
Bibliometric Analysis of Zoology Research and Contributions to Indonesia

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ABSTRACT: This study aims to determine the map of the development of research in the field of zoology. The study was conducted in December 2021 by searching the Scopus database for the last 5 years (2017-2021) with the keywords *zoology*. The search results were then analyzed bibliometrically based on publication year, author's name, journal name, affiliation/institution name, distribution by country, type of publication, and language used. In obtaining data on research trends in the field of zoology, the data is exported in a format *to him* descriptive research. The export data is then processed and analyzed using the Vos viewer application program. The results of the research show that the number of publications of research results in the field of zoology at Scopus in 2017-2021 is 1,921 documents. The data shows that in the last 5 years the number of publications has decreased. The most prolific author is Li, S, namely 20 articles. The highest number of articles is found in the *Heliyon* journal with 75 articles. The names of affiliates/institutions with the highest number of articles published by the Chinese Academy of Science totaled 69 articles, the most types of publications were journals, namely 1,763. The language used the most is English with 1,812 articles. Distribution by country, the most from the United States, which is 416 articles and Indonesia ranks 16th out of 139 countries. As a recommendation that research in the field of zoology in Indonesia is still very much needed that Indonesia is a country that has a wealth and diversity of animals, both animals on land and at sea. With this wealth of animals, studies and research in the field of zoology are urgently needed so that their continuity and sustainability are maintained. As well as being able to develop zoology in Indonesia in particular and the world in general.

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INTRODUCTION

The rapid development of science is currently supported by research conducted by academics. Research from various fields of science is published in the form of scientific publications in journals so that it is easily known by other researchers. Research results published in these journals become a reference for other researchers so that they will produce other research and so on so that science can develop rapidly. Especially now that journals can be published in digital form or *online* or electronic journals (e-journals) that can be accessed online from anywhere and anytime.

One of the well-known areas of scientific publication in the biology family is the field of zoology. Zoology is the branch of biology that focuses on studying the *animal kingdom* animals and animal life in general. Knowledge it also includes the investigation of individual animals and their components from the cellular to the individual level. In addition, this science also discusses the interaction between animals and the biotic and abiotic environment. Zoology has several focus or specialized into several studies but in essence this science emphasizes unity structural and functional life rather than diversity. Researchers are interested in studying this field due to global climate change that is happening has a broad impact on habitats or the natural environment where the animals

live (Burgin & Ross, 2015). These changes also affect human life because Animals have many benefits in human life. Apart from having economic value, animals are beneficial to humans food security for human survival and as a source of nutrition (Varijakshapanicker, et.al., 2019).

Zoology has a large role to study the habitat, behavior, structure, and classification of animals, as well benefits for human life. Studying zoology has the following benefits (Hanson, 2019):

1. Can know the ins and outs of animal life in general as a basis for studying science others in a similar field

2. Can know the animals that can be cultivated

3. As a scientific basis for investigation of endangered animal populations and their preservation in the wild
4. Can identify, control, or eradicate animals that can become disease outbreaks
5. Can know the types of animals that are useful as a food source by knowing the benefits of studying zoology for human life, this is an attraction for humans to study zoology through various studies. The field of zoology has been extensively researched by academics, especially at the Faculty of Medicine Animal. The results of research on zoology can be seen in *database* Scopus. The Scopus database is The largest database of abstracts and citations from peer-reviewed literature and quality web sources with smart tools for track, analyze, and visualize research. (<https://atenea.epn.edu.ec/bitstream/25000/326/1/Enriquezca-su-experiencia-Scopus.pdf>).

On the basis of matter. Therefore, this research examines trends in zoology research, how publications are distributed by country and institution, who is the top author of research in zoology, what is the pattern of publications that occur, how is the visualization, and how researchers used the Scopus database to examine the results of research on zoology with bibliometric analysis and used vosviewer to visualize data.

PREVIOUS RESEARCH

Bibliometric analysis research on research development has been carried out a lot. Wulan (2020) examines the Work of Zoological Researchers at the Biology Research Center-Lipi and Research Collaborations in International Publications: Bibliometric Analysis. The results of the study show that the total distribution of writings by zoological researchers for five years is 274 articles with a distribution of 365 authors. The three most frequently written sequences of collaborative article writing by researchers are > 5 authors, 3 authors, and 5 authors. The total average number of authors per paper is 1.330 and the average productivity per author is 0.751. The lowest number of authors' productivity is 46 (0.754%) in 2018. The most productive contributor is Amir Hamidy with 34 papers (9.32%). Research collaboration during 2015-2019 was quite significant with a percentage of 98%, corroborated by the calculation of the collaboration rate of 0.98%. The journal that is widely used by zoological researchers is *Zootaxa* with 38 articles (30%).

