Media Konservasi Vol.28 No.1 April 2023: 69-76 **ISSN: 0215-1677**
DOI: 10.29244/medkon.28.1.69-76 **E-ISSN: 2502-6313**

HEART RATE, RESPIRATORY RATE, AND BODY TEMPERATURE OF HALIASTUR INDUS IN KAMOJANG EAGLE CONSERVATION CENTER

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Accepted May 19, 2022 / Approved January 30, 2023

ABSTRACT

Brahminy Kite, or Halistur Indus, is one of many protected eagle species in Indonesia. The eagle's presence in the environment is very important because the eagle is one of the environmental health indicators. Unfortunately, based on the last research, the H. indus population in Java, Indonesia has decreased. Some factors that contribute to the decrease in the H. indus population include pesticide overuse, destruction of natural habitats, illegal hunting, and illegal trading. Therefore, the conservation programs of H. Indus are very important to maintain its population in nature. To support the preservation of H. indus, this study provides an overview of H. indus, including heart rate, respiratory rate, and body temperature which is expected to be useful for consevation programs. There are 15 Halistur Indus from The Kamojang Eagle Conservation Center, Sukakarya, Samarang, Garut, West Java, Indonesia, used as observation objects. This study applies a descriptive method to analyze the data. The observation data shows that the average Halistur Indus heart rate is 173.467/minute, with a standard deviation of 11.275 /minute. The respiratory rate was 76.400 ± 14.065 /minute, and the body temperature was 42.570 ± 0.290 ˚C.

Key words: *Body Temperature, Haliastur indus, Heart Rate, Respiratory Rate, Vital Sign*

INTRODUCTION

Indonesia is a megabiodiversity hotspot and one of the world's biodiversity hotspots. The number of bird in Indonesia totals ±1,794 species, demonstrating the country's diversity (Mulyadi and Dede 2020). There are 69 species of birds belonging to the order *Accipitriformes* (also known as raptors or birds of prey) in Indonesia, one of which is the eagle (Rohman et al. 2019).

Eagles are predators that play a role in controlling animal populations in the food chain in their natural habitat. The presence of eagles will aid in the reduction of the population of these animals, preventing overpopulation. The eagle is also known as the ecological barometer or enviromental health indicator because birds of prey that occupy the top of the food chain are susceptible to environmental changes such as decreased prey numbers, destruction of natural habitats, and climate change.

One type of eagle in Indonesia is the bondol eagle (*Hiliastur indus*). *H. indus* is primarily found on the Indonesian islands of Kalimantan, Java, Sumatra, Maluku, Papua, Sulawesi, and Nusa Tenggara (Danica et al. 2019).The population of bondol eagles on the island of Java was still quite large in 1937. *H. indus* evidences this in ports, waterways, mangrove forests, lakes, and mountains. The *H. indus* population decreased between 1979 and 1990. Only 20 of these species of the eagle were discovered in ten different locations, indicating a decline (Van Balen et al. 1993). Hunting and trading of eagles are also contributing to the population decline. Keeping eagles as pets force eagles to get used to interacting with humans and also to live in cages so that these actions can influence the eagle's behavior (Safanah et al. 2018).

In Indonesia, the Regulation of the Minister of Environment and Forestry Number: P.106/MENLHK/SETJEN/KUM.1/12/ 2018 refers to Law No. 5 of 1990 concerning the Conservation of Biological Natural Resources and Their Ecosystems, as well as protection for the Accipitridae family (Rohman et al. 2019). The Republic of Indonesia's Government Regulation No. 7 of 1999 aided in protecting eagles (Danica et al. 2019). According to these regulations, one way to ensure eagles' survival is to engage in conservation activities such as releasing captive-bred animals or rehabilitating animals (Mathews et al. 2005). Animal rehabilitation aims to provide treatment and care for wounds, diseases, and abandoned animals until they are healthy and released into their natural habitat (Miller 2012). Rehabilitation will also affect behavioral recovery, ensuring that they are ready to be released into the wild and survive (Safanah et al. 2018). Taking into account an animal's good health is one of the requirements for its release.

The essential health status of the animal can be seen based on the results of the examination of vital signs and the results of laboratory support. One of the simplest and most common ways to measure

physiological parameters such as heart rate, respiratory rate, and body temperature is to examine vital signs (Doss and Mans 2016). The measurement results or values from these vital signs help veterinarians determine the animal's health condition and take appropriate medical action. Currently, there is little research on the vital sign values of *H. indus*, so more needs to be done and studied.

