

## RESEARCH ARTICLE



# The Bibliometric Analysis of The Sunda Pangolin (*Manis javanica* Desmarest, 1822) Ecological Research in Indonesia

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## Abstract

Illegal wild animal trade is a conservation threat, predominantly in Indonesia. Most of the animals traded is the pangolin which almost all parts of the body are used, especially the scales. This research used a bibliometric review that uses *Scopus* and Google Scholar to analyse publications for one decade to map trends and gaps in pangolin research. The result of this research showed that the total of publications significantly increased over several decades, but the topic for pangolin research is not learned in the same proportion. There is a gap between the distribution of pangolin research topics, where dominated by ecology (48%) and wildlife conservation (37%), while conservation status (1%), *Manis* (1%), genome (1%), genetics (1%), and wildlife trade/hunting (1%). There is an inconsistency between the researchers in developed countries and developing countries where more research is conducted in developed countries than developing countries. The data from the analysis research collected systematically in developing countries were not published proficiently, therefore it caused several publications to fall into the grey literature. There are some research gaps, which are research topics are not diverse and have too many things in common, other than that the population data is not aligned with the biodiversity distribution and conservation priorities, especially concerning endangered species such as pangolins. The success of conservation relied on the policymakers and practitioners, and the implications of this research gave suggestions for the management to overcome the pangolin trade polemic that has become increasingly widespread recently.

Keyword: conservation, ecology, *Manis javanica*, pangolin, wildlife

## 1. Introduction

Pangolin (*Manis javanica* Desmarest, 1822) is an insectivorous mammal in the pholidota order, which is at risk of extinction in nature. In the last 15 years, the population of Javanese pangolins in nature has decreased to 50%. The population of pangolins is estimated to be only 350-700 individuals particularly in conservation areas in Java [1]. This condition caused pangolins to be categorized as Critically Endangered in Redlist IUCN (*International Union for Conservation of Nature and Natural Resources*) (IUCN 2008) and included in Appendix I CITES since 2017 according to (*Convention on International Trade in Endangered Species of Wild Fauna and Flora*). Apart from that, pangolin is also one of the one of the protected species in the Republic of Indonesia Government Regulation Number 7 of 1999 regarding Preserving Types of Plants and Animals and included in the high priority species based on Minister of Forestry Regulation Number P.57/Menhut-II/2008 concerning Strategic Directions for National Species Conservation 2008–2018.

The main reason for the decrease in the pangolin population is rampant hunting and illegal trade of meat, especially scales. more than 30.000 individuals of Javanese pangolins were officially traded between 1998-2007 from West Asia and Southeast Asia to China, Mexico, the USA, Hong Kong, Singapore, and Japan [2]. Scales are keratin, which is a protein that contains the active ingredient Tramadol HCl, an active substance that is an analgesic drug [1,3]. The scales are processed and sold at a high price.

The exact amount of pangolin population on Java Island remains unknown, but it is estimated that it will continue to decrease, and the spread is expected to narrow further. According to IUCN [4] stated that the population of Javanese pangolins in the last 15 years has decreased by more than 50%; therefore, the population in the 2000 centuries was estimated to be as much as 638.920 individuals. Pangolin conservation is the main priority of the Ministry of Environment and Forestry (KLHK) because the existence of individuals in nature is increasingly threatened, and illegal trade has become increasingly massive, especially in the last decade. Therefore, data and information regarding pangolins are essential as the basis for deciding on population management in nature (*in situ*) and outside natural habitats (*ex situ*).

Many studies regarding pangolin conservation have been conducted, but some are limited to the discussion of illegal trade and excessive exploitation, use of scales and meat, *ex situ* conservation management through captive breeding, ecology of several types of pangolins in Asia other than *M. javanica*, and the impact of overharvesting due to illegal hunting. According to Nash et al. [5] stated that pangolins are the most heavily trafficked mammals across illegal wildlife trade globally, and for Javan, pangolins (*M. javanica*) have not been widely studied, especially in insular Southeast Asia. Limited research has been conducted on the ecology of pangolins in nature, especially the Javan pangolin (*Manis javanica* Desmarest, 1822). According to Kwatrina et al. [6] states that a literature review can be used to find research to see research development trends. This research aims to identify research regarding Javan pangolin (*M. javanica*) ecology through a bibliometric search and analyzing research trends regarding pangolin conservation research in Indonesia for more than the last ten years. The research results are expected to provide information regarding the gaps in pangolin research in Indonesia. Moreover, it is hoped that this will be useful as a theoretical basis for solving problems related to *in situ* pangolin conservation, especially on the island of Java.

