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Mitigation of wildlife disturbance at oil and gas industry electrical facilities in Riau Province, Indonesia

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Abstract. *Suwondo, Darmadi, Roza D, Murdiya F, Oktarianda R, Risaundi DD. 2023. Mitigation of wildlife disturbance at oil and gas industry electrical facilities in Riau Province, Indonesia. Biodiversitas 24: 6914-6922.* Electrical facilities in the oil and gas industry often experience interference from wildlife, disrupting oil and gas operational activities. Solutions are required to mitigate these disturbances. This research analyzes the level of wildlife disturbance in electrical facilities in the oil and gas industry and their mitigation. This research used a survey method with purposive random sampling; the observation was carried out in the work area of Pertamina Hulu Rokan Company, Riau Province, Indonesia. The data obtained are primary and secondary, and the parameters measured consist of population, behavior, disturbance, and mitigation of disturbance to wildlife. A total of 38 species of wild animals were found, consisting of the mammal group (5 species), the reptile group (3 species), and the aves group (30 species). The population of long-tailed monkey (*Macaca fascicularis*) is the largest species of mammal found (1,500 individuals), and the most common daily behaviors of macaques are climbing (22.5%), eating (17.5%), and playing (15%). There were 169 incidents of wildlife disturbance at the WK Rokan electrical facility, with the most disturbance caused by macaques at 111 incidents. Disturbance from wildlife has a linear positive interaction with wildlife mortality around oil and gas industry electrical facilities. Mitigation is conducted as follows: isolating/eliminating the presence of wild animals in affected facilities/locations, building barriers against wild animals around electrical facilities, and providing repellents.

Keywords: Animal disturbance, electrical facilities, mitigation

INTRODUCTION

Riau is a province in Indonesia famous for its oil and natural gas wealth (Risaundi et al. 2023). The oil industry in Riau Province is recorded as the largest source of national oil production (Bayu et al. 2020). The oil and gas industry comprises upstream and downstream activities (Falfushynska et al. 2019). Upstream activities focus on oil extraction activities from the ground, such as activities around oil wells. In contrast, downstream activities focus on oil processing, such as oil production in oil refinery areas (Janabi 2020). In this modern era, almost all activities in the oil and gas industry require electricity supply. Electrical energy is used to move upstream and downstream facilities in the oil and gas industry, such as to extract oil from oil wells to gathering stations. This makes electricity a very important factor; the quality of the industry's electrical system will influence production quality. Disruption of the electricity flow that drives the entire oil and gas industrial system will result in losses in many ways, such as hampered oil and gas production (Zhuravlev and Grigor'ev 2020), which will cause a negative domino effect in other sectors. One of the determining factors for the electrical quality system is the continuity of electrical power, which is needed to support the industrial production process continuously. However, the electrical power continuity in industry will experience disruptions in the electrical system, including an electrical short circuit. Electrical short circuit disturbances are generally caused by various factors, including external factors (outside the system) caused by wildlife disturbances. Disturbances caused by wild animals in the form of carrying out activities in high-voltage electrical facilities, damaging cables, damaging panels around electrical facilities and others that result in damage or disruption to operations that depend on the electricity supply. The oil and gas industry in the United States also often experiences disruptions to electrical facilities caused by external factors (animal disturbances), such as disturbances caused by birds in several high-voltage electrical facility cables to the oil and gas industry (Allison et al. 2019). Limited human access or mobility in industrial areas means many flora and fauna, such as bird species, develop very well (Riefani et al. 2019); hence, their development and diversity in industrial areas must be maintained.

The oil and gas industry in Riau Province, such as Pertamina Hulu Rokan (PHR), is a corporation operating in

the oil and gas industry managed by the state. PHR Company utilizes electricity as the main energy source in its operational and production businesses in the Rokan Working Area (WK). The key to the successful management of the Rokan WK can be in guaranteeing a reliable electricity supply to electrify the Rokan WK, so there is no disruption in the operations and production. At the same time, PHR Company often experiences distribution network disruption problems to guarantee electricity supply in the Rokan WK. The distribution network wildlife disturbances can cause power cessation followed by production cessation; these wildlife disturbances disrupt PHR's operational activities. The impact of wildlife disturbance has reduced production by ±22,620 barrels from 2020 to 2023 (Pertamina Hulu Rokan 2023). Therefore, several mitigations to reduce or avoid this disturbance must be developed. This mitigation considers the sustainability of existing fauna (Cross et al. 2021) because human activities and construction of existing infrastructures will also impact the fauna in the surroundings (Raiter et al. 2014).

