



Scanning Electron Microscopy of *Goniodes dissimilis* Denny, 1842 (Insecta: Phthiraptera) from Domestic Chickens on Seram Island

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Abstract: *Goniodes dissimilis* (Denny, 1842) is one of the chewing lice (Ischnocera: Phthiraptera) that commonly infests native chickens (*Gallus gallus domesticus*). The aims of this study were to describe the morphological and ultrastructural characteristics of *G. dissimilis* using scanning electron microscopy (SEM). The sampling of *Goniodes dissimilis* was conducted in Seruawan, Hatusua, and Kamarian villages on Seram Island. SEM preparation was carried out through 2.5% glutaraldehyde fixation, 0.25 M phosphate buffer post-fixation, multistage dehydration, critical-point drying, mounting on stubs, and gold coating before being observed at various magnifications. SEM results showed that *G. dissimilis* from Seram Island has ultrastructural characteristics, such as the head is *circumfasciate* with a rounded anterior margin, a complete band on the marginal carina, a pulvinus surrounding the ventral carina, and no hyaline margin. The eyes appear reduced with long ocular setae, while the temporal region has five marginal setae, with setae numbered 2 and 3 presents. The antennae are sexually dimorphic, consisting of a scape, pedicel, and three flagellomeres. In this study, we collected only females of *G. dissimilis*, and the first *flagellomer* shows no radial grooves in the sensilla placodea. The thorax shows a *pteronomum* with several long spines, while the abdomen shows medially separated tergites II-VIII, spiracles on tergites III and VIII, and a thin, membranous sternal plate. The SEM results also show that the female *G. dissimilis* has terminalia displaying a dorsal plate connected with tergopleurites and a vulva lined with fine setae. This finding represents the first ultrastructural record of the *G. dissimilis* population on Seram Island, thereby enriching the morphological diversity and distribution data of chewing lice in the Maluku region.

Keywords: *Goniodes dissimilis*; Native chicken; Phthiraptera; Seram Island; Ultrastructure

Introduction

The native chickens, *Gallus gallus domesticus*, are more commonly found in rural areas. Their daily activities make them highly susceptible to ectoparasite infestation, which leads to a decline in their productivity (Camacho-Escobar et al., 2014). One factor that causes a

decrease in egg production in native chickens is the presence of ectoparasite infections, which act as vectors for various pathogens (Sychra, 2005). Chewing lice reproduce massively and continuously and are found in native chickens (Naz et al., 2018a). Chewing lice are ectoparasites that have the ability to suck blood from all terrestrial vertebrate species, including mammals, birds,

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reptiles, and amphibians (Anderson et al., 2008; Emerson, 1951).

The group of lice frequently found on the bodies of the native chickens (*G. gallus domesticus*) in rural Ambon is the soft-bodied lice (Argasidae). Argasidae are grouped into the order Mallophaga Nitzsch, 1818. Previous research indicates that Mallophaga is a type of wingless insect. This order is usually classified as an ectoparasite of birds, both wild and domestic (Mishra et al., 2016). Lice of the order Mallophaga can be found across all continents (Lamb et al., 2018). Lice distribution is determined by geographic range (Ziani et al., 2021). In addition to geographic factors, lice distribution is also related to human activities, including bird transportation, which can lead to long-distance ectoparasite vector spread. Lice of the order Mallophaga are often found living as ectoparasites of mammals and birds (Clay, 1951; Gustafsson et al., 2020).

Research shows that native chickens *G. gallus domesticus* (Linnaeus, 1758; Temminsk, 1820) can be infested by lice of the family Menoponidae (Mjoberg, 1910), genus Menopon (Nitzsch, 1818), *Menopon gallinae* (Linnaeus, 1758); *Menopon cornutum* (Schommer, 1913) and *Menacanthus* (Neumann, 1912), *Menacanthus stramineus* (Nitzsch, 1818); *Menacanthus cornutus* (Schömmmer, 1913), as well as the *Goniocotes* species group (Burmeister, 1838) of the family Goniididae (Mjoberg, 1910), *Goniocotes hologaster* (Nitzsch, 1838); *Goniocotes gigas* (Taschenberg, 1789). and *Goniodes* (Nitzsch, 1818), *Goniodes dissimilis* (Nitzsch, 1818); *Goniodes truncates*, (Giebel, 1861), and by *Lipeurus* (Nitzsch, 1818) from the Philopteridae family (Burmeister, 1838), *Lipeurus caponis* (Linne, 1758); *Lipeurus heterographus* (Giebel, 1874). It was found that as many as 80% of livestock worldwide are infested with lice (Gustafsson et al., 2023; Patodo et al., 2018).

