Morphological Variation of *Malayopython reticulatus* (Schneider, 1801) from Several Population in Indonesia

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**ABSTRACT**

Reticulated python (*Malayopython reticulatus*) is a widely distributed snake covering throughout Southeast Asia and almost all of Indonesia archipelago and divided into several subspecies based on morphological variation and its locality. Morphological variation data of *M. reticulatus* from Indonesia population has never been done thoroughly. This study aims to determine the morphological variations based on 21 meristic and 3 morphometric characters from several populations in Indonesia. The data was collected from the Museum Zoologicum Bogoriense (MZB) Cibinong, Indonesia and other additional collections that are carried out from June to July 2018 and then analyzed by Principal Component Analysis (PCA) to determine the population grouping. The result showed a high variation on the scale range of anterior prefrontal, posterior prefrontal, frontal, parietal, preocular, postocular, loreal, temporal, upper labial, lower labial, and dorsal scales. Ventral and subcaudal scales in male and female specimens show high variation in the total scale count, the ratio comparison of tl: SVL measurement, indicated the sexual dimorphism. Prefrontal (anterior-posterior) and frontal scales show high variation and difficult to distinguish between each locality at the subspecies level and suggest it to be intra-specific variation. There is no significant grouping were found between populations from data on morphological variations.

**Keywords:** Malayopython reticulatus, morphological variation, intra-specific variation, Indonesia

**Introduction**

Reticulated python (*Malayopython reticulatus*, Schneider, 1801) is a large constrictor snake of Pythonidae family that’s widely distributed throughout Southeast Asia and almost all of Indonesia archipelago [1]. The widespread of this species give rises to morphological and genetic variations given by many factors such as population isolation, geographical barrier, evolutionary process and also the influence of the environment and its habitat. The variation is then used as a comparing reference (diagnostic character) for distinguishing a species [2]. Morphological variations are observed based on phentenetic characters including color patterns, specific characteristics of species, patterns, and body size ratios, and meristical characters such as scale ranges [3]. These variations are further analyzed, to determine the existence of significant differences between species or sub-species.

*M. reticulatus* is divided into 3 subspecies based on its locality, namely *M. reticulatus reticulatus* (Greater Sunda), *M. reticulatus saputrai* (Selayar Island), and *M. reticulatus jampeanus* (Tanahjampea Island). Two subspecies recently recognized (*M. reticulatus saputrai* and *M. reticulatus jampeanus*) by having a few specific morphological variations that only subspecies posses-
characters of *M. reticulatus* eral problems, to wit: 1) the tendency of other logical characters of *M. reticulatus*. Thus, examini
sively categorizes it as geographical or prefrontal scales, yet are still confused to
from several population in Indonesia is needed. Therefore, we present an overview of morpho-
from certain locality [4]. These differences are based on the shape of the anterior-posterior
prefrontal meristic and morphometric
were observed by meristic and morphometric
were obtained from the collection of the Museum Zoologicum Bogoriense (MZB) that are observed during July-
September 2018 and few additional specimens that are collected on July - August 2013 and April - May 2014 (Table 1). Morphological variations were observed by meristic and morphometric

### Material and Methods

#### Specimens observation

All of 38 specimens of *M. reticulatus* from several populations in Indonesia were obtained from the collection of the Museum Zoologicum Bogoriense (MZB) that are observed during July-

### Table 1. *M. reticulatus* specimens observed from several populations in Indonesia, collection of Museum Zoologicum Bogoriense (MZB) LIPI and several additional specimens

