

The importance of regulatory compliance in wildlife captive breeding: Case study from deer captive breeding in Indonesia

SUBENO^{1,*}, SATYAWAN PUDYATMOKO¹, MUHAMMAD ALI IMRON¹, TRI SATYA MASTUTI WIDI²

¹Wildlife Ecology and Management Laboratory, Faculty of Forestry, Universitas Gadjah Mada. Jl. Agro No. 1, Bulaksumur, Sleman 55281, Yogyakarta, Indonesia. Tel.: +62-274-512102, Fax.: +62-274-550541, *email: wishben@yahoo.com

²Faculty of Animal Science, Universitas Gadjah Mada. Jl. Fauna No. 3, Karanggayam, Sleman 55281, Yogyakarta, Indonesia

Manuscript received: 30 September 2022. Revision accepted: 1 December 2022.

Abstract. Subeno, Pudyatmoko S, Imron MA, Widi TSM. 2022. The importance of regulatory compliance in wildlife captive breeding: Case study from deer captive breeding in Indonesia. *Biodiversitas* 23: 6128-6136. Indonesia has five deer species that the Indonesian government protects. Among these deer, Javan deer (*Rusa timorensis*) and sambar deer (*Rusa unicolor*) have received conservation attention through captive breeding. Despite this conservation approach being applied for these two species, a review on captive breeding implementation is still lacking. This research aimed to assess the management of captive breeding of two deer species, which will support the natural population of endangered species in Indonesia. A triangulation method is used to collect secondary data (documents), interviews, and field observations in Parengan of East Java for Javan deer and Dumai of Riau for sambar deer. Then we assessed the management aspect and the ability of captive breeding to contribute to the release program using descriptive qualitative analysis. The Pertamina RU 2 Dumai sambar deer captive breeding has been carried out since 2016. However, during four years of management, the documents required for captive management, assessed by the Nature Resources Conservation Agency (Balai Konservasi Sumber Daya Alam/BKSDA), were not fully available. Consequently, the population increment in captive breeding could not participate in the release program. The Parengan Javan deer captive breeding was built in 2014. Management documents, population and habitat management were carried out intensively. As a result of the assessment by BKSDA East Java, this captive breeding received an excellent value (A). The population development showed an increasing trend. The results of this population development are then taken 10% to be released into the wild. In 2018, 4 captive-breed Javan deer were released in their natural habitat of Tahura R. Soeryo, East Java. The implication is that captive breeding, which is managed through proper management of population, habitat, and infrastructure, can contribute to supporting the addition of wildlife populations in their natural habitats.

Keywords: Assessment, captive breeding, Javan deer, Sambar deer, triangulation method

INTRODUCTION

The sambar deer (*Cervus unicolor*) and Javan deer (*Rusa timorensis*) are native species of Indonesian deer protected by law. Their population numbers continue to decrease due to illegal hunting and increasing habitat degradation (Krisna et al. 2020; Giarat et al. 2021). Many efforts can be made to protect endangered animals under human pressure or change their habitat to conserve natural resources. To avoid extinction and simultaneously utilize deer optimally and sustainably, this can be conducted through captivity (ex-situ conservation) (Rasyidi et al. 2020). Captive breeding is a technique of breeding animals that are managed in a particular place to increase the population, and then they can be released back into nature (Ralls and Ballou 2013). The government carries out efforts to protect and make sustainable use of the potential of sambar deer (*Cervus unicolor*) and Javan deer (*Rusa timorensis*) as protected animals in Indonesia through captive breeding (Semiadi and Jamal 2015). To ensure that captive activities can run properly and correctly, the Government of the Republic of Indonesia has issued a Government Regulation No. 8 of 1999 concerning the use of wild plant and animal species, and captive breeding is a form of ex-situ conservation and utilization justified by the

regulation (Kasso and Balakhrisnan 2013; McCleery et al. 2014; Hutapea et al. 2021).

Wildlife captivity is one of the conservation and utilization programs for conservation and economic purposes (Skonhoft et al. 2013). Individuals, legal entities, cooperatives, or conservation organizations can carry out captive breeding. The results of captive deer also have the prospect of being developed on a commercial cultivation scale to fulfill the function of the forest as a food source (Adji 2015; Miller and Miller 2016). In the formula to obtain the optimal solution for the development of captive deer, it is necessary to consider carrying capacity and still pay attention to development for conservation purposes (Broom 2019; Krisna et al. 2020). The habitat's carrying capacity components include cover, water, and space used to obtain food, shelter, water, and breeding area (Noonan and MacFarlane 2012; McComb 2016). The space in the habitat depends on the size of the animal species (Frynta et al. 2013; Landaa et al. 2017).