This research aims to analyze any wildlife disturbances that disrupt electricity facilities. In addition to wildlife disturbance, this research analyzes the population of wild animals, their behavior and habitat, and alternative mitigation planning to avoid wildlife disturbance. Wild animals naturally have mobility and a home range that allows animal interactions within their habitats, including electrical equipment (Yi et al. 2022). The interaction disturbances result in losses to industrial operations and deaths of wild animals (Dixon et al. 2018; Cunneyworth and Slade 2021). Wild animal interaction disturbances are caused by various parameters, such as the availability of food sources, roaming space, and living spaces to support these wild animals' lives (Mellor 2020). Therefore, it is important to study mitigating wildlife disturbances in oil and gas industry electrical facilities in the Rokan WK.

MATERIALS AND METHODS

Study area

This research was conducted in March-Juli 2023 and carried out in the work area of Pertamina Hulu Rokan Company, Riau Province, Indonesia (Figure 1). Sampling points were determined using purposive random sampling by considering the level of disturbance to wildlife, data obtained from company reports, as well as the location of electrical facilities and cable lines.

The study observation locations are spread across 4 (four) locations based on the intensity of the number of disturbances (the magnitude of the incident) on the type of electrical facility, including (i) Bangko Balam, (ii) Duri Steam Flood, (iii) Bekasap Rokan, and (iv) Minas-Siak. The electrical facility that often experiences disruption is the distribution network (feeder). The study locations are presented below (Table 1).

