}\right] \quad (9)$$

2.3.2. Analysis of species literacy in biology student teachers

The species literacy test consists of species identification skills and in-depth knowledge of species. Species identification skill is scored using a partial credit system. If students can identify species correctly at the species level, they will be given a score of 1, but if students can only determine at the genus or family level, the score is 0.5 (Randler & Heil, 2021; Randler 2008). In this case, errors in spelling and vernacular names relevant to the species are justified. If students do not answer incorrectly or outside the partial credit system categories mentioned, the score is 0. For in-depth knowledge of species, it consists of 7 questions, each of which includes questions about habitat, food, the position of the species in the food pyramid, conservation status according to IUCN, predator, behavior, benefits, or roles of species for local people. The score for each correct question is 1, and the incorrect question is 0 (Hooykaas *et al*., 2022a). The total score for each species is 8. There were 13 species in this study, so the maximum total score was 104. Next, the total score obtained is divided by the maximum total score (104) and multiplied by 100. The final score obtained will be analyzed with one-way ANCOVA using IBM SPSS Statistics version 25 to determine the differences between the two groups.

3. RESULTS AND DISCUSSION

3.1. Utilization of Animals by the Local People of Enggano Island

The study results show a relationship between the local people of Enggano Island and animals regarding their economic, social, and cultural aspects. There are 64 animal species used for ten categories, including traditional medicine, consumption, decorative purposes, traditional ceremonies, breeding, pets, hunting, trading, mythology, and tools. Based on search results on the IUCN Redlist database in June 2023, the conservation status of animals used by the Enggano tribe is divided into several categories, namely Not Evaluated (NE), Least Concern (LC), Near Threatened (NT), Vulnerable (VU), Endangered (EN), and Critically Endangered (CR). The population trends of each species used by the Enggano tribe include Unknown, Stable, Decreasing, and Increasing. Several species do not have conservation status and population trends in the IUCN Redlist database. The animals used by the Enggano tribe, their conservation status, and population trends are in **Table 2**.

The potential animal diversity based on ethnozoology in Enggano Island belongs to both the invertebrate and vertebrate species. These animals consist of 13 classes, namely Anthozoa, Malacostraca, Oligochaeta, Cephalopoda, Gastropoda, Bivalvia, Arachnida, Insecta, Holothuroidea, Actinopterygii, Reptilia, Aves, and Mammals. The number of animal species for each class and each use category is in **Figure 3.**

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Table 2. Utilization of animals by the Enggano Tribe on Enggano Island, Indonesia.

No	Scientific Name	Common Name	Vernacular Name	Utilization	Status Conserva-tion[a)]	Current Population Trend[b)]
1	*Euplexaura* spp.	Sea fan	Akar bahar	Traditional medicine Decorative purposes Trade	-	-
2	*Lumbricus rubellus*	Humus earthworm	Cacing tanah/ *Hier*	Traditional medicine	NE	-
3	*Pinctada* sp.	Pearl shell	Kerang Mutiara	Decorative purposes	-	-
4	*Tridacna* spp.	Elongate giant clam	Kima/Kimo	Consumption Decorative purposes Trade Tools	-	-
5	*Geloina coaxans*	Common geloina	Lokan bakau/Lokan	Consumption Trade	NE	-
6	*Corbicula* sp.	Clam	Remis/Rimis	Traditional medicine Consumption	-	-
7	*Cypraea* spp.	Cowries	Sikucing	Decorative purposes	-	-
8	*Nautilus* spp.	Nautilus	Siput laut	Decorative purposes	-	-
9	*Trochus niloticus*	Commercial top shell	Keong lola/Loklak	Consumption Trade	NE	-
10	*Lambis lambis*	Common spider conch	Kerang tanduk/Eba-eba	Consumption Decorative purposes Trade	NE	-
11	*Cassis cornuta*	Horned Helmet	Kerang kepala kambing	Decorative purposes	NE	-
12	*Charonia tritonis*	Giant triton snail	Triton terompet	Traditional ceremony Tools	NE	-
13	*Penaeus* spp.	Shrimp	Udang/*Epaik/Nuki*	Consumption Trade	-	-
14	*Scylla serrata*	Mangrove crab	Kepiting bakau/*Ya'Ec/Eyukh*	Consumption Trade	NE	-
15	*Panulirus* spp.	Lobster	Lobster	Consumption Trade	-	-
16	*Apis* sp.	Honeybee	Lebah madu/*Ebih*	Traditional medicine	-	-
17	*Myrmeleon* spp.	Ant lion	Undur-undur	Traditional medicine	-	-

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Table 2 (Continue)**.** Utilization of animals by the Enggano Tribe on Enggano Island, Indonesia.

No	Scientific Name	Common Name	Vernacular Name	Utilization	Status Conserva-tion[a)]	Current Population Trend[b)]
18	*Araneae* spp.	Spider	Laba-laba	Traditional medicine	-	-
19	*Holothuria* spp.	Sea cucumber	Teripang	Trade	-	-
20	*Channa striata*	Snakehead murrel	Ikan Gabus/*Eeyauye* gabus	Traditional medicine Consumption Trade	LC	Stable
21	*Anabas testudineus*	Climbing perch	Betok/*Eeyauye* betook	Consumption	LC	Stable
22	*Anguilla marmorata*	Giant mottled eel	Sidat, Pelus/*Kama/moak*	Consumption Trade	LC	Unknown
23	*Hemiramphus far*	Blackbarred halfbeak	Julung-julung	Consumption Trade	NE	-
24	*Chelon subviridis*	Greenback mullet	Belanak/Jompol	Consumption Trade	LC	Unknown
25	*Lethrinus nebulosus*	Spangled emperor	Lencam kuning/Ketambak	Consumption Trade	LC	Unknown
26	*Lutjanus fulviflamma*	Blackspot snapper	Ikan tanda/Kunyit-kunyit	Consumption Trade	LC	Unknown
27	*Lutjanus rivulatus*	Speckled snapper	Kampo/Kakap sirip kuning	Consumption Trade	LC	Unknown
28	*Lutjanus malabaricus*	Malabar snapper	Kakap merah	Consumption Trade	LC	Unknown
29	*Lutjanus argentimaculatus*	Mangrove jack	Jarang gigi/Kakap bakau	Consumption Trade	LC	Unknown
30	*Upeneus cf. Sulphureus*	Yellowbelly goatfish	Kunir/Pinang-pinang	Consumption Trade	LC	Stable
31	*Tylosurus crocodilus*	Hound needlefish	Caroang/Todak	Consumption Trade	LC	Unknown
32	*Siganus* spp.	Spinefoots	Baronang/Ikan cabe-cabe	Traditional medicine Consumption Trade	-	-
33	*Caranx ignobilis*	Giant trevally	Ikan gebur/Arau	Consumption Trade	LC	Unknown

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Table 2 (Continue)**.** Utilization of animals by the Enggano Tribe on Enggano Island, Indonesia.

