

**HOME RANGE SIZE ESTIMATION OF A SATELLITE
COLLARED FEMALE GAUR AT ULU JELAI FOREST
RESERVE, PAHANG BY USING MINIMUM CONVEX POLYGON
AND FIXED KERNEL ANALYSIS: A PRELIMINARY STUDY**

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ABSTRACT

A study on the home range of a wild gaur using a satellite collar was carried out in Ulu Jelai Forest Reserve, Pahang. A female gaur was captured, fitted with a satellite collar and released into the forest reserve. The gaur was monitored for five months. A total of 380 GPS locations were retrieved from the transmitter within 133 days. The home range generated from the GPS locations was estimated at 29.62 km². Most of the home range areas are secondary forest where food is abundant. The mean daily movement distance of the gaur was 1.58 ± 0.03 km, while the longest distance travelled in a day was 6.31 km.

Keywords: Gaur, satellite collar, home range, movement, habitat utilities.

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INTRODUCTION

Malayan gaur (*Bos gaurus hubbaki*) or Seladang is the only remaining wild cattle species in Peninsular Malaysia (Rosli *et al.*, 2011) and can be found in Pahang, Kelantan, Kedah, Perak, and Terengganu (Ebil, 1981). Currently, the

species occurs in Bhutan, Cambodia, China, India, Lao People's Democratic Republic, Peninsular Malaysia, Myanmar, Nepal, Thailand and Vietnam (Duckworth *et al.*, 2016). Globally, the estimation of gaur populations was less accurate with limited resources in order to carry out population based studies. In Peninsular Malaysia, there were few ecological studies on gaur populations have been conducted. Among the earliest study in Peninsular Malaysia was by Hubback (1937) who wrote about "The Malayan Gaur or Seladang", Ogilvie (1954) on the "Behaviour of Seladang", and Weigum (1968) on the "Habits and Habitat of the Seladang". Unfortunately, there was no national level population census of gaur population carried out in Peninsular Malaysia.

According to Khan (1977), the estimated number of gaur individuals in Peninsular Malaysia was 400. While in the year 1991 the study by Zaaba *et al.* (1991) shows the estimated number of gaur individuals were 600. In addition, a report by Sahir (1999) shows the estimated gaur populations were within 549 to 577 individuals. The current estimation of gaur populations by Department of Wildlife and National Parks (DWNP) were in between 270 to 330 individuals. This estimation was based on various observations and wildlife surveys. Based on these studies, several management initiatives were undertaken since the 1970s to enhance gaur conservation in Peninsular Malaysia. This includes revise the protection status under the law, surveys gaur population in selected sites, captive breeding programme and restocking them into the wild habitat.

The decrease in wild gaur populations in recent decades has been due largely to habitat exploitation (Kawanishi *et al.*, 2003; Clement *et al.*, 2014; Ahmad-Zafir & Magintan *et al.*, 2016) that has affected the populations drastically (Zaaba *et al.*, 1991) and increased poaching (DWNP, 2012). The large-scale conversion of lowland forests since the 1970s has impacted many wildlife species in Peninsular Malaysia, including the gaur (Manokaran, 1992 & DWNP/DANCED, 1996). Gaur prefers lowland forests with ample water resources, salt licks and food sources. It spends most of the time in its habitat, searching for quality food that consists of varieties of grasses and shrubs (Ebil, 2009). It may consume over 80 species of plants available in the natural forests (Conry, 1981).

In terms of protection status, gaur is a totally protected species under the Malaysian Wildlife Conservation Act 2010 [Act. 716]. It is also included in Appendix I of the Conservation on International Trade in Endangered Species of Wild Fauna and Flora (CITES), categorised as Vulnerable globally under the IUCN Red List and Endangered under the Red List of Mammals for Peninsular Malaysia (DWNP, 2017). Globally, the gaur population is decreasing as stated by the International Union for Conservation of Nature and Natural Resources (IUCN).

The lack of research on gaur is partly due to the elusiveness of this species in their habitat, making it challenging to research. Among the studies that were carried out were habitat selection and home range of Malayan gaur in central Pahang, Malaysia (Conry, 1981), habitat requirement (Ebil, 1982; Saharudin, 1984) and forage utilisation (Ebil, 1991). Inventories and surveys by the DWNP had been conducted in the Temenggor Forest Reserve, Perak and surrounding forest reserves revealed that several herds of gaur exist (Dennis, 2008). The objective of this study was to determine the home ranges of the gaur in Ulu Jelai Forest Reserve, Pahang.