Tupan et al (2018) have researched the Bibliometric Analysis of Research Development in the Field of Instrumentation Science. The results of the study show that the development of the growth in the field of instrumentation in 2006 - 2016 indexed at *Scopus* the highest occurred in 2014 which reached 310 publications (14.90%). Most international publications in the field of instrumentation are published in journals *Spine*. Universidade de Sao Paulo – USP is the institution that publishes the most research in the field of instrumentation and the United States is the largest contributor. Yazici, M., Zhang, H.Q., dan Aubin, C.E. is the most prolific writer in the field of instrumentation with the most subject areas *medicine* and *engineering*. Map of the development of the field of instrumentation based on *coword* grouped into 5 clusters and *co-author* grouped into 7 clusters.

Tupan (2016) conducted a study entitled Bibliometric Mapping With *Vosviewer* on the Development of Agricultural Research Results in Indonesia. The results showed that the number of publications on agricultural research results in Scopus in 1995-2015 had increased significantly and most of them were published in the Bulletin of Indonesian Economic Studies. The largest contributor to publications on agricultural research in Indonesia indexed in Scopus is the Bogor Agricultural Institute (IPB). The most productive foreign researcher who publishes the results of research on agriculture in Indonesia is Tscharrntke. The most productive researchers from Indonesia are Parikesit and Buchori. Agricultural researchers in Indonesia mostly work with academics from the United States, followed by academics from Australia and Japan. Most of the subjects of research in agriculture are *Agricultural and Biological Sciences*. Through visualization *network* shows that the agricultural research development map is divided into 3 clusters. Cluster 1 consists of 149 topics, cluster 2 consists of 105 topics, and cluster 3 consists of 48 topics.

Another research was conducted by Saifudin with the title "Analysis of bibliometric mapping and obsolescence of literature in the Journal of Engineering and Technological Sciences for the 2015-2018 period. The results of his research are that the Journal of Engineering and Technological Sciences has a tendency towards the same subject and lacks research innovation. This study obtained interesting results regarding collaboration and the relationship with author productivity. Also obtained data on the obsolescence of literature and the relationship with the level of use or citation. Overall this study provides a visualization of the relationships between networks and the obsolescence of the literature, as well as presents findings regarding the quality of the journal.

In contrast to previous studies, this research examines the bibliometric analysis of research trends in zoology and contributions to Indonesia. To the best of the researcher's knowledge, this theme has never been studied by other researchers.

Problem Formulation

The formulation of the problem in this journal research is:

1. What are the trends in zoological research?
2. How is the distribution of publications by country and institution?
3. Who is the top author of research in the field of zoology?
4. What is the pattern of publication that occurs and its visualization?
5. How is the contribution to Indonesia?

LITERATURE REVIEW

Zoology

"The term zoology is composed of two words, namely "zoo" and "logos". The word "zoo" means animal, meanwhile "Logos" means science. So what is meant by zoology is the study of animal. Furthermore, the science of zoology collaborates with the science of botany so that together they form a science biology or life sciences. Zoology is a branch of biology that studies the structure, function, behavior and evolution of animals. This science includes, among others, comparative anatomy, animal psychology, molecular biology, ethology, behavioral ecology, biology evolutionary, taxonomy, and paleontology. The scientific study of zoology began around the 16th century" (<https://www.ejurnal.com/2013/12/pengertian-zoologi.html>). Zoology has various branches of science, among others (pendidikan.co.id/pengertian-zoologi/):

1. Malacology

Malacology is a branch of zoology that studies all aspects of mollusk animal life. Like as well as basic knowledge, fields of cultivation and applied.

2. Nematology

Nematology is a branch of biology that studies nematodes or nematodes. which is a group or group of invertebrates with some parts of its members namely as important parasites in the fields of agriculture, health and medicine.

3. Ichthyology

Ichthyology is a branch of zoology that studies fish life. But a branch of science it focuses on cultivation and the field of pathology. That is, as many as 25,000 fish were found later also identified. Every year the scientists themselves announce that as many as 250 species of fish are new. In in the application of branches of ichthyology related to marine biology, oceanography, and limnology.

