REGULAR ACTIVITIES OF ADULT *PTYAS MUCOSA* (LINNAEUS, 1758) IN A FARMING CONDITIONS OF NGHE AN PROVINCE, VIET NAM

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ARTICLE INFORMATION

Journal: *Vinh University Journal of Science*
ISSN: *1859-2228*

Volume: 52
Issue: 4A
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Received: *16 August 2023*
Accepted: *24 October 2023*
Published: *20 December 2023*

Citation:
Ong Vinh An, Dang Huy Huynh, Hoang Xuan Quang, Tran Kien (2023). Regular activities of adult Ptyas mucosa (Linnaeus, 1758) in a farming conditions of Nghe An province, Viet Nam.
Vinh Uni. J. Sci.
Vol. 52 (4A), pp. 70-84
doi: 10.56824/vujs.2023a091

ABSTRACT

In the feeding condition in Cua Lo Town, Nghe An province, Viet Nam, adult *Ptyas mucosa (P. mucosa)* operates seasonally and day and night with the rule: The active season is from March to December and hibernating in January and February every year. For the rule of day and night operation: In March and April, they are mainly active from 6-18h; from May to July, they are operates at the 2 time periods: 7-11h (at most 8-10h), and 15-20h; In August, they are also operates 2 time periods, but from 5-11h, and 14 - 20h; From September to December, it operates at one period (6 or 7-19h), not active at night. The activity of adult *P. mucosa* is closely dependent on the temperature and humidity of the environment (20-40^{o}C, 40-100%), the most favorable is 27-31^{o}C, 76-92%. They officially hibernate in January and February when the ambient temperature is below 17^{o}C for many days.

Keywords: Cua Lo Town; Vietnam; *Ptyas mucosa*.

1. Introduction

P. mucosa (Linnaeus, 1758) is a big snake species inhabiting from Indonesia (Sumatra) to Southern Europe [1, 2, 3] and in most of the provinces of Vietnam [6]. In nature, *P. mucosa* lives in areas that are close to residential regions [4, 5]. *P. mucosa* (Oriental Rat Snake) [6, 11], which is one of the beneficial reptiles that protect crops and maintain ecological balance. Due to their economic and pharmaceutical value, they were over - exploited (Figure 2), and they were mentioned in the list of protected species (India, 1972; Indonesia, 2004; Malaysia, 2007) [4, 7]. In Vietnam, this species is also being traded at a serious level [8, 9], which is really difficult to control. Therefore, it was listed in the 2007 Vietnam Red Data Book [9], Decree of Government No. 84/2021/ND - CP Vietnam at state of danger, precious and rare; Appendix IIB [10] and in IUCN Red list 2023 at Least concern species (LC) [12]. In the scope of this article, we present the activity regulation and the relationship between their activities and the temperature, humidity of their habitat in the rearing condition at Nghe An province, Vietnam to contribute well as breeding this snake species for the sustainable development, reducing the pressure of Biodiversity.

2. Time, place and method of research

2.1. Time and place of research

The research was carried out at Cua Lo Town, Nghe An province, Vietnam (19°47′53″N, 105°43′33″E) on 20 mature individuals: 10 male snakes with average body length L_{bd} = 1706.5 ± 66.37 mm, average body weight W_{bd} = 757.73 ± 94.16 (g); 10 females with L_{bd} = 1604.2 ± 61.14 mm, W_{bd} = 697.5 ± 88.18 (g), which were reared from January 2006 to December 2008.