MATERIALS AND METHODS

This study was conducted in Ulu Jelai Forest Reserve, Pahang (Figure 1). The duration of the study was between February and July 2013. The area covers 1,955 km² with an altitude range from 60m to 880m above sea level and situated between the Titiwangsa Main Range and Taman Negara National Park (TNNP). Other surrounding forest reserves extend from the north, namely Batu Papan Forest Reserve, Ulu Galas Forest Reserve, Persit Forest Reserve and Sungai Yu Forest Reserve, while the western part included Ulu Jelai are Sungai Brok Forest Reserve, Sungai Wi Forest Reserve and Bukit Jerut Forest Reserve. Most of these reserves are secondary forests where sustainable logging had taken place.

The forest type in this reserve ranges from lowland dipterocarp to hill dipterocarp. This area is classified as a production forest, mainly for logging and mining of gold and iron. Two main river systems in this area are the Telom River and Serau River. The nearby human settlements are the FELCRA Sungai Temau, FELDA Chegar Perah, Kg. Chegar Perah, Kuala Medang, Pos Lanai and Pos Betau. The Ulu Jelai Forest Reserve is separated from the nearby Taman Negara National Park (TNNP) by Kuala Lipis - Gua Musang highway and rail road with the average separation distance approximately 4 km wide. To re-establish the connectivity between these two forest complexes, three viaducts were built along the elevated highway with funds allocated by the Federal Government under the Central Forest Spine (CFS) Master Plan project.

The gaur capture programmes were initiated in December 2011. A female adult gaur was tracked and successfully immobilised with chemical restraint (Etorphine-HCl + Acepromazine) on the 27th February 2013. A satellite transmitter developed by Tellus Televilt quickly fitted to the gaur and antidote (Revivon) was delivered immediately after the procedure. The collar is programmed to transmit a GPS location every three hours (eight fixes per day). Data from the collar was then delivered via email to the user email account. The data was then tabulated in an Excel spreadsheet. The Minimum Convex Polygon

(MCP) and Fixed Kernel (FK) were obtained using software package BIOTAS 1.03 Alpha (Ecological Software Solution LLC). This analysis was used to determine the home ranges of the gaur. The interpretation and comparison of home range sizes were measured by 100% MCP and 95% FK.

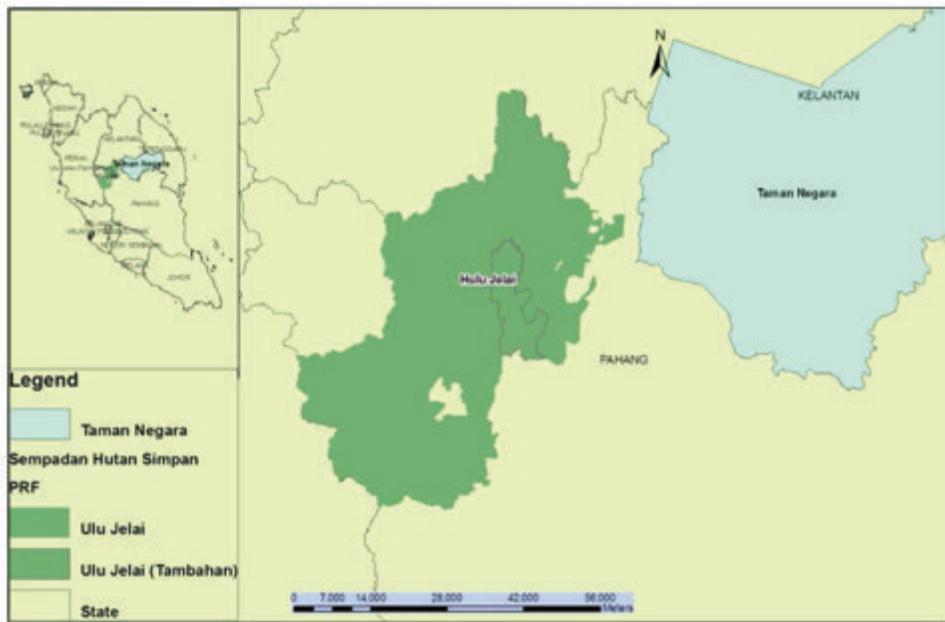


Figure 1 Maps showing the location of Ulu Jelai Forest Reserve, Lipis, Pahang.