4. Herpetology

Herpetology is the next branch of zoology that studies the life of amphibians and reptiles. As for The object of this study used are cold-blooded animals and four-legged ones. Knowledge of the branch this then more and more are studied because most of the reptiles have now become pets. In addition, the two groups of animals can produce poison to be used, namely as main ingredient in stroke and heart disease.

5. Entomology

Entomology is a science that deals with or interacts with insects, which is a branch of science that related to arthropods. Examples are spiders, spiders, etc.

6. Ornithologists

Ornithology is a branch of zoology that studies all aspects of birds. This branch of science focuses more on the ability to see higher and also the approach process of birds it aesthetically.

7. Paleozoologi

Paleozoology is a branch of paleobiology that is used to study discoveries and identify the types of fossils from animals that have many cells. The fossil will then be used for environmental reconstruction and prehistoric ecology were carried out.

8. Primatologists

Primateology is a branch of zoology that studies the life of other primates humans. Examples are apes, monkeys and so on.

Bibliometric analysis

According to Lasa H.S. (2008:323), bibliometrics is an oversight of library collections by applying statistical and mathematical methods to books and other recording media. This study is intended to provide information and knowledge, as well as a system for communicating information with the object.

According to Pendit (2003), the term bibliometrics was first used by Alan Pritchard in 1969 to refer to the use of mathematical and statistical methods for measuring phenomena in books and other media. It was further said that the use of mathematics and statistics, or the use of measurement principles, was originally intended to determine the productivity of scientific writing seen from the number of scientific writings, besides that it is also to find out the use of one's scientific writing by others by paying attention to the citation in an article. Since the beginning, bibliometrics has been descriptive and evaluative based on quantitative empirical principles. Bibliometric research and testing aims to find universal truths about production and development of science through studies of authors, articles, and citations of articles in scientific writing.

Vosviewer app

Vosviewer is a data visualization application. According to Maryono (2020), visual analysis of bibliometric data through *mapping tools* much needed in today's era. With *mapping tools* an overview and various information on developments in the field of science and research performance that have been carried out can be obtained.

According to Maryono (2020), Vosviewer is very popular and has the following characteristics: maps various types of bibliometric analysis; supports several major bibliographical databases; the time dimension is ignored; limited to analyzing small to medium amount of data; intended for the function of processing text; using technique *layout* and clusters; use advanced visualization features; using a visual labeling system; and use visualization *overlay* and *density*. It is further said that the types of bibliometric mapping that can be done with Vosviewer are:

- Co-author mapping (*Co-authorship maps*), consisting of: author, organization, country
- Citation mapping (*citation maps*), consisting of: publications, journals, organizations, countries
- Co-citation mapping (*Co-Citation maps*) consists of publications, journals, essays (first author only)
- Mapping of bibliographical pairs (*Bibliographic coupling maps*), consisting of: publications, journals, authors, organizations, and countries
- Subject/keyword mapping (*Co-occurrence maps*), consisting of keywords and terms from the title and abstract. Vosviewer is used to visualize a bibliography or *dataset* which contain *field* bibliography (title, author, author, journal, and so on). In the world of research, Vosviewer is used for bibliometric analysis, looking for topics that still have opportunities to be researched, looking for the most widely used references in certain fields and so on (Purwoko, 2019).

MATERIALS AND METHODS

This research is a descriptive research. The study was conducted in December 2021 by searching through the Scopus database for the last 5 years (2017-2021) with the keywords *zoology* which is not limited by a country. The search data was then analyzed bibliometric using Vosviewer, based on publication year, author name, journal name, affiliation/institution name, distribution by country, type of publication, language and mapping visualization.

RESULTS AND DISCUSSION

Publications Mapping by Year

Based on the results of the research, it is known that the mapping is based on the year of publication in the last 5 years, so there is a decrease in the number of publications in the field of Zoology each year. The most years were in 2017. This became a trigger for academics to be more active in researching the field of Zoology.