2.2. Research method in rearing conditions

2.2.1. Cage design

Ptyas mucosa was reared in 9 cages in shaded areas (Figures 3, 4):

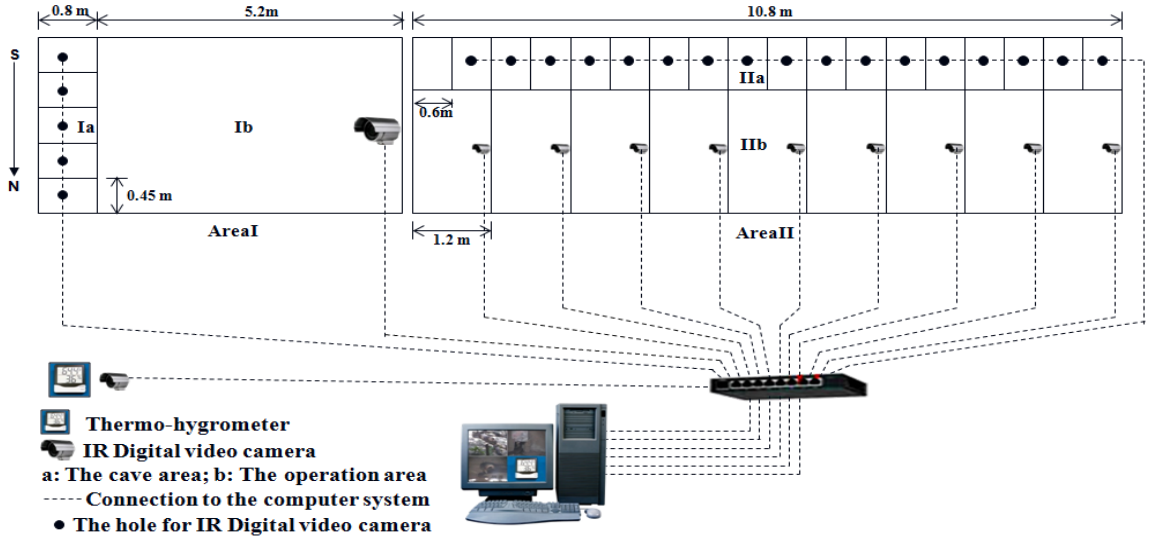

Figure 1: *Diagram of the experimental area*

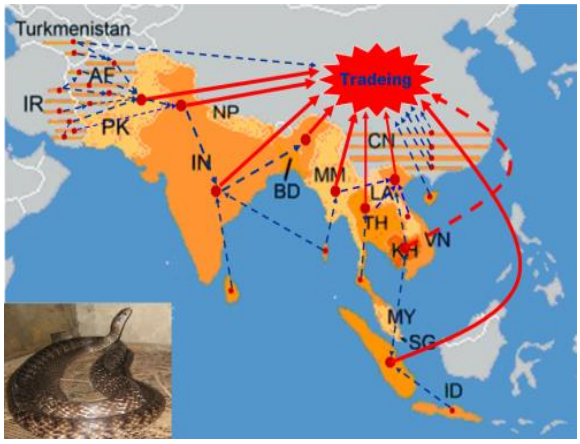

Figure 2: *Trade of P. mucosa in Southeast Asia [3]*

Figure 3: *Large cage*

Figure 4: *Small cage*

Figure 5: *IR Digital video camera*

Figure 6: *CCTV IR Digital video camera in cave snakes*

Figure 7: *Thermo - hygrometer*

Figure 8: *Computer system*

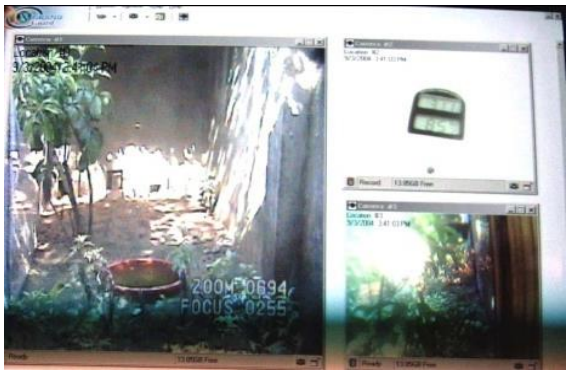

Figure 9: *View from computer*

(i). The large cage with dimensions of 6m in length, 2.2m in width, and 1.2m in height (6 x 2.2 x 1.2m) was divided into two parts (Figure 3):