## 2. Materials and Methods

### 2.1. Method

This publication presents research that resulted from a literature review (LR) to provide a picture of the method, obstacles, and obstacles in a review topic. Data extraction from the literature and narrative analysis were performed between January and September 2023. Several methods of working in the library and bibliographic searches are as follows:

#### 2.1.1. Limitations of Library Search Terms

A search through Google Scholar was performed for relevant literature, using terms combination in the pangolin population and conservation. The search terms included: "Manis javanica," "Sunda Pangolin," "trenggiling," "pangolin population," "pangolin," "conservation on pangolin," "estimates population of Sunda Pangolin," "pangolin and ecology," and "distribution population of pangolin."

#### 2.1.2. Literature/Article Screening

All results from the Internet are listed in the tables and graphics and checked visually. The articles obtained from Google Scholar will be grouped according to years to help the screening process, and every website checked for relevance to the literature review, which is a priority in the literature search, then reselected based on the publication title and the most recent publication year (2011-2023). The early screening result had 326 articles and the last screening result according to keywords had as many as 51 articles. Based on the initial screening, articles will be rejected from the bibliography list if there are insufficient details about the methods used, the source is not relevant, the content of the article is not very relevant to the topic, or if the article is in a language other than English or Indonesian.

#### 2.1.3. Article Review

According to the results of the final screening/screening, an assessment of the content of the article was conducted to determine whether the information on population status obtained adequately described the current pangolin populations.; the decrease of pangolin population

caused by global or local reason? Which conservation strategy has been used by several parties to overcome the pangolin population decrease? What are the steps taken by the government and stakeholders in dealing with the pangolin trade, based on the strategic steps of several countries and Indonesia?

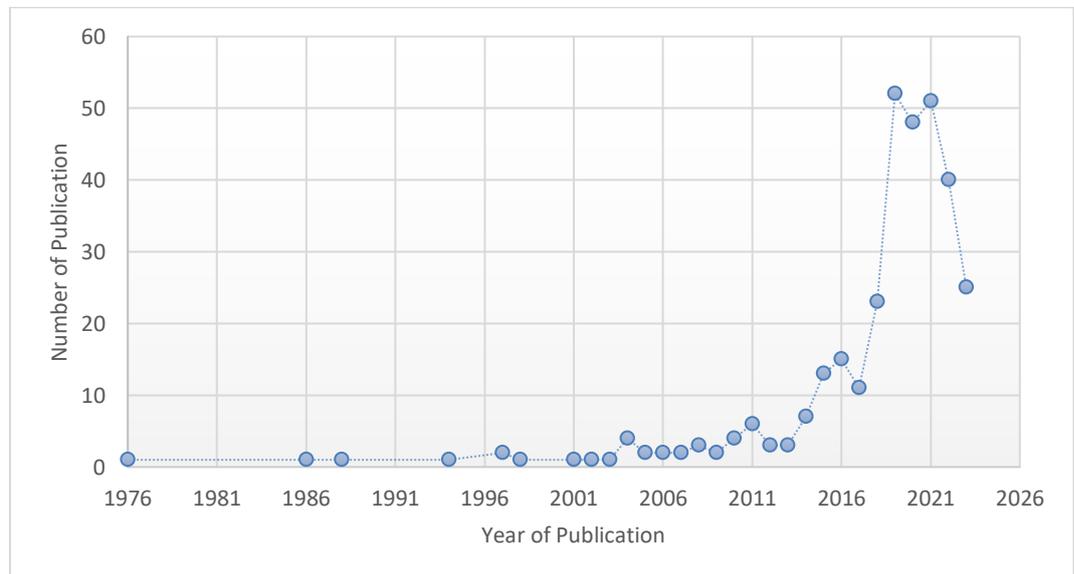
## 2.2. Data Analysis

Publication data from the screening process were exported and analyzed using the *Visualization of Similarities (VOSviewer)* application program to determine the bibliometric map. Descriptive analysis was used to draw the results of visualization using VOS-viewer to be more communicative and clearer [7].