| No. | ID. Number | Population | Locality |
|-----|------------|------------|----------|
| 1.  | MZB. Ophi. 5287 | Sumatera | Dalas, Southern Lampung |
| 2.  | MZB. Ophi. 201  |  | F. Krakatau Island, Lampung |
| 3.  | MZB. Ophi. 4680 |  | F. Krakatau Island, Lampung |
| 4.  | MZB. Ophi. 2412 |  | Saraya, Southeast Aceh |
| 5.  | MZB. Ophi. 1692 |  | Tiwi River, Kota Tua, Riau |
| 6.  | MZB. Ophi. 2192 |  | Bengkalis, Riau |
| 7.  | MZB. Ophi. 2936 | Jawa | Pangandaran, West Java |
| 8.  | MZB. Ophi. 197  |  | Cikopo, West Java |
| 9.  | MZB. Ophi. 4681 |  | Cikopo, West Java |
| 10. | MZB. Ophi. 5286 |  | Malang, East Java |
| 11. | MZB. Ophi. 2152 | Kalimantan | Hilir Village, Southern Barito, Central Kalimantan |
| 12. | MZB. Ophi. 1906 |  | Pontianak, West Kalimantan |
| 13. | MZB. Ophi. 1457 |  | Banjarmasin, South Kalimantan |
| 14. | MZB. Ophi. 5884 |  | Lumbis River, Nunukan, North Kalimantan |
| 15. | MZB. Ophi. 3020 |  | TNKM Kragan, Nunukan, East Kalimantan |
| 16. | MZB. Ophi. 3121 |  | Marang, Sangkulirang, East Kalimantan |
| 17. | MZB. Ophi. 5785 | NTB  | Kawiwinda Toi, Sumbawa Island |
| 18. | MZB. Ophi. 5589 |  | Saunulu, Central Maluku |
| 19. | MZB. Ophi. 1951 |  | Saunulu, Central Maluku |
| 20. | MZB. Ophi. 4481 | Maluku | North Halmahera, North Maluku |
| 21. | MZB. Ophi. 4482 |  | North Halmahera, North Maluku |
| 22. | MZB. Ophi. 194  |  | West Seram Island, Maluku |
| 23. | MZB. Ophi. 200  |  | Timor Island, Maluku |
| 24. | MZB. Ophi. 1558 |  | Anca Danau Lindu, Central Sulawesi |
| 25. | MZB. Ophi. 3221 |  | Dampala River, Morowali, Central Sulawesi |
| 26. | MZB. Ophi. 2895 |  | Goa Keramat, Tawaeti, Donggala, Central Sulawesi |
| 27. | MZB. Ophi. 1762 |  | Tomodo, Lindu Valley, Central Sulawesi |
| 28. | MZB. Ophi. 2297 |  | Marowo, Tojo Una-Una, Central Sulawesi |
| 29. | MZB. Ophi. 1657 |  | Jompi, Raha, Muna Island, Southeast Sulawesi |
| 30. | MZB. Ophi. 4682 |  | Jompi, Raha, Muna Island, Southeast Sulawesi |
| 31. | MZB. Ophi. 2041 | Sulawesi | Latimojong Mountain, Luwu, South Sulawesi |
| 32. | MZB. Ophi. 3436 |  | Selayar Island, Southern Sulawesi Archipelago |
| 33. | MZB. Ophi. 3223 |  | Tanahjampea Island, Southern Sulawesi Archipelago |
| 34. | MZB. Ophi. 3437 |  | Kalaotoa Island, Southern Sulawesi Archipelago |
| 35. | S.Voucher. 020  |  | Karompa Island, Southern Sulawesi Archipelago |
| 36. | S.Voucher. 021  |  | Kalaotoa Island, Southern Sulawesi Archipelago |
| 37. | S.Voucher. 022  |  | Kalaotoa Island, Southern Sulawesi Archipelago |
| 38. | S.Voucher. 023  |  | Madu Island, Southern Sulawesi Archipelago |
Measurement of meristic, morphometric characters, and analysis

Morphometric characters are observed by 3 characters, as follows: a total of length (ToL), tail length (tl), and snout-vent length (SVL). Then, 21 meristic characters observed by scales counting, as follows: rostral (r), internasal (i), anterior prefrontal (apf), posterior prefrontal (ppf), frontal (f), supraocular (so), parietal (p), interparietal (ip), preocular (pro), postocular (psp), loreal (l), temporal (t), upper labial (la), upper labial contacting orbit (lao), lower labial (la'), anterior upper thermal pits (tp), posterior lower thermal pits (tp'), mental (m), dorsal midbody scales (d), ventral (v), and subcaudal (sc) (Figure 1), the characters used are according to Auliya [4] with standard measurement and scale counting following Lilywhite & Wray [5]. Male and female specimens were differenti-
Table 2. Measurement of meristic characters and morphometric ratios of *M. reticulatus* (♂=14, ♀=24).

