



Development of a Popular Scientific Book about Pulau Population Structure (*Alstonia scholaris*) in the Lake Sari Embun Region, South Kalimantan

Putri Wulan Sari AJ^{1*}, Dharmono, Kaspul

¹Pendidikan Biologi, Universitas Lambung Mangkurat, Banjarmasin, Indonesia

*Email: putriwulansariaj@gmail.com

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Abstract

Indonesia has high biodiversity, one of the plants that is widely distributed in Indonesia is Pulau (*Alstonia scholaris*). The Island is used as a traditional medicinal plant. Pulau trees can be found in the Danau Sari Embun area, Tanah Laut Regency and have the potential to be a source of learning, so the results of the Population Structure study are made in the form of a locally based PSB. This research aims to describe the structure of Pulau (*Alstonia scholaris*) in the Danau Sari Embun area, Tanah Laut Regency, describe the process of developing BIP. Population structure of Pulau (*Alstonia scholaris*) in the Danau Sari Embun area, Tanah Laut Regency, Describe the feasibility of the population structure of BIP Pulau (*Alstonia scholaris*). The method used is the R&D (Research and Development) research method and the Plomp model. The results obtained by the number of Islands found in the reproduction phase and in the post-reproduction phase, thus showing a picture of the form of Srukpop, namely pot paintings, the PSB about Island Population Structure that was developed was declared very valid. So it can be concluded that PSB teaching materials can be used as teaching materials in the learning process.

Keywords: biodiversity; plant; Pulau (*Alstonia scholaris*); popular scientific books; population structure

INTRODUCTION

Indonesia has high biodiversity, one of the plants that is widely distributed in Indonesia is Pulau (*Alstonia scholaris*), Pulau is a family of Apocynaceae that grows wild and is not cultivated (Silalahi, 2019; Mayor & Wattimena, 2022; Wibisono & Martino, 2023). Pulau is a plant in the form of a tree with a height of 10 to 50 m, a straight trunk with a diameter of up to 60 cm, Pulau leaves are arranged circularly in 4 to 9 strands, the bones are pinnate and green in color. Pulau is used as a traditional medicinal plant, ethnobotanically, Pulau stems are used to treat digestive tract disorders, malaria fever, asthma, dyspepsia and skin diseases, while Pulau leaves have antidiabetic properties (Setiono *et al.*, 2015; Tambunan *et al.*, 2016; Mayor & Wattimena, 2022). Pulau has a natural distribution in most parts of Indonesia. Pulau can be found on the islands of Java, Sumatra, Bali, Jambi, Palembang, Sulawesi,

Lampung, Maluku, Nusa Tenggara, and Irian Jaya, West Kalimantan and South Kalimantan. In South Kalimantan, one of the places where Pulai trees grow is in the area around Lake Embun which is called Sari Bentok Dalat Village, Bati-Bati District, Tanah Laut (Setiono *et al.*, 2015; Silalahi, 2019; Wibisono & Martino, 2023).

The Pulai plant is a plant that is used as traditional medicine in the community of Sari Bentok Dalat Village, South Kalimantan, so the Pulai plant is a local wisdom in the area. Population structure needs to be studied to determine the status or condition of a population of island plants in a habitat. A population is defined as a group of individuals who are able to cross each other and occupy a space or place (Ismail *et al.*, 2015; Syahdi *et al.*, 2016; Syarifah & Maulana, 2016). Population status in habitats is categorized into 3, namely crisis, threatened and safe. Population structure is influenced by several things, namely birth, death, the environment and various human activities. If the structure of plant populations is known then action can be taken against the population so that it does not become extinct (Ismail *et al.*, 2015; Setiono *et al.*, 2015; Syarifah & Maulana, 2016). It has the same point with animal (Pertiwi 2019; Pertiwi & Lathifah, 2019; Ratih *et al.*, 2021; Triacha *et al.*, 2021; Fatonah *et al.*, 2023; Mufida *et al.*, 2023; Putri *et al.*, 2023).