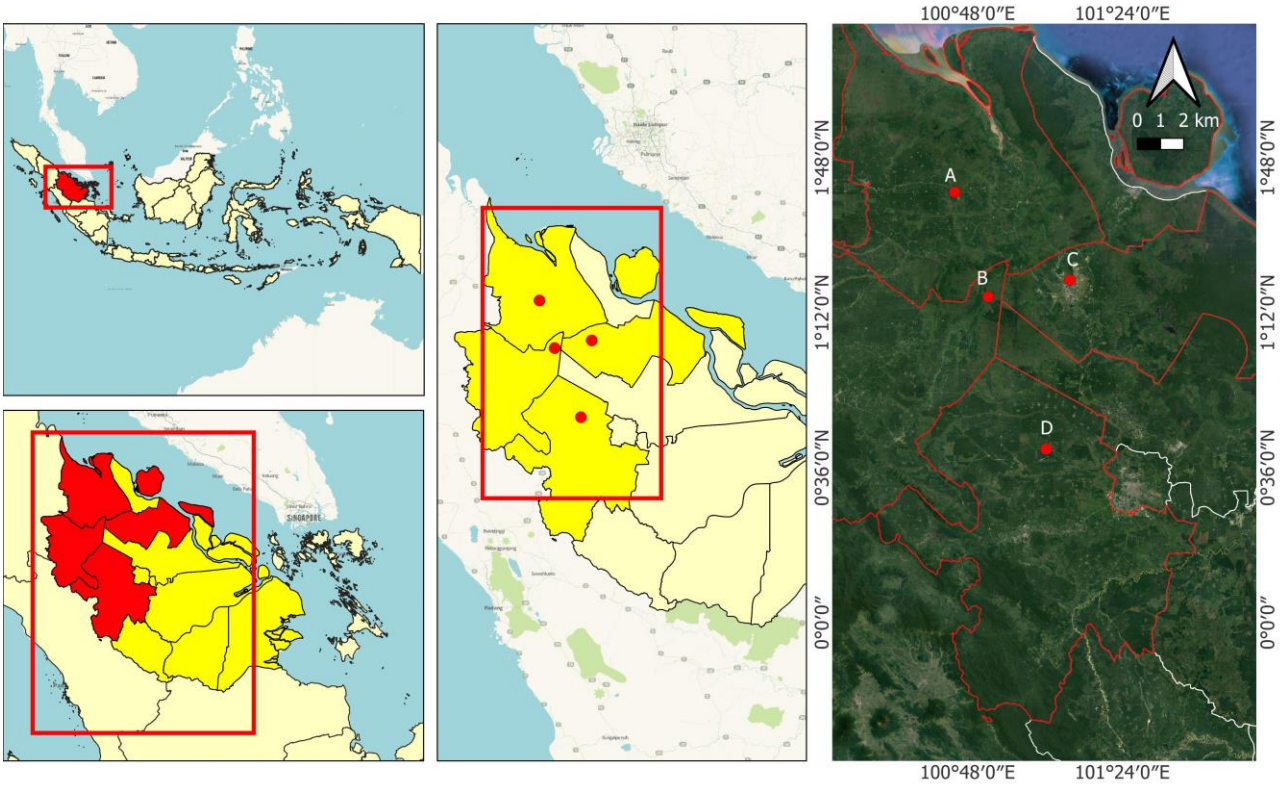

Figure 1. Research sites in the work area of Pertamina Hulu Rokan Company, Riau Province, Indonesia. A. Bangko-Balam; B. Bekasap-Rokan; C. Duri Steam Flood; D. Minas-Siak

Procedures

Data collection was carried out by direct sampling and indirect sampling. The parameters measured consist of data collection was carried out by direct sampling and indirect sampling. The parameters measured consist of (i) identification of animal species located around electricity facilities using a combination of line transect and point count techniques (Figure 2); (ii) animal behavior by observing the animals encountered activities; (iii) animal disturbance by calculating their disturbance around electrical facilities, and; (iv) mitigating animal disturbance by looking at animal activity and considering possible solutions to deter or move wild animal activity away from electricity facilities. Research was conducted using a survey method and data analysis was carried out descriptively quantitatively. The research uses the primary data and secondary data types and sources. Primary data were obtained through field observations, and secondary data were obtained from research journals and company reports related to the research objectives, such as a report regarding the number of disturbances, which is used as a preliminary study and basis for making observations (Table 2).

Observations of animal populations were carried out using a combination of line transect and point count techniques. Transects are placed at locations of electrical facilities that have been attacked by wild animals and locations considered to be roaming areas and animal habitats. Carrying out a census using line transects begins with point 0, the beginning of observations of animals encountered along the transect route. The recording on the tally sheet includes the number and type of animals, their distance from the observer, and the distance of each observation point from the starting point (point 0). The wildlife census was carried out at 5 observation points (point count), using the point count method, with a radius of 50 meters and the distance between point counts was 500 meters; recording of animal findings in an area within a 50-meter radius of the designated circle.

Data analysis

Animal population density calculations were analyzed using the King equation (Spaan 2019). Animal behavior observation activities are carried out at certain time intervals according to their animal's activity conditions. Observing animal behavior was carried out using a combination of line transect and point counting techniques and recording data on behavior, including grooming, climbing, mating, playing, walking, moving, and eating (Fitriyah et al. 2021). Animal behavior is recorded based on the results of observations and converted into a percent value (%). Behavioral data recorded as frequency of behavior is the number of behaviors carried out by each individual (Xi) divided by all the behaviors observed in that individual (Yi) multiplied by 100%.

Table 1. Locations of animal disturbance studies at oil and gas industry electrical facilities

Coordinate point	Number of disturbances	Species disturbance
N: 1° 40'. 3.587" E: 100° 45'. 1.951"	28	Monkey, squirrel
N: 1° 19'. 37.096"E: 101° 11'. 48.287"	12	Monkey, bird
N: 1° 30'. 44.828" E: 100° 59'. 13.155"	15	Monkey, bird, monitor lizard
N: 0° 40'. 18.592" E: 101° 6'. 16.324"	8	Monkey, bird

Table 2. Types and sources of data collected

Parameter	Data		Collection techniques
	Primary	Secondary	
Animal population (species composition, estimated population, protection list)	√	√	Combine method line transect and point count
Animal behavior (eating, resting, mating, grooming activities, etc.)	√	-	Observation
Animal disturbance (number of disturbances, location of disturbances)	√	√	Documentation Interview

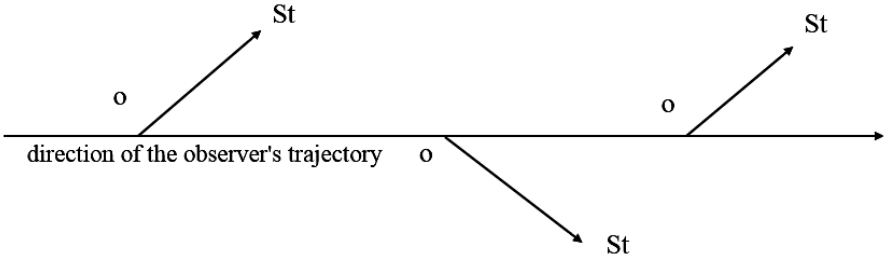

Figure 2. Illustration of the line transect & point count method. o: observer position, St: wildlife position