Six species of chewing lice are found in Southeast Asia, including: *Goniocotes gallinae* (De Geer, 1778), *Goniodes dissimilis* (Denny, 1842), *Lipeurus caponis* (Linnaeus, 1758), *Menacanthus pallidulus* (Neumann, 1912), *Menopon gallinae* (Linnaeus, 1758), dan *Gallancyra dentate*. Of the six species of chewing lice, according to Emerson (1956), four are considered natural chewing lice, these are: *G. gallinae*, *G. dissimilis*, *L. caponis*, and *M. gallinae*. These four species are distributed across almost all continents and are often found in drier or more humid habitats (Gustafsson et al., 2020; Santos et al., 2011).

Therefore, identification of the type of chewing lice is necessary to be conducted. It was done by Emerson (1951) and Emerson (1956). The characteristics of chewing lice can be seen from the body parts, including: the head and neck, the dorsal surface of the body, the ventral surface of the body (including the legs), the wings, and the tail (including the ventral anus), or the

entire body. The morphological characteristic that forms the basis for determining the key to identification for both families is the conscutum/scutum. This layer is a thickened layer of chitin (Leitinger et al., 2018).

The overall diversity of chewing lice species found in Asia (India) includes 6 species, two of which are *M. stramineus* and *M. gallinae*. These two species are the most dominant found in the location of the manifestation of lice. Four other species found include *L. caponis*, *Cuclotogaster heterographus* (Nitzsch, 1866), *G. gigas*, and *Goniocotes gallinae* (De Geer, 1778). Species *Goniocotes* sp. were found to be rarer in the Asian region (Surman, 2013). So far, recording data on chicken lice species, especially on *G. gallus domesticus*, have not been widely documented in East Indonesia, including Seram Island. Seram has 1–2 hectares of land and there are livestock farmers who traditionally raise livestock, especially chickens and goats (Makaruku et al., 2025). This study was conducted with the aim of identifying and documenting the morphological characteristics of chicken louse species (Order: Mallophaga) that infest the body surface of *G. gallus domesticus* in Seram.

Method

Place and time of research

The research locations are spread across three locations: point 1 (Hatusua), point 2 (Kamarian), and point 3 (Seruawan), Kairatu District, West Seram Regency (SBB), Maluku Province, Indonesia (Figure 1). The map was created using the QGIS application, which is an open-source software application (Aurellia et al., 2023). Lice samples collected at the three sampling locations were prepared at the Biotechnology Laboratory, Faculty of Science and Technology (FST), Pattimura University, Ambon. A total of 64 lice specimens were collected from the chickens' bodies. There are 90 native chickens at the three locations that were sampled.

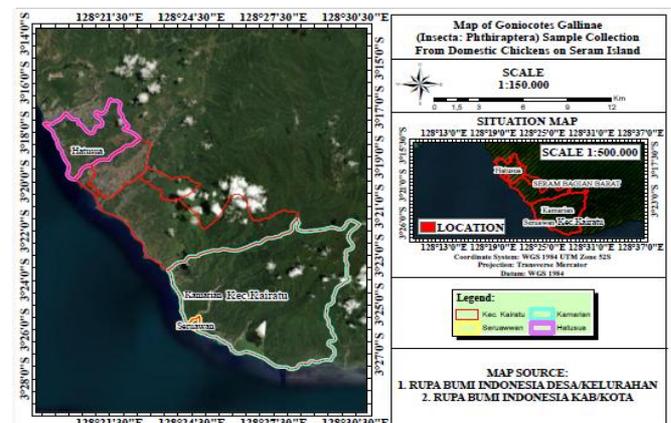


Figure 1. Research location

Materials and tools

The materials used were lice from the native chickens, collected randomly from three locations in Kairatu sub-district, West Seram Regency. Other materials included 70%, 80%, and 90% alcohol, distilled water, and other materials for collection purposes. The equipment used included an SEM microscope and a stereo microscope.

Research Methods

Collection of Samples of Chicken Lice

Lice were obtained from 50 native chickens aged \pm 1 year which were taken in Kairatu, Seram, Ambon. The native chickens lived and were kept in the backyards of residents' homes. Native chicken lice were collected from the whole body parts (Palma, 1978).