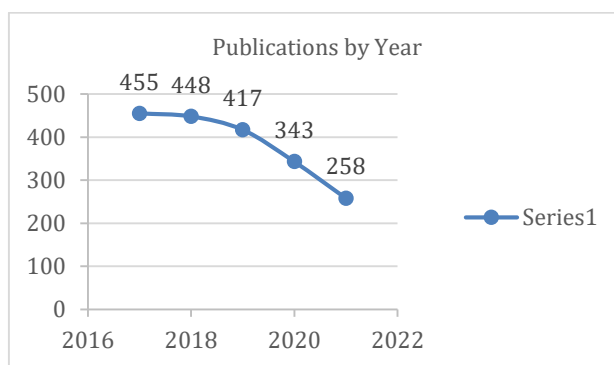


Figure 1. Publications by Year

In the diagram for the number of publications for the last 5 years (2017-2021) regarding zoological research, it can be seen that there are increasing years of existence or the number of research journals in the field of zoology tends to decrease, with the average number of journals over the last 5 years being 384 publications, with the highest number of publications being in the first year, namely In 2017 there were 455 publications and at least in the fifth year, namely 2021, there were 258 publications. The details of the number of publications each year are as follows:

Mapping Number of Publications Based on Authors

To know the productivity of an *author* in field research *zoology* can be seen in the table and figure below.

Table 1. Top Publications by Author

Authro	Document
Li, S.	20
Amendit, J.	13
Wang, Y.	10

Bouyer, J.	9
Maiga, H.	7
Matuszewski	7
Parola, P.	7

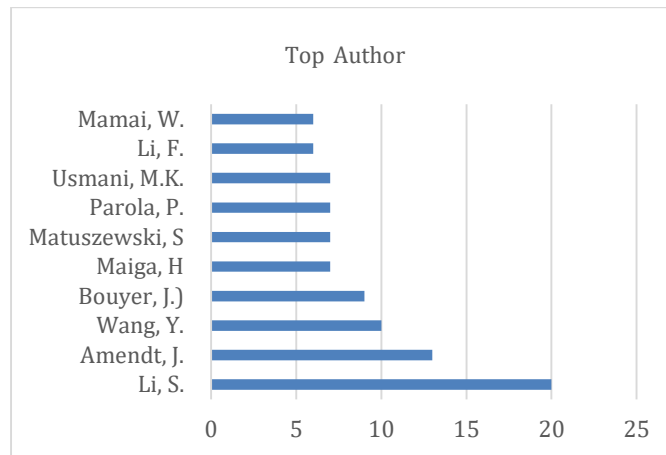


Figure 2. Top Publications by Author

In table 1 and figure 2 above shows several *author/a* journal writer who often publishes leading scientific journals in the field of zoology, we can see that Li, S is the top author or author who is the most productive in publishing articles in the field of zoology, as many as 20 articles, while the smallest number of articles is 6 published by Mamai, W. and Li, F.

Publication Mapping Based on Journal Name

To know the distribution of field research developments *zoology* can be seen in the table and figure below.

Table 2. Publication Mapping Based on Journal Names

Journal Name	Document
Heliyon	75
Nature	63
Zootaxa	57
Parasites And Vectors	54
Malaria Journal	38
Journal Of Insect Science	36
Plos Neglected Tropical Diseases	34
Journal Of Medical Entomology	33
Forensic Science International	32
Iscience	31

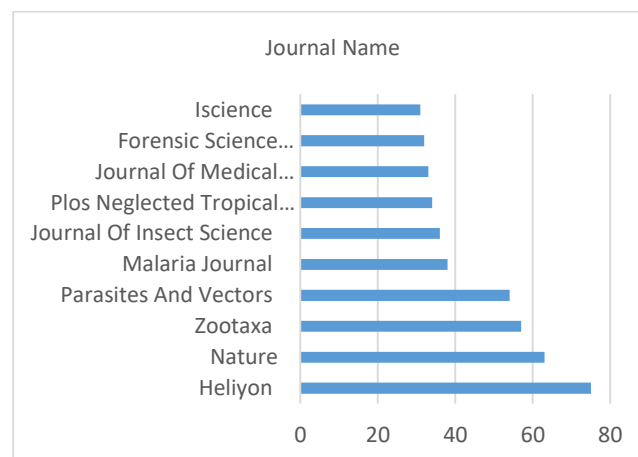


Figure 3. Publication Mapping Based on Journal Names

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Based on table 1.3 and figure 4, it can be seen that the Heliyon journal contains the most articles on Zoology, namely 75 articles, while the journal that contains the least articles on Zoology is Iscience, as many as 31 articles.

Mapping Based on Affiliation/Institution

To find out affiliations /institutions related to the development of field research *zoology* can be seen in the table and figure below.

