Describing and visualizing the progress of ethnozoology in Indonesia by using VOSviewer

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Abstract. As a science, ethnozoology is relatively less popular compared to ethnobotany, although local people in Indonesia have been practicing ethnozoology for thousands of years. This paper aimed to describe the progress of ethnozoology in Indonesia, specifically about research topic within ethnozoology, taxa mostly harvested by the local people, as well as institutions that mostly conduct ethnozoological research. An intensive literature study of the published papers in the last 20 years was performed. Data were analyzed by using VOSviewer. Of the 53 published literatures, VOSviewer showed that the research topic of ethnozoology based on keywords has 16 clusters with 464 links and mostly related to traditional medicine (15 occurrences; 62 total link strength) and reptiles (13 occurrences; 54 total link strength). Among vertebrates, the most widely-utilized taxon was herpetofauna (reptiles and amphibians) which were included in 44 references. The institutions that have been conducting research on this topic mostly were IPB University (15 refs), Tanjungpura University (7 refs), and Bangka Belitung University (4 refs). Although VOSviewer was meant to construct and visualize bibliometric networks based on authors/co-authors and their affiliations, citation/co-citation, and bibliographic coupling, this software can also be used to describe and visualize specific themes or topics as well.

1. Introduction
Local people in many parts of the world have been known to use environmental resources, including wild plants and wild animals (wildlife) to fulfill their daily needs [1,2,3]. There have many articles that report the wildlife utilization by the local people around the world, for example in Pakistan [4], India [5], Brazil [6], and even in Indonesia [3,7].

The knowledge of the connection between local people and their usability of environmental resources is called ethnobiology [8]. Ethnozoology is a branch of ethnobiology, which is defined as the usability of animals by the local people to fulfill their daily needs [9]. However, compared to ethnobotany (i.e. the usability of plants by the local people), ethnozoology is less explored and perhaps also less reported by researchers.

Local people in Indonesia use animals to fulfill their daily needs, including for consumption [10], traditional medicine [11], and traditional rituals and myths [12]. The information on animal use by the local people could give an overview of the current condition of ethnozoology in Indonesia. It could also help the government to determine the right direction of policies so that the local people can continue to utilize the natural resources and the wild animals while also preserving them, especially if rare and endangered species are involved.

It is useful to conduct a bibliometric analysis to understand the state of the art of ethnozoology in Indonesia. Bibliometric is a statistical technique to analyze the literatures to understand the impact of
articles on a specific research topic [13]. Currently, the information on the current condition of ethnozoological study is lacking, especially in Indonesia.

VOSviewer is “a software tool for creating maps based on network data and for visualizing and exploring these maps” [14]. This software has been increasingly popular in Indonesia and elsewhere, intended primarily for analysing bibliometric data networks. However, it can be used to create, explore, visualize, and create maps based on other types of network data. As there has been no published paper in Indonesia that using VOSviewer for ethnozoology data, this paper aimed at presenting an overview about the state of the art of ethnozoological study in Indonesia by mapping the articles from journals, scientific reports, and books by using VOSviewer. Furthermore, the objective of this paper was to analyze the progress of ethnozoology in Indonesia from VOSviewer maps (network-visualization map and overlay-visualization map).

2. Methods
The intensive literature study was done by collecting journal articles, theses, scientific reports, and books that contain an ethnozoology in Indonesia. The terms used for searching for literatures were "ethnozoology", "wildlife utilization", and "ethnobiology". Although there was no limitation to the literatures’ published year, the results showed that the available literatures were dated from 2001 to 2020. Following an intensive literature study, there were 53 literatures that could be retrieved and collected from many open source websites.

The analyses of the collected literature were using MS Excel (v. 2019), Mendeley Desktop (v. 1.19.4), and VOSviewer (v. 1.6.15). MS Excel was used to perform simple statistics and develop charts. Mendeley Desktop was used to collect and review the literatures’ metadata (e.g., title, authors, abstract, and keywords) and to export data (.ris) to be analyzed in VOSviewer. VOSviewer was used to develop maps of collaboration based on co-authorship and co-occurrence analysis.

3. Results and discussion
Network-visualization map of ethnozoology (figure 1) showed that ethnozoology was closely linked to clusters of traditional medicine, utilization, consumption, local wisdom, and traditional belief. It could indicate that most local people in Indonesia utilized wildlife species mostly for traditional medicine, consumption, or/and cultures [7,15,16]. Certain species appeared in many literatures, and the most listed was Water Monitor Varanus salvator [11,17,18]. In terms of science, papers in ethnozoology sometimes used other similar terminology, including ethnomedicine, ethnobotany, ethnobiology, and ethnoecology.