RESULTS

A female gaur that was captured in the Ulu Jelai Forest Reserve was a member of a small herd, consisting two adult females, a calf (sex not identified) and a subadult male. Based on Ahrestani and Prins (2011), the age of the collared gaur was estimated between two to four years old. Figure 2 shows the location of the gaur captured and collared in the study area. We assigned the name for this herd as the Bukit Beras herd to differentiate it from other herds. The captured and collared female gaur was assigned with the identification name ID2606.

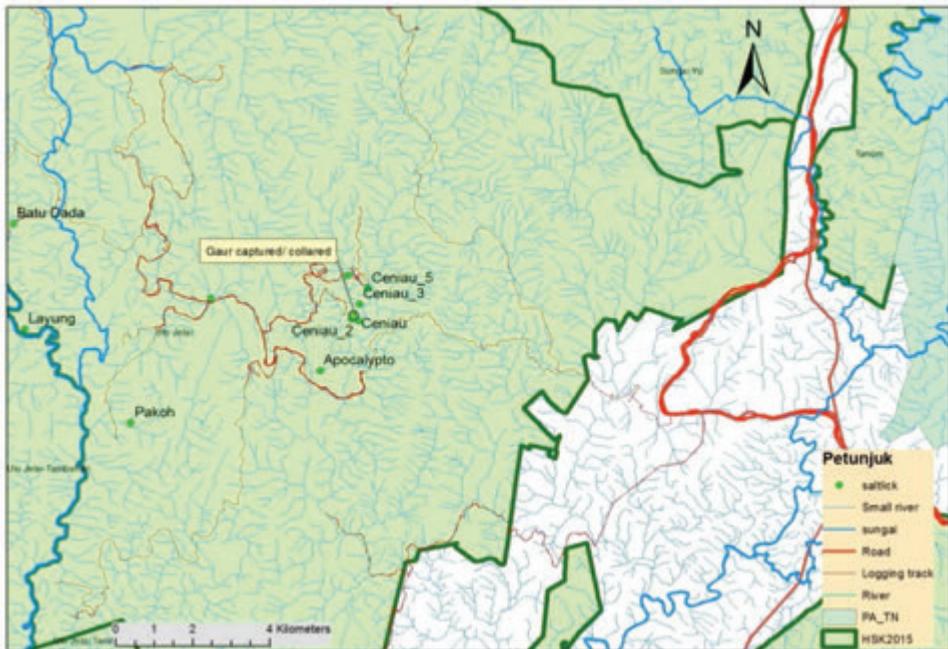


Figure 2 The location of the capturing and collaring of the female gaur ID2602 in Ulu Jelai Forest Reserve.

A total of 380 location fixes were obtained from the gaur between February and July 2013. The GPS collar had a success rate of 35.82%, which is 380 fixes per 1061 attempts. In terms of time, the success rate was 10.84% (115 fixes) for daytime locations and 24.98% (265 fixes) for night-time locations. The tracking duration was four and a half months. The GPS collar recorded 112 fixes for the first 30 days, and the number increased in the consecutive 30 days. Of all fixes, only 220 fixes were obtained with altitude readings. 89% of the fixes fell within the lowland dipterocarp forest (below 300 m of altitude), while 11% of the fixes fell in the hill dipterocarp forest (300 m to 750 m).

The estimated home range size generated by the gaur in this study was 29.68 km² and 6.51 km² for 100% and 50% MCP, respectively (Figure 3). The mean home ranges size for FK for 50%, 75% and 95% were 8.15 km², 1.46 km² and 0.37 km², respectively. The mean daily movement distance of the gaur was 1.58 ± 0.03 km. The home range areas for gaur include primary and secondary forest, and degraded forest due to heavy logging activities. The longest distance travelled a day for the collared gaur was 6.31 km on 28th of February 2013. Most of the distance travelled by the gaur in a day was within 1-2 km. Based on the data from the satellite collar, the total distance travelled by the gaur during this

study was 201.25 km and the highest altitude was 544 m a.s.l. Most of the locations based on elevation was under the forest type of lowland dipterocarp (<300 m).