| Characters | Sumatera (♂=1) | Sumatera (♀=5) | Jawa (♂=3) | Jawa (♀=3) | Kalimantan (♂=2) | Kalimantan (♀=4) | NTB (♂=1) | NTB (♀=4) | Maluku (♂=2) | Maluku (♀=5) | Sulawesi (♂=10) | Sulawesi (♀=5) |
|------------|----------------|----------------|------------|------------|------------------|------------------|------------|------------|--------------|--------------|----------------|----------------|
| r          | 1              | 1              | 1          | 1          | 1                | 1                | 1          | 1          | 1            | 1            | 1              | 1              |
| i          | 2              | 2              | 2          | 2          | 2                | 2                | 2          | 2          | 2            | 2            | 2              | 2              |
| apf        | 2              | 2              | 2          | 2          | 2                | 2                | 2          | 2          | 2            | 2            | 2              | 2              |
| pff        | 7              | 6              | 10         | 9          | 5                | 8                | 7          | 8          | 7            | 6            | 1              | 4              |
| f          | 1              | 1              | 2          | 1          | 2                | 1                | 1          | 2          | 1            | 1            | 1              | 2              |
| so         | 2              | 1              | 2          | 2          | 2                | 2                | 2          | 2          | 2            | 2            | 2              | 2              |
| p          | 2              | 2              | 3          | 2          | 2                | 2                | 2          | 2          | 2            | 2            | 2              | 2              |
| ip         | 1              | 2              | 3          | 5          | 2                | 1                | 2          | 4          | 2            | 3            | 1              | 3              |
| pro        | 2              | 2              | 2          | 2          | 2                | 2                | 2          | 2          | 2            | 2            | 2              | 2              |
| pso        | 2              | 4              | 3          | 3          | 5                | 3                | 4          | 3          | 4            | 3            | 2              | 2              |
| t          | 4              | 5              | 6          | 8          | 4                | 3                | 6          | 8          | 6            | 5            | 5              | 4              |
| La         | 14             | 13             | 13         | 14         | 14               | 13               | 12         | 14         | 13           | 13           | 13             | 13             |
| Lao        | 7              | 7              | 7          | 7          | 7                | 7                | 7          | 7          | 7            | 7            | 8              | 6              |
| la'        | 22             | 21             | 23         | 21         | 22               | 22               | 22         | 21         | 22           | 22           | 19             | 24             |
| Tp         | 5              | 5              | 6          | 5          | 5                | 5                | 5          | 5          | 5            | 5            | 4              | 6              |
| tp'        | 6              | 5              | 6          | 5          | 6                | 5                | 5          | 5          | 5            | 5            | 5              | 5              |
| m          | 1              | 1              | 1          | 1          | 1                | 1                | 1          | 1          | 1            | 1            | 1              | 1              |
| d          | 66             | 67             | 76         | 66         | 66               | 73               | 74         | 63         | 72           | 69           | 67             | 77             |
| v          | 319            | 310            | 320        | 319        | 301              | 312              | 316        | 314        | 324          | 320          | 300            | 294            |
| Sc         | 89             | 87             | 100        | 94         | 87               | 93               | 89         | 95         | 87           | 96           | 84             | 91             |
| tl:Tol     | 0.17:1         | 0.14:1         | 0.14:1     | 0.12:1     | 0.14:1           | 0.14:1           | 0.13:1     | 0.14:1     | 0.14:1       | 0.14:1       | 0.12:1         | 0.13:1         |
| SVL:Tol    | 0.83:1         | 0.86:1         | 0.86:1     | 0.88:1     | 0.86:1           | 0.87:1           | 0.86:1     | 0.86:1     | 0.86:1       | 0.86:1       | 0.86:1         | 0.87:1         |
| tl:SVL     | 0.20:1         | 0.16:1         | 0.16:1     | 0.14:1     | 0.16:1           | 0.15:1           | 0.16:1     | 0.16:1     | 0.16:1       | 0.13:1       | 0.15:1         | 0.14:1         |