Pulai plants in the Bentok Dalat Village area, South Kalimantan need to be preserved, because these plants represent local wisdom that reflects the original culture of a group of people living in the area. One way to increase efforts to preserve island plants is to create teaching materials based on local potential. In learning activities, teaching materials are one of the supports in the teaching and learning process. Teaching materials are arranged in an interesting way so that they can increase students' interest in learning and make it easier for students to receive lessons (Hanifah *et al.*, 2020; Eliana *et al.*, 2022; Gultom *et al.*, 2022). The development of teaching materials can be seen as a process where a series of elements are placed to produce a product. Development refers to a type of research known as R&D, which is the process of producing visible objects. Teaching materials can be prepared to support environmental conditions both physically and be beneficial for social conditions, local insight, beliefs and ideas. Local content must be the basis of teaching materials because it is important to improve existing local wisdom by making it based on local potential, so that it is easier for students to understand (Fajrin *et al.*, 2021; Irianti & Mahrudin, 2021; Noorannisa *et al.*, 2022).

The Popular Scientific Book (PSB) is one of the teaching materials that can be used in the teaching and learning process as well as as information enhancing material for the local community to increase their insight. PSB equips students with valuable information and knowledge about the subjects studied, as well as their relation to regional potential. The fact that PSB have local potential has helped to gain a better understanding of the objects in their environment and improved student science process skill (Putri *et al.*, 2020; Astuti *et al.*, 2021; Setiana *et al.*, 2022). As a learning object, students will become more familiar with the learning material they encounter every day. Based on the description above, it is known that there are still many plants that can be developed as teaching materials based on local content, but Pulai plants have their own charm so the aim of this research is to find out the Population Structure of Pulai (*Alstonia scholaris*) which is used as a learning resource in the Plant Ecology course.

METHOD

This research was conducted in the Danau Sari Embun area of Tanah Laut Regency to obtain Population Structure Study data. The Telaga Sari Embun area has an area of 50 Ha with a circumference of 2 km. This area was chosen as an observation location because the area is surrounded by forests so there are various kinds of plants. Sampling was taken using the total roaming method by exploring the environment around the lake. The samples in this study were all islands located on the edge of the lake with a width of 10 meters from the water's edge. Observation of Pulai morphology includes: roots, stems, leaves, flowers and fruit. Plant morphology observations were carried out on adult plant samples using the available plant description format. Searches along the Lake Sari Embun area using a total exploration method at each observation point found Pulai from each phase, namely the reproductive,

post-reproductive phases, and except for the pre-productive phase, none were found. Then the sample calculation at each point includes the pre-productive phase, reproductive phase and post-reproductive phase based on the individual. The limitations of these three phases are, the pre-productive phase has the characteristics of not yet flowering and fruiting or still budding, the reproductive phase has the characteristics of flowering and fruiting, large and branched stems, and the post-reproductive phase has the characteristics of growing from cut stems. Next, the data is entered into the Pulai population structure observation table. Calculation of Pulai (*Alstonia scholaris*) species density in Sari Embun Lake area.

Area of observation = width x perimeter of the lake = 10 m x 2,500 m = 25,000 m / 10,000 = 2.5 Ha

$$\begin{aligned}
 1. \text{ Pra-reproductive} &= \frac{\text{total individual}}{\text{area (ha)}} = \frac{0}{2,5} = 0 \text{ ind/ha} \\
 2. \text{ Reproductive} &= \frac{\text{total individual}}{\text{area (ha)}} = \frac{3}{2,5} = 1,2 \text{ ind/ha} \\
 3. \text{ Post-reproductive} &= \frac{\text{total individu}}{\text{area (ha)}} = \frac{4}{2,5} = 1,6 \text{ ind/ha}
 \end{aligned}$$

After knowing the population structure of the island, the data was used in making teaching materials, namely the Popular Scientific Book. The method used in making teaching materials is R&D (Research and Development). The PSB creation process follows the steps of the 5-phase Plomp model. Initial Investigation Stage, This stage is to collect information about material demands in the RPS for the Plant Ecology course in the Biology Education Study Program Curriculum 2020. Then collect and analyze information about the population structure of Pulai plants (*Alstonia scholaris*) including pre-reproductive, reproductive and post-reproductive phases. Design Phase (systematization), this phase aims to design a solution to the problem posed in the initial investigation phase by generalizing all parts of the solution, comparing and evaluating various alternatives, and producing the best design option to be promoted or formed the solution.

Realization or Construction Stage, Design is a work plan or design based on the objectives to be realized in order to obtain a solution at the realization or construction stage. The activity carried out at this stage is to realize the PSB design that has been prepared previously. Test, Evaluation and Revision Stage, this stage is carried out to obtain data on the validity and readability of the PSB being developed. Data validity is carried out through expert testing and data readability is carried out through individual testing. Implementation Stage: After evaluation is carried out and a valid and good product is obtained, the implementation stage is only carried out through limited printing of PSB that are developed or published to the wider public in the form of links via Facebook or Instagram without any evaluation. According to (Arikunto, 2016) the calculation of the validity of learning media data is analyzed using the percentage of Eligibility is found by dividing between real value and expected value then multiplied by 100%. Validity criteria can be seen in Table 1.