Chewing lice collection involves capturing the chicken, then carefully examining it and searching for lice on designated body parts. To facilitate the task, cotton wool slightly moistened with 70% alcohol is applied to the chicken's body if lice are visible. The alcohol-soaked cotton wool immobilizes the lice, making them easier to remove. Lice from different hosts are separated and stored in separate plastic vials containing 70% alcohol. The collected lice are then separated according to the location of the individual host (Jassim et al., 2019).

Sample Identification

All collected lice were stored in vials containing 70% ethanol. Maceration was performed in 10% KOH solution for 24 hours, neutralization was performed with dilute acetic acid, dehydration was performed by sorting the lice specimens in an alcohol series from 10% to 100% ethanol, and fixation was performed with immersion oil for 3–5 minutes. The lice were placed face down on the slide, their legs straightened and permanently fixed with a needle. All slide specimens were examined under an Olympus stereomicroscope, and identification was performed using available literature (Clayton et al., 2003).

SEM Documentation

SEM testing was conducted at the Integrated Laboratory of Bioproduct (iLaB) facility at the National Research and Innovation Agency (BRIN–Cibinong). The SEM test consisted of two testing stages: sample preparation and coating. The sample preparation process began with the sample being immersed in cacodylate buffer for 2 hours. Next, the sample was agitated in an ultrasonic cleaner for 5 minutes. Then, the sample was immersed in a 2.5% glutaraldehyde solution for 2–48 hours, immersed in 2% tannic acid for 6 hours, washed with cacodylate buffer and left for 5 minutes four times, dehydrated by immersing in graded alcohols

of 70%, 85%, and 95% for 20 minutes each, and immersed in absolute alcohol for 10 minutes twice. All processes were carried out at 4°C, except for the immersion in 95% and absolute alcohol. After sample preparation was complete, the coating process was carried out and photographic documentation of the sample results was conducted (Zahran et al., 2022).

Result and Discussion

In this study, a total of 90 chickens were examined to see the manifestation of lice. *Goniodes dissimilis* at three different locations on Seram Island. Of the 30 chickens examined at each location, the number of free-range chicken lice collected was 21 (Hatusua), 24 (Kamarian), and 19 (Seruawan) (Table 1). Observations revealed that chicken lice often live as ectoparasites on older the native chickens. A characteristic of older the native chickens is the loss of feathers on their bodies.

Regarding the gender of the chewing lice, *G. dissimilis*, in this research, we did not differentiate between males and females. The identification results used in the identification key were female individuals. In the SEM documentation results, we found characteristics that characterize the species *G. dissimilis*.

The list of characters in *G. dissimilis* in female based on this study are as follows:

- The head is circumfasciate with a rounded anterior margin, a complete banded marginal carina, a pulvinus surrounding the ventral carina, and no hyaline margin. The body length is 1.7 mm (Figure 2 and 3).
- The eyes appear reduce with long ocular setae, while the temporal region has five marginal setae with setae numbers 2 and 3 being the most dominant. The antennae are sexually dimorphic, consisting of a scape, pedicle, and three flagellomeres (Figure 4).
- The thorax shows a pteronotum with several long spines, while the abdomen shows medially separated tergums II–VIII, spiracles on tergums III and VIII, and a thin, membranous sternal plate.
- Female terminalia show a dorsal terminal plate formed from tergopleurites and a vulva margin lined with fine setae (Figure 4).
- The flagellomere III character has variations in terms of the width of the flagellomere III. The inner flagellomere III width is 30.8 μ m while the width of the flagellomere III at the end of the leg is 21.3 μ m. (Figure 6). The size of the hairs also varies greatly. The length of the flagellomere III is 25 μ m, 13 μ m, and 4 μ m (Figure 7).
- Other characteristic features of the species observed from the SEM documentation results are the a spiracle openings characters (Figure 8); The thick

setae used for gripping characters (Figure 9); and characteristics of ventral side of the female terminalia on *G. dissimilis*, hyaline section where the anus is located teeth character (Figure 10).

- g) The body parts measurements of chewing lice *G. dissimilis* in the present study show that the Kamarian site has the largest body length compared with Hatusua and Seruawan. Not only in body length measurement, *G. dissimilis* from the Kamarian site also showed significantly higher measurements in pterothoracic width, prothoracic width, head width, head length, and abdominal width.