No	Scientific Name	Common Name	Vernacular Name	Utilization	Status Conserva-tion[a)]	Current Population Trend[b)]
34	*Epinephelus coioides*	Orange-spotted grouper	Kerapu balong/Kerapu muara	Consumption Trade	LC	Decreasing
35	*Epinephelus spilotoceps*	Epinephelus spilotoceps	Kerapu botol/Kerapu macan	Consumption Trade	LC	Stable
36	*Variola albimarginata*	White-edged lyretail	Kerapu gunting/Kerapu nanas	Consumption Trade	LC	Decreasing
37	*Scarus* spp.	Parrotfish	Ikan kakatua/ Bayam-bayam	Consumption Trade	-	-
38	*Kyphosus vaigiensis*	Brassy chub	Kakap lodi/Narun	Consumption Trade	LC	Unknown
39	*Ostracion cubicus*	Yellow boxfish	Ikan kotak kuning	Consumption Trade	LC	Stable
40	*Acanthurus xanthopterus*	Yellowfin surgeonfish	Botana belang kuning/Lodem	Consumption Trade	LC	Stable
42	*Terapon jarbua*	Jarbua terapon	Kerong-kerong	Consumption Trade	LC	Unknown
43	*Lobotes surinamensis*	Tripletail	Kakap hitam/ Bekuku	Consumption Trade	LC	Stable
44	*Plectorhinchus vittatus*	Oriental sweetlips	Kaci belang/Ikan zebra	Consumption Trade	LC	Unknown
45	*Chelonia mydas*	Green sea turtle	Penyu hijau/*Ekeh*/ *Bakbebak*/Katung biasa	Traditional ceremony Tools	EN	Decreasing
46	*Eretmochelys imbricata*	Hawksbill sea turtle	Penyu sisik/*Ekeh*/ *Bakbebak*/Katung karang/Katung sisik	Traditional ceremony Decorative purposes	CR	Decreasing
47	*Python reticulatus*	Reticulated python	Ular sanca/*Eyapu'u*	Traditional medicine	LC	Unknown
48	*Crocodylus porosus*	Saltwater crocodile	Buaya muara/*Ebuaiya*	Traditional medicine Mythology	LC	Unknown
49	*Varanus salvator*	Water monitor	Biawak air/*Eddhaiya*	Traditional medicine	LC	Unknown
50	*Hemidactylus frenatus*	Common house gecko	Cicak	Traditional medicine	LC	Increasing

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Table 2 (Continue)**.** Utilization of animals by the Enggano Tribe on Enggano Island, Indonesia.

No	Scientific Name	Common Name	Vernacular Name	Utilization	Status Conserva-tion[a)]	Current Population Trend[b)]
51	*Gallus gallus domesticus*	Domestic chicken	Ayam kampung/*Anyam*	Traditional medicine Consumption Decorative purposes Breeding Pets Mythology	NE	-
52	*Ducula oenothorax*	Enggano imperial-pigeon	Pergam hijau enggano/*Ke'ep* pergam	Consumption Hunting	NT	Stable
53	*Treron vernans*	Pink-necked green pigeon	Punai gading/*Ke'ep* punai	Consumption Pets Hunting	LC	Stable
54	*Gracula religiosa enganensis*	Enggano hill myna	Beo enggano/*Hia*	Pets Hunting	LC	Decreasing
55	*Psittacula longicauda*	Long-tailed parakeet	Betet ekor panjang/*Iyak ha*	Pets Hunting	VU	Decreasing
56	*Zosterops salvadorii*	Enggano white-eye	Kacamata enggano/*Ke'ep* mikmik	Hunting Pets	LC	Decreasing
57	*Ciconia* spp.	Stork	Bangau/*Akomak*	Mythology	-	-
58	*Pteropus* spp.	Small flying fox	Kalong/*Hoan*	Traditional medicine	-	-
59	*Bos javanicus domesticus*	Bali cattle	Sapi bali/*Kaakuyurru/Ekapi'i*	Consumption Breeding	NE	-
60	*Bubalus bubalis*	Domestic water buffalo	Kerbau air/*Karbo/Ekadabae*	Consumption Breeding Tools	NE	-
61	*Capra aegagrus hircus*	Domestic goat	Kambing/Kami	Consumption Breeding	NE	-
62	*Sus scrofa*	Wild boar	Babi hutan/*Yaruuiya/Eeyebbe /Ekeiye*	Consumption Hunting Trade	LC	Unknown
63	*Canis lupus familiaris*	Domestic dog	Anjing kampung/*Ebe*	Pets Hunting	NE	-
64	*Felis catus*	Domestic cat	Kucing kampung/*Eiyae'e*	Pets	NE	-

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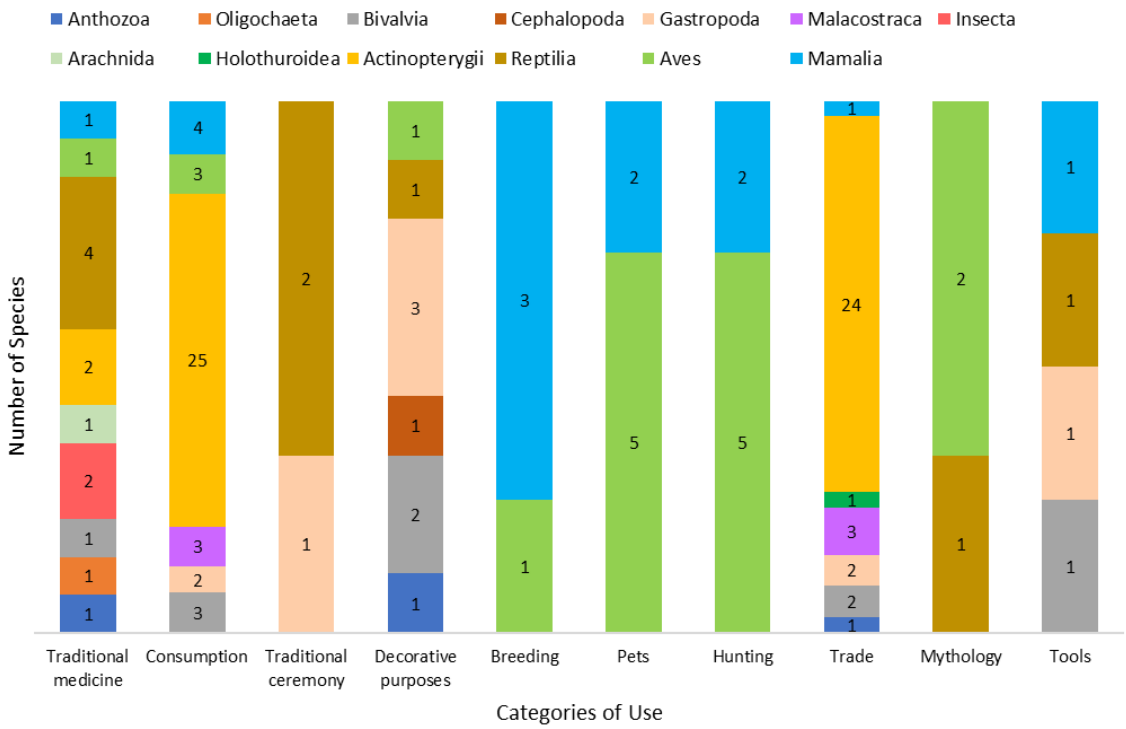

Figure 3. Number of animal species used by the Enggano tribe based on class and category of use.