Regarding the utilization of the area for captive breeding, there are at least two choices of captive systems that can develop, namely ranching and farming (Takandjandi 2015; Taylor et al. 2015; Ho et al. 2018; Krisna et al. 2020). One of the essential considerations that must be done first is the design of the optimal allocation of

available space to suit the functions and needs of the site in the development of a captive deer unit (Yang et al. 2016; Selvarajah et al. 2022). The facilities and infrastructure used in captive deer follow SEAZA (Southeast Asian Zoos and Aquariums Association) standards (SEAZA 2019).

Pertamina RU 2 Dumai (A state-own enterprise produces a variety of fuel oil and non-fuel oil to meet domestic and foreign needs, including to meet the fuel needs of Riau and northern Sumatra as well as southern parts. Doing business in the oil and petrochemical processing sector that is managed professionally and with an environmental perspective) has started to make efforts to conserve the sambar deer through deer breeding activities that had carried out since 2016 (Imron et al. 2021). Meanwhile, Pertamina EP 4 Cepu (An upstream subsidiary of PT. Pertamina (Persero) is engaged in upstream oil and gas business activities with a mining working area in the Cepu Block and commits to responsible operating activities through Social and Environmental Responsibility activities) has started to make efforts to conserve the Javan deer through deer breeding activities that had carried out since 2014 (Subeno and Mukhlison 2016). The Sambar and Javan deer are protected animals, so in captivity, they need permission from the authorized institution. Applying for a captive permit must meet the requirements for the legality of bred animals, infrastructure, documents, and management institutions. After at least two years, the manager can submit a captive assessment to the authorized institution (Anugrah 2018). The assessment results will determine whether improvements still needed or get an opportunity. If a breeding permit is obtained, there is an opportunity to take advantage of the obtained derivatives for Edu-ecotourism or commercial development while simultaneously carrying out the obligations that must be fulfilled, namely conducting releases to support deer populations in the wild (Tensen 2016; Arini et al. 2020).

Methodological triangulation or mixed-methods research uses more than one kind of method to study a phenomenon. Triangulation method is a data collection technique that combines various data collection techniques and existing data sources (Mertens and Hesse-Biber 2012). Methodological triangulation has been found to be beneficial in providing confirmation of findings, more comprehensive data, increased validity, and enhanced understanding of the studied phenomenon. With triangulation, researchers can use two research methods to decrease the weaknesses of an individual method and strengthen the outcome of the study. Data triangulation using different sources of data. This includes different times for data collection, different places from which to collect the data, and different people who could be involved in the research study. Triangulation can be used in quantitative and qualitative research, and it even seems as though triangulation is just another term for mixed-methods research. The Journal of Mixed Methods Research

has a special issue devoted to analyzing and exploring the various ways triangulation is used in mixed.

Deer captive breeding at Pertamina RU 2 Dumai and Pertamina EP 4 Cepu has been running for almost five years. It is appropriate to start submitting an assessment or audit to determine the success of the breeding. Therefore, this study is essential to assess the management of captive breeding of two deer species, which will serve as crucial management measures for captive breeding of endangered species in Indonesia and supporting the natural population of endangered species in its habitat.

MATERIALS AND METHODS

Study area

Locations of area study were Parengan of East Java for Javan deer captive breeding and Dumai, Riau for Sambar deer captive breeding. Both captive breedings received support for establishment and earlier management assistantship by state-own enterprises of Pertamina EP 4 Cepu for the Parengan captive breeding and Pertamina RU II Dumai for the Sambar deer captive breeding in Dumai, Riau province. Pertamina RU 2 Dumai has started the sambar deer captive breeding since 2016. Meanwhile, Pertamina EP 4 Cepu has started the Parengan Javan deer captive breeding since 2014. KPH Parengan is part of PERUM PERHUTANI (the state-own forest company) area in Bojonegoro, East Java which is dedicated to the development of captive breeding.

Data collection

A triangulation method is used to collect secondary data (documents), interviews, and field observations (Thamhain 2014; Hopf et al. 2016; Moleong 2018; Shin et al. 2022). Secondary data includes captive licensing documents, documents related to deer population regulation and management (origin of deer, genealogy, marking/tagging, and population development reports), captive management institutional documents, and captive assessment documents by the authorized institution (BKSDA). The interview was conducted using semi-structured question and answer with the management and staff of the deer breeding management, which was guided by questions as the topic of conversation and a control direction. Key persons were chosen by purposive sampling (Etikan et al. 2016). Field Observation is intended to verify secondary data/document information and interview results and obtain more detailed information related to the verifier to be assessed (Natow 2020). Direct observation was conducted to see captive facilities and infrastructure, supporting facilities built in the cage area, forage planting areas, supporting buildings: guard house/guard post, feed and tool warehouse, and availability of experts. This triangulation method is applied to each verifier so that the information obtained can be accurate.