Part 1: The activity area is 5.2 x 2.2 x 1.2 m, with grass bottom, and shrubs; the other sides are made of wire mesh, mesh 1 cm x 1 cm. Inside, there are troughs, water tanks, lights, and sterilization balls;

+ Part 2: The cave area is 0.8 x 2.2 x 1.8 m in size including 5 caves, each of which is 0.8 x 0.45 x 0.35 m of clay. The top has a wooden lid, mounted with the infrared video camera. The opposite side of the cave area is attached with CCTV cameras to observe and record. The roof of the cave is tilted 1.5 - 1.8m with cement fibrils covered with palm leaves to protect against the heat.

(ii). The small cages (8 cages) with dimensions of 1.2 x 2.2 x 1.5 m were divided into two areas (Figure 4):

+ The activity area is 1.2 x 1.8m. Its top side is covered with a metal net whereas the bottom side is covered with plants and grass. The four surrounding sides are built with cement bricks. Each side has a small mesh window. The infrared camera is fixed on the top to observe. Trough, water tanks are put inside;

+ The hidden cave of the snake is divided into 2 cells with the size (0.6 x 0.4 x 0.5 m) made of clay. Its top has a wooden lid where an infrared camera and thermometer are fixed. The cement fibril roof of the cave is covered with palm leaves to protect it from rain and sun.

2.2.2. Observation method

All the activities of the snakes were continuously observed for 24 hours per day by a wired IR digital video camera system connected with a computer located in a room that is far from the rearing area. The computer is installed in real - time during the day (Figures 1, 4, 5, 6, 7, 8, 9).

+ Observation of snakes's movement with a remote control which has ZOOM & FOCUS function with a maximum rotation angle of 360° (Figures 5, 6);

+ Temperature and humidity of the environment are observed by the thermal connector, thermo - hygrometer and computer installed real - time observing the changes of the weather every day (Figure 7);

+ The operation of the camera of observation, camera of records of temperature, and humidity of the environment were displayed on the screen at the same time. The computer was set to capture images automatically in the specified time zone to calculate the activity frequency by date and time (Figures 8, 9);

+ The frequency of activity (T_F) was calculated as the number of times recorded in the period of 1 hour: from (i) to hour (i + 1);

The Activity Index in Months (K_M), Activity Index in the morning, afternoon and evening K (K_D), and activity index in Hours (K_H) were calculated as the percentage of the times adult *P. mucosa's* activities were recorded over the total of times of their activities recorded in a unit of time (Month, Day, Hours).

2.2.3. Method of data processing

Data processing by a mathematical statistical method using Excel, and R software [13, 14].

3. Results and discussions

3.1. Seasonal activities

3.1.1. The activity season of adult P. mucosa

The data of adult *P. mucosa*'s seasonal activities are shown in Table 1.