Table 1. Validity Criteria Based on Value

Score	Validity information	Information
3.26 - 4.00	Very Valid	No need for revision
2.51 - < 3.26	Valid	Minor revisions
1.76 - < 2.51	Less valid	Major revisions
1.00 - < 1.76	Invalid	Total Revisions

The readability of the BIP has been done by calculating the score from the readability test of 3 students. Based on the average score of reading ability, students' responses to learning on individual tests were written descriptively.

$$PK = \frac{\text{Total score of data collection results}}{\text{Criteria Score}} \times 100\%$$

Information:

PK = readability percentage (%)

Skor kriteria = total maximum score Readability

The results of the readability of the known content were matched with the criteria according to (A. I. Putri et al., 2020), as presented in Table 2.

Table 2. Readability criteria based on value

No.	Score	Information
1.	>80%	Very good
2.	70 - < 80%	Good
3.	60 - < 70%	Worth
4.	50 - < 60%	Deficient
5.	< 50%	Not Good

RESULT AND DISCUSSION

Based on the results of research on Pulai plants in the Sari Embun Lake area, Bati-Bati District, Tanah Laut Regency. Morphological observations which include the following plant characteristics.



Figure 1. Pulai (*Alstonia scholaris*)

The position of the Pulai plant (*Alstonia scholaris*) in taxonomy according to plantamor (2023) is as follows:

Kingdom : Plantae
 Sub kingdom : Tracheobionta
 Super division : Spermatopyta
 Division : Magnoliophyta
 Class : Magnoliopsida
 Subclass : Asteridae

Order : Gentianales
 Family : Apocynaceae
 Genus : *Alstonia*
 Species : *Alstonia scholaris* R. Br

Based on observations, the pulai root is a tap root with secondary growth. The taproot on Pulai spreads from the main plant root and then grows again from the same root. The roots are light brown or cream colored (Setiono *et al.*, 2015; Mawazin & Adi, 2016; Noviyanti *et al.*, 2021). The morphology of Pulai leaves has a nested or circular leaf position, the surface of the leaf is shiny and dark green, while the underside of the leaf is pale or light green, the tip of the leaf is blunt or rounded or often connected (Mashudi & Adinugraha, 2014; Siahaan *et al.*, 2015; Wibisono & Martino, 2023). Based on observations of Pulai trunks in the research area, they are not much different from the morphology of Pulai trunks in other areas, the height of Pulai trees reaches 60 meters and the trunk diameter is more than 80 cm. The bark is smooth, scaly or shallowly cracked and peeling in a rectangular shape, yellowish brown or light brown with white latex. Branches are smooth or slightly rough, scaly, with thin or dense lenticels (Mawazin & Adi, 2016; Silalahi, 2019; Bhandary, 2020). Pulai flowers are compound flowers that have a fragrant aroma. The fruit rides between oval-shaped fruit plates that are light green in color, when they are ripe they will dry out and turn brown and crack. However, when observations were made, researchers did not find the presence of flowers and plant fruit on the island due to biotic factors such as environmental and abiotic parameters, namely human activity. Pulai trees flower and bear fruit from May to August while the research was carried out in March (Bhandary, 2020; Simanjuntak *et al.*, 2022; Wibisono & Martino, 2023).

Based on the results of observations, 7 Pulai plants were found. Three plants are in the reproductive phase and four are in the postreproductive phase, the distribution can be seen in table 3.

