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Assessing primate's pelage colour using RGB method in Malayan Pale-thighed Surili (*Presbytis siamensis siamensis*)

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Abstract

The Red, Green and Blue (RGB) colour model has been used to investigate relationships between primates' physiological and colour data. This study uses the RGB method to determine various pelage hues in white-thighed surili at different latitudes in Peninsular Malaysia. Universiti Kebangsaan Malaysia (UKM) represents the lowland while Genting Highlands and Fraser's Hill represent the highland area. Results indicated that no significant values were found based on the sample t-test on every section of the samples except on the nose (Green). Our findings can be utilised further for systematic and population genetic studies of *Presbytis siamensis siamensis* in Peninsular Malaysia.

Keywords: *Presbytis siamensis siamensis*, Malayan pale-thigh surili, langur, primate colour, Malaysian primate

Introduction

The RGB colour model is described by showing how much is used in each of the red, green, and blue colours (Hirsch 2004). RGB is crucial to display images in electronic devices correctly and to ensure that graphic cards have the same structure in displaying colours. The RGB colour space is defined as additive colour space based on the three primary colours Red, Green and Blue (Loesdau et al., 2014). This approach is effective to link physiological data with colour data, hence

providing clues of what underlies the colour variability and improve models of colouring mechanisms (Jolly 1993).

Several studies have employed RGB methods to portray colour. For example, Gerald et al. (2001) specified the numerical measures of three colour components which are hue, value and chroma of *Cercopithecus aethiops sabaeus*. RGB colour model was also used by the quantifying ratio of red/green values to study trichromacy and red pelage function for sociosexual signaling in primates (Kamilar et al. 2013). However, this method was not accurate as difference wavelengths sensors in digital cameras might affect the result of Red and Green values (Higham et al. 2010).

Assessment of pelage colour in primate by utilising photograph seldom been discovered. Previous research was primarily emphasis in ecological behaviour of Malayan langurs rather than comparison of colours amongst primate at various latitude (Mohd-Daut et al. 2021; Najmuddin et al. 2020; Ruslin et al. 2019). On the other side, previous research have been carried out on phylogenetic relationships among langurs in Malaysia (Aifat et al. 2020; Abdul-Latiff et al. 2019). Hence, this study intends to identify the pelage colour of Malayan pale-thighed surili from several localities including UKM, Genting Highlands, and Fraser's Hills. This species is also locally known as White thighed-surili or Lotong Kakoh (Md-Zain et al. 2022). In this study, RGB format was chosen while a digital camera was used to capture an images of surili. RGB format was more relevant to display an image of the subject. RGB method characterizes colour by determining the numerical dimensions of three-colour components: hue, value and chroma (Gerald et al. 2001). Hue refers to the term colloquial colour and is measured by evaluating pixel brightness in three colour channels: red, green, and blue. Chroma refers to the saturation of colour. Value, also known as brightness, refers to the relative light and darkness of the sample.

Material and methods

This research was conducted at Kolej Dato' Onn, UKM, in July 2019 to represent lowland area (N 2 º 55.865' E 101 º 46.896' m asl). Fieldwork photo surveys at highland area were conducted at Genting Highlands (N 3º 23'47.572191" E 101º 43'48.652 1553 m asl) in Dec 2019 and at Fraser's Hills (N 3º 23'47.572191" E 101º 43'48.652 1553 m asl) in July 2019. Pictures of white-thighed surili were taken using a Nikon camera. Four adults of the white-thighed surili were randomly chosen regardless of the gender. The selection of pictures was taken based on the nearest same posture and distance of the adult surilis. Using Photoshop CS6, value of colour was obtained in Red, Green and Blue (RGB) formats (Gerald et al. 2001). Colour values at the main pelage point were recorded for crown, nose, lower body, beard, lips and eyes. The t-test and PCA analysis were conducted to notify the statistical differences. Figure 1 (A-D) shows pictures used in

morphological analysis of white-thighed surili in Kolej Dato' Onn, UKM. Figure 1 (E-H) shows the the pictures used in morphological analysis of white-thighed surili in Fraser's Hill and Genting Highlands.