Table 1: *Adult P. mucosa seasonal activity index (%)*

The stages	Year	♂							♀						
		2006		2007		2008		K_{TC} (%)	2006		2007		2008		K_{TC} (%)
	Month	T_F (times)	K_M (%)	T_F (times)	K_M (%)	T_F (times)	K_M (%)		T_F (times)	K_M (%)	T_S (times)	K_M (%)	T_F (times)	K_M (%)	
Winter hide	Jan	*Inactive*													
	Feb														
Saesonal activity	Mar	36	3.31	41	4.51	45	4.36	4.06 ± 0.66	33	4.06	49	5.81	44	5.22	5.03 ± 0.89
	Apr	97	8.91	91	10.00	109	10.57	9.83 ± 0.85	86	10.59	96	11.37	89	10.56	10.84 ± 0.46
	May	150	13.77	130	14.29	145	14.06	14.04 ± 0.26	113	13.92	124	14.69	134	15.90	14.83 ± 1.0
	June	149	13.68	116	12.75	127	12.32	12.92 ± 0.7	84	10.34	90	10.66	83	9.85	10.28 ± 0.41
	July	141	12.95	106	11.65	135	13.09	12.56 ± 0.8	78	9.61	82	9.72	92	10.91	10.08 ± 0.73
	Aug	190	17.45	157	17.25	167	16.20	16.97 ± 0.67	158	19.46	146	17.30	119	14.12	16.96 ± 2.29
	Sept	137	12.58	117	12.86	124	12.03	12.49 ± 0.42	116	14.29	121	14.34	130	15.42	14.68 ± 0.64
	Oct	115	10.56	96	10.55	110	10.67	10.59 ± 0.07	94	11.58	84	9.95	82	9.73	10.42 ± 1.01
Before winter hide	Nov	58	5.33	41	4.51	48	4.66	4.83 ± 0.44	35	4.31	34	4.03	44	5.22	4.52 ± 0.62
	Dec	16	1.47	15	1.65	21	2.04	1.72 ± 0.29	15	1.85	18	2.13	26	3.08	2.35 ± 0.65
Sumary		1089	100	910	100	1031	100	100	812	100	844	100	843	100	100

It can be seen from the table that adult *P. mucosa's* activity is cyclic. They hibernate from January to February. Their activities are mainly from March to October. The hibernating preparation is from October to December.

* During the hibernation season (January and February): They don't move outside.

* In the season of activity: The adult *P. mucosa's* activities increase gradually from March (4.06% - 5.03%) to April (9.83% - 10.56%) and reached (14.04% - 14.83%) in May. After that, their activity gradually decreased in June (12.92% - 10.28%) and July (12.06% - 10.28%). In August, they are the greatest active (16.96% - 16.97%), and gradually decrease in September (12.49% - 14.68%) and October (10.42% - 10.67%).

* Before the hibernation season (November, December) their activities are few and they decrease rapidly from November (4.52% - 4.83%).

3.1.2. The relationship between ambient temperature and humidity of the environment to the activities of adults P. mucosa

The results are shown in Figures 10, 11 and 12.

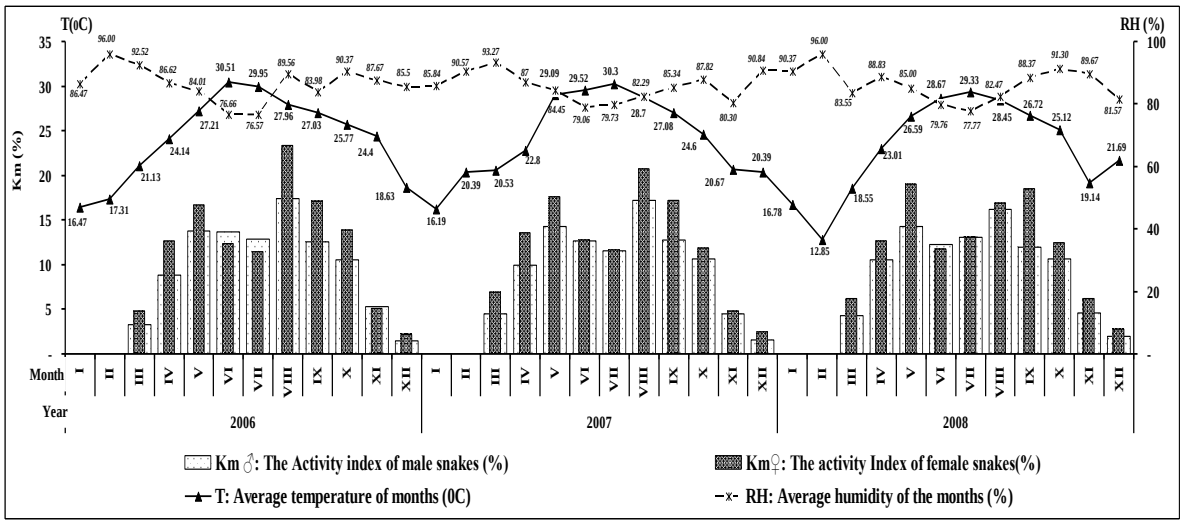

Figure 10: *Correlation between temperature, humidity of the environment with adult P. mucosa seasonal activities*