RESEARCH METHOD

The observation occurred in January and February 2022 at the Kamojang Eagle Conservation Center (Pusat Konservasi Elang Kamojang/PKEK) in Garut, West Java, Indonesia (https://maps.app.goo.gl/1h9UK7n1JMY7pMo1A). This research is a descriptive study with a quantitative approach. This study will describe the data from the observations of the sample animals. The samples were fifteen adult bondol eagles (*Haliastur indus*) with ten males and five females. The selection of sample animals was based on a purposive sampling technique that adjusted to predetermined criteria. All of the sampled animals are undergoing the rehabilitation process at the PKEK, which will be released into the wild.

Heart rate, respiratory rate, and body temperature were measured immediately after arrest and in the clinic. After the animals arrive at the clinic, collect observation data for 30 minutes, then repeat the process after 60 minutes. When observed, the eagle was in a dorsal recumbency position, covered by a towel and the keeper held its legs with one finger (middle finger) positioned between its legs. The Restrain process did not use any chemical agent (anesthesia agent). The bird's heart rate was measured using a stethoscope placed on the bird's chest and observing the respiratory rate directly through chest movements. A thermometer was inserted into the cloacal area to measure body temperature. The result presented in tabular format. The table presents data in the form of heart rate, respiration, and body temperature of the bondol eagle shortly after capture and during the examination at the clinic. The data's average and standard deviation are then displayed.

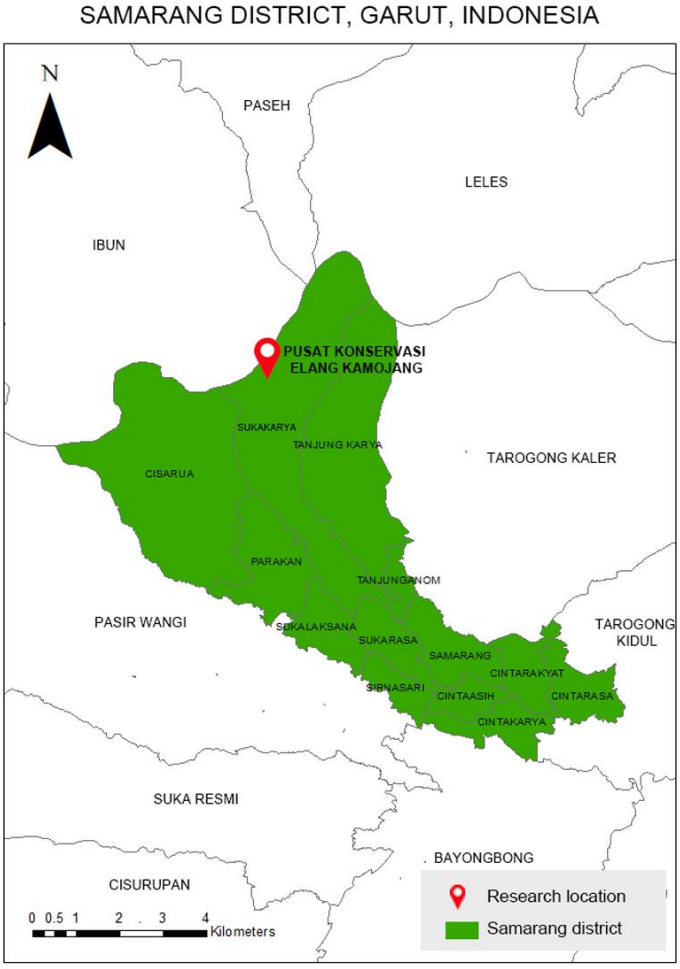

Figure 1 Kamojang eagle conservation center location

RESULT AND DISCUSSION

1. Sample Animal Profile

The research subject is H. indus which is currently undergoing rehabilitation at the Kamojang Eagle Conservation Center. The number of objective samples was 15, all of whom were undergoing rehabilitation at the same facility. The information gathered is based on the PKEK's routine and scheduled health checks. All of their age category is adult. Based on the origin of the sample animal, they divided into three origin location ; 10 from East Java, 4 from West Java, and 1 from DKI Jakarta.

Figure 2 Data Collecting Proccess

Tabel 1 Sample animal profile.