Table 3. Mapping by Affiliation/Institution

Affiliation	Document
Chinese Academy of Sciences (69)	69
Institute of Zoology Chinese Academy of Sciences	52
CNRS Centre National de la Recherche Scientifique	51
Universidade de São Paulo	27
Université de Montpellier	25
IRD Centre de Montpellier	24
The Natural History Museum, London	23
London School of Hygiene & Tropical Medicine	22
Museum National d'Histoire Naturelle	21
University of Florida	20

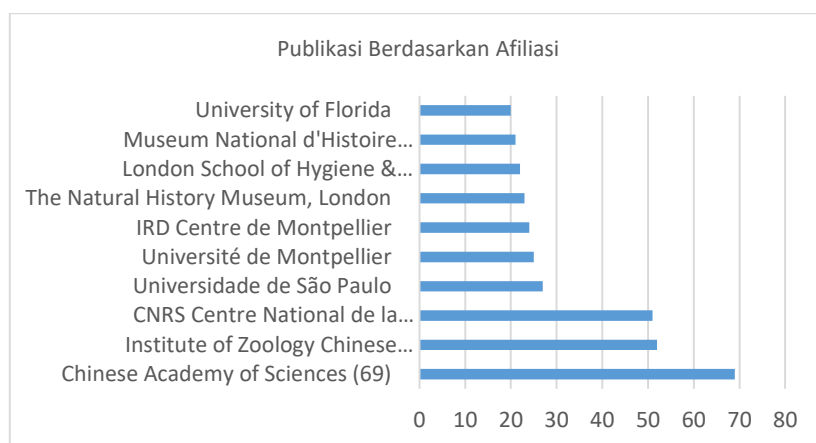


Figure 4. Mapping by Affiliation/Institution

Based on Table 1.4 and Figure 5, it can be seen that the institution that published the most articles in the field of zoology was the Chinese Academy of Sciences with 69 articles and the smallest was published by the University of Florida, namely 20 articles.

Distribution of Zoology Publications by Country

To know the distribution of field research developments *zoology* can be seen in the table and figure below.

Table 4. Distribution of Zoology Publications by Country

Country	Document
United States	416
United Kingdom	204
Germany	143
China	134
France	128
Brazil	126
Italy	92

Australia	88
India	77
Canada	70
Spain	63
Russian Federation	46
Poland	45
South Africa	44
Japan	42
Indonesia	38

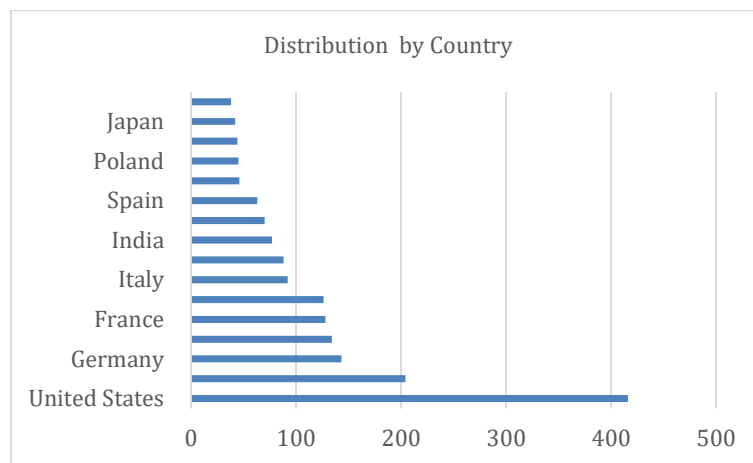


Figure 5. Distribution by Country

Based on table 1 and figure 5 above, it can be seen that the country that has published the most articles in the field of zoology is the United States, namely 416 articles, while Indonesia ranks 16th out of 139 countries. This shows that Indonesia is a country that has a wealth and diversity of animals, both animals on land and at sea. This wealth of animals can become research material in the field of zoology so that zoology can be developed in Indonesia in particular and the world in general.

Mapping Based on Article Type

To know the distribution of field research developments *zoology* can be seen in the table and figure below.