Figure 1. A-D : White-thiged surili in UKM (source: Md-Zain), E-G : White- thiged surili in Genting Highlands & H: Fraser's Hill (Source: Md-Zain & Eddie Chan)

Results and discussion

Table 1 indicated the colour values for UKM representing the lowland area. For Red, highest standard deviation recorded was in beard (42.74) while the lowest was in nose (17.41). For Green, highest value recorded was in the beard (42.52) while the lowest was in nose (18.65). For Blue category, the highest value of standard deviation was in the lower body (53.99) while the lowest was in nose (17.02). In Red, highest value of standard deviation was in the beard (45.62) while the lowest was in nose (19.55). In Green, the highest value of standard deviation was in beard (44.20) while the lowest was in lips (16.09). The highest value of standard deviation in Blue was in the lower body (42.09) while the lowest was in the nose (16.62). The results showed that Pearson correlation coefficients in Red, Green and Blue colour values were insignificant (Figure 2). This result might be affected by countershading. Kiltie (1989) showed that squirrel skins appear most vague when they are exposed to sunlight in a horizontal position. A comparative approach was used by Kamilar (2009) found that small primates are more prominent than large ones and argue

that this may be due to small species requiring additional anti-predatory adaptation due to increased predation. Different morphological types may be due to the stochastic expression of eumelanin and felomelanin produced by melanocytes, and result in differences in hair colouring (Kaelin & Barsh 2013). However, the data of the study is not strong enough to justify the difference between white-thighed surili in the highland and lowland as many technical aspects have been neglected. Therefore, molecular phylogenetic studies need to be conducted to see the genetic differences in the lowland langur (UKM) and highland (Genting Highlands and Fraser's Hills) populations.

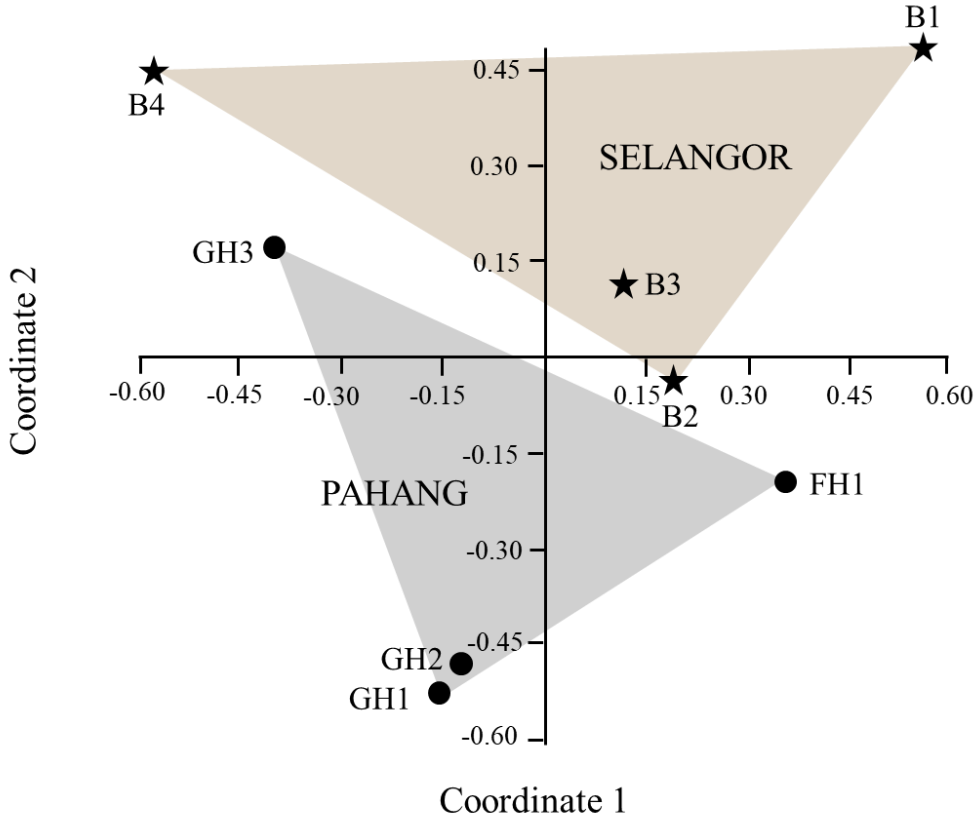

Figure 2. PCoA illustrates the relationship between white-thighed langur in lowland and highland.