Results and Discussion

*Morphological characters of M. reticulatus from several population*

The analysis showed the high variation on the scale range of anterior prefrontal, posterior prefrontal, frontal, parietal, preocular, postocular, loreal, temporal, upper labial, lower labial, and dorsal, ventral and subcaudal scales (Table 2). The obtained meristic character shows the intraspecific variations of the total number of scales that vary between specimens from several populations. The varying number of scales might be correlated to habitat use and environmental conditions that cause adaptation. This adaptation is done to prevent excess water loss in the body. A large number of scales might indicate habitats with high humidity, whereas fewer scales might indicate a drier habitat [6]. Reduction of dorsal scales might also be affected by the development of the cutaneous muscle system and cost-cutaneous muscles located below the skin as a result of the evolution of rectilinear locomotion [7].

Meristic characters do not show the sexual dimorphism based on the number of ventral and subcaudal scales due to the high variation. Male specimens have a range of 84-96 on subcaudal scales, and a range of 284-343 on ventral scales. Whereas in the female specimens, the total range is 83-100 on subcaudal scales and the total range is 294-341 on ventral scales. The measurement of the morphometric ratio tail length (tl): snout-vent length (SVL) from each population shows that the average ratio of tail length of the male specimens is longer than the average ratio of tail length of female specimens (Table 2). According to Kerfoot [7], ventral scales attach to the cost-cutaneous.
muscle system that connected to the ribs and vertebrae, so the number of ventral scales reflects the number of vertebrae of the specimens. Individuals with a large number of vertebrae have a possibility to grow longer than individuals who have fewer vertebrae, affecting the number of existing scales.

Differences in the shape and number of frontal scales were also found with the presence of a single, divided, anterior-posteriorly notch, and anteriorly notch frontal scales (Figure 2). It was stated that this variation is due to geographical variations expressed in the form of divided or single scales, different from one region to another [8, 9]. Kluge [10] states that there are several morphological characters that are different from some of the specimens studied in Kalimantan (Borneo) with a variation of almost dividing from posterior, anterior, or both, as well as singles and divided scales. Underwood and Stimson, also Mark Auliya et al. [11, 4] state that the formation of the frontal scales is a type of intraspecific variation. These findings strongly support the existence of intraspecific variations in frontal scales in the population studied, and cannot be categorized as geographic variations based on frontal scales of reticulated python.

**The diagnostic characters of M. reticulatus sbp. problems**

Prefrontal scales show inconsistencies in a variation of *M. reticulatus* specimens in each population (Table 3). Mark et al. [4], states that there were specific variations in the row of prefrontal scales in each *M. reticulatus* sbp. The species of *M. reticulatus reticulatus* has 2 rows of posterior prefrontal scales with slightly short anterior prefrontal scales, the species of *M. reticulatus jampeanus* has only 1 row of prefrontal posterior scales, with elongated anterior prefrontal scales. Whereas *M. reticulatus saputrai* has 2 rows of posterior prefrontal scales, and slightly enlarged anterior prefrontal scales. Direct observations showed specimens from Sulawesi has 1-row of fragmented posterior prefrontal scales and anterior prefrontal scales on varying size (ID. Number: MZB.Ophi. 1762, MZB.Ophi. 2297, MZB.Ophi. 1558, MZB.Ophi. 3221) resembles *M. reticulatus jampeanus*. Specimens from Maluku also showed the presence of 1 row posterior prefrontal scales with elongated anterior prefrontal scales (ID. Number: MZB.Ophi. 1951, MZB.Ophi.4481, MZB.Ophi. 4482). However, the specimen observed from Tanahjampea, Kalaaota, Karompa,
and Madu Island (ID. Number: MZB. Ophi. 3223, MZB. Ophi. 3437, S.Voucher.020, S.Voucher.021, S.Voucher.022, S.Voucher.023) shows the tendency of 1 row posterior prefrontal scales with elongated anterior prefrontal scales, resembling the diagnostic character of the *M. reticulatus jampeanus*. In accordance Hanifa et al. [12], which suggest that the Karompa, Kalaotoa, and Madu islands were acting as stepping stones on the dispersal patterns of this species, though