## 3. Results and Discussion

### 3.1. Publication Based on Years

Publication analysis regarding pangolin conservation (*Manis javanica* Desmarest, 1822), focused on population estimation, ecology, and publication trends. Data was derived from the Scopus database and Google Scholar, shows that this research began in 1976, and there has been a significant increase since 2015. The results of this study are shown in **Figure 1**.



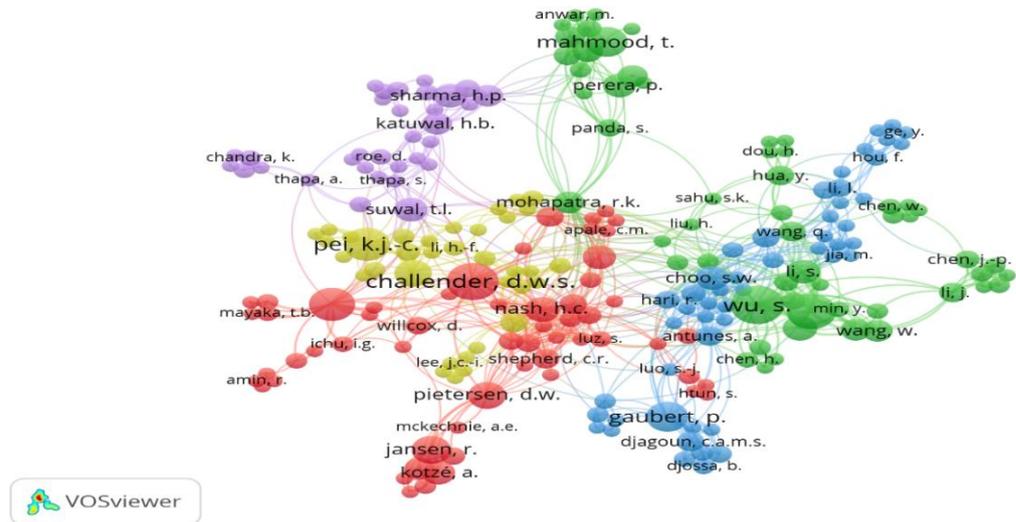
**Figure 1.** The amount of publication every year

The number of publications from the past three decades demonstrates a rise in pangolin conservation research reaching a peak of 51 publications in 2021. Subsequently, there has been a decrease, with 40 publications in 2022 and 25 in 2023. This increase in ecology research is likely linked to the conservation status change from Appendix II to Appendix I in 2017, which spurred more research on pangolins. As Heighton and Gaubert [8] noted, while pangolin research is less frequent than for other animals, the number of research finding had been steadily increasing each year.

### 3.2. The relations of authors

*Co-authorship* is an important indicator of research productivity because data about joint publications will be easier to find in a publication search [8,9]. In addition, in the development of information and communication technology, with the collaboration of authors from various parts of the world, interaction and communication become easier. Furthermore, Shahbazi-Moghadam et al. [10] stated that collaboration in research provides various benefits apart from funding issues, namely, the opportunity for the community of collaborating countries to share research source data, ideas, expertise, and facilities. Moreover, international collaboration can increase citation rates. Sharing knowledge locally or internationally can encourage the urge to publish.