Based on **Figure 3**, the category of animal commonly used by the people of Enggano Island is for consumption. Actinopterygii, Malacostraca, Gastropoda, and Bivalvia are the most common food sources. To meet their protein needs, the Enggano tribe consumes saltwater fish and other marine animals. They catch it for personal consumption but also as an economic resource. Most people living in coastal areas are fishermen with traditional ecological knowledge of marine animal species and their uses (de Sousa *et al*., 2022). The abundance of species in a particular area strongly correlates to the extensive utilization of natural resources (Jaroli *et al*., 2010; Turner *et al*., 2022). Differences in environments and ecosystems greatly influence local people's interactions with animals (Solís & Casas, 2019). People living on an island are closely related to marine species and species in other ecosystems. The animals used by the Enggano tribe are not only from marine ecosystems but also from other ecosystems such as forest, swamp, and mangrove ecosystems. This relationship is essential for effective management in marine, coastal, and other regions (Narchi *et al*., 2014). Coastal communities have several ethnozoology practices, including ethnotaxonomy, food taboos, traditional medicine, animal utilization, and fishery resource management plans (Seixas & Begossi, 2001).

The Enggano tribe uses animals to treat various diseases. *Euplexaura* spp. (sea fan) is the most popular animal used for traditional medicine. The Enggano tribe categorizes sea fans into two types: black sea fans and white sea fans. White sea fans are used to cure toxicity caused by consuming fish or marine animals. On the other hand, black sea fans are used as bracelets to treat conditions such as rheumatism, gout, and various types of pain, as shown in **Figure 4.** The use of sea fans as traditional medicine is popular among people living in the Indonesian archipelago. Sea fans contain protein components and secondary metabolites such as phenols, alkaloids, hydroquinone, flavonoids, triterpenoids, saponins, and steroids, indicating therapeutic potential (Teffu *et al*., 2015). The Enggano tribe also uses animal organs and animal derivative products such as bile, liver, testicles, eggs, blood, meat, honey, and

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whole animal bodies for medicine. The animal's body parts are processed using several techniques, such as burning or consuming them directly. Local people use various preparation techniques to process animal organs and animal-derived products into traditional medicine, such as direct consumption, cooking, heating, mixing, and other methods (Hassan *et al*., 2022; Hussain & Tynsong, 2021). Using animals in traditional medicine provides potential studies about animal-derived compounds with therapeutic benefits (Kendie *et al*., 2018).

Figure 4. Bracelets from *Euplexaura* sp. as traditional medicine.

For decorative purposes, ornaments that are famous from the Enggano tribe are head accessories from *Gallus gallus domesticus* feathers. The number of chicken feathers on the head accessory symbolizes the number of sub-tribes on Enggano Island, as shown in **Figure 5**. This headdress is only worn by the Chief of the Enggano tribe during traditional ceremonies. Cephalopods, gastropods, and bivalves are dominant animals used for other decorative purposes. The beauty and uniqueness of the shell have high artistic value, so it is often used as a commodity in the antique trade (Ordinario & Anticamara, 2023). Trade in animals for decorative purposes also threatens the survival of animal species, so legal regulations are needed to increase awareness among buyers and sellers (Alves, 2012).

Figure 5. Head accessories from feathers of *Gallus gallus domesticus.*

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The Enggano tribe uses green sea turtles as a culinary dish in traditional ceremonies. Traditional ceremonies that serve sea turtles as food are the *Buka Pantang* (a period of mourning for the death of a tribal chief) and the traditional marriage ceremony. The people of Enggano Island believe that if sea turtles are not included in traditional ceremonies, these activities will not occur well. This traditional ceremony shows the high demand for sea turtle meat. Over six months, the average number of sea turtles used in traditional marriage ceremonies is 16, and the annual demand for sea turtle meat reaches 11.2 tons (Tambunan *et al*., 2021). For breeding purposes, livestock is dominated by *Bubalus bubalis*, *Bos javanicus*, and *Capra aegagrus hircus*. Several animal species that are also kept as pets are *Felis catus* and *Canis lupus familiaris*. Animal domestication is part of the culture of local people. Cultural factors and anthropogenic activities significantly impact animal domestication, resulting in changes in animal behavior, physiology, and morphology (Zeller & Göttert, 2019).

The Enggano tribe engages in animal hunting. Wild boar is the most common game hunted by the local people of Enggano Island. Hunted wild boars are utilized both for trade and consumption. The Enggano tribe commonly uses domestic dogs that have undergone training to track and capture wild boars. Hunting wild boar in Indonesia using dogs is one of the most popular methods because it has a high success rate (Pattiselanno *et al*., 2023). Culturally, local people consider dogs useful for hunting and symbolic guardians because they can protect humans and be loyal friends (Plata *et al*., 2019). The Enggano tribe also hunts animals as pets. Endemic bird species hunted and kept as pets include *Gracula religiosa enganensis*, *Psittacula longicauda*, and *Zosterops salvadorii*. *Gracula religiosa enganensis*, a subspecies of *Gracula religiosa*, is currently very vulnerable to extinction due to poaching and illegal trade (Jarulis *et al*., 2021).

The Enggano tribe also has mythological animals such as storks, domestic chickens, and crocodiles. The Enggano tribe interprets the chirping of a domestic chicken at night as a sign that a girl is pregnant out of wedlock (without a husband), while a stork flying across the village is a sign that someone will die. Another mythological creature popular among the people of Enggano Island is the white crocodile. The white crocodile is considered the guardian of the lake Bak Blaw. This crocodile will show itself if someone commits terrible acts such as creating pollution, throwing rubbish carelessly, and committing indecent acts around the lake. If someone who commits terrible acts sees the appearance of a white crocodile, the person will get sick. Belief in mythological creatures leads the people of Enggano Island to be more careful in their behavior. They avoid something that taboos for doing, especially in places considered sacred. Animal mythology that develops in local people contains practical values that form positive attitudes and behavior toward living creatures and the environment (Permana *et al*., 2019). Regardless of the differences in belief among local community groups, mythology is a cultural identity of the population that contains symbolic activities and taboos closely related to religion and spirituality (Berk, 2016; Bobo *et al*., 2015).