Table 3. Pulai (*Alstonia scholaris*) Population Structure Data in Sari Embun Lake Area

Fase	Plot				
	1	2	3	4	5
Prareproductive	0	0	0	0	0
Reproductive	1	1	0	1	0
Postreproductive	1	0	2	0	1

Based on the data in table 1, it shows that the number of individual Pulai plants in the Lake Sari Embun area consists of the pre-reproductive phase, reproductive phase and post-reproductive phase. The most common individuals found in an area of 2.5 hectares were in the post-reproductive phase. This is because these plants mostly grow on cut stems, while the pre-reproductive phase is not found in this area because before fertilization the stems have been cut down. This also results in few reproductive phases being found. This plant also grows by itself, which is why it is not found in the pre-reproductive phase in that area. After the data is collected, the population density is calculated. The population density can be seen in Table 4

Table 4. Population structure of Pulai Plants in the Lake Sari Embun area

No	Growth Phase	Total ind/2.5 Ha	In/Ha	Km ² (inch/km ²)
1.	Prereproductive	0	0	0
2.	Reproductive	3	1.2	12
3.	Postreproductive	4	1.6	16

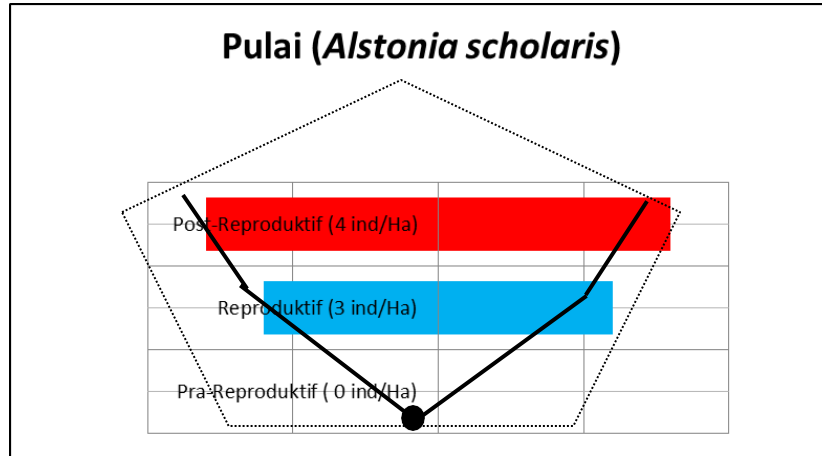


Figure 2. Population structure pyramid of Pulai Plants

Based on the calculation of the number of individuals per hectare, the pyramid shape obtained is a pot or jug because based on table 4 it is known that there are more old individuals than young individuals so that the Pulai population structure in this area is threatened. A pyramid in the shape of a jug or vase has fewer offspring or daughter individuals than the parent individual. If there are too few individuals to mature, to meet replacement needs, then the population structure will decline. This is thought to be caused by environmental and human factors (Setiono *et al.*, 2015; Syahdi *et al.*, 2016; Syarifah & Maulana, 2016). Environmental factors are very important factors for growth. The main biotic factor influencing plant populations is human activity. Community activities are very damaging to the population of Pulai plants. Based on this, it is necessary to carry out conservation efforts and efforts to attract the interest of the local community so that they want to preserve Pulai plants even better. So the data from this research is used to create teaching materials based on local potential.

The making of teaching materials was carried out in several stages, the first stage was the investigation stage analyzing the needs of Pulai PSB plants (*Alstonia scholaris*) through user surveys which were carried out by distributing needs questionnaires to students who had taken the Plant Ecology course. Apart from that, it also collects information about material requirements in the RPS for the Plant Ecology course. The second stage, namely the design stage, PSB design develops and generalizes all problem solutions, starting from comparing and offering various alternatives, to producing the best solution to be developed or a solution created at the beginning. The designs produced from this stage are content and materials. The third stage is the realization stage. At this stage, the PSB creation is realized into a real product. The fourth stage is the testing, evaluation and revision stage which is carried out by obtaining data validity and PSB readability. Data validity is carried out through expert tests and data readability is carried out through individual tests. The final stage, namely the implementation stage, is only carried out by printing BIPs which are developed on a limited basis, published to the wider public via Instagram without any evaluation. PSB was validated by 2 validators. The validity results are presented in Table 5.