No.	Eagle Name	Species	Age Category	Sexuality	Arrival Date	Examination Date	From
1	Luna	*H. indus*	Adult	Female	13/03/2019	10/01/2022	BKSDA East Java
2	Melody	*H. indus*	Adult	Female	19/12/2019	10/01/2022	BKSDA East Java
3	Tukul	*H. indus*	Adult	Male	13/03/2019	11/01/2022	BKSDA East Java
4	Kasep	*H. indus*	Adult	Male	13/03/2019	11/01/2022	BKSDA East Java
5	Japri	*H. indus*	Adult	Female	13/03/2019	11/01/2022	BKSDA East Java
6	Ripet Hitam	*H. indus*	Adult	Male	09/04/2018	13/01/2022	BKSDA West Java
7	Ripet Biru	*H. indus*	Adult	Male	19/04/2019	13/01/2022	BKSDA East Java
8	Ripet Kuning	*H. indus*	Adult	Male	20/01/2016	13/01/2022	BKSDA West Java
9	Ripet pink	*H. indus*	Adult	Female	07/04/2017	13/01/2022	BKSDA West Java
10	Jalu	*H. indus*	Adult	Male	19/12/2019	17/01/2022	BKSDA East Java
11	Bima	*H. indus*	Adult	Male	06/04/2020	17/01/2022	BKSDA West Java
12	Komeng	*H. indus*	Adult	Male	19/12/2019	17/01/2022	BKSDA East Java
13	Ochan	*H. indus*	Adult	Male	13/03/2019	17/01/2022	BKSDA East Java
14	Rinjani	*H. indus*	Adult	Female	11/10/2019	17/01/2022	Indonesian Police
15	Marco	*H. indus*	Adult	Male	19/12/2019	17/01/2022	BKSDA East Java

2. Heart Rate of *H. indus* in PKEK

The highest bodyweight of H. indus in this study was 0.820 kg, and the lowest was 0.510 kg, with a mean of 0.646 ± 0.104 kg. According to (Hardy, 2019), the susceptible weight of H. indus in adolescents is 0.320 kg-0.545 kg, and the susceptible weight of H. indus in adults is 0.494 kg-0.673 kg in 2019. In the cage, the lowest heart rate was 156 beats per minute, and the highest was 192 beats per minute, with an average of 173 ± 10.104 beats per minute. Meanwhile, at the clinic, the lowest heart rate was 146 beats per minute, and the highest was 190 beats per minute, with an average of 173 ± 11.275 beats per minute. Birds with an average body weight of 0.646 kg and in restraint have a heart rate of 150-300 beats per minute (Chitty and Lierz 2008).

On examination at the clinic, H. indus had an average heart rate of 179.6 beats per minute when grouped by sex, while H. indus had an average heart rate of 170.4 beats per minute. Based on this, it shows that bird's heart rate with the female sex is higher than birds of the male sex. According to Smith (2014) the average heart rate of hens from various types of chickens is 348 beats per minute, while the average heart rate of roosters is 227 beats per minute.

There are not many explanations about relation between sex and heart rate in bird but, in mammals, it occurs because female mammal has smaller heart size. Small heart pumps less blood to the body so it has to pump blood quickly (Prabhavathi et al. 2014). Another explanation states, in human, difference hormonal regulation between female and male affect heart rate (Lutfi et al. 2011). The factors that inffluence heart rate values between female and male heart rate in bird need further research.

On examination at the clinic, H. indus, which weighs more than the average (> 0.673 kg), has an average heart rate of 175.4 beats per minute, while H. indus, which weighs the same as the average (0.494 kg-0.673 kg), has an average heart rate of 175.4 beats per minute. The average heart rate was 171.8 beats per minute. This result contradicts the findings of Chitty and Lierz (2008) who found that the higher the bird's body weight, the lower the heart rate. During the arrest and restraint process, the alleged discomfort occurred. Even though there has been a rest process at the clinic for 30 minutes and 60 minutes to reduce stress due to the arrest process, the subjects of this study are wild animals and are currently in a rehabilitation period, so many factors can trigger a re-emergence of stress. Elevating heart rate when bird in stress condition happened because the body release catecholamin, epinephrine, and norepinephrine (Cyr et al., 2009).

When flyings, physical activity increases. The consequence of increased physical activity is birds need more oxygen especially for the head, wings, and flight muscles. To respon the requirement of oxygen, birds increase heart rate to get more blood into the tissue and it is supported by high stroke volume and stiff arteries (O'Malley, 2005). But this situation not applicable when bird flying for a long time or migrating. Branta leucopsis have been reported have a decreased heart rate from 317 beats per minute to 226 beats perminute. This happened because B. leucopsis have decreased of body weight but not with heart mass and it make requirement of oxygent for tissue decreased (Butler et al. 1998).

Tabel 2 Heart rate of *H. indus* in PKEK.