Table 1 shows the analysed data for red, green and blue colour values in pale thighed surili. Overall, comparison based on a t-test does not depict clear distinction between *P. s. siamensis* in UKM, Genting Highlands and Fraser's Hill. No significant value obtained was based on the samples except nose in the Green hue between langur in lowland and highland. Classification merely on morphological traits did not yield definitive conclusions, as it is derived or impacted by the environment surrounding the species. *P. s. siamensis*, formerly known as *Presbytis melalophos* (Brandon-Jones et al., 2004) was characterised as having dorsal section of the body in dark grey-brown, while the ventral part, including tail and limbs are pale grey to white. Many *Presbytis*

langurs are limited to lowland and hill forests below 1000m – 1500m asl, occasionally reaching the lower montane zone (Matsuda et al. 2022). Thus, comparing primate of a similar species solely on pelage colour is not complete since genetic studies is necessary to assess whether patterning and colouring are adaptive (Munds et al., 2021). The use of colour evaluation in morphological analysis has several drawbacks. Five disadvantages have been highlighted by Endler (1989), i) The ambient light spectrum influences all colour components, ii) colour chips are susceptible to weather and fading, iii) humans differ in how they evaluate certain conditions, and other circumstances (such as weariness) can further complicate colour evaluation, iv) Human colour standards are based on human colour perception, not animal spectrum vision; v) colours that are close to one other might impact colours appearance. To address the shortcomings in the Malaysian primate population's ability to observe colour differences, further research is still required. Settings used by the camera are adjusted according to the scene being photographed and so may be inconsistent (Stevens et. al 2007). Studies of the coevolution with colour patterns of courtship, predation timing and microhabitat choice will also be more practical with precise measurements of animal colour patterns and backgrounds under varying natural conditions (Endler 1990).

Assessment of pelage colour based on images is not sufficient as numerous technical errors being missed. However, this result might be utilised as a preliminary basis for further analysis on phylogeny of *P. s. siamensis*. Thus, sample data should be acquired from a most region of Peninsular Malaysia since the data might be skewed if only targeted in certain locations. Species and subspecies classification are still poorly known due to a lack of molecular data. Faecal samples should be often collected during field surveys as they yield DNA that is helpful for population genetics, metabarcoding diet intake and microbiome in addition to taxonomic and systematic studies (Ang et al., 2020). Taxonomy and conservation efforts could be hampered by a lack of nuclear and mitochondrial data. More information is also needed in order to properly understand *Presbytis siamensis* genetic structure and systematic relationships.

Table 1 Red, Green, and Blue colour values in the RGB format of *P. s. siamensis* in Bangi, Genting Highlands & Fraser's Hill

Sample	Crown			Nose			Lower Body			Beard			Lips			Eyes		
	R	**G**	**B**	**R**	**G**	**B**	**R**	**G**	**B**	**R**	G	**B**	**R**	**G**	**B**	**R**	**G**	**B**
B1	149	149	145	80	**73**	77	155	151	147	160	149	145	80	73	77	155	151	147
B2	109	106	114	86	**85**	103	181	185	209	109	106	114	86	85	103	181	185	209
B3	157	142	138	107	**103**	109	174	157	139	157	142	138	107	103	109	174	157	139
B4	85	79	74	117	**115**	116	119	115	77	85	79	74	117	115	116	119	115	77
Mean	127.8	119	117.8	97.5	**94**	101.3	157.3	152	143	110	105.8	74	155	138	129.8	124.3	121	127.8
σ	36.85	32.65	32.05	17.41	**18.65**	18.65	27.7	28.77	53.99	42.74	42.52	38.11	31.10	26.88	34.29	41.96	41.74	49.49
GH1	160	149	145	80	**73**	77	155	151	147	158	155	42	174	148	134	184	180	192
GH2	109	106	114	86	**85**	103	181	185	209	102	101	107	174	156	153	123	121	139
GH3	157	142	138	107	**103**	109	174	157	139	124	115	107	163	150	152	95	93	101
FH1	85	79	74	117	**115**	116	119	115	77	56	52	40	109	98	80	95	90	79
Max	87.5	77.3	88	81.5	**77.8**	91.5	163.25	160	168.5	137.3	135.5	142.8	150	125.8	124.5	79.8	78.3	89
t	1.17	1.25	1.04	3.17	**3.44**	2.73	-0.22	-0.35	-0.73	0.64	-0.72	-1.96	0.35	1.07	0.31	1.47	1.39	1.12
P	0.375	0.63	0.63	0.06	**0.04***	0.07	0.84	0.75	0.51	0.56	0.52	0.14	0.70	0.36	0.78	0.23	0.25	0.34

R=Red; G= green; B= Blue
*significant at P< 0.05

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