Table 5. Results of scientific book validation

Indicators	Validators		Average
	1	2	
I. Coherence Aspect			
A. Each paragraph in a populer science book has one main ide.	4	4	4
B. Connect between sentences using linkers	3	4	3,5
C. Ideas are delivered sequentially.	3	4	3,5
D. The sentence has led the reader to understand the conctects of the book.	4	3	3,5
Sum			3,63
II. Readability			
A. The content of the text is in accordance with the age level/level of education..	4	4	4
B. Sentences and many words can measure readership rates.	3	4	3,5
Average sum			3,75
III Vocabulary : expressions, work, choices, exaggeration			
A. Limited use of expressions is used.	3	3	3
B. The word or expression used does not use a lot of vocabulary.	3	3	3
Average sum			3
IV. Active and passive voice			
A. Use active voice and passive voice..	4	4	4
Average sum			4
V. Format			
A. writing that displays evidence in the form of data or images that are compiled systematically	4	4	4
Average sum			4
VI. Writing Method			
A. Simplicity and attractiveness of a piece of writing.	4	3	3,5
Average sum			3,5
VII. Application, implications			
A. Using real-world problems to attract readers.	3	4	3,5
Average sum			3,5
VIII. Definitions and explanations			
A. Use; descriptions, examples, analogies, and metaphors to facilitate reader understanding	3	4	3,5
Average Sum			3,5
IX. Other styles and devices: narrative, humor, analogy			
A. Using analogies to explain complex ideas	3	4	3,5
B. Using narration to explain the ideas presented	4	4	4
Average sum			3,75
Total Average Validation Score			3,63
Validation Criteria			Very Valid

Based on the results table, the average validation score shows that the PSB developed is validated in these 9 aspects. The total average validation score is 3.63 so that the criteria obtained are

included in the very valid validity criteria. By getting the maximum score in the coherence aspect of part A, the readability aspect of part A, the active and passive sentence aspect, and the format aspect. As well as a minimum score in the vocabulary aspect. Based on the average validation results, the results show that BIP is very valid or suitable for use in the field learning media that has a score of 3.26 - 4.00 is included in the very valid category without requiring revision (Arikunto, 2016). However, researchers are still making improvements according to suggestions from the validator. This is done so that the product in the form of a scientific book can be better and can be used for further research. Then PSB was also tested on 3 students, the results data can be seen in Table 6 .

Table 6. Student individual test results

No	Aspects assessed	Response		
		M1	M2	M3
1	Each section studied is easy to understand.	4	4	4
2	The entire content of the BIP is complete (Cover, editorial, preface, table of contents, introduction, main body, references, index, glossary).	3	4	3
3	The words used are easy to understand.	4	4	4
4	Image quality is good and can be understood.	4	4	4
5	There are no typographical or grammatical errors.	3	3	3
6	The photo on the cover is clear and can be understood.	4	3	4
	Sum	22	22	22
	Average	91,67%	91,67%	91,67%
	Average validation score		91,67%	
	Validation Criteria		Very good	

The six aspects tested by three students had an overall average score of 91.67%, including very good criteria. Thus it can be concluded that in this individual test there were three students who reported using teaching materials that were very good or potential in terms of appearance, presentation and usability. Teaching materials that have a score of <80% are included in the very good category and are suitable for use (Putri *et al.*, 2020). The popular scientific book on the population structure of Pulaui in Sari Embun Village that was developed is a popular scientific book based on local potential. The BIP contains the structure of the Pulaui population in the Sari Embun Village area, explains its benefits both ecologically and biologically, provides morphological characteristics of the Pulaui plants in the area as well as other interesting information. In this way, the popular scientific book being developed will improve students' process skills and increase their insight into the local environment (Astuti *et al.*, 2021; Fajrin *et al.*, 2021; Setiana *et al.*, 2022). This PSB will be beneficial to human like this research product (Istiana *et al.*, 2019; Saputri *et al.*, 2020; Pertiwi & Saputri, 2020; Saputri & Pertiwi, 2021).

CONCLUSION

Based on the results of research on the development of a popular scientific book on the population structure of Pulaui (*Alstonia scholaris*) in the Danau Sari Embun area, Tanah Laut Regency, it can be concluded that the population structure of Pulaui (*Alstonia scholaris*) in the Danau Sari Embun area, Tanah Laut Regency has a density value in the pre-productive phase of 0 ind/km², the reproductive phase is 0.12 ind/km², and the post-reproductive phase is 0.16 ind/km² with the Pasu or kendi pyramid, so that the Pulaui population is in a critical condition. The data obtained was then developed as teaching materials developed using the Plomp model. Teaching materials in the form of Popular Scientific Books were developed with the title Development of Popular Scientific Books on Pulaui Population Structure (*Alstonia scholaris*) in the Danau Sari Embun Area, Tanah Laut Regency. This is shown by the validity score of validator 1 and validator 2 with an average validity score of 3.63 with very valid or worthy of development criteria and a student readability test of 91.67% with very good criteria so that the Popular

Scientific Book Pulau Population Structure (*Alstonia scholaris*) in the Danau Sari Embun Area, Tanah Laut Regency is suitable to be used as teaching material.

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