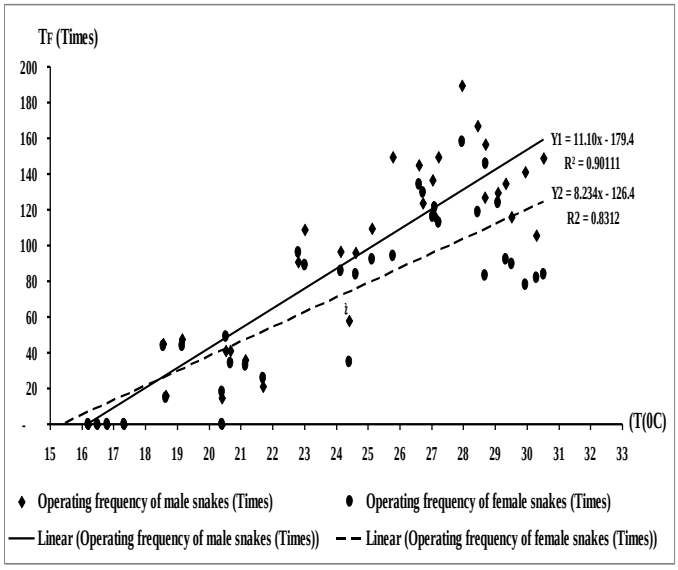

Figure 11: *Correlation between environmental temperature and frequency of seasonal activity of adult P. mucosa*

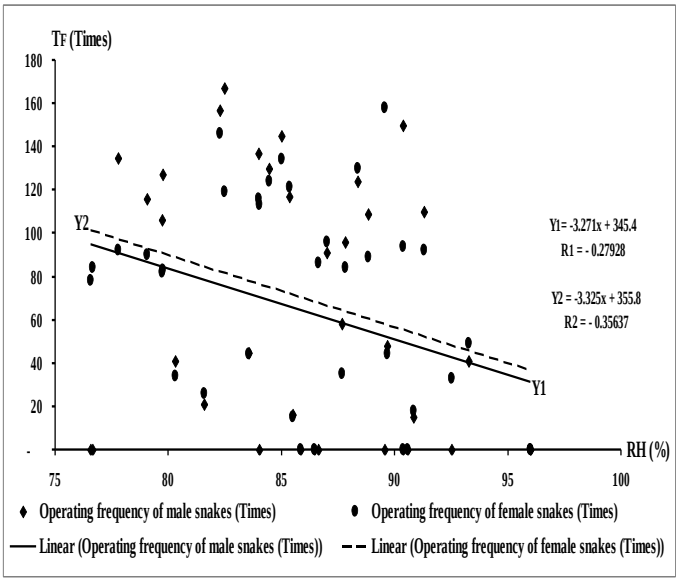

Figure 12: *Correlation between environmental humidity and frequency of seasonal activity of adult P. mucosa*

The activity of adult *P. mucosa* depends on environmental changes (Figures 10, 11, 12). The relationship between adult *P. mucosa's* activity and temperature is a positive linear correlation (R1 = 0.9011; R2 = 0.8312) and fluctuates in the temperature range 17^{o}C - 32^{o}C; with humidity being negative linear (R1 = - 0.22928; R2 = - 0.35637), with an average humidity range of 75% - 100%.