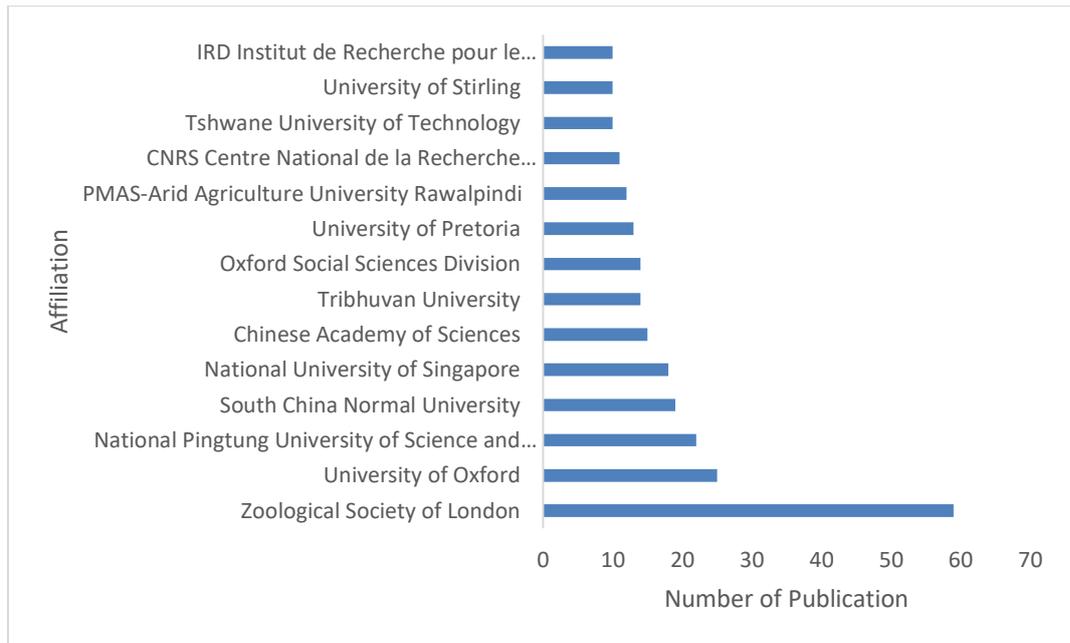
Based on the analysis of relationships between authors, it is known that there is collaboration between authors of publications on pangolin conservation. The collaboration map between authors is divided into five clusters with 229 authors (**Figure 2**) and shows the linkages between authors. Ulucak et al. [11] states that the relationship between authors is usually due to the close relationship of the authors on the same research topic. In addition, the activity of citing each other's publications also brings the relationship between authors closer. This is evidenced by the visualization of the author collaboration network map, as shown in **Figure 2**.



**Figure 2.** Author collaboration network map

The network map shows that the five clusters are closely interconnected. For example, the red author cluster is dominated by Challenger DWS from the University of Oxford affiliate and is associated with authors from the Zoological Society of London affiliate in the green cluster. The purple author cluster does not show excessive dominance among the authors, hence it is evenly distributed. In addition, some authors such as Sharma HP, Katuwal HB, Thapa A, and Thapa S collaborated on many of the same publications, although they also collaborated with authors from the green cluster such as Mohapatra RK.

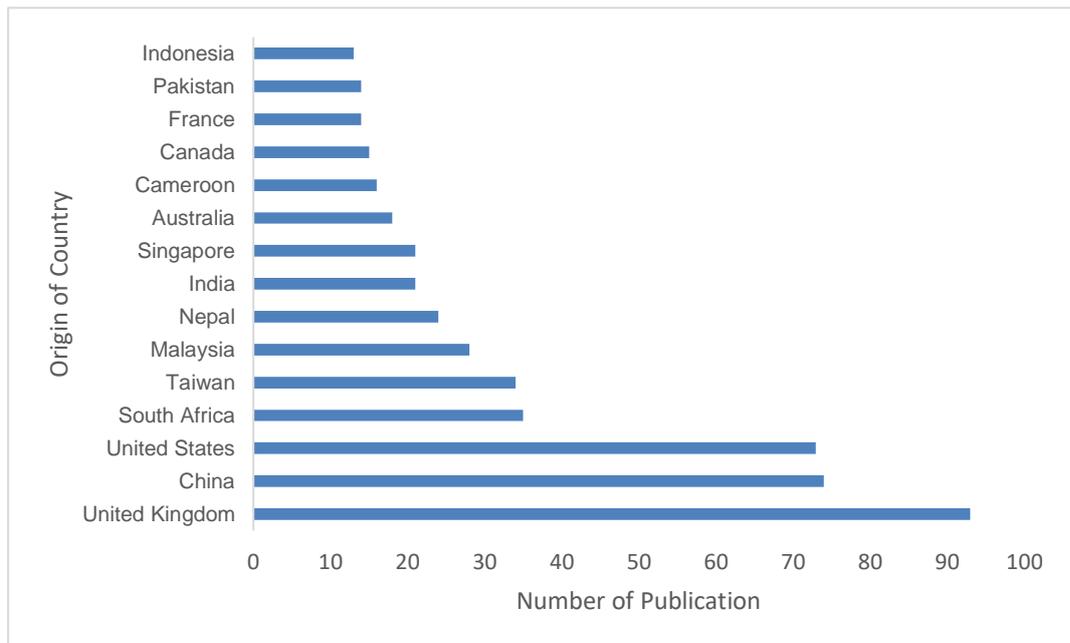
Visualization of the bibliometric analysis results of the relationship between authors, apart from informing about the research topic, is related to the author's affiliation and the distribution of publications based on affiliation (**Figure 3**). Author affiliations were dominated by the Zoological Society of London with 50 publications and the University of Oxford with 25 publications. According to Shahbazi-Moghadam et al. [10], there is a close relationship between research topics and affiliation between authors in a publication. The advantage of this linkage is that it can increase the citation rates of publications.