Table 3. Comparison of dorsal, ventral, prefrontal scales to few literature of *M. reticulatus*

| Population         | Mid-Dorsal Scale | Ventral Scales | Prefrontal Scales | Resemblance                  | Source         |
|--------------------|------------------|----------------|-------------------|------------------------------|----------------|
| (Sunda land)       |                  |                |                   |                              |                |
| *M. r. reticulatus*| 68-78            | 304-325        | 2 rows ppf, apf small | -                            | [4]            |
| (Selayar)          |                  |                |                   |                              |                |
| *M. r. jampeanus*  | 64-68            | 290-301        | 1 row of ppf, apf slightly longer than Sunda retic | -              | [4]            |
| (TanahJampea)      | 77-81            | 330-334        | 2 rows of ppf, apf very long | -               | [4]            |
| *M. reticulatus*   | 69-79            | 297-330        | Varied            | Sulawesi Population          | [13]           |
| *M. reticulatus*   | 71-75            | 300-322        | -                 | Java Population              | [1]            |
| Sumatera (n=6)     | 65-76            | 310-319        | Varied            | to *M. r. reticulatus*       | This study     |
| Kalimantan (n=6)   | 63-74            | 312-320        | 2 rows of ppf     | to *M. r. reticulatus*       | This study     |
| Jawa (n=4)         | 61-77            | 301-320        | 2 rows of ppf     | to *M. r. reticulatus*       | This study     |
| Sulawesi (n=13)    | 66-90            | 294-343        | Varied            | -                            | This study     |
| Maluku (n=6)       | 67-78            | 284-333        | Varied            | to Sulawesi Population       | This study     |
| NTB (n=1)          | 69               | 314            | 2 rows of ppf     | to *M. r. reticulatus*       | This study     |

Figure 3. Two-dimensional Scatter plot of 38 *M. reticulatus* specimens from several population (Sumatra: Brown, Java: Yellow, Kalimantan: Green, NTB: Red, Sulawesi: Blue, and Maluku: Turquoise)
share similarities to the M. reticulatus jampeanus based on morphological and molecular data.

However, these variations are still difficult to distinguish morphologically based on their locality (reticulatus: Greater Sunda-land; saputrai: Selayar; jampeanus: Tanahjampea), given the high morphological variations in these specimens, although phylogenetically have proven to be distinct subspecies [4]. This underlines that the diagnostic character of subspecies based on morphological differences in the prefrontal scales of M. reticulatus is still ambiguous and needs deep observation in other characters such as anatomical and morphological features. Specifically, a measurement of prefrontal scales (Anterior-Posterior) are suggested in the future analysis to distinguish this species.

**Population grouping of M. reticulatus from Indonesia**

Scatter plots show an overlap in each observed population. The population of Sulawesi has a wide plot width, due to the strong number of Ventral and Dorsal mid characters, where the number of Ventral Scales in the Sulawesi Population and some specimens from Sumatra and Kalimantan have a higher range than other populations.

Based on the analysis, there is no significant differences were found between populations from data on morphometric variations and prominent signs of character variation among the islands. Characters that are owned by a population are still owned by other populations. Geographic isolation has not made any morphological variations that can be used as distinguishing characters. This possible in regards to the varied landscape, habitats, and ecosystems in Indonesia, making it difficult to select a new adaptive character.

**Conclusion**

The analysis showed the highly variation on the scale range of anterior prefrontal, posterior prefrontal, frontal, parietal, preocular, postocular, loreal, temporal, upper labial, lower labial, and dorsal scales. Ventral and subcaudal scales in male and female specimens showed highly variation in the scale count, but ratio comparison of t:SVL length indicated the sexual dimorphism. Anterior-posterior prefrontal and frontal scales show high variation and are difficult to distinguish between each locality at the subspecies level and suggest it to be intra-specific variation. There is no significant grouping were found between populations from data on morphological variations.

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