The Enggano tribe commonly uses dead animal body parts as tools. *Bubalus bubalis* horns are used as handles for their traditional weapons. The shells of *Tridacna* spp. can be used as cigarette ashtrays. The carapace of *Chelonia mydas* serves as a feeding spot for chickens. Additionally, **Figure 6** shows that the shell of *Charonia tritonis* is used as a blowing instrument for a trumpet-like device known as a *Kemiu*. This instrument has a sound transmission range exceeding 1 kilometer. *Kemiu* is employed in customary practices, particularly during fighting performances, collaboration, or community gatherings. Only specific people, typically traditional figures, can blow *Kemiu*.

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Figure 6. *Kemiu*, a sound-producing wind instrument from the shell of *Charonia tritonis*.

3.2. Quantitative Ethnozoology of Enggano Island

Quantitative analysis was also carried out in this study. Based on the results of interviews, we analyzed quantitative data to determine which species were considered essential and very useful for the local people of Enggano Island. We carry out an analysis of basic values, including Use Report (UR), Number of Uses (NU), and Frequency of Citation (FC). The index calculations in this study include the Relative Frequency of Citation (RFC) index, the Relative Importance (RI) index, the Cultural Importance (CI) index, and the Cultural Value (CV) index.

The CI index is used to find out which species are most important in the culture of local people. Based on the CI index in **Table 3**, the most important species that has the highest cultural value for the local people of Enggano Island is the *Chelonia mydas*. *Chelonia mydas* has the highest CI index (1.071). The CI index plays a role in identifying which species are the highest priority for conservation action because they are threatened due to human use (Shaheen *et al*., 2017). Based on the CI value, it can be concluded that *Chelonia mydas* is the most important species to be conserved on Enggano Island. This data also aligns with the IUCN conservation status that *Chelonia mydas* is included in the endangered (EN) category, where the population trend decreases over time.

Based on **Table 3**, the CI index has a strong correlation with the RFC index. *Chelonia mydas* has the highest RFC index (1,000) among other species. Based on the RFC index, it is known that *Chelonia mydas* is the species most frequently mentioned by respondents. The highest RFC index indicates that the species is widely known and used by local people (Faruque *et al*., 2018). Based on the CI index, the second rank for animals considered culturally important by the Enggano tribe is *Gallus gallus domesticus* (1.036), while the third rank is *Sus scrofa* (0.964). According to the RFC index, *Euplexaura* spp. is in second rank (0.714), while *Gallus gallus domesticus* is in third (0.643).

The RI and CV indices determine a species' relative importance and cultural value. **Table 3** shows that *Gallus gallus domesticus* has the highest RI (0.821) and CV (0.399) values among other species. *Gallus gallus domesticus* has six Number of Uses (NU), including traditional medicine, consumption, decorative purposes, breeding, pets, and mythology. This index indicates that *Gallus gallus domesticus* has a high cultural value for the Enggano tribe.

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Table 3. Basic value, indices, and indices rank of animal utilization by local people on Enggano Island, Bengkulu, Indonesia.

No	Scientific Name	Indonesia Name	Basic Value			Indices				Ranking			
			UR	NU	FC	RFC	RI	CI	CV	RFC	RI	CI	CV
1	*Euplexaura* spp.	Akar bahar	23	3	20	0.714	0.607	0.821	0.176	2	3	4	3
2	*Lumbricus rubellus*	Cacing tanah	14	1	14	0.500	0.333	0.500	0.025	5	19	13	22
3	*Pinctada* sp.	Kerang Mutiara	3	1	2	0.071	0.119	0.107	0.001	51	61	59	61
4	*Tridacna* spp.	Kima	14	4	11	0.393	0.530	0.500	0.079	11	4	14	8
5	*Geloina coaxans*	Lokan bakau	7	2	6	0.214	0.274	0.250	0.011	26	24	32	29
6	*Corbicula* sp.	Remis	6	2	3	0.107	0.220	0.214	0.005	44	38	39	39
7	*Cypraea* spp.	Mata kucing	3	1	3	0.107	0.137	0.107	0.001	45	59	60	58
8	*Nautilus* spp.	Siput laut	3	1	2	0.071	0.119	0.107	0.001	52	62	61	62
9	*Trochus niloticus*	Keong lola	19	2	13	0.464	0.399	0.679	0.063	8	12	8	10
10	*Lambis lambis*	Kerang tanduk	11	3	9	0.321	0.411	0.393	0.038	18	10	18	13
11	*Cassis cornuta*	Kerang kepala kambing	3	1	3	0.107	0.137	0.107	0.001	46	60	62	59
12	*Charonia tritonis*	Triton terompet	13	2	11	0.393	0.363	0.464	0.036	12	15	15	16
13	*Penaeus* spp.	Udang	8	2	6	0.214	0.274	0.286	0.012	27	25	28	26
14	*Scylla serrata*	Kepiting bakau	7	2	5	0.179	0.256	0.250	0.009	33	30	33	31
15	*Panulirus* spp.	Lobster	7	2	4	0.143	0.238	0.250	0.007	39	35	34	36
16	*Apis* sp.	Lebah madu	6	1	6	0.214	0.190	0.214	0.005	28	52	40	40
17	*Myrmeleon* spp.	Undur-undur	4	1	4	0.143	0.155	0.143	0.002	40	57	50	51
18	*Araneae* spp.	Laba-laba	3	1	2	0.071	0.119	0.107	0.001	53	63	63	63
19	*Holothuria* spp.	Teripang	7	1	7	0.250	0.208	0.250	0.006	25	42	35	37
20	*Channa striata*	Ikan gabus	16	3	13	0.464	0.482	0.571	0.080	9	6	10	7
21	*Anabas testudineus*	Ikan betook	2	1	2	0.071	0.119	0.071	0.001	54	64	64	64
22	*Anguilla marmorata*	Sidat	11	2	9	0.321	0.327	0.393	0.025	19	20	19	20
23	*Hemiramphus far*	Julung-julung	4	2	1	0.036	0.185	0.143	0.001	64	54	51	60
24	*Chelon subviridis*	Belanak	7	2	5	0.179	0.256	0.250	0.009	34	31	36	32
25	*Lethrinus nebulosus*	Lencam kuning	11	2	9	0.321	0.327	0.393	0.025	20	21	20	21
26	*Lutjanus fulviflamma*	Ikan tanda	4	2	2	0.071	0.202	0.143	0.002	55	43	52	52
27	*Lutjanus rivulatus*	Kampo	5	2	2	0.071	0.202	0.179	0.003	56	44	43	47
28	*Lutjanus malabaricus*	Kakap merah	10	2	6	0.214	0.274	0.357	0.015	29	26	24	23
29	*Lutjanus argentimaculatus*	Jarang gigi	5	2	3	0.107	0.220	0.179	0.004	47	39	44	44
30	*Upeneus cf. Sulphureus*	Kunir	4	2	2	0.071	0.202	0.143	0.002	57	45	53	53
31	*Tylosurus crocodilus*	Todak	5	2	3	0.107	0.220	0.179	0.004	48	40	45	45
32	*Siganus* spp.	Baronang	20	3	14	0.500	0.500	0.714	0.107	6	5	6	5

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Table 3 (Continue). Basic value, indices, and indices rank of animal utilization by local people on Enggano Island, Bengkulu, Indonesia.