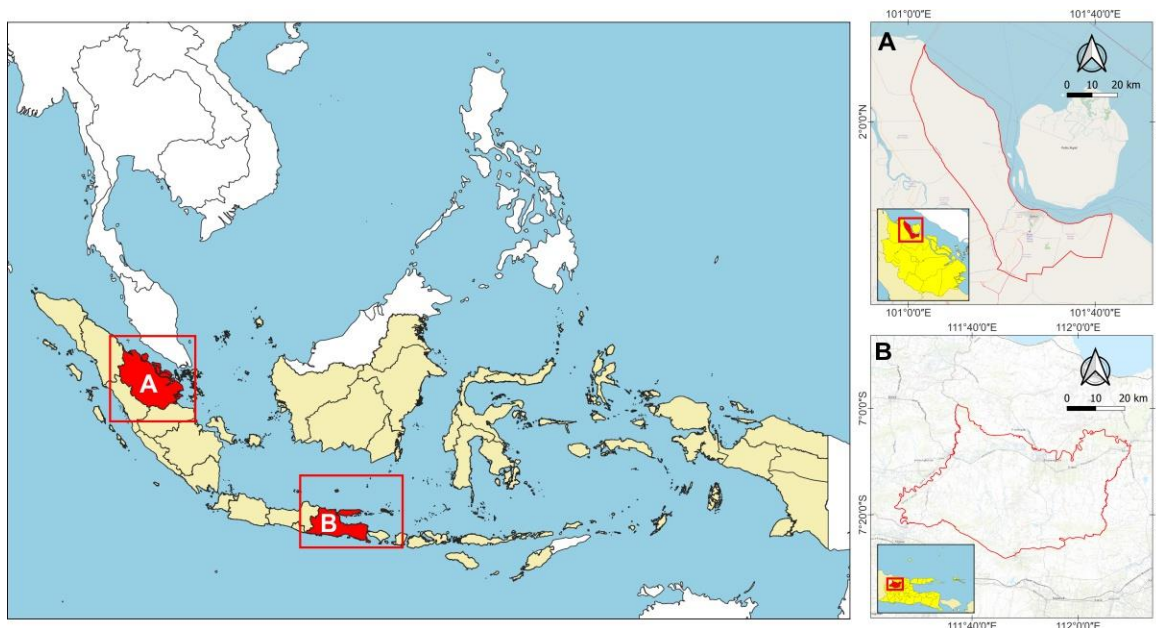


Figure 1. Study area. A. Sambar deer captive breeding at Pertamina RU II Dumai, Riau, Indonesia; B. Javan deer captive breeding at Malo, Parengan, East Java by Pertamina EP 4 Cepu, Central Java, Indonesia

Data analysis

To see the suitability of Java deer captivity that has been managed following captive management standards, the data obtained then carried out a comparative analysis of the aspects that have been determined, such as availability of documents needed in captivity, deer captive breeding infrastructure, population management of deer captive breeding, and habitat management of deer captive breeding. After that, an assessment of the management aspect and the ability of captive breeding to contribute to the release program used descriptive qualitative analysis.

RESULTS AND DISCUSSION

A captive assessment by an authorized institution (BKSDA) was conducted on a captive activity to determine the success of the captive management. This assessment was a means to carry out guidance by the authorized institution (BKSDA) and, simultaneously, could provide incentives for successful captive managers. Captive success could be achieved if, in the assessment carried out, the predicate is A or B (Perdirjen PHKA Number P. 6/IV-SET/2011).

Availability of documents needed in captivity

Based on the search for important documents needed in the implementation of a captive activity at the captive sambar at Pertamina RU 2 Dumai and the captive Javan deer at Pertamina EP 4 Cepu, the following results were obtained Table 1.

One of the requirements needed in applying for a captive breeding permit is proof of the legality of the origin of the bred wildlife. Meanwhile, in captivity of the sambar deer at Pertamina RU 2 Dumai, there is no legal document on the origin of the sambar deer. So, in the future, it is

necessary to strive for the availability of legal documents of the origin of this wildlife to strengthen further the deer breeding permit that Pertamina RU 2 Dumai obtained.

Deer captive breeding infrastructure

The following results were obtained based on direct observations of the existing infrastructure in captivity for sambar and spotted deer at Pertamina RU 2 Dumai and the captive Javan deer at Pertamina EP 4 Cepu and interviews with managers, as presented in Table 2.

Population management of deer captive breeding

The manager of Javan deer captive breeding Pertamina EP 4 Cepu did this activity by recording the development of the population through a studbook. Every birth or death that occurs is recorded in the document. The genealogy of the individual Javan deer clarify by every birth of an individual that can survive is marked by tagging. Meanwhile, no document on population development could be found at Sambar deer captive breeding the Pertamina RU II Dumai based on documents, interviews, and field observations. Until 2020, we can see the development of the Javan deer population in the Pertamina EP 4 Cepu Javan deer captivity, as presented in the following Table 3.

Habitat management of deer captive breeding

Habitat management is necessary to realize deer captivity that can provide environmental conditions close to their natural habitat. This activity should the manager do so that the deer feel comfortable, and their welfare fulfilled so they can grow and develop optimally and have good reproductive abilities. Until 2020, habitat management done by Javan deer captive breeding of Pertamina EP 4 Cepu is presented in the following Table 4.