RESULTS AND DISCUSSION

Animal population

The results of observations of the types of animals found around electrical facilities resulted in the discovery of 38 species, consisting of the mammal group (5 species), the reptile group (3 species), and the aves group (30 species). The following Table shows the types of animals distributed in the electrical facilities of the oil and gas industry (Table 3). The observations revealed that long-tailed monkeys can be found at all observation locations. Apart from the Macaca genus, other types of primates were also found at the observation location, namely the *budeng* langur (*Trachypithecus auratus* É.Geoffroy Saint-Hilaire, 1812). Langurs rested in trees, where the animal's activities were arboreal. There are not many langurs present, only three in the Bekasap-Rokan location. Langurs are known to live in groups and have their leader. Langur groups live in small numbers; usually, each group consists of four to seven individuals. When in physical contact, langurs tend to avoid humans. The observation results also found that more types of animals were found in the aves class because they were easy to find. The variety of species in the aves class (30) is much greater than those in other classes, such as mammals (5) and reptiles (3).

Table 3. Species of animals distributed in oil and gas industry electrical facilities and list of threatened and protected animal species

Local name	Species	Family	Observation location	Status		
				IUCN	App CITES	Ministry Regulation LHK No 106
Mammalia						
Long-tailed monkey	*Macaca fascicularis*	Cercopithecidae	1,2,3,4	EN	II	-
Beruk	*Macaca nemestrima*	Cercopithecidae	1	VU	II	-
Budeng langur	*Trachypithecus auratus*	Cercopithecidae	2	VU	II	Protected
Squirrels	*Callosciurus notatus*	Scuridae	3	LC	-	-
Weasel	*Viverra tangalunga*	Viverridae	3	LC	-	-
Reptile						
Monitor lizard	*Varanus salvator*	Varanidae	3,4	-	II	-
Cobra	*Naja spularis*	Elapidae	4	-	II	-
Water snake	*Xenochrophis piscator*	Natricidae	4	LC	-	-
Aves						
Turtledove	*Streptopelia chinensis*	Collumbidae	1,2,3,4	LC	-	-
Dove	*Geopelia striata*	Collumbidae	1,2,3,4	LC	-	-
Green pigeon	*Treron vernans*	Collumbidae	2	LC	-	-
Yellow-vented bulbul	*Pycnonotus goiavier*	Pycnonotidae	1,2,3,4	LC	-	-
Sooty headed bulbul	*Pycnonotus aurigaster*	Pycnonotidae	1,2,3,4	LC	-	-
Baya weaver	*Ploceus philippinus*	Ploceidae	2,3	LC	-	-
Eurasian tree sparrow	*Passer montanus*	Ploceidae	1,2,3,4	LC	-	-
White-headed munia	*Lonchura maja*	Estrildidae	2,4	LC	-	-
Lowlands of India	*Lonchura malacca*	Estrildidae	2,3	LC	-	-
Crow	*Corvus enca*	Corvidae	1,2	LC	-	-
Leaser coucal	*Centropus bengalensis*	Cuculidae	1,2,3,4	LC	-	-
Plaintive cuckoo	*Cacomantis merulinus*	Cuculidae	3,4	LC	-	-
Cekakak	*Halcyon cymernensis*	Alcedinidae	1,2,3,4	LC	-	-
River cekakak	*Todirhampus chloris*	Alcedinidae	2	LC	-	-
White-vented	*Acridotheres javanicus*	Sturnidae	3	VU	II	
Bar winged prinia	*Prinia familiaris*	Sylviidae	2	LC	-	-
Coppersmith barbet	*Megalaima haemacephala*	Megalaimidae	4	LC	-	-
Barn swallow	*Hirundo rustica*	Hirundinidae	1,2,3,4	LC	-	-
Asian house martin	*Delichon dasypus*	Hirundinidae	1,2,3,4	LC	-	-
White-breasted wood swallow	*Artamus leucorynchus*	Artamidae	2	LC	-	-
Thick-billed shrike	*Lanius tigrinus*	Laniidae	4	LC	-	-
White-breasted waterhen	*Amaurornis phoenicurus*	Rallidae	2,3,4	LC	-	-
Little egret	*Egretta garzetta*	Ardeidae	2	LC	-	-
Purple heron	*Ardea purpurea*	Ardeidae	2	LC	-	-
Black thighed falconet	*Microhierax fringillarius*	Falconidae	2	-	II	Protected
Black-winged kite	*Elanus caeruleus*	Accipitridae	2	-	II	Protected
Grey-headed fish eagle	*Ichtyophaga ichthyaetus*	Accipitridae	2	-	-	Protected
Pied triller	*Lalage nigra*	Campephagidae	4	LC	-	-
Oriental dollarbird	*Eurystomis orientalis*	Coraciidae	4	LC	-	-
Blue-throated bee-eater	*Merops veridis*	Meropidae	4	LC	-	-