No	Scientific Name	Indonesia Name	Basic Value			Indices				Ranking			
			UR	NU	FC	RFC	RI	CI	CV	RFC	RI	CI	CV
33	*Caranx ignobilis*	Ikan gebur	18	2	12	0.429	0.381	0.643	0.055	10	14	9	11
34	*Epinephelus coioides*	Kerapu balong	9	2	5	0.179	0.256	0.321	0.011	35	32	25	28
35	*Epinephelus spilotoceps*	Kerapu botol	8	2	4	0.143	0.238	0.286	0.008	41	36	29	34
36	*Variola albimarginata*	Kerapu gunting	8	2	4	0.143	0.238	0.286	0.008	42	37	30	35
37	*Scarus* spp.	Ikan kakatua	6	2	3	0.107	0.220	0.214	0.005	49	41	41	41
38	*Kyphosus vaigiensis*	Kakap lodi	8	2	6	0.214	0.274	0.286	0.012	30	27	31	27
39	*Ostracion cubicus*	Ikan kotak kuning	4	2	2	0.071	0.202	0.143	0.002	58	46	54	54
40	*Acanthurus xanthopterus*	Botana belang kuning	4	2	2	0.071	0.202	0.143	0.002	59	47	55	55
41	*Acanthurus triostegus*	Botana lorek	4	2	2	0.071	0.202	0.143	0.002	60	48	56	56
42	*Terapon jarbua*	Kerong-kerong	5	2	2	0.071	0.202	0.179	0.003	61	49	46	48
43	*Lobotes surinamensis*	Kakap hitam	5	2	2	0.071	0.202	0.179	0.003	62	50	47	49
44	*Plectorhinchus vittatus*	Kaci belang	4	2	2	0.071	0.202	0.143	0.002	63	51	57	57
45	*Chelonia mydas*	Penyu hijau	30	2	28	1.000	0.667	1.071	0.214	1	2	1	2
46	*Eretmochelys imbricata*	Penyu sisik	13	2	10	0.357	0.345	0.464	0.033	14	16	16	17
47	*Python reticulatus*	Ular sanca	6	1	5	0.179	0.173	0.214	0.004	36	55	42	43
48	*Crocodylus porosus*	Buaya muara	11	2	10	0.357	0.345	0.393	0.028	15	17	21	19
49	*Varanus salvator*	Biawak air	11	1	10	0.357	0.262	0.393	0.014	16	29	22	24
50	*Hemidactylus frenatus*	Cicak	9	1	9	0.321	0.244	0.321	0.010	21	34	26	30
51	*Gallus gallus domesticus*	Ayam kampung	29	6	18	0.643	0.821	1.036	0.399	3	1	2	1
52	*Ducula oenothorax*	Pergam hijau enggano	7	2	5	0.179	0.256	0.250	0.009	37	33	37	33
53	*Treron vernans*	Punai gading	4	3	3	0.107	0.304	0.143	0.005	50	23	58	42
54	*Gracula religiosa enganensis*	Beo enggano	20	2	14	0.500	0.417	0.714	0.071	7	9	7	9
55	*Psittacula longicauda*	Betet ekor Panjang	15	2	10	0.357	0.345	0.536	0.038	17	18	11	12
56	*Zosterops salvadorii*	Kacamata enggano	9	2	6	0.214	0.274	0.321	0.014	31	28	27	25
57	*Ciconia* spp.	Bangau	5	1	4	0.143	0.155	0.179	0.003	43	58	48	50
58	*Pteropus* spp.	Kalong	7	1	6	0.214	0.190	0.250	0.005	32	53	38	38
59	*Bos javanicus domesticus*	Sapi bali	22	2	15	0.536	0.435	0.786	0.084	4	8	5	6
60	*Bubalus bubalis*	Kerbau air	11	3	9	0.321	0.411	0.393	0.038	22	11	23	14
61	*Capra aegagrus hircus*	Kambing	12	3	8	0.286	0.393	0.429	0.037	23	13	17	15
62	*Sus scrofa*	Babi hutan	27	3	11	0.393	0.446	0.964	0.114	13	7	3	4
63	*Canis lupus familiaris*	Anjing kampung	15	2	8	0.286	0.310	0.536	0.031	24	22	12	18
64	*Felis catus*	Kucing kampung	5	1	5	0.179	0.173	0.179	0.003	38	56	49	46

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Table 4 shows that the CI index has a very strong correlation with the RFC index, and the RI index has a strong correlation with the RFC index. The CV, RFC, and CI indexes moderately correlate with NU. The second rank for the RI index is *Chelonia mydas* (0.667), followed by *Euplexaura* spp. (0.607). The second and third rank for the CV index are also *Chelonia mydas* (0.214) and *Euplexaura* spp. (0.176). Based on **Table 2**, the lowest RFC index is *Hemiramphus far* (0.036), while the lowest RI index (0.119), CI index (0.071), and CV index (0.001) is *Anabas testudineus*. This data shows that *Anabas testudineus* is not an important species for the local people of Enggano Island. During the interview, the Enggano tribe stated they did not like this animal for consumption. The local people of Enggano Island prefer marine fish to freshwater fish. Respondents in this study explained that freshwater fish seemed to have an earthy taste and aroma, so they were less desirable.

Table 4. Correlation between basic value and indices.

***Pearson* Correlation**							
	UR	**NU**	**FC**	**RFC**	**RI**	**CI**	**CV**
UR	1						
NU	0.560**	1					
FC	0.930**	0.406**	1				
RFC	0.930**	0.406**	1.000**	1			
RI	0.915**	0.785**	0.885**	0.885**	1		
CI	1.000**	0.560**	0.929**	0.930**	0.915**	1	
CV	0.834**	0.715**	0.776**	0.776**	0.890**	0.834**	1

**. Correlation is significant at the 0.01 level (2-tailed). N=64

3.3. Management and Conservation of Animals by the Local People of Enggano Island, Bengkulu, Indonesia

The Enggano tribe has indigenous knowledge of managing and conserving animals, which has been practiced for a long time. The Enggano tribe applies a strategy of catching animals that emphasizes the sustainability of species. **Table 5** shows animal-catching methods and conservation by the Enggano tribe. As conservation efforts, the Enggano tribe has rules for using animals for traditional purposes, pets, consumption, and trade. Customary fines and apologies to the tribal chief are forms of regulations binding and apply to anyone proven to have illegally hunted and sold animals without a permit.