Table 1. Availability of documents needed in captive breeding

Secondary data	Pertamina RU II Dumai		Pertamina EP 4 Cepu	
	Completeness of data		Completeness of data	
	Yes	No	Yes	No
Captive permit document,	√		√	
Document Legality of parent origin		√	√	Yes
Document Availability Master Book (Stuudbook)/Log Book		√	√	Yes
Document marking or tagging of species in captivity		√	√	Yes
Population development document:		√	√	Yes
a. Growth of tillers				
b. Mortality Rate				
Reporting and planning documents:		√	√	Yes
a. Monthly report				
b. The annual work plan				
Captive Management Institutional Documents		√	√	Yes, so far the management is under the responsibility of HSSE and KPH Parengan assisted by 2 keepers.
Captive assessment document by the authorized institution (BKSDA).		√	√	Yes

Table 2. Captive Breeding Infrastructure in captive breeding

Type	Pertamina RU II Dumai			Pertamina EP 4 Cepu		
	Availability		Eligibility (condition and quality)	Availability		Eligibility (condition and quality)
	Yes	No		Yes	No	
Captive breeding facilities and infrastructure, including :						
a. Main cage						
b. Weaning/enlargement cage	√		• Not have a transit enclosure to carry newly-imported deer	√		• Already have a transit enclosure to carry newly-imported deer
c. Handling/treatment cage		√		√		
d. Quarantine cage	√		• The handling cages are not suitable for captive standards	√		• The handling cage is suitable for captive breeding standards
e. Shade vegetation	√		• Shade vegetation is quite good	√		• Shade vegetation is quite good
Supporting facilities that need to be built in the captive area:						
a. Water installation	√		Many former playground buildings such as tables, benches, and toilets should be dismantled or removed.	√		• Almost all supporting facilities for deer captive breeding are available
b. Shade building (shelter)	√			√		
c. Puddle	√			√		
d. Drinking water tub	√			√		
e. Corridor road		√		√		
Forage planting area		√		√		• Already available with odot grass, lamtoro, sweet potato and papaya
Supported building:						
a. Guard house/guard post	√		It still uses the former stage building from the playground.	√		• Already have a guardhouse and warehouse which are usually occupied by the keeper
b. Feed and tool warehouse.		√		√		
Availability of Experts						
a. Experts in the field of captivity and or animal health		√	The available staff are 2 keeper on duty with the shift system	√		• Collaborate with veterinary medical personnel with the district livestock office
b. Experienced captive technical personnel	√			√		• The existing staff are 2 keepers on duty with the shift system
c. Administration staff		√		√		

Table 3. Deer population development in deer captive breeding Pertamina EP 4 Cepu, Central Java, Indonesia

Year	Initial number	Addition	Reduction	Total
2014	11	3	0	14
2015	14	4	1	17
2016	17	10 (new breeder) + 2 (birth)	0	29
2017	29	13	0	42
2018	42	12	2 (die in a fight) + 2 (sold)	50
2019	50	6	4 (releasing) + 3 (sold) + 2 (requested by divre)	47
2020	47	5	3	49

Table 4. Habitat management activities in Javan Deer Captivity by Pertamina EP 4 Cepu, Central Java, Indonesia

Year	Management activities	Description
2015	Addition of shelters, puddles and provision of protective vegetation	Protective vegetation in captivity is provided with protection at the bottom of the tree to avoid disturbance so that the tree bark is not peeled off due to eating or rubbing with deer antlers.
2016	Addition of facilities for handling cages and maintenance cages.	
2016, 2018	Making a place for providing forage	To support the lack of feed, especially in the dry season
2018	Addition of the main cage	This is done through the main enclosure to avoid fights between adult male parents, especially during the breeding season

While in Sambar deer captivity for the Pertamina RU II Dumai, habitat management, mainly feed, tends to still rely on the availability of natural food. Natural food for this deer is quite widely available around the captivity area. The existence of former playground equipment such as tables, benches, and toilets has not been moved from the captive cage.

Releasing Javan deer from captive breeding

Based on proper management of population, habitat, and infrastructure, the population development of Javan deer captive breeding of Pertamina EP 4 Cepu shows an increasing trend from the initial population of 20 individuals within four years became 50 individuals. The Regulation of the Minister of Forestry No. 19 of 2005, article 71 states that every breeder who conducts captivity must return to his natural habitat from captive-bred specimens of plants and animals of protected species. That have met the qualification standards for captive breeding of at least 10% of captivity results (Willoughby and Christie 2019; Webb 2020). The results of this population development took 10% to be released into the wild. Pertamina EP 4 Cepu succeeded in releasing 4 Javan deer (*Rusa timorensis*) from captive breeding of Javan deer located in KPH Parengan. In 2018, 4 captive-breed Javan deer were released in their natural habitat of Tahura R. Soeryo, East Java. Meanwhile, the Pertamina RU 2 Dumai sambar deer captive breeding during four years of management, the documents required for captive management assessed by the Nature Resources Conservation Agency (BKSDA) were not fully available. Consequently, the population increment in captive breeding could not participate in the release program.