Note: 1. Bangko-Balam; 2. Bekasap-Rokan; 3. Duri Steam Flood; 4. Minas-Siak. CR: Critically Endangered, EN: Endangered, VU: Vulnerable, LC: Least Concern

The threatened and protected animals category includes several animal species found around electrical facilities. Of the 38 types of animals found around the WK Rokan electrical facility, there are 8 (eight) types of animals whose existence is threatened globally (according to the International Union for Conservation of Nature/IUCN), included in the CITES (Convention on International Trade in) Appendix II list. Endangered Species of Wild Fauna and Flora), and is included in the list of protected fauna by the Indonesian government according to Minister of Environment and Forestry Regulation No. 106 of 2018. Table 3 shows lists threatened and protected animal species around the Rokan WK electrical facility (Table 3).

The IUCN Redlist is a list that contains the rare status of various species of living creatures throughout the world, including fauna. The rare status of a species is determined based on various predetermined criteria. Meanwhile, the CITES appendix contains the names of flora and fauna whose trade is regulated internationally. In the mammal group, some species are categorized as threatened (EN) and vulnerable (VU) according to the IUCN, namely long-tailed monkey (*Macaca fascicularis* Raffles, 1821) (EN), *beruk* (*Macaca nemestrima* Linnaeus, 1766) (VU), and *budeng* langur (*T. auratus*) (VU) (Table 3). Furthermore, the long-tailed monkey species experienced a change in status from initially vulnerable (a species that faces the risk of extinction in the wild in the future) to endangered (a species that faces the risk of extinction shortly). This is caused by various hindrances that harm the *M. fascicularis* population. This change in status was made after the IUCN conducted an assessment of the long-tailed monkey population on 7 March 2022, as reported by iucnredlist.org, stating that the long-tailed monkey population is predicted to decline by 40% in the last three generations or around 42 years. This population decline occurred in several countries, such as Indonesia, Cambodia, Laos, and Bangladesh, reaching 50% in the last ten years. In addition, several types of birds, such as black thighed falconet (*Microhierax fringillarius* Drapiez, 1824), black-winged kite (*Elanus caeruleus* Desfontaines, 1789), and grey-headed fish eagle (*Ichtyophaga ichthyaetus* Horsfield, 1821), are included in the protected category. This increasingly encourages studies to take action or mitigation efforts to avoid further population decline.

The study focused on the macaque species, counting the number of disturbances that reached 111 incidents. The most common encounters of *M. fascicularis* were found at the Bekasap-Rokan observation location with 30 individuals; these disturbances are thought to be influenced by food and water sources around the observation route. The Bekasap-Rokan observation location is known to be on the Rokan River. Furthermore, on the Duri Steam Flood observation route, 17 individuals of *M. fascicularis* were found to be disturbances. The ecosystem typology of the Duri Steam Flood location, which is a secondary forest, allows many types of animals to be found because of the presence of various species of vegetation as food sources for these animals. This aligns with Mellor's (2020) statement, which states that food availability and habitat are influential factors in the distribution of wild animals. Table 4 shows the distribution location and number of wild animal estimations in electrical facilities in the oil and gas industry.

Animal behavior

The results of observations of the behavior of macaque at the observation location showed that the animal behavior data had a proportion of behavior, namely grooming (12.5%), climbing (22.5%), mating (10%), playing (15%), perched (10%), moving (12.5%), and eating (17.5%) (Figure 3). Climbing activity (22.5%) is the most frequently encountered behavior of macaques. In addition, macaques also have playing behavior amounting to 15% and eating at 17.5% of the total activities.