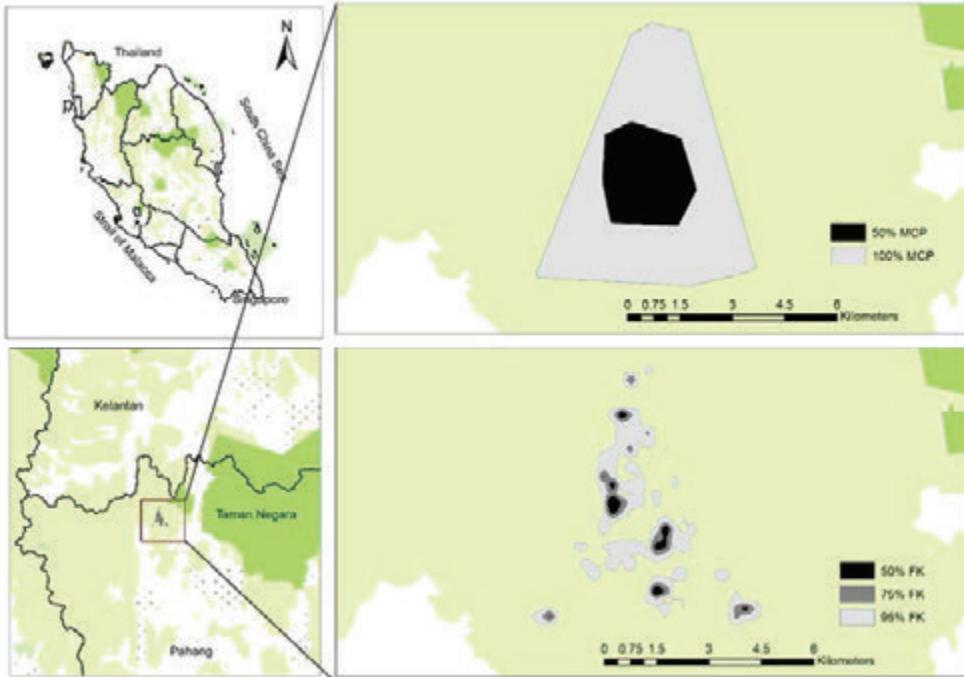


Figure 3 Home range pattern estimated for the captured gaur using Minimum Convex Polygon and Fixed Kernel.

DISCUSSION

Four decades ago, Ebil (1981) reviewed the ecology, behaviour, population and management of gaur (*Bos gaurus hubbacki*) in Peninsular Malaysia. He estimated the gaur population in the wild was less than 500 individuals. Since then, very few papers or articles have been written on the importance of this species. The home range data and information of gaur in Peninsular Malaysia was limited to a study using radio telemetry in Central Pahang using the MCP method (Conry, 1981). It was a three years study during a period of extensive logging and agricultural development in the area of Lepar Valley, Pahang (Conry, 1989). Thus, the findings of this research are an important contribution to home range and habitat utilisation by gaur in Peninsular Malaysia. The study of home range and movements patterns of other mammals in Malaysia has been

encouraging, such as the elephant (Alfred *et al.*, 2012; Magintan *et al.*, 2016) and Malayan Tapir (Khadijah-Ghani, 2010; Mahathir *et al.*, 2017).

Based on the data area curve analysis, the six months of tracking and monitoring of GPS collar fixed gaur has provided sufficient data for home range analysis. Analysis of the data area curve shows that the line was starting to level off. The home range assessed by Conry (1981) for the adult bull was 70.18 km², for female was 52.18 km², whereas for yearling male it was 29.89 ha² using MCP. The home range generated for the adult female in this study was 29.68 km². It is suggested that the difference in home range size between Conry (1981) and this study were mainly influenced by the distribution and location of mineral licks in the study area. The distribution of mineral licks in this study area is confined within less than 10 km², while, Conry (1981) stated that gaur moved at least 19 km from one mineral lick to the other.

The different habitat types within the home range influenced the availability of the preferred species of plants eaten by the gaur. Thus, the gaur has to move a significant distance in the home range to search for palatable foods. The Bovidae family also eat grassy vegetation that provides more choices of food sources typically found in lowland areas (Tweedie, 1978). The gaur avoid hilly areas, accept crossing a ridge when travelling one river valley to another, and preferred plants are found along rivers and on the clearing of a forest (Ebil, 1981). The habitat utilised by the collared gaur in this study is a secondary forest mosaic with an emerging stand of timber wood, and openings at all places. It is estimated that the area has been logged almost 25 years ago and in the stage of regenerating. The area is mostly lowland forests with the highest peak of 600 m (Bukit Beras) where fixes were largely found. Conry (1981) showed that the female occupied a home range that included secondary forests, agriculture estates and lakes and rivers, while, in this study, the female home range occupied primary forests, secondary forests and rivers, but did not occupy a home range in agriculture estates.