Discussion

A captive permit document from the government is essential in a deer captive breeding activity because deer have registered in the Decree of the Minister of Forestry No. 305/Kpts-11/1991, dated June 19, 1991, and Government Regulation No. 7/1999 concerning Preservation of Plant and Animal Species as protected animal species. In the IUCN (International Union for Conservation of Nature), the Sambar and Javan deer are categorized as threatened species (Vulnerable) due to their declining population (IUCN 2018; Zerbini et al. 2019).

Protection and utilization of deer as a protected species has been carried out based on Government Regulations 7 and 8 of 1999 concerning the Preservation and Utilization of Wild Plant and Animal Species. One form of protection and utilization can be in the form of captive breeding. Permits for captive breeding wild plants and animals that are protected or not protected are granted for 5 (five) years. They can be extended by applying for an extension no later than 3 (three) months before the expiry of the captive breeding permit. The management of captive breeding permits is regulated in the Minister of Forestry Regulation Number 69/Menhut-II/2013 concerning the Captive Breeding of Wild Plants and Animals.

One of the requirements needed in applying for a captive breeding permit is proof of the legality of the origin of the wildlife bred. The sambar deer captive breeding at Pertamina RU 2 Dumai does not yet have a legal document on the origin of the sambar deer. So, in the future, it is necessary to strive for the availability of legal documents of the origin of this wildlife so that it will further strengthen the deer breeding permits that have been obtained.

In managing wildlife captivity, under the mandate of government regulations, there are obligations for the breeder to carry out captive activities (Government Regulation No. 8 of 1999), namely: (i) Make a parenting book about wild plants or animals in captivity; (ii) Implement a system of marking and certification of breed individuals in captivity; (iii) Prepare and submit periodic reports to the government; (iv) Maintaining the purity of protected wildlife species until the first generation.

From the search for documents, the mandatory documents are Documents of Availability of a Parent Book (Studbook)/Logbook, Documents of marking or tagging of species in captivity, Documents of population development (Growth of fawn and Mortality rate), and Reporting and planning Documents (Monthly Report and Annual Work Plan) not yet available. The captive deer breeding at Pertamina RU 2 Dumai only received a captive permit in 2019, so it has only been running for 2.5 years. It can be prepared for the preparation of these documents. In particular, no documents show the existence of a management agency appointed by the company to manage the sambar deer captive breeding at Pertamina RU 2 Dumai. The existing management is still under the responsibility of the HSSE head, who is assisted by 2 or 3 field workers (keepers).

Meanwhile, Pertamina EP 4 Cepu's Javan deer captive breeding already has legal documents on the origin of the Javan deer. The availability of documents on the legality of the origin of these animals will further strengthen the deer breeding permits that have been obtained. The mandatory documents such as Documents of Availability of a Parent Book (Studbook)/Logbook, Documents of marking or tagging of species in captivity, Documents of population development (Growth of tillers and Mortality rate), and Reporting and planning documents (Monthly Report and Annual Work Plan) are available. Javan deer captive breeding by Pertamina EP 4 Cepu got a captive permit in 2015 and received a distribution permit for animals starting in 2017. Some documents show the company appoints a management agency to manage the Javan deer breeding at Pertamina EP 4 Cepu.

The Javan deer captive breeding at Pertamina EP 4 Cepu has been conducted intensively, including population and habitat management (Subeno and Mukhlison 2016). Population management emphasizes setting the composition of the population, which is very important in supporting the reproductive process (Christie et al. 2012; Zakaria et al. 2016; Kaumanns et al. 2020). At the same time, habitat management is emphasized by providing the availability and adequacy of deer feed at all times (Dahlan and Dawend 2013; Khattak et al. 2021). This feed is vital in supporting the growth and performance of deer in captivity so that deer in captivity have reproductive capabilities according to the developmental age of the deer (Hutapea et al. 2021). It can be seen that the deer population development in Pertamina EP 4 Cepu deer captivity shows a significant increase from time to time. Khan et al. (2017) reported the population trends of captive animals showed the enormous increase in population.

Minister of Forestry Regulation No. 19 of 2005 article 71 states that every breeder who conducts captivity, as referred to in Article 4 paragraph (1) letters b and c, and paragraph (2) letter a, is obliged to return to their natural habitat from captive-bred plant and animal specimens of this type. They are protected species that have met the captive qualification standards of at least 10% of the captive yields. The return of captive-bred plants and animals, as referred to in paragraph (1), is carried out if they meet the requirements, among others: (1) have high genetic value, which is close to the parent or origin seed; (2) the population of this species is low so that restocking will help restore the population; (3) free from disease; (4) not physically disabled; (5) predicted to be able to survive in natural habitats; (6) release habitat is a natural distribution area, or it known in its life history, the species has existed in the area; (7) the release habitat is technically adequate and able to accommodate the life of animal specimens to be released; and (8) Pay attention to/consider animal behavior. Based on this regulation, Javan deer captive breeding held by Pertamina EP 4 Cepu in KPH Parengan and Sambar deer captive breeding by Pertamina RU 2 Dumai are obliged to release Javan deer from captive breeding that has been managed.