Animal disturbance

The number of wildlife disturbances recorded at Pertamina Hulu Rokan's electrical facilities was 169 incidents for the last 6 months (Figure 4). Disturbances include damaging facilities, touching high voltage currents, and carrying out activities around all the electrical equipment facilities, especially power cables. The species of wild animal that is mostly identified with electrical disturbances is the macaques, with a total of 111 cases. The recorded number of deaths of macaques due to electric shock in oil and gas industry electrical facilities reached 40 (Figure 5).

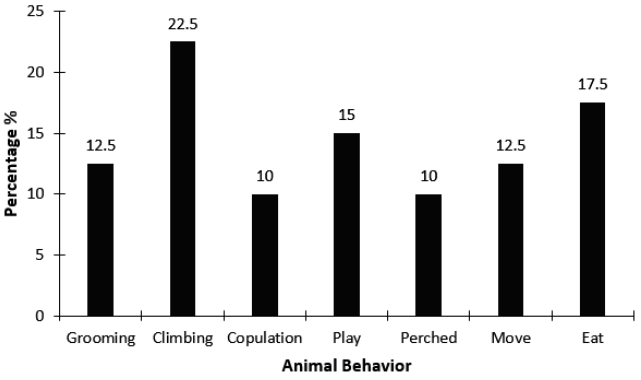

Figure 3. Behavior of macaques in electrical facilities in the oil and gas industry

Table 4. Distribution location and number of wild animals in oil and gas industry electrical facilities

Location	Species	Total	Number of group	Population estimates
Bangko-Balam	*Macaca nemestrima*	5	1	125
Bekasap-Rokan	*Macaca fascicularis*	30	2	750
	Trachypithecus auratus	3	1	75
Duri Steam Flood	*Macaca fascicularis*	17	1	425
Minas-Siak	*Macaca fascicularis*	13	1	325

Wild animal disturbance positively interacts with the number of wild animal deaths linearly, with a regression coefficient of 66% (Figure 5). This analysis explains that 66% of wild animal deaths around electricity facilities are caused by carrying out activities around electricity facilities (wildlife disturbance to electricity facilities), while 34% of animal deaths are caused by other factors. The death of these wild animals is caused by electric shock, especially in areas with high-voltage electricity, such as when wild animals carry out their activities on high-voltage electric cables. This data also shows that the higher the number of wildlife disturbances to electricity facilities, the higher the number of animal deaths. If this trend continues, apart from the material losses the company bears, such as damage to electrical facilities, it will also impact the lack of wildlife diversity around these facilities. Hence, this needs to be mitigated so that these losses do not continue to recur.

Interference mitigation

The interference mitigation efforts that can be carried out in oil and gas industry electrical facilities are as follows (Figure 6).

Forms of mitigation for wildlife disturbances in electrical facilities (Figure 6) include (i) isolation/cutting off the presence of wild animals in affected facilities/locations, such as providing food sources for wild animals far from electrical facilities and cutting on roaming routes by cleaning (trimming trees) under cables and around electrical facilities (Birot et al. 2019), (ii) barriers/barriers to the interaction of wild animals with existing electrical facilities, and (iii) repellent/repellent, in the form of providing certain treatments to repel wild animals.

Discussion

Based on research results, it can be seen that monkeys, especially the *M. fascicularis* species, are the wild animals that most often disturb electrical facilities. The *M. fascicularis* species is known to live in various natural and disturbed habitats due to its fairly good adaptability (Krisanti et al. 2017). Based on its good adaptability, *M. fascicularis* can live quite close to the human environment, such as in urban areas (Ling et al. 2018). This species is easier to find in its habitat in the late afternoon (Alison and Riley 2017). *M. fascicularis* in large or small groups is led by an alpha individual or group leader (Riley et al. 2015) tasked with organizing and protecting the group (Hakim and Nasution 2021). It is estimated that the largest population of macaques is at the Bekasap-Rokan observation location, with 750 individuals. It is possible to find these animals in large numbers because there is a flowing river (Rokan River) at the observation location