Figure 1. Network-visualization map of ethnozoology research in Indonesia. Items: 130 clusters: 16, links: 464, total link strength: 580. The data displayed was based on keywords that have two or more occurrence values.
As mentioned previously, research in ethnozoology is not as popular as ethnobotany that has been developing fast since many decades ago. Overlay-visualization map of ethnozoology research revealed that the number of researches on this topic was limited, but has been increased lately (shown in light-colored in figure 2). Institutions as affiliation of the researchers were mainly in Java. Institut Pertanian Bogor (Bogor Agricultural University, IPB University) in West Java conducted ethnozoological research the most (figure 3), as many as 28.3% of the total research (figure 4), followed by Tanjungpura University (West Kalimantan Province) with 7 research papers, and the University of Bangka Belitung (in Bangka Belitung Province) with 4 papers. Based on figure 4 (right side), Tanjungpura University had ethnozoological studies that were most recent than other institutions (indicated by the lightest colored point), followed by Institut Pertanian Bogor. Some important studies from Tanjungpura University could increase the information of Dayak Tribe's wildlife utilization since this tribe had several sub-tribe (such as Dayak Ella, Dayak Seberuang, and Dayak Belangin) that still exploit the natural resources to fulfill their daily needs [12,16,18].

Figure 2. Overlay-visualization map of ethnozoology research in Indonesia based on publishing year; the oldest was 2001, the newest was 2020; light colors indicated newer research.

Of the 24 universities that researched ethnozoology, only 20 universities had done one to two research, leading to a conclusion that the ethnozoology topic was not a popular topic yet. The good news is that the universities that have been doing research were scattered all over Indonesia’s Archipelago, from Papua University [19]; [20] in the eastern part to Andalas University [21] in the western part of Indonesia. Foreign universities also showed some interest in this topic. So far, researchers from the University of Washington in the US and Oxford Brookes University in the UK have published papers on Indonesia’s ethnozoology [22]. In terms of researchers, so far it is still difficult to mention Indonesian researcher(s) with a long track record in ethnozoology (figure 5). All of the identified researchers conduct ethnozoological research only once, twice, or on an intermittent basis. There was only one or two researcher(s) that has the most ethnozoological study publication from IPB University and Tanjungpura University. Therefore, long-term research on ethnozoology should be conducted to enrich the information on ethnozoology in Indonesia.
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**Figure 3.** Network-visualization map of the researcher of ethnozoology study in Indonesia based on clusters (left; items: 119, clusters: 44, links: 154, total link strength: 163) and year of publication (right; the oldest was 2001, the newest was 2020).
Collaboration between/among universities, however, was very limited. Most published papers were originated from small research activities to get academic degrees in universities, including Bachelor, Master’s, and Doctoral degree. Besides, the research was conducted in a short time, not a multi-year basis. Therefore, the results of the research were still at the early stage of the development stage, which can be categorized as Phase 3 by many researchers (i.e., [8]), that focused on publication and ethnoecology. Phase 4, the collaboration of various stakeholders, was still not detected yet amongst the paper being studied. Reaching the highest position (i.e. Phase 5; research and activities that have moved forward to biocultural diversity) is obviously still far away.

Figure 4. The affiliation institutions of researchers who have published ethnozoology papers analyzed in this paper.

Figure 5. Density-visualization map of the researcher of the ethnozoology study in Indonesia
The animals used by the local people in Indonesia.

Taxa that have been utilized the most by the local people as the object of ethnozoology were reptiles (figure 6), similar to findings in Brazil [15] and India [16]. In fact, all higher (Chordata, animals with backbones) taxa were listed as useful species by the local people. Lower taxa also have been used, including Arthropoda, Annelida, and Mollusca. If certain species were used as traditional medicine based on belief and word to mouth information, further research is still needed to reveal its actual remedies.

4. Conclusion
The development and state of the art of ethnozoology study in Indonesia were still at the early stage. Although VOSviewer was originally designed to construct and visualize bibliometric networks based on authors/co-authors and their affiliations, citation/co-citation, and bibliographic coupling, this software can also be used to describe and visualize specific themes or topics within ethnozoology as well. Certain modifications on the database construction, however, need to be done to produce the desired output.

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