Table 5. List animal management and conservation by the local people of Enggano Island, Bengkulu, Indonesia.

Animal	Techniques for Hunting and Catching Animals	Animal Conservation by the Enggano Tribe
Wild Boar	Wild boar hunting involves domestic dogs to chase game animals. The weapon used for hunting is a spear, while the bait is made from grated coconut.	The Enggano tribe does not catch piglets or pregnant wild boar.
Fish	Marine fish are caught using nets, fishing rods, and traditional shooting tools made of wood and iron, while freshwater fish, such as snakehead fish, are caught using fishing rods and electric shocks.	a) The Enggano tribe only catches medium to large fish. Fish that have just hatched or are still small are not caught; b) the Enggano tribe does not catch fish with poison or bombs; and c) there are customary fines for anyone who catches fish with poison or bombs.

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Table 5 (Continue). List animal management and conservation by the local people of Enggano Island, Bengkulu, Indonesia.

Animal	Techniques for Hunting and Catching Animals	Animal Conservation by the Enggano Tribe
Green sea turtles	Green sea turtles are caught using nets and spears made from wood and iron. Sea turtle catching occurs during the full moon at any time: morning, afternoon, or evening. **Figure 7** shows the capture of green turtles at night.	a) Green sea turtles may only be caught and used for traditional ceremonies; b) The maximum number of green sea turtles that may be used for traditional purposes is only three; c) The size of green sea turtles that used for traditional ceremonies that have a minimum length of 60–80 cm; d) Green sea turtles may not be bought and sold outside Enggano Island; e) There is a customary fines accompanied by an apology to all tribal chiefs for those who violate these rules.
Enggano hill myna & Long-tailed parakeet	The Enggano tribe catches the newly hatched Enggano hill myna and long-tailed parakeet birds using their hands and tools made from soft palm fiber. Hunters climb tall trees using spikes as footholds to reach bird nests. Adult birds are not caught and are allowed to mate.	a) Enggano hill myna bird can only be caught in odd years and cannot be caught in even years; b) adult Enggano hill myna and long-tailed parakeet birds cannot be caught; c) The number of Enggano hill myna or long-tailed parakeets that local people can keep as pets is one; d) Enggano hill myna and long-tailed parakeets may not be sold or taken outside Enggano Island.; e) there are customary fines for anyone who sells birds outside Enggano Island.
White-eyed Enggano	White-eyed Enggano birds were caught using the sap of the *Kayu Bendo* (*Artocarpus elasticus*). Birds caught in traps will be cleaned from sap using water.	White-eye Enggano birds may not be sold or taken outside of Enggano Island. Only the local people of Enggano Island can catch the white-eye Enggano birds to keep as pets.
Crocodile	In the past, before there was a ban on catching crocodiles, the Enggano tribe caught saltwater crocodiles using spears made of wood and iron.	There are customary fines for anyone who catches a saltwater crocodile.
Wild cows & wild buffalo	Catching wild cows and wild buffalo is prohibited.	There are customary fines for anyone who catches wild cows or wild buffalo

Figure 7. Catching *Chelonia mydas* for traditional ceremony.

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The main concern of the Enggano tribe is the conservation of green sea turtles. They do not want these animals to become extinct because it will cause the extinction of their traditions. Even though the Enggano tribe is highly aware of turtles, several respondents in this study thought that green sea turtles always lay eggs in large numbers throughout their breeding season. Respondents in this study also said that they did not take turtle eggs and hatchlings in their habitat. This knowledge and attitude make the perception that the green sea turtle population will not decline in nature. Efforts to increase knowledge about the species, especially threats to the species and potential causes of conservation failure, are essential (Ma *et al*., 2022; Ternes *et al*., 2023). This study suggests that local people knowledge about green turtles needs to be improved.

The Enggano tribe is also concerned for endemic birds. They have an adequate understanding of the native species with unique traits different from other species. This knowledge formed the Enggano tribe's perception that endemic species are important. Conservation of endemic species is also carried out to ensure the preservation of these species. Local people's perspectives and attitudes toward wildlife conservation play a significant role in the success of environmental conservation and management (Bennett, 2018; Mir *et al*., 2015; Cebrián-Piqueras et al., 2020). However, other threats, such as illegal hunting, illegal trade, and forest destruction, are also the main factors causing the decline in the population of endemic bird species on Enggano Island (Jarulis *et al*., 2021). Animal conservation by the Enggano tribe indicates an awareness of biodiversity. Indigenous knowledge about the relationship between humans and animals has economic, biological, and socio-cultural benefits to humans and nature (Alves & Souto, 2015). Cultural traditions practiced by local people provide practical values that are cost-effective, low-risk, and effective in minimizing species exploitation (Kideghesho, 2009; Rudy *et al*., 2021). As a people who live in coastal areas, the Enggano tribe has close relationships with species from various ecosystems. Ethnoconservation is part of coastal communities' culture, dominated by marine species. There is a relationship between culture and ecology, which is critical for the sustainable management of coastal, marine, and other resources (Keiluhu *et al*., 2023; Noble et al., 2020).

3.4. Species Literacy in Biology Student Teachers

The results of ethnozoology research on Enggano Island can bridge the research gap between the traditional knowledge of the indigenous people and the teaching of science and biology. The application of ethnozoology research on Enggano Island is presented in ethnozoology textbook. The Enggano Island ethnozoology textbook consists of 5 chapters, namely Ethnozoology in Human Life (Chapter I); Use of Animals by Enggano Tribe (Chapter II); Ethnotaxonomy of Animals used by the Enggano Tribe (Chapter III); Attitudes, Perceptions, Local Wisdom and Local intelligence of the Enggano tribe towards animals (Chapter IV); and, Ethnozoology Research Methodology on the Enggano tribe (Chapter V). The Enggano Island ethnozoology textbook that was developed has been validated by experts. **Table 6** shows the result of textbook validation by experts.