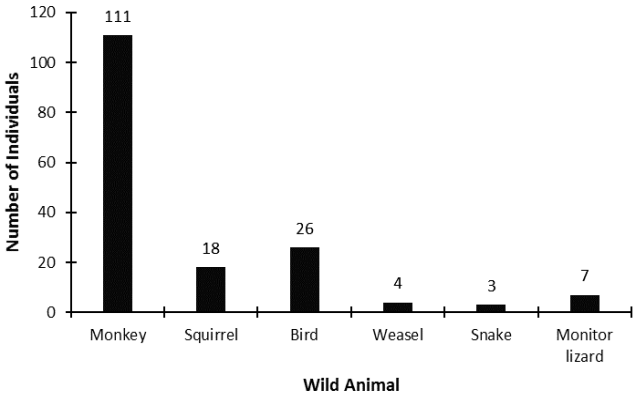

Figure 4. Total number of animal disturbances at electrical facilities in the oil and gas industry for the last 6 months

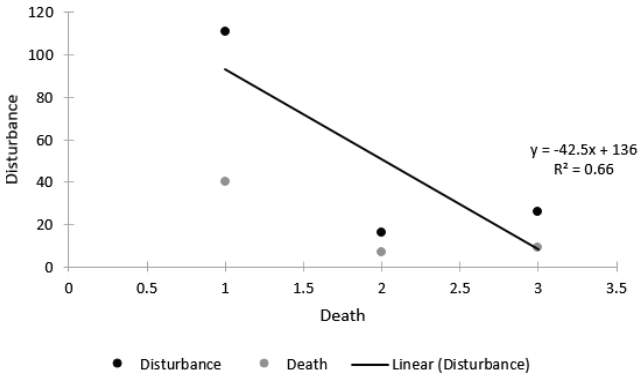

Figure 5. Interaction of wildlife disturbance with the number of wildlife death

Figure 6. Solutions for mitigating wildlife disturbances in electrical facilities. A. Isolation; B. Barrier; C. Repellent

Macaques are very easy to find along rivers because they are related to the available food sources (Brotcorne et al. 2014). Their preference to live on river banks is possibly related to the high productivity of the environment (Alison and Riley 2017). Apart from macaques, the level of bird disturbance is also quite high. Aves often found at observation locations and its species variation is higher than other animal groups. Aves have a wide range of species; the numbers found are abundant, relatively unaffected by observation activities, occupy a wide habitat, and are close to the top of the food chain (Barcante 2017).

Moreover, animal behavior is also observed to see the proportion of animal activity or behavior that is used as the basis for mitigation. The random behavior of wild animals often causes these animals to suffer electrical injuries (Schulze et al. 2016). Therefore, to mitigate wildlife disturbance by providing the animals with their needs based on their habitat habits (Cross 2021), looking at how many animals are engaged in eating activities will observe food source variations for the animals evaluated. Likewise, other behaviors in wild animals can be used to mitigate disturbances from these wild animals (Marty et al. 2019), playing involves threatening and lunging to fight over food. In addition, grooming is one of the typical activities of macaques, with a percentage of 12.5% of the total activity. Grooming is cleaning oneself from lice, which is carried out either on oneself (autogrooming) or with the help of another individual (allogrooming).

Macaques are arboreal primates that like to climb and spend almost their entire life in trees (Carvajal 2014). In the context of electrical studies, macaques will climb poles across the cables and cause electrical disturbances (Ditus 2020). In India and several South Asian countries, wild monkey attacks are a problem often faced by humans, which cause much damage to existing facilities, such as electrical currents (Gupta 2019). Apart from blackouts due to electrical disturbances, another impact is a serious injury and even death to macaques (Schulze et al. 2016). Various reports published incidents of macaques deaths due to electric shock (Al-Razi et al. 2019; Cunneyworth and Slade 2021). Other animal activities from the aves group are perched on poles, and electric cables and poles to do daily activities (Avian Power Line Interaction Committee 2006). The impact of animal disturbance on Pertamina Hulu Rokan's electrical facilities is the reduced production of ± 22,620 barrels from 2020 to 2023 (Pertamina Hulu Rokan 2023). Another impact caused by electrical interference is a serious injury resulting in death (Al-Razi et al. 2019; Ditus 2020; Cunneyworth and Slade 2021). Macaques species in several areas are often becoming a source of disturbance for plantations or community settlements (Tee et al. 2019; Jayapali et al. 2023). Several Asian countries, such as Sri Lanka and India, have been researching monkeys to find solutions to overcome the conflict between monkeys and human society (Poornima et al. 2022; Jayapali et al. 2023) because these conflicts are common in their various regions.