Table 5. Mapping by Article Type

Article Type	Document
Journal	1763
Book	79
Conference	43
Proceeding	
Book Series	36

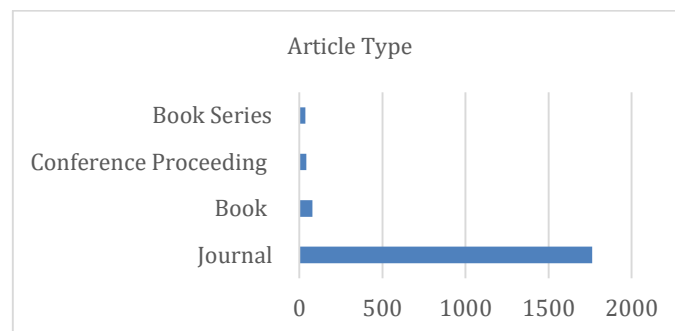


Figure 6. Mapping by Article Type

Based on Table 1.6 and Figure 7, it can be seen that the most published articles on Zoology were journal articles with 1,763 articles, while the least published were in book series, namely 36 articles.

Mapping of Zoology Publications Based on Language

To know the language used in field research *zoology* can be seen in the table and figure below.

Table 6. Mapping based on the language used

Language	Document
English	1812
Spanish	31
Chinese	21
French	20
Russian	14
Portuguese	10
German	9
Polish	8
Italian	3
Czech	2
Slovak	2
Bosnian, Croatian, Danish	1

Based on table 6 it can be seen that the most widely used language in Zoology articles is English, 1.812 articles, Spanish 31, Chinese 21.

Mapping Based on Network Visualization in Zoology

Based on research results, the development of field publications-*zoology* uses the Scopus Database for the last 5 years from 2017-2021, there are 1921 documents. Mapping of publications in the field of *zoology* can be seen in the image below.

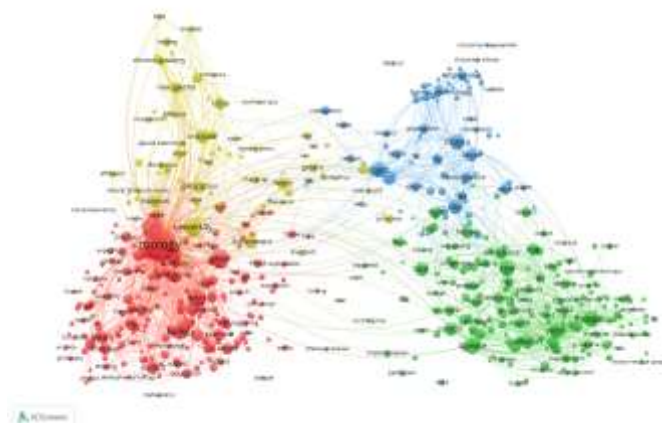


Figure 7. Mapping of Zoology Publications based on Database Scopus

The image above shows that the publication field *zoology* for 5 years from 2017-2021 there are 4 cluster shown in red, green, blue and yellow. Cluster 1 is shown in red which contains related research on zoology related to biology, evolution, education, developmental biology and others. Cluster 2 which is shown in green, namely research related to *disease, infection, mosquito, mortality* and others. Cluster 3 is shown in blue, namely research related to *insect, diptera, larvae, estimation* and others. Cluster 4th is shown in yellow, namely research related to *university, departments, museums, institute*, and others.

Figure 1 shows that the larger the circle indicates that the research has been studied by many people. The smaller the circle, the research has not been studied by many people. In the picture above it is shown that there are nets, these nets show that they are interconnected.

In figure 7 illustrates the relationship *zoology* with *science* and *university*, people have done a lot, but *zoology* associated with Southeast Asia, indonesia, *labor, control group, biodiversity* has not been widely studied by researchers. Even though this study is very important considering the importance of maintaining the preservation and survival of the natural sea in this world.