**Figure 3.** Publication distribution according to affiliation

**3.3. Publication distribution according to Country**

Bibliometric analysis for publication distribution according to country showed that The United Kingdom dominated pangolin publications with 93 publications, China with 74 publications in second place, followed by the United Kingdom with 73 publications. Indonesia is the least abundant country in pangolin publications, and there have been only 13 publications regarding Javanese pangolin ecology for more than a decade. According to Kahfi et al. [12], the visualization of the bibliometric analysis results for the distribution of countries in the publication collaboration network is influenced by the closeness of collaboration between different countries, and the visualization color appears dominant in the network map. The paper/publication distribution according to the country is shown in **Figure 4**.



**Figure 4.** Publication distribution according to country





## 6. Research Gap and Implication

Based on the results of the bibliometric analysis, there are many research gaps. Publications on pangolins are dominated by authors from developed countries compared to authors from developing countries, and few publications on pangolins have been published over a long period of time. Most pangolin research over a long period of time is based on camera trap observations, and it is part of time series research and not many have used the literature review (LR) method in their research. Little research has been conducted on pangolin population density and ecology in nature, as well as the spatial distribution of pangolin habitat use. According to Panaino [14], information and knowledge about the use of space, habitat selection, and behavior of pangolins are critical for effective management and conservation practices.

The bibliometric analysis also shows that publications on conservation management, especially for the Javan pangolin (*Manis javanica*), have increased in the last decade. This can be seen from the gradual increase in the number of citations, thus increasing the awareness of researchers in academia over time to continue conducting research on pangolin conservation. Bibliometric data have shown that there are many researchers distributed spatially all around the world, not only in Indonesia. This research is expected to create a roadmap for wildlife researchers to provide comprehensive information on the historical trends of research publications on Javan pangolin conservation in the last ten years based on key topics. The keywords we focus on in publications are author affiliation, co-authorship, and the country most frequently chosen as a place to publish research results.

The results of network analysis between publications in terms of citations still show a gap between author countries (divided into developing and developed countries). This paper discusses the literature review for conducting research and provides an overview of the different types of pangolin research conducted both in Indonesia and abroad. The research gap shows that there is currently very little research on pangolin conservation and populations in Indonesia when compared to the same research abroad. There is a gap between the distribution of pangolin research topics: ecology and animal conservation dominated by 48% and 37%, respectively. The percentages of ecology and animal conservation are the total percentage of topics related to ecology and wildlife conservation, including ecosystem, ecology, habitat, and conservation strategies. Therefore, less popular research topics include conservation status (1%), manis (1%), genome (1%), genetics (1%), and wildlife trade/hunting (1%).

In conclusion, ecological research is critical to pangolin conservation. It can provide information and knowledge on population dynamics, habitat requirements, ecological interactions and threats, enabling stakeholders, policy makers and practitioners to develop effective pangolin conservation strategies. In addition, this study suggests that developing countries should begin to pay attention to the study of conservation management, including ecology, population estimation, and conservation management of pangolins in the wildlife.

## 7. Conclusions

According to research that has been done on scientific articles related to pangolin ecology and conservation, the following conclusions can be drawn: (1) Research on pangolin in Indonesia has increased over the past two decades, (2) There is a gap between the distribution of pangolin research topics, ecology, and wildlife conservation dominated by 48% and 37%, while conservation status (1%), manis (1%), genome (1%), genetics (1%), and wildlife trade/hunting (1%), (3) There is a gap between the distribution of pangolin research locations and the countries of origin of researchers conducting research on pangolin ecology and conservation, with researchers from developed countries conducting more pangolin research than those from developing countries, and (4) The most widely used literature is the journal type (63%) while the rest is gray literature such as theses and dissertations (30%) and reports (7%).

## Author Contributions

**AR:** Conceptualization, Methodology, Software, Writing - Review & Editing; **RTK:** Writing - Review & Editing, Supervision, revision; and **YS:** Writing - Review & Editing, revision, supervision.

## Conflicts of interest

The authors declare no conflict of interest on this manuscript.

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