Moreover, the study shows that the Rokan WK's electrical facilities experienced problems with decreased production due to the supply of electrical energy being interrupted/outages to the pump wells. The presence of macaques in electrical facilities makes it possible to provide food in the area. Sufficient food sources in a habitat are one of the supporting variables for the existence and sustainability of wild animals in nature (Eikenberry et al. 2022). In the ecosystem typology of electrical facilities (feeders), several types of horticultural plants were deliberately planted under the existing electrical network. Moreover, monkeys and *beruk*, in their movements, are oriented toward feeding locations. Several types of horticultural plants that are deliberately planted include banana/ *Musa* × *paradisiaca* L., corn/*Zea mays* L., cassava/*Manihot* sp., long beans/*Vigna unguiculata* (L.) Walp., eggplant/*Solanum* sp., sugar cane/*Saccharum officinarum* L., and dragon fruit/*Hylocereus* sp. (Santoso et al. 2019). These horticultural plants are wild monkey food sources (Thatcher et al. 2020). Therefore, overcoming the problem of electrical disturbances caused by animals requires conflict prevention management (mitigation) efforts by keeping potential food sources not reachable under all electrical facilities and planting fruit plants far from electricity facilities so that wild animal activity does not move near electricity facilities. Providing a food source for an animal can control the animal's activity (Comlishaw and Dunbar 2021). Following the mitigation is providing barriers by installing climbing balls, barbed wire, protective shields on the poles, and the use of PVC Insulators and Insulated Phase Wire (Avian Power Line Commite 2006; Jorde and Lindahl 2015; Ditus 2020) in the substation area. Installing a climbing ball prevents wild animals from effectively climbing and carrying out activities around sensitive disturbed areas (Kelly et al. 2013; Laidlaw et al. 2021). These protective shields are effectively installed to reduce wildlife disturbance to electrical facilities in the Sri Lanka region (Wolfgang 2020). Another way to mitigate wildlife disturbance is to provide shock sounds to drive animals to move and stay away from electrical facilities. Shock sounds, such as GPS shock collars, are often used on agricultural land and plantations to drive wild animals out of agricultural and plantation areas, and this technique is very effective for short-term mitigation (McCormick and Stokes 2023). Install sound devices (buzzers) to deter animals and plant specific plants that are not preferred by animals around the facility, like *Evodia suaveolens* Scheff., *Cymbopogon citratus* (DC.) Stapf, *Aloe vera* (L.) Burm.f., *Sansevieria* sp., *Cerbera manghas* L., and replacing horticultural plants along the electrical route with other economic plants such as *Ocimum* sp., *Withania* sp., *Asparagus* sp., and *Capsicum annum* L. is one way to control wildlife (Gupta 2019; Springer et al. 2020). Mitigating human-wildlife conflict is a process and efforts or activities to overcome or reduce conflict between humans and wild animals (Makindi et al. 2014) by prioritizing human interests and safety without reducing the interests and safety of wild animals (Blackwell et al. 2016). The mitigation of human-wildlife conflict objectives are (i) isolating the presence of wild animals in affected facilities or locations, (ii) installing barriers to the interaction of wild animals with existing electrical facilities, and (iii) repellent by providing certain

treatments to repel pests (Miller et al. 2015; Smith and Dwyer 2016; Springer et al. 2020; Laguna et al. 2022; Gracanin et al. 2023).

In conclusion, the research results found 38 types of wild animals consisting of the mammal group (5 types), the reptile group (3 types), and the aves group (30 types). The population of *Macaca fascicularis* is at 1,500 individuals, the *M. nemestrima* at 125, and *T. auratus* is 75. The largest daily behavior of macaques is climbing (22.5%), eating (17.5%), and playing (15%). There were 169 incidents of animal disturbances at the WK Rokan electrical facility, including (i) monkey, (ii) squirrel, (iii) birds, (iv) weasel, (v) snake, and (vi) monitor lizard. The animal disturbances often occur due to monkeys at 111, birds at 26, squirrels at 18, weasels 4, snakes 3, and monitor lizards 7 incidents. Significantly, animal disturbance positively interacts with the number of wildlife deaths with a regression coefficient of 66%. Mitigation could be conducted using alternatives: (i) isolating or cutting off the presence of wild animals at affected facilities or locations, (ii) building barriers to the interaction of wild animals with existing electrical facilities, and (iii) providing repellent.

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