Table 6 shows that the textbook developed based on an ethnozoology study on Enggano Island is valid but needs to be revised based on expert suggestions before being used to empower species literacy among biology student teachers. One of the criteria for suitable learning and teaching materials to be used in learning activities is valid based on expert assessments (Sari *et al*., 2020; Dewi *et al*., 2020). After revising the textbooks, the use of textbooks to empower species literacy was implemented. We used one control class and one experimental class to evaluate the effectiveness of ethnozoology textbooks. The

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experimental class is a class that studies using Enggano Island ethnozoology textbooks, while the control class is a class that does not use Enggano Island ethnozoology textbooks. In the control class, the textbook is replaced with a general ethnozoology textbook. Even though the two classes use different textbooks, they use the PBL learning model for their learning activities.

Table 6. Validity of Enggano Island ethnozoology textbook.

Validator	Assessment Aspect	Validity (%)	Recommendation
Learning Expert	Feasibility of Content, learning support, language, and display	98.82	Some spelling errors need to be corrected
Practitioner	Feasibility of Content, learning support, language, and display	87.64	Add a question asking about local wisdom for animals in the student's area
Media Expert	Book Cover Design, Book Content/Page Design, Physical Printed Book,	100	Add running text to identify the book in the footer
Content Expert	Facts, concepts, principles, procedures, attitudes and values	100	Consistency in the use of the word “spesies” or “jenis”

Pretest and posttest data from the control and experimental classes must comply with the assumption criteria before being used in ANCOVA analysis. The ANCOVA assumption test has four criteria: variance homogeneity, residual data normality, covariate and dependent variable linearity, and regression line homogeneity. The Shapiro-Wilk test using SPSS software shows the Sig. (p-value) > 0.05, It can be concluded that the residual species literacy data is normally distributed [D(45) = 0.990, p = 0.963]. Based on the Levene test using SPSS software, the Sig. (p-value) > 0.05, it can be concluded that the variance in the species literacy data for one class and another class is homogeneous [F(1, 43) = 2.186, p = 0.147]. The following assumption needed for conducting the ANCOVA test is the linearity of the pretest and posttest data in each class**. Figure 8** shows a scatter plot of covariate data (pretest) over posttest data in the experimental class.

Based on **Figure 8**, the scatter plot shows a straight line pattern, where the higher the pretest, the higher the posttest. The scatter plot indicates that the pretest data is linear with the posttest data. **Figure 9** shows the scatter plot of covariate data (pretest) over posttest data in the control class. Similar to linearity in the experimental class, the pretest results in the control class are also linear with the posttest results.

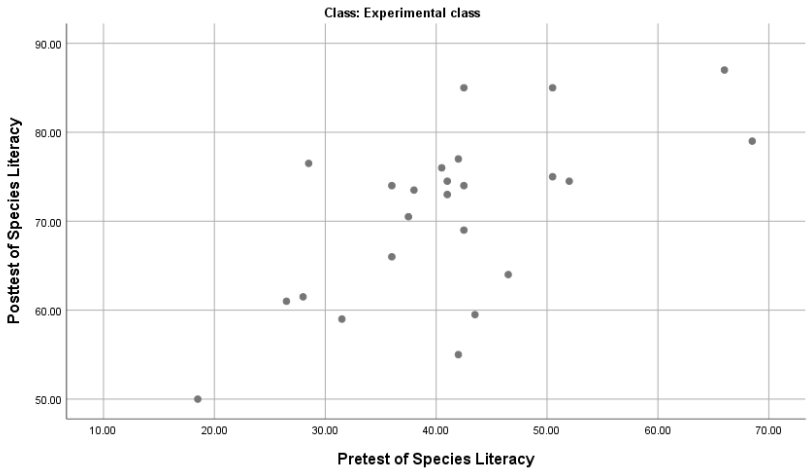

Figure 8. Scatter plot of covariate (pretest) over posttest in the experimental class.

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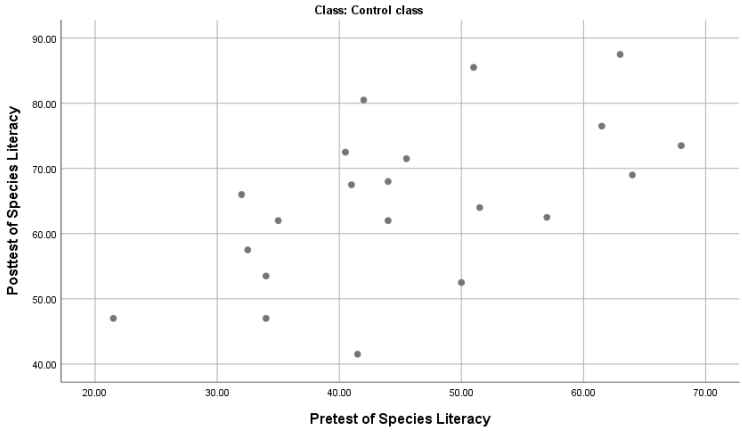

Figure 9. Scatter plot of covariate (pretest) over posttest in the control class.

The next assumption test is the homogeneity of the regression lines for the two classes. Based on the Between-Subjects Effects tests in the Class*Pretest column, using SPSS software, it is known that the value of Sig. (*p*-value) = 0.848, where $p > 0.05$. The *p*-value results show that the slope of the regression of pretest data with posttest data on species literacy between the experimental class and the control class is homogeneous. Based on the four assumption test results, the pretest and posttest data in the control and experimental classes have been qualified for ANCOVA tests. A one-way ANCOVA analysis was carried out to determine whether there were differences in species literacy in the control class and the experimental class. **Table 7** shows the results of one-way ANCOVA posttest species literacy.

Tabel 7. One-way ANCOVA of species literacy.

Tests of Between-Subjects Effects

Dependent Variable: Posttest of Species Literacy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2204.734[a]	2	1102.367	13.849	0.000	0.397
Intercept	5661.447	1	5661.447	71.124	0.000	0.629
Pretest	1841.682	1	1841.682	23.137	0.000	0.355
Class	688.283	1	688.283	8.647	0.005	0.171
Error	3343.177	42	79.599			
Total	214581.000	45				
Corrected Total	5547.911	44				

a. R Squared = 0.397 (Adjusted R Squared = 0.369)

Based on **Table 7**, it is known that Sig. (*p*-value) < 0.05, it can be concluded that there is a significant difference in species literacy between the control class and the experimental class by controlling the students' initial species literacy [$F(1, 42) = 8.647$, $p = 0.005$, $\eta p = 0.171$]. **Table 8** shows the adjusted mean in the experimental class and control class. Based on **Table 8**, the mean of the dependent variable (species literacy posttest) corrected by the pretest mean in the experimental class is greater than that in the control class. **Table 9** shows a recapitulation of species literacy means.

After implementing the Enggano Island ethnozoology textbook in the experimental class, we asked for responses from teachers and students who had used the book during learning activities. This response aims to determine ethnozoology textbooks' practicality in increasing biology teacher students' species literacy. Practicality assessment includes ease of use of books, how books can help and motivate students to learn, and how books can make learning

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activities more effective and efficient. The result of the practicality assessment of the Enggano Island ethnozoology textbook is in **Table 10**.