Table 1. Number of Lice *G. dissimilis* Manifestations on the Native Chickens *G. gallus domesticus* in Seram

Location	Number of Chickens	Number of Lice	Types of Parasites
Point 1 (Hatusua)	30	21	<i>G. dissimilis</i>
Point 2 (Kamarian)	30	24	<i>G. dissimilis</i>
Point 3 (Seruawan)	30	19	<i>G. dissimilis</i>

All *Goniodes* genera have simple solenoid male genitalia that are inseparable from the other Phthirapterans (Mey, 1997; Smith, 2000). The preliminary morphological study shows that *Goniodes* has approximately 50% similarity in characters with *Goniocotes*. They are divided into smaller genera of Phthiraptera. *Goniodes* and *Goniocotes* are included in homogeneous groups (Mallophagen, 2009; Smith, 2001).

All species of *Goniocotes* and *Goniodes* can be distinguished from other Ischnoceran species. There are some significant morphological characters: (1) male genitalia without mesosome; (2) female vulval margin gently rounded; (3) male parameres continuous with lateral margins of the basal apodeme, but the parameres are separated; (4) male tergopleurites II-V with 1-2 tergo-central setae (ss + tps) on each side in *Goniocotes* (Gustafsson et al., 2020; Qadri, 1936).

Table 2. Quantitative Body Parts Measurement of Chewing Lice *Goniodes dissimilis* on *G. gallus domesticus* (female) in Seram

Morphological characters (mm)	Lice sampling location		
	Hatusua (n= 21)	Kamarian (n= 24)	Seruawan (n= 19)
Total Length (TL)	1.32-1.68	1.46- 1.70	1.29-1.65
Pterothoracic Width (PTW)	0.43-0.44	0.45-0.50	0.42-0.43
Prothoracic Width (PRW)	0.32-0.37	0.35-0.39	0.31-0.35
Head Width (HW)	0.51-0.60	0.58-0.63	0.53-0.58
Head Length (HL)	0.43-0.44	0.45-0.50	0.42-0.43
Abdominal Width (AW)	0.69-0.71	0.70-0.73	0.67-0.70

Measurements were taken from the specimens, for the following dimensions: TL = total length (at midline); PTW = pterothoracic width; PRW = prothoracic width; HW = head width (at widest point of temples); HL = head length (at midline); AW = abdominal width (at segment V)

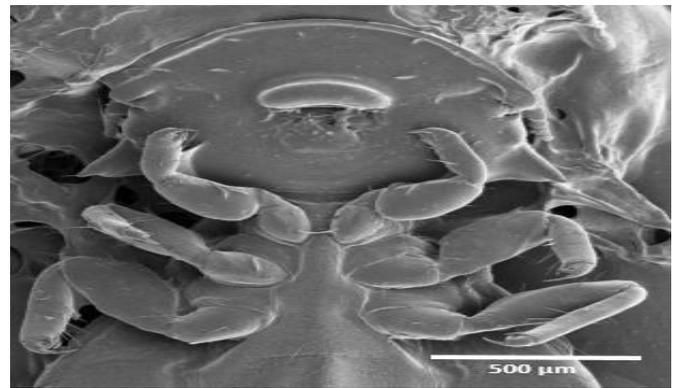


Figure 2. Complete body parts in an inverted position lice, *Goniodes dissimilis*

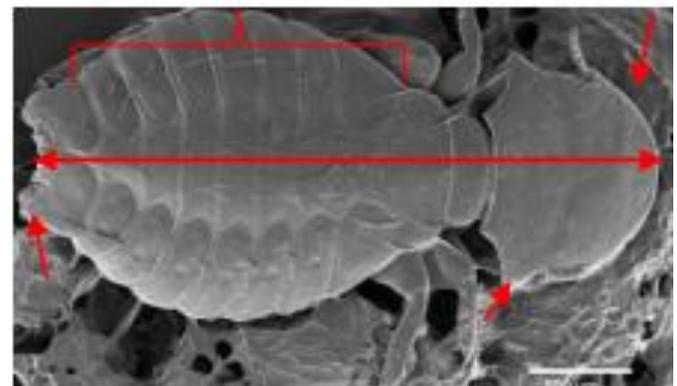


Figure 3. Complete body parts of a louse *Goniodes dissimilis* (head, thorax, abdomen and external genitalia structures)