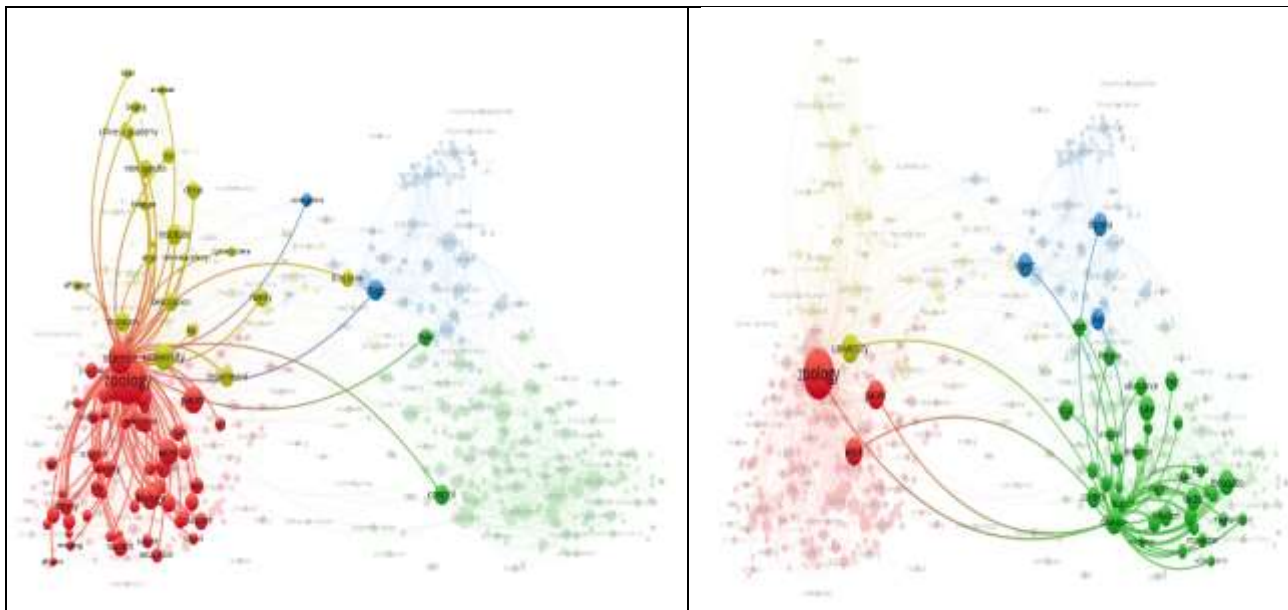


Figure 8. Cluster 1 and Cluster 2

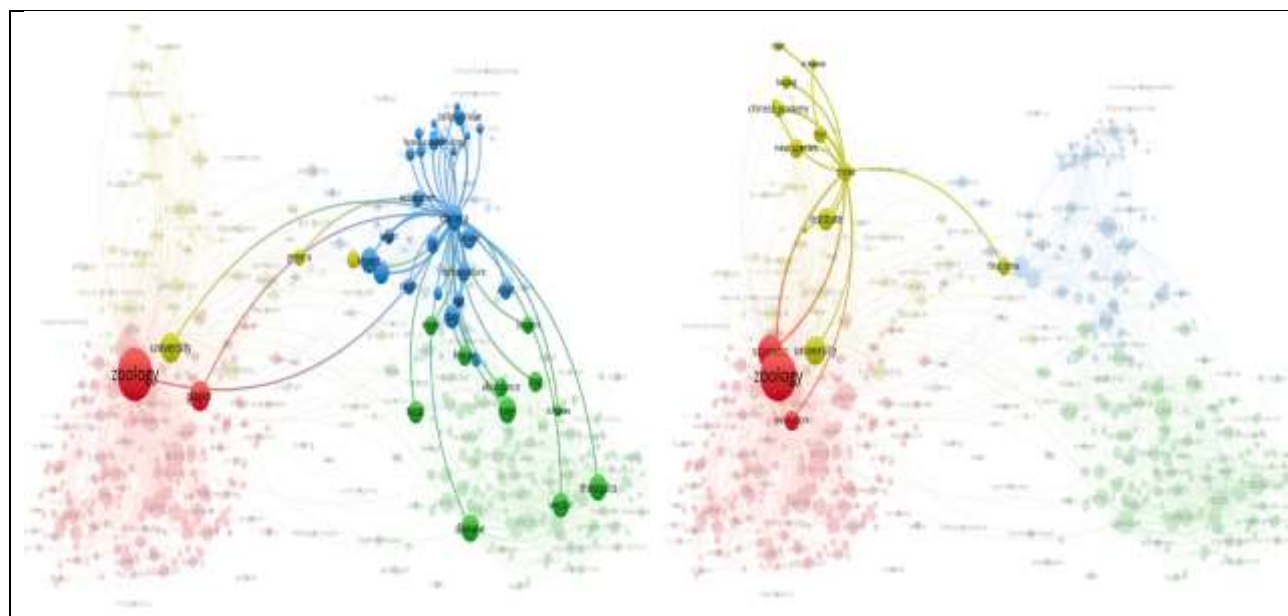


Figure 9. Cluster 3 and Cluster 4

Overlay Visualization of Zoology Mapping by Year

To know Overlay Visualization of the mapping of the field of zoology by year can be seen in the image below.