Eagle Name	Bodyweight (kg)	Heart Rate (beats/minute)	
		Cage	Clinic
Luna	0.715	156	180
Melody	0.730	184	166
Tukul	0.510	172	178
Kasep	0.710	180	164
Japri	0.600	192	178
Ripet Hitam	0.510	168	186
Ripet Biru	0.550	164	146
Ripet Kuning	0.530	180	176
Ripet pink	0.670	164	184
Jalu	0.750	184	178
Bima	0.750	180	174
Komeng	0.535	172	162
Ochan	0.820	168	176
Rinjani	0.720	160	190
Marco	0.590	176	164
Average ± SD	0.646 ± 0.104	173 ± 10.104	173 ± 11.275

3. Respiratory Rate of *H. indus* in PKEK

The respiratory H. indus in PKEK was taken in two places, namely in the cage, immediately after arrest, and in the clinic. In the cage, the lowest breathing frequency was 56 times per minute, and the highest was 108 times per minute, with an average of 79.2 ± 14 times per minute. At the clinic, the lowest respiratory rate was 52 times per minute, and the highest was 106 times per minute, with an average of 76.4 ± 14.065 times per minute. On examination at the clinic, H. indus with female genitalia had 77.2 beats per minute respiratory rate, while H. indus with male genitalia had a respiratory rate of 76 beats per minute. There is no clearly explanation about correlation between gender and respiratory rate in bird but in human, female has smaller lung and has higher flow rate

H. indus with a bodyweight greater than or equal to the mean (> 0.673 kg) has a respiratory rate of 72.3 times per minute, while H. indus with a bodyweight equal to or less than the mean (0.494 kg-0.673 kg) has a respiratory rate of 80 times per minute. Calder, 1968, proposed that the lower the bodyweight, the higher the respiratory rate. Birds with a bodyweight of 400 g - 1000 g have a respiratory frequency of 15-30 times per minute (Hoppes 2021). There are not many studies on the respiratory rate of eagles in normal circumstances. Heatley (2007) published a study on bald eagle respiratory frequency, finding that bald eagles with mycobacteriosis had 30 times per minute respiratory rate. Under general anesthesia, Milvus milvus (red kite) frequency varies between 16 and 28 times per minute (Martin-Jurado et al. 2011).

There are some factors that influence respiratory rate. One of factors that influence respiratory rate is weight. The greater of bird's body weight, the smaller of bird's respiratory rate. Some bird's respiratory rate data : Nymphicus hollandicus 40-50 beats per minute, Colombidae sp. 25-30 beats per minute, Meleagris sp. 13 beats per minute, and Struhio camelus. 3-5 beats per minute (O'Malley, 2005). The second factor can influence respiratory rate is ambient temperature and humidity. Ambient temperature and humidity can make bird body releasing adrenocorticotropin who induced steroid hormon releasing (Sundari and Santosa, 2015).

When bird exposure with hight ambient temperature for long time, body will response with releasing of body heat. First, body will be releasing body heat from skin through conduction, convection, and radiation. When body can not release the body heat with this mechanism, body will release the body heat through skin pores and the end, body will release the body heat through respiratory system and noted by panting or gasping (Sundari and Santosa, 2015).

Another factor that can elevated respiratory rate is flying. The higher bird flies, the quantity of oxygen will decrease, to maintain requirement oxygen in body, bird will increase ventilation process, and it will make respiratory rate higher. The elevated of respiratory rate when flying its about 20-30 beats per minutes (O'Malley, 2005). Decreased of respiratory rate in bird may occur when the bird is under use of isuflurane in general anesthesia. Isoflurane induces depression of central nervous system, and relaxation of respiratory muscle (Chemonges, 2014).

Tabel 3 Respiratory rate of H. indus in PKEK.

Eagle Name	Bodyweight (kg)	Respiration (times/minute)	
		Cage	Clinic
Luna	0.715	68	70
Melody	0.730	80	78
Tukul	0.510	72	82
Kasep	0.710	80	58
Japri	0.600	108	92
Ripet Hitam	0.510	68	84
Ripet Biru	0.550	56	62
Ripet Kuning	0.530	76	92
Ripet pink	0.670	76	76
Jalu	0.750	92	106
Bima	0.750	60	72
Komeng	0.535	84	70
Ochan	0.820	80	52
Rinjani	0.720	108	70
Marco	0.590	80	82
Average ± SD	646 ± 0.104	79 ± 14.829	76 ± 14.065

4. Body Temperature of *H. indus* in PKEK

In cages and the clinic, H. indus measurements were taken immediately after capture. The lowest body temperature measured after capture was 41.20 oC, and the highest was 42.90 oC, with a mean of 42.61 oC. In clinical measurements, H. indus had the lowest body temperature of 42.10 oC and the highest body temperature of 42.90 oC, with a mean of 42.57 ± 0.286 oC. According to Barefield (2012) the bald eagle's body temperature is 106 oF, or 41.11 oC. Under the influence of isoflurane, the body temperature of Milvus milvus, also known as the red kite, is 40.4 oC (Martin-Jurado et al. 2011). H. indus has been reported to have a body temperature of 41.6 C when suffering from carbofuran poisoning (Sravanthi et al. 2018).