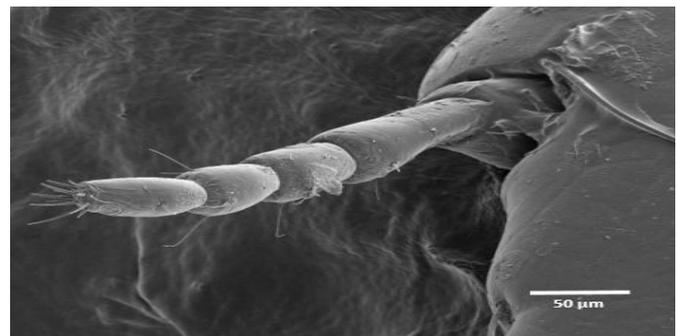


Figure 4. Characteristics of the female terminalia in *G. dissimilis*

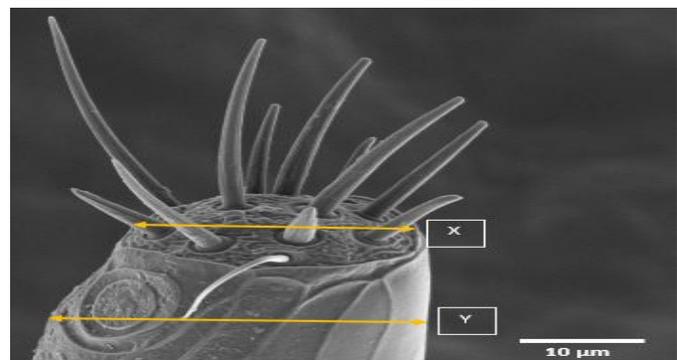


Figure 5. flagellomere III on the body of a louse in *G. dissimilis* (X=21.3μm; Y=30.8μm)

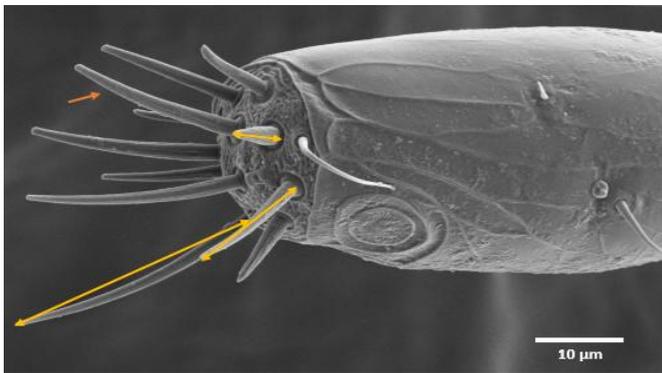


Figure 6. Characteristics of the flagellomere III in *G. dissimilis*

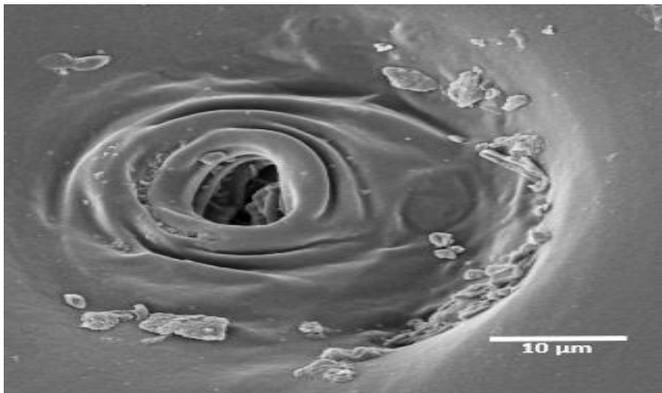


Figure 7. Characteristics of the spiracle openings in *G. dissimilis*

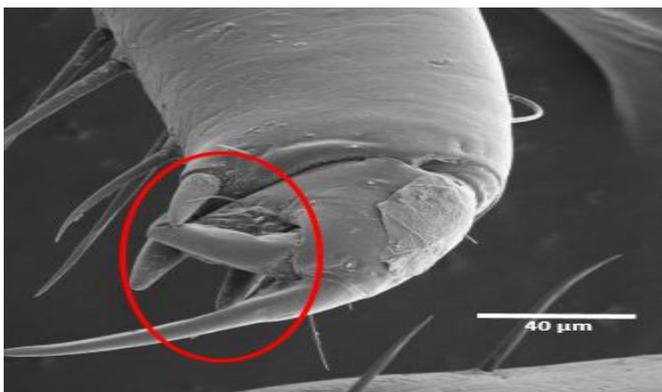


Figure 8. The thick setae used for gripping of *G. dissimilis* (Gustafsson et al., 2020)