The Pertamina RU 2 Dumai sambar deer captive breeding has been carried out since 2016, starting with the construction of a breeding cage and its facilities, including bringing in broodstock of sambar deer. However, during four years of management, the documents required for captive management assessed by the Nature Resources Conservation Agency (BKSDA) were not fully available. Consequently, the population increment in captive breeding could not participate in the reintroduction program. Whereas the Pertamina EP 4 Cepu Javan deer captive breeding built captive cages and facilities in 2014, followed by bringing in broodstock of Javan deer. Management documents, population management, and habitat management were conducted intensively, and as a result, during the captive breeding assessment by BBKSDA Jawa Timur, this captive breeding received an excellent value (A). The population development shows an increasing trend from the initial population of 20 individuals within four years became 56 individuals. The results of this population development took 10% to be released into the wild. Four years since the captive deer breeding was established, Pertamina EP 4 Cepu succeeded in releasing 4 Javan deer (*Rusa timorensis*) from captive breeding of Javan deer located in KPH Parengan. The release was carried out to coincide with the National Flower and Wildlife Love Day, which fell on November 5, 2018. In 2018, 4 captive-breed Javan deer were released in their natural habitat of Tahura R. Soeryo, East Java. This Javan deer release activity is the first carried out in Indonesia. In conclusion, Javan deer captive breeding of Pertamina EP 4 Cepu, managed through proper management of population, habitat, and infrastructure, can support the addition of Javan deer populations in their natural habitats. While The Pertamina RU 2 Dumai sambar deer captive breeding has not managed the population and habitat properly, its population growth has yet to be able to support release in

nature. For this reason, Javan deer captive breeding of Pertamina EP 4 Cepu needs to maintain the management that has been carried out in terms of population, habitat, and infrastructure. While The Pertamina RU 2 Dumai sambar deer captive breeding must be carried out to complete the documents needed in captive management must complete the deer captive infrastructure and complete habitat management so that it follows management standards.

ACKNOWLEDGEMENTS

We want to thank Pertamina RU 2 Dumai and Pertamina EP 4 Cepu, who have been willing to help collaborate so that this paper can be facilitated and run well and smoothly. Our special thanks to HSSE Pertamina RU 2 Dumai, their deer captive breeding management staff, Public affair of Pertamina EP 4 Cepu, ADM KPH Parengan, and their staff, who have faithfully and patiently accompanied and assisted the team in data collection in the field, and also for their contribution in supporting the required data.