On clinical examination, H. indus with female sex has a body temperature of 42.69 oC, while H. indus with male sex has a body temperature of 41.51 oC. Based on Scanes (2014) managed to observe the body temperature of Dromaius novaehollandiae and Phoeniculus purpureus. D. novaehollandiae females have a body temperature of 38.2.5 oC, while males have a body temperature of 37.7 oC. P. purpureus females have a body temperature of 39.7 oC, while males have a body temperature of 39.6 oC. The findings of this study support previous research on H. indus, which found that birds with female sex have warmer body temperatures. Based on bodyweight grouping, H. indus with bodyweight above the average (> 0.673 kg) had an average body temperature of 42.50 oC, while H. indus with a bodyweight equal to the average (0.494 kg-0.673 kg) had an average body temperature of 42.63 oC.

One factor that influences the difference in body temperature values between female and male bird is behavior. One of behavior that most influence body temperature is egg-laying. When female bird laying eggs, it reaches the peak of body temperature. It occurs because of hormonal changing that increase the bird's metabolic rate up to 20-30%. When metabolic rate increase, body temperature will increase too (Guillemette and Pelletier,2022). Based on Wilson and Woodard, 1954, female birds in some species were found to have higher body but not clearly explained why this situation happened. In mammals, represented by mice, female mice had higher body temperature than male mice especially when female mice in oestrus condition. It happened because some hormone elevated when oestrus (Sanchez-Alavez, et al., 2011).

There are some factors that influence the body temperature of bird. Ambient temperature is one of factors that influence the body temperature of bird. It happened because homeostasis of thermoregulation and osmolality is related from skin evaporation process. When ambient temperature is high, the respiratory rate will drecreased and if the bird exposured by high ambient temperature in long time, the bird will dehydration, hypovolemia, hyperoslolality, and hypethermia (Scanes, 2014). Restraint process can induce elevated body temperature on bird up to 0,6oC-0,8oC above the normal temperature standard value (Cabanac and Aizawa, 2000).

Another factor that influences body temperature in bird is flying. when flying, body temperature of bird can increase up top 2-4oC (Torre-Bueno,1976). It happened because when the bird flying, there is an elevated of metabolic rate markedly with elevated of endogenoys heat. The elevated of body temperature of bird descripted too by Adams et al. 1999.

Decreasing of body temperature or hypothermia can be find in the bird during winter. It is usefull to save energy, because during winter, availability of feed drecreased too. The consequences of senergy saving through hypothermia is loss of ability to fly. Birds will be able to fly again when the body temperature has returned to normal (Carr and Lima, 2013). Other condition that causes hypothermia is under use of isoflurane. It happens because isoflurane makes dilatation of blood vessel and resulting increase of heat dissipation throgh the skin (Boedeker et al. 2005).

Tabel 4 Body temperature of H. indus in PKEK

Eagle Name	Bodyweight (kg)	Body Temperature (˚C)	
		Cage	Clinic
Luna	0.715	41.20	42.50
Melody	0.730	42.80	42.55
Tukul	0.510	42.00	42.65
Kasep	0.710	42.90	42.25
Japri	0.600	41.70	42.90
Ripet Hitam	0.510	42.90	42.05
Ripet Biru	0.550	42.90	42.75
Ripet Kuning	0.530	42.90	42.30
Ripet pink	0.670	42.90	42.75
Jalu	0.750	42.50	42.10
Bima	0.750	42.90	42.90
Komeng	0.535	42.90	42.75
Ochan	0.820	42.90	42.45
Rinjani	0.720	42.90	42.75

Marco	0.590	42.90	42.90
Average ± SD	646 ± 0.104	42,61 ± 0.540	42.57 ± 0.286

CONCLUSION

The purpose of this study was to describe the heart rate, respiratory rate, and body temperature of *H. indus*. The result of the heart rate measurement of *15 H. indus* obtained the mean and standard deviation was 173.467 ± 11.275 /minute, respiratory rate was 76.400 ± 14.065 /minute, and body temperature was 42.570 ± 0.290 ˚C.

Thank you to all of the Kamojang Eagle Conservation Center staff, particularly M Fajar Hezah, S.KH., The West Java Conservation Center, Padjadjaran University, and everyone else who assisted us in putting this journal together.

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