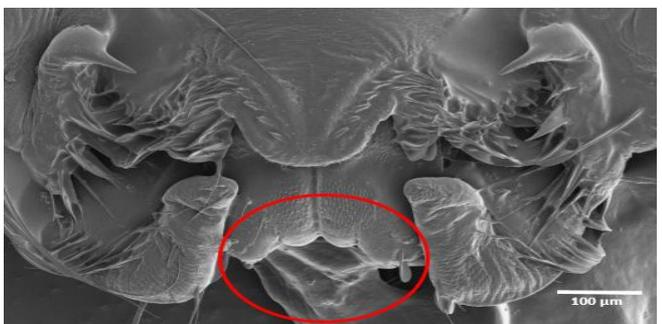


Figure 9. Characteristics of ventral side of the female terminalia on *G. dissimilis*, hyaline section where the anus is located

A similar study was conducted by Ahmad et al. (2022), who found that in Odisha, *G. dissimilis* was first found infecting native chickens (*G. gallus domesticus*). Besides *G. dissimilis*, several other types of ectoparasites can infect native chickens (*G. gallus domesticus*). Al-Iraqi et al. (2012), showed the presence of six species of biting lice in chickens, namely the chicken body louse (*Menacanthus stramineus*), feather lice (*Menopon gallinae*), chicken head lice (*Cuclotogaster heterographus*), downy lice (*Goniocotes gallinae*), large chicken head lice (*Goniodes gigas*), and wing lice (*Lipeurus caponis*). These types of lice can also infect other poultry (Boucheikhchoukh et al., 2023).

The flattened body shape of *G. dissimilis* is an adaptation to its environment. *G. dissimilis* places its body on the host surface, on feathers or hair (Kumar et al., 2015; Mishra et al., 2016). The flattened body shape of chicken lice is also used to increase the tenacity of the lice to grip the hair or fur on the host (Mohammed et al., 2021; Villa et al., 2018).

Most types of ectoparasites in native chickens *G. gallus domesticus* are known to reach 20% prevalence (Adnan et al., 2021). Many studies have discovered new species that infect local The native chickens, for example in Saudi Arabia (Nasser et al., 2015), Pakistan (Naz et al., 2016, 2018b; Shaikh, 2022, 2023), Iran (Rassouli et al., 2016), Philippines (Portugaliza et al., 2015), Russia (Гапонов, 2021), Czech Republic (Sychra, 2005), Moldova (Zamornea et al., 2025) and Alaska (Sweet et al., 2020). Abiotic factors that influence the population of chewing lice as ectoparasites are: temperature, humidity, light intensity, wind speed, dry matter, ash content, protein content, crude fat, and crude fiber (Rofieq et al., 2023). In order to, several types of diseases that endanger human health due to microorganism contamination from livestock (Jayadi et al., 2022), especially in native chickens. This contamination can originate from chewing lice bites in native chickens that carry microbiota (Sweet et al., 2020).

Conclusion

This study provides a morphological and ultrastructural description of *G. dissimilis* from native chickens in Kairatu District, Seram Island, using SEM. Key diagnostic characters include circumfasciate head shape, marginal and ventral carina patterns, antennal sensilla structure indicating sexual dimorphism, thorax and abdomen configuration, and differentiation of male and female terminalia showing agreement with previous taxonomic descriptions of the species. This documentation is the first ultrastructural report of *G. dissimilis* population's on Seram Island and adds important data regarding the morphological variation

and geographical distribution of chewing lice on poultry in the Maluku region. These findings are expected to be the basis for the development of taxonomic studies, poultry ectoparasite epidemiology, and infestation control strategies in native chicken farming systems in Indonesia.

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Author Contributions

Conceptualization, MN and RMK; methodology, YA, RMK, and MP; validation, RMK, VCT, and AH; formal analysis, YA and RMK; investigation, MN, YA, and RMK; resources, RMK and MN; data curation, YA and RMK; writing the original draft, MN, RMK, and YA; writing the review and editing, RMK and YA; visualization, VCT and AH. All authors have read and approved the published version of this manuscript.

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Conflicts of Interest

All authors declare that there is no conflict of interest in this article. The funder (LPPM Universitas Pattimura) was not involved in the research design, data collection, analysis, interpretation, or writing of the publication from inception to publication.

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