REFERENCES

- Adji BD. 2015. The policy of the directorate general of KSDAE in fostering deer breeding by the community for export commodities. Proceeding Potential Development of Deer as an Export Commodity and Captivity as a Rehabilitation Tool for Conservation Areas, Seameo Biotrop. Bogor, 19 November 2015. [Indonesian]
- Anugrah N. 2018. Development of a monitoring system for the population of timor deer (*Rusa timorensis*) from captivity (F2 and so on) as brooders for captive breeding by the community. Proceeding Workshop Acceleration of Breeding of Timor Deer as Contribution of the Forestry Sector in Strengthening Food Sovereignty, Sarana Wana Jaya Foundation, The Indonesian Wildlife Conservation Foundation and Seameo Biotrop. Jakarta, 8 Mei 2018. [Indonesian].
- Arini DID, Christita M, Sheherazade, Mayasari A, Suryaningsih R, Simamora ATAJ. 2020. A review of anoa conservation efforts in Sulawesi, Indonesia. IOP Conf Ser Earth Environ Sci 533: 012003. DOI: 10.1088/1755-1315/533/1/012003.
- Broom DM. 2019. Animal welfare complementing or conflicting with other sustainability issues. Appl Anim Behav Sci 219: 1-5. DOI: 10.1016/j.applanim.2019.06.010.
- Christie MR, Marine ML, French RA, Waples RS, Blouin MS. 2012. Effective size of a wild salmonid population is greatly reduced by hatchery supplementation. Heredity 109 (4): 254-260. DOI: 10.1038/hdy.2012.39.
- Dahlan I, Dawend J. 2013. Growth and reproductive performance of sambar deer in Sabal Forest Reserve of Sarawak, Malaysia. Trop Anim Health Prod 45: 1469-1476. DOI: 10.1007/s11250-013-0383-6.
- Director General of Forest Protection and Nature Conservation Regulation of Republic of Indonesia No. P.6/TV-SET/2011 concerning Guidelines for Assessment of Conservation Institutions.
- Etikan I, Musa SA, Alkassim RS. 2016. Comparison of convenience sampling and purposive sampling. Am J Theor Appl Stat 5 (1): 1-4. DOI: 10.11648/j.ajtas.20160501.11.
- Frynta D, Šimková O, Lišková S, Landová E. 2013. Mammalian collection on Noah's ark: The effects of beauty, brain and body size. Plos One 8 (5): 1-13. DOI: 10.1371/journal.pone.0063110.
- Giarat ANAN, Abdullah ML, Siti AMN, Pau TM, Kulaimi NAM, Naim DM. 2021. A review of the genus *Rusa* in the Indo-malayan archipelago and conservation efforts. Saudi J Biol Sci 28: 10-26. DOI: 10.1016/j.sjbs.2020.08.024 1319-562X.
- Government Regulation of the Republic of Indonesia Number 7 of 1999 concerning Preservation of Plant and Animal Species.
- Government Regulation of the Republic of Indonesia Number 8 of 1999 concerning the Utilization of Wild Plants and Animals.
- Ho H, Chai I, Abdullah R, Azlan C, Hamzah H, Jesse FF, Hassim H, Wahid H. 2018. Age and sex comparison in determining baseline blood and coagulation profiles in semi-extensive Rusa Deer (*Rusa timorensis*). Malays J Vet Res 9 (2): 53-62.
- Hopf YM, Francis J, Helms PJ, Haughney J, Bond C. 2016. Core requirements for successful data linkage: an example of a triangulation method. BMJ Open 6: e011879. DOI: 10.1136/bmjopen-2016-011879.
- Hutapea FJ, Kuswanda W, Barus SP. 2021. Productivity and feed management strategies of sambar deer (*Rusa unicolor*) at the special purpose forest area (KHDTK) of Aek Nauli. IOP Conf Ser Earth Environ Sci 713: 012007. DOI: 10.1088/1755-1315/713/1/012007.
- Imron MA, Subeno, Cahyandra TA, Febri AW, Cosmas MKP. 2021. Study of Potential Biodiversity Fauna and Evaluation of Sambar (*Cervus unicolor*) Captive Breeding in the Patra Seroja Area of PT Pertamina (Persero) Refinery Unit II Dumai. [Report]. PT. Pertamina RU II Dumai and Faculty of Forestry, Gadjah Mada University, Yogyakarta.
- International Union for Conservation of Nature. 2018. *Rusa timorensis*. The IUCN Red List of Threatened Species. <http://www.iucnredlist.org/details/full/41789/0>.
- Kasso M, Balakrishnan M. 2013. Ex Situ Conservation of Biodiversity with Particular Emphasis to Ethiopia. ISRN Biodivers 2013: 1-11. DOI: 10.1155/2013/985037.
- Kaumanns W, Begum N, Hofer H. 2020. Animals are designed for breeding: Captive population management needs a new perspective. J Zoo Aquar Res 8 (2): 76-85. DOI: 10.19227/jzar.v8i2.477.
- Khan MZ, Imdad U, Ghalib SA, Hussain K, Zubair S, Fraz TR, Hashmi MUA, Safi A, Iqbal N, Lateef T. 2017. A review: Status of captive wild animals in Safari Park, Karachi. Can J Pure Appl Sci 11 (2): 4189-4204.
- Khattak RH, Teng L, Mehmood T, Rehman EU, Zhang Z, Liu Z. 2021. Hostile interactions of punjab urial (*Ovis vignei punjabiensis*) towards indian gazelle (*Gazella bennettii*) during feeding sessions in captive breeding settings. Animals 11 (1274): 6-12. DOI: 10.3390/ani11051274.
- Krisna PAN, Supriatna J, Suparmoko M, Garsetiasih R. 2020. Sustainability of timor deer in captivity: Captive breeding systems in West Java, Indonesia. Trop Conserv Sci 13: 1-12. DOI: 10.1177/1940082920915651.
- Landaa A, Flagstad Ø, Areskoug V, Linnella JDC, Stranda O, Ulvund KR, Thierry AM, Rød-Eriksen L, Eide NE. 2017. The endangered arctic fox in Norway-the failure and success of captive breeding and reintroduction. Polar Res 36 (9): 1-14. DOI: 10.1080/17518369.2017.1325139.
- McCleery R, Hostetler JA, Oli MK. 2014. Better off in the wild? Evaluating a captive breeding and release program for the recovery of an endangered rodent. Biol Conserv 169: 198-205. DOI: 10.1016/j.biocon.2013.11.026.
- McComb BC. 2016. Wildlife Habitat Management: Concepts and Applications in Forestry, 2nd Edition. CRC Press, Taylor and Francis Group, Florida.
- Mertens DM, Hesse-Biber S. 2012. Triangulation and mixed methods research: Provocative positions. J Mix Methods Res 6 (2): 75-79. DOI: 10.1177/155868981243710.
- Miller JE, Miller DA. 2016. Introduction: Ecological, biological, economic, and social issues associated with captive cervids. Wildl Soc Bull 40 (1): 7-9. DOI: 10.1002/wsb.639.
- Minister of Forestry Regulation of Republic of Indonesia Number P.19/Menhut-II/2005 Concerning the Breeding of Wild Plants and Animals. Minister of Forestry Regulation of Republic of Indonesia, Jakarta.
- Minister of Forestry Regulation of Republic of Indonesia Number: P. 63/Menhut-II/2013 Concerning Procedures for Obtaining Specimens of Wild Plants and Animals for Conservation Institutions. Minister of Forestry Regulation of Republic of Indonesia, Jakarta.
- Moleong LJ. 2018. Qualitative Research Methods, Revised Edition. Remaja Rosdakarya Ltd., Bandung.
- Natow RS. 2020. The use of triangulation in qualitative studies employing elite interviews. Qual Res 20 (2): 160-173. DOI: 10.1177/1468794119830077.
- Noonan E, MacFarlane A. 2012. The New Zealand Deer Farmers Landcare Manual. The New Zealand Deer Farmers' Association and Deer Industry New Zealand. Wellington.