Table 8. Adjusted mean of species literacy in the experimental class and control class.

Estimates				
Dependent Variable: Posttest of Species Literacy				
			95% Confidence Interval	
Group	**Mean**	**Std. Error**	**Lower Bound**	**Upper Bound**
Experimental class	71.871[a]	1.834	68.169	75.573
Control class	63.910[a]	1.963	59.948	67.871
a. Covariates appearing in the model are evaluated at the following values: Pretest of Species Literacy = 43.2333.				

Table 9. Recapitulation of pretest means, posttest means, and adjusted means.

Class	Pretest		Posttest		Difference	Enhancement (%)	Adjusted means
	Mean	(SD)	Mean	(SD)			
Control	45.40	12.27	65.12	12.39	19.71	43	63.91
Experiment	41.33	11.28	70.81	9.58	29.48	71	71.87

Table 10. Practicality of Enggano Island ethnozoology textbook.

User	Practicality (%)	Response
College Teacher	98.82	Textbooks are beneficial. For further suggestions, authors can add photos of several animal species.
Students	87.64	Textbooks make learning more accessible and help students do group assignments well.

Based on **Table 9**, In the control class, there was an increase of 43% from the pretest to the posttest, while in the experimental class, there was an increase of 71% from the pretest to the posttest. The adjusted means of species literacy posttest of biology student teachers in the experimental class was 71.87. In the control class, the adjusted means of species literacy posttest of biology student teachers was 63.91. Based on the results of the one-way ANCOVA, there is a significant difference in species literacy between the control class and the experimental class by controlling students' initial species literacy. The significant differences are influenced by the different types of learning and teaching materials used. Students who use Enggano Ethnozoology textbook have higher species literacy than students who use general ethnozoology textbook. Using biology learning and teaching materials based on local knowledge can improve the learning experience and preserve traditional ecological knowledge (Andriana *et al*., 2017; Ramdiah *et al*., 2020; Zukmadini *et al*., 2020).

The Enggano Island ethnozoology textbook tries to bring local knowledge into science learning in the classroom. This textbook provides insight into animals in a local cultural context that has yet to be widely explored. Apart from containing specific information about animal species, Enggano Island ethnozoology textbook is equipped with pictures of animals and videos of local people activities related to animals on Enggano Island. The use of specific picture books has the potential to increase awareness about animal species so that it can become a trigger for discussions about animal diversity more broadly (Hooykaas *et al*., 2022b). Books with colored illustrations about animal species can improve species identification skills and more profound knowledge about species, such as ecology, behavior, species conservation, and so on (Randler, 2008). What is very interesting is that books are the

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second primary source for someone to study animals after family, teachers, or animals (Jaun-Holderegger *et al*., 2022). It shows that books are still a favorite source of information for learning about species. Learning and teaching materials developed based on ethnozoology in a local community can play a role in becoming a learning resource with conservation content and contain the values of sustainable use of animal resources. Learning and teaching materials based on local knowledge of indigenous people about biodiversity is an effort to increase species literacy (Leksono *et al*., 2023). Based on **Table 10**, the percentage of practicality of textbooks from students and lecturers is above 80%. This data shows that textbooks have high practicality for ethnozoology learning, especially in increasing students' species literacy. According to Lukman *et al*. (2023), learning and teaching materials must have good practical value in improving student learning outcomes.

Increasing species literacy among students is also influenced by learning activities. Appropriate learning strategies will be very effective in developing species identification skills and in-depth knowledge about species (Gerl *et al*., 2021; Randler, 2010). PBL learning allows students to explore their ethnozoology knowledge further. PBL learning directs students to carry out activities outside the classroom to investigate and find solutions to problems that arise from the use of animals by local people. Learning about species should focus on learning activities that emphasise students' experiences and interactions with species (Wolf & Skarstein, 2020). In PBL learning, students find solutions to overcome problems related to biodiversity issues, especially regarding the protection of animal species. PBL is a biology teaching method that can increase students' literacy species and improve problem-solving skills relevant to sustainability issues. Combining learning and teaching materials containing biodiversity issues implemented with PBL can increase students' knowledge and thinking abilities to solve problems regarding species.

Integrating local knowledge into the formal curriculum can provide contextual learning because cultural, social, and scientific elements are related to students' lives (Mpuangnan & Ntombela, 2023; Yemini *et al*., 2023). Traditional knowledge facilitates curriculum development relevant to the community's culture and for cultural sustainability (Zidny *et al*., 2021). Science teachers are crucial in providing students with knowledge and understanding of the relationship between science and local knowledge (Sotero *et al*., 2020). Ethnozoology-based learning can provide students with a more contextual and meaningful experience, influencing their knowledge about the various uses of animals and conservation. Ethnozoology learning is essential in increasing species literacy, including species morphology, behavior, taxonomy, benefits, and threats to species (Rodrigues *et al*., 2022).

4. CONCLUSION

Biodiversity potential based on ethnozoology studies on Enggano Island can be seen from the use of animals by local people, quantitative analysis of basic values and indices, and animal conservation practices. In addition, the potential for ethnozoology biodiversity on Enggano Island can also develop biological learning resources related to the local knowledge of the local people. The Enggano tribe uses 64 animal species in 10 distinct categories: traditional medicine, food, traditional ceremony, decorative purposes, breeding, pets, trade, hunting, mythology, and tools. From quantitative calculation, *Chelonia mydas* has the highest CI index (1.071) and RFC index (1.000). *Gallus gallus domesticus* has the highest RI (0.821) and CV (0.399) index. Based on the CI and RFC index, it is recognized that *Chelonia mydas* is the most important species in Enggano tribal culture because it is frequently mentioned in traditional ceremonies. The strategy of the local people of Enggano Island in capturing and

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hunting animals shows that they have animal management practices that pay attention to conservation principles.

We developed a textbook using the results of ethnozoology research on Enggano Island to facilitate ethnozoology learning and empower species literacy in biology student teachers. Based on the results of validation by experts, user practicality tests, and implementation in class, the Enggano Island ethnozoology textbook is valid, practical, and effective in increasing the species literacy of biology student teachers. In the experimental class, students who used the Enggano Island ethnozoology textbook had an adjusted mean for species literacy of 71.87. In contrast, students in the control class had an adjusted mean of 63.91.

This study has potential limitations. We indicate several unknown species with "sp" or "spp" in their scientific names. Naming animals in this manner hinders an accurate assessment of their conservation status and population trends on the IUCN Red List. Reliable species identification procedures must support future research, given the limited expertise in recognizing and naming specific animals. We will empower species literacy by involving more students and utilizing other learning methods.

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6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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