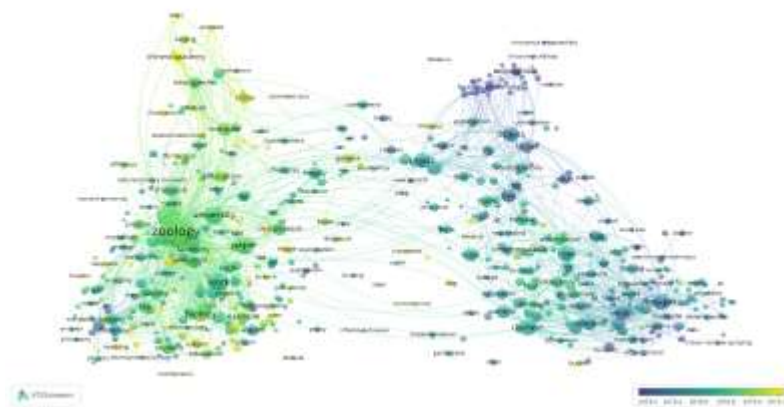


Figure 9. Overlay Visualization of Zoology Mapping by Year

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This Visualization Overlay shows that the colors represent the year of publication. The more purple it is, the longer the publication has been made, namely in 2017, but on the contrary, the more yellow the color indicates that the publication is the most recent publication, namely in 2021.

Density Visualization in Zoology

To find out Density Visualization in the field of zoology in field research *zoology* can be seen in the picture below.

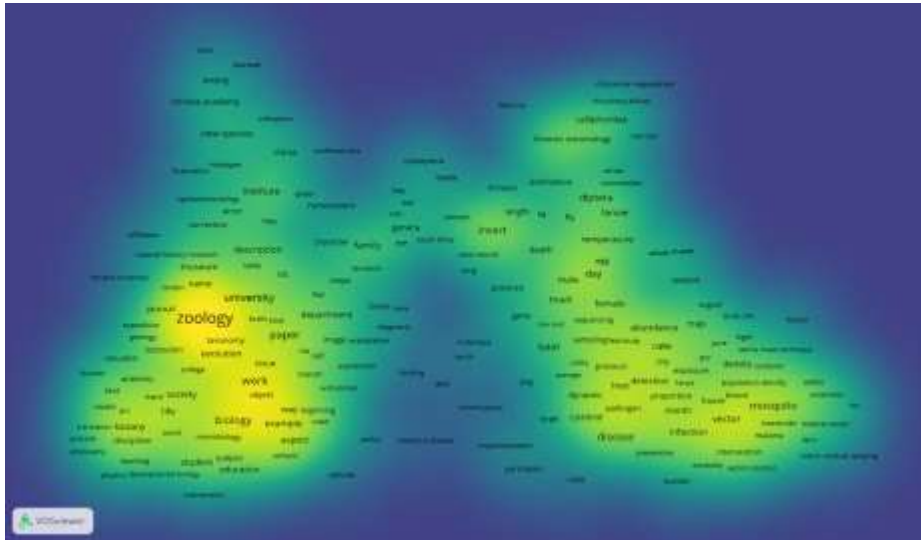


Figure 10. Density Zoology Field Visualization

The image above shows that *Density* This visualization shows that the colors represent the many studies that people have done. The more yellow this research has been done by many people, the ancient color will be able to red. This shows that a lot has been done by people. However, if the color shows a dark blue color, it means that this research has not been studied by many people.

CONCLUSION

Based on the research data above, we can conclude that there is a trend-research in the field of zoology in the last 5 years (2017-2021) has decreased from the number of publications of 455 to 258. Meanwhile, based on the institution that published the most research in the field of zoology, namely the Chinese Academy of Science, there were 69 articles and the top authors who were the most productive were Li, S, with 20 articles. The highest number of articles is found in the Heliyon journal with 75 articles and the language used is English with 1,812 articles. As for the distribution by country, the United States is the largest with 416 articles and Indonesia ranks 16th out of 139 countries. This shows that Indonesia is a country that has a wealth and diversity of animals, both animals on land and at sea. This wealth of animals can become material for research studies with great potential in the field of zoology so that zoology can be developed in Indonesia in particular and the world in general.

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