Tweedie (1978) suggested that gaurs are attracted to clearing areas where grasses were starting to grow at Kuala Tahan in Taman Negara Pahang. Logging creates new pasture areas for ungulates to survive. Bamboo and grass (mainly *Puspallum conjugatum*) were abundant in the area, beside secondary vegetation such as *Trema* spp., *Sapium baccatum* and *Macaranga* spp. were also available as a favourite diet for the gaur. A total of five saltlicks were recorded within the fringes of the ranging area at the riverbank of the Ceniau river and its tributaries. Abdul-Kadir *et al.* (2008) also reported the presence of gaur in the main range in Peninsular Malaysia mostly found in the hill dipterocarp forest during several surveys of wildlife between 2005 and 2007. In the Red List of mammals for Peninsular Malaysia, the gaur was categorised as Endangered (EN) and targeted by hunters (DWNP, 2017). Any translocation, reintroducing or breeding in

captivity programme should consider the best plan; ecologically and genetically to help maintain this native Malaysian subspecies (Rosli *et al.* 2011).

CONCLUSION

A female gaur was successfully collared in Ulu Jelai Forest Reserve, Pahang, for home range study. Based on the MCP (100%), the estimated home range generated by the gaur was 29.68 km² with the daily movement rate of 1.58 ± 0.03 km. This study has enhanced understanding of the home range, movements and habitat utilisation of gaur in the wild. The Ulu Jelai Forest Reserve should be preserved as a gaur habitat as this area is among the few suitable habitats remaining in Pahang. Negotiation should be undertaken at the highest level between the state governments (SG) to protect this area with the Federal Government (FG) deploying enough rangers on site to intensively protect the site and these remaining gaurs from being poached. In addition, at least 15 natural salt licks were found in this area and utilised by gaurs.

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REFERENCES

- Abdul-Kadir, A.H. (2008). The distribution of large mammals within the main range (state border of Kelantan, Perak and Pahang) in Peninsular Malaysia. In *Biodiversity resources and conservation status in Peninsular Malaysia* (Elagupillay, S., Siti-Hawa, Y., Abdul-Kadir, A. H., Hasdi, H., Lim, H.B., Rosli, H., Noorlidah, A., Shukor, M.N. & Rahmah, I., eds.), pp. 1-11. Kuala Lumpur: Department of Wildlife and National Parks Peninsular Malaysia.
- Ahmad-Zafir, A.W. & Magintan, D. (2016). Historical review of human-elephant conflict in Peninsular Malaysia. *Journal of Wildlife and Parks*, **31**: 1-19.
- Ahrestani, F.S. & Prins, H.H.T. (2011). Age and sex determination of gaur *Bos gaurus* (Bovidae). *Mammalia*, **75**(2): 151 - 155.
- Alfred, R., Ahmad, A.H., Payne, J., Williams, C., Ambu L.N. & How, B.G. (2012). Home range and ranging behaviour of Bornean Elephant (*Elephas maximus borneensis*) females. *PLoS ONE* **7** (2): e31400.

Clement, G.R., Lynam, A.J., Gaveau, D., Yap, W.L., Lhota, S., Goosem, M., Laurance, S. & Laurance, W.F. (2014). Where and how are roads endangering mammals in Southeast Asia's forests? *PLoS ONE* 9: e115376

Conry, P.J. (1981). Habitat selection and use, movements and home range of the Malayan seladang (*Bos gaurus hubbacki*) in Central Pahang, Malaysia. University of Montana. Unpublished M.Sc. thesis,

Conry, P.J. (1989). Gaur *Bos gaurus* and development in Malaysia. *Biological Conservation*, **49**: 47-65.

Dennis, T.C.Y. (2008). The distribution of gaur in Titiwangsa Main Range-Temenggor Forest Reserve and its surrounding areas. In *Biodiversity resources and conservation status in Peninsular Malaysia* (Elagupillay, S., Siti-Hawa, Y., Abdul-Kadir, A.H., Hasdi, H., Lim, B.L., Rosli, H., Noorlidah, A., Shukor, M.N. & Rahmah, I., eds.), pp.13-17. Kuala Lumpur: Department of Wildlife and National Parks Peninsular Malaysia.

Duckworth, J.W., Sankar, K., Williams, A.C., Samba Kumar, N. & Timmins, R.J. (2016). *Bos gaurus*. The IUCN Red List of Threatened Species 2016: e.T2891A46363646. Available from <https://dx.doi.org/10.2305/IUCN.UK.2016.2.RLTS.T2891A46363646.en>. Downloaded on 20 May 2020.