- Ralls K, Ballou JD. 2013. Captive breeding and reintroduction. In: Samuel MS (eds). Encyclopedia of Biodiversity (Second Edition). Elsevier, United States of America.
- Rasyidi G, Ulasaswini AA, Karno K. 2022. Study of timor deer behavior at the exit conservation location of cakura village, takalar regency. Intl J Multidiscip Res Anal 5 (8): 2181-2187. DOI: 10.47191/ijmra/v5-i8-36.
- SEAZA. 2017. SEAZA Standard on Animal Welfare. Manila, Philipina.
- Selvarajah K, Nadzir MNHM, Annavi G. 2022. Comparative study on the social behavior of Sambar Deer (*Rusa unicolor*) in three selected captive facilities in Peninsular Malaysia. Pertanika 30 (1): 527-546. DOI: 10.47836/pjst.30.1.29.
- Semiadi G, Jamal Y. 2015. The nutritional quality of captive sambar deer (*Rusa unicolor* brookei Hose, 1893) velvet antler. Biodiversitas 16 (2): 156-160. DOI: 10.13057/biodiv/d160209.
- Shin GD, Jeon K, Lee HE. 2022. Public library needs assessment to build a community-based library: Triangulation method with a social media data analysis. Libr Inf Sci Res 44: 1-11. DOI: 10.1016/j.lisr.2022.101142.
- Skonhoft A, Veiberg V, Gautepluss A, Olaussen JO, Meisingset EL, Myrsterud A. 2013. Balancing income and cost in red deer management. J Environ Manag 115: 179-188. DOI: 10.1016/j.jenvman.2012.11.006.
- Subeno, Mukhlison. 2016. Study on Assistance for Javan Deer (*Rusa timorensis*) Captive Breeding at KPH Parengan, Perhutani Divre II East Java. Report. Pertamina EP 4 Cepu, KPH Parengan and Faculty of Forestry, Gadjah Mada University, Yogyakarta.
- Takandjandi M. 2015. Deer captive breeding techniques. Proceeding Potential Development of Deer as an Export Commodity and Captivity as a Rehabilitation Tool for Conservation Areas, Seameo Biotrop. Bogor, 19 November 2015. [Indonesian]
- Taylor WA, Lindsey PA, Davies-Mostert H. 2015. An Assessment of the Economic, Social and Conservation Value of the Wildlife Ranching Industry and Its Potential to Support the Green Economy in South Africa. The Endangered Wildlife Trust, Johannesburg.
- Thamhain HJ. 2014. Assessing the effectiveness of quantitative and qualitative methods for R&D project proposal evaluations. EMJ-Eng Manag J 26 (3): 3-12. DOI: 10.1080/10429247.2014.11432015.
- Tensen L. 2016. Under what circumstances can wildlife farming benefit species conservation? Glob Ecol Conserv 6: 286-298. DOI: 10.1016/j.gecco.2016.03.007.
- Webb J. 2020. Training animals in captivity or the wild, so they can return to the wild. In: Melfi VA, Dorey NR, Ward SJ (eds). Zoo Animal Learning and Training. John Wiley & Sons, New York.
- Willoughby JR, Christie MR. 2019. Long-term demographic and genetic effects of releasing captive-born individuals into the wild. Conserv Biol 33 (2): 377-388. DOI: 10.1111/cobi.13217.
- Yang B, Li S, Binder C. 2016. A research frontier in landscape architecture: Landscape performance and assessment of social benefits. Landsc Res 41 (3): 314-329. DOI: 10.1080/01426397.2015.1077944.
- Zakaria MA, Zamri-Saad M, Hasliza AH, Wahid H. 2016. Growth and reproductive performances of farmed Timorensis deer, *Cervus timorensis*. Pertanika 39 (1): 79-86.
- Zerbini A, Fisheries A, Oceanic N, Secchi ER, Danilewicz D. 2019. *Rusa unicolor*, Sambar. www.iucnredlist.org.