DWNP. (2012). *Seladang Information Sheet*. Kuala Lumpur: Department of Wildlife and National Parks Peninsular Malaysia

DWNP. (2017). *Red List of mammals for Peninsular Malaysia*. Kuala Lumpur: Department of Wildlife and National Parks Peninsular Malaysia.

DWNP/DANCED. (1996). *Capacity building and strengthening of the protected area system in Peninsular Malaysia*. Kuala Lumpur: Department of Wildlife and National Parks.

Ebil, Y. (1981). *A Review of the Malayan Seladang (Bos gaurus hubbacki)*. Kuala Lumpur: Department of Wildlife and National Parks Peninsular Malaysia.

Ebil, Y. (1982). Habitat requirement for the Malayan gaur. *Journal of Wildlife and Parks*, **1**: 7-16.

Ebil, Y. (1991). The study of forage utilisation of seladang in Ulu Lepar, Pahang. *Journal of Wildlife and Parks*, **11**: 1-11.

Ebil, Y. (2009). Estimating cover preferences of seladang (*Bos gaurus hubbacki*) in Krau Wildlife Reserve, Pahang. *Malaysian Forester*, **72**(2):175-184.

Hubback, T.R. (1937). The Malayan gaur or seladang. *Journal of Mammalogy*, **18** (3): 267-279.

Kawanishi, K., Siti-Hawa, Y., Abdul-Kadir, A.H. & Rahmat, T. (2003). Distribution and potential population size of the tiger in Peninsular Malaysia. *Journal of Wildlife and Parks*, **21**: 29-50.

Khadijah-Ghani, S. (2010). Home range size, density estimation, and food of Malayan tapirs (*Tapirus indicus*) at Krau Wildlife Reserve. Universiti Sains Malaysia, Kuala Lumpur: Unpublished MSc Thesis.

Khan, M. (1977). The future of the seladang. *Nature Malaysiana*, **2**: 22-27.

Magintan, D., Shukor, M.N., Lihan, T., Ahimza-arceiz, C., Salman, S., Shahril, M.H. & Mohd Noh, A. (2016). An assessment of elephant home ranges and movement patterns during construction of Hulu Terengganu hydroelectric dam, Terengganu using GPS satellite collars. *American Institute of Physics Conference Proceedings*, **1784**: 060006-1- 060006-7.

Mahathir, M., Donny, Y., Noor, J.N.J., Magintan, D., Anuar, I., Shahril, E.J., Rosli, S., Norzalie, A.S., Mohd Syafiq, A.L., Zaihamrizal A.H., Amri, I., Mamat S., Pazil, A.P., Traeholt, C., Simpson, B., Sanusi, M. & Rizal, A.R. (2017). Movement patterns of a translocated Malayan tapir in Senaling Inas Forest Reserve, Negeri Sembilan. *Journal of Wildlife and National Parks*, **32**: 13-21.

Manokaran, N. (1992). An overview of biodiversity in Malaysia. *Journal of Tropical Forest Science*, **5**(2): 271-290

Ogilvie, C.S. (1954). The behaviour of seladang. *Malayan Nature Journal*, **9**:1-10.

Rosli, M.K.A., Zakaria, S.S, Syed-Shabthar, S.M.F., Zainal, Z.Z., Shukor, M.N., Mahani, M.C., Abas-Mazni, O. & Md-Zain, B.M. (2011). Phylogenetic relationships of Malayan gaur with other species of the genus *Bos* based on cytochrome b gene DNA sequences. *Genetics and Molecular Research*, **10**(1): 482-493.

Saharudin, A. (1984). Habitat sustainability Index Model: seladang (*Bos gaurus hubbacki*). *Journal of Wildlife and Parks*, **3**: 68-74.

Sahir, O. (1999). The captive breeding programme for the Seladang (*Bos gaurus hubbacki*): an assessment and recommendations. *Journal of Wildlife and Parks*, **17**: 96-103.

Tweedie, M.W.F. (1978). *Mammals of Malaysia*. Kuala Lumpur: Longman Malaysia Sdn. Bhd.

Weigum, L. (1968). *Habits and habitat of the seladang (Bos gaurus hubbacki)*. Manuscript Report. Office of the Chief Game Warden, State of Malaya.

Zaaba, Z.A., Mohd Tajuddin, A., Mustafa, A.R. & Ebil, Y. (1991). Large mammals in Peninsular Malaysia. In *The status of nature conservation in Malaysia* (Kiew, R., ed.), pp. 173-176. Petaling Jaya, Malaysia: Malayan Nature Society.