Thus, in March (temperature increases, humidity decreases) adult *P. mucosa* begin to become activitve again; in November and December (temperature decreases, humidity increases) they are activity gradually decreases and hibernates. During the months of March to November *P. mucosa'*s activity corresponding to the physiological prosess the rule:

*At the beginning of the operating season (March): When there are signs of increased environmental temperature (18.55^{o}C - 21.13^{o}C) and decreased humidity (92.57% - 83.55%), they begin to leave the cage. sunbathing, accumulating heat to start physiological processes to prepare for a new season of activity after a long hibernation period. Adult *P. mucosa* is only active on days with relatively high temperatures (22.12^{o}C - 24.45^{o}C), K_{TC} = 4.06% for male and K_{TC} = 5.03% for female.

* In April, the environmental temperature 22.8^{o}C - 24.14^{o}C, they are increasing their sunbathing activities, some individuals have begun to mate, search for food and prepare for the main mating season, the activity of *P. mucosa* increased (K_{TC} = 9.83% for male and K_{TC} = 10.84% for female).

* In May, the environmental temperature is from 26.59^{o}C - 27.21^{o}C corresponding to the main mating season, male is eager to mate, so the activity index reaches 14.04%. Some females have increased their search for food to raise eggs (K_{TC} = 14.83%).

* In June, the environmental temperature is 28.67^{o}C - 31.51^{o}C. The activities of male and female snakes are different: Some female snakes lay eggs, are weak, stop eating, incubate eggs and are less active (K_{TC} = 10.28%); Male are very eager to mate K_{TC} = 12.92%, they can mate with other snakes and even with dead female [15, 16].

* In July: The activity of male and female both decreases (K_{TC} = 12.56% and 10.08%), this is the period when some female lay eggs, and the weather is the hottest of the year (29.53^{o}C - 30.3^{o}C), snakes are less active, mainly drinking water and soaking to regulate their body temperature.

* In August and September: The environmental temperature is 27^{o}C - 28^{o}C corresponding to the post - reproductive time of *P. mucosa*. Most female, male rarely mate *P. mucosa* increase nutrients to compensate for the energy consumed during the reproductive process *P. mucosa* activity gradually decreased: K_{TC} = 16.97% - 12.49% for male; K_{TC} = 16.96% - 14.68% for female.

* In October, November, and December, activity of adult *P. mucosa* gradually decreases: In October, they are still active to accumulate more nutrients to prepare for hibernation (K_{TC} = 10.42% -10.59%); In November, the ambient temperature is low (19.4^{o}C - 24.4^{o}C), *P. mucosa* is less active (K_{TC} = 4.52% - 4.83%); In December, when the environmental temperature drops sharply from 18.83^{o}C - 20.19^{o}C, they are very inactive (K_{TC} = 1.72% - 2.35%).

* In January and February, when the environmental temperature is very low (16.46^{o}C - 17.3^{o}C) for a long time, the humidity is high due to cold rain, and they hibernate and are inactive. The hibernation phenomenon of adult *P. mucosa* is similar to the hibernation phenomenon of *Naja naja* [17], *Bugarus fasciatus* [18], *Bungarus multicinctus* [19].

In Cua Lo, Nghe An when adult *P. mucosa* is hibernating (not eating, not active), if the temperature is increased to 20^{o}C - 23^{o}C, they still refused to eat; In November and December, when they are not hibernating, if the temperature is maintained continuously above 23^{o}C - 25^{o}C, they will not hibernate. When it rains and low ambient temperatures last for many days, snakes become inactive, after the sun comes out, snakes come out to bask in the sun en masse. According to Wall, *P. mucosa* operates on warm days [15, 16]. However, in Sunda of Indonesia [3, 4], Malaysia [5] and in Tay Ninh snake farms (Vietnam), which are areas with high temperatures all year round, *P. mucosa* is active throughout the months of the year, without hibernation period. This proves that temperature plays a role in maintaining physiological processes for reptiles in general, including *P. mucosa*.

3.2. The day/night activities of adult P. mucosa

3.2.1. The time of adult P. mucosa's activities

The results on the time of adult *P. mucosa's* activities are shown in Figure 13 and Table 4.

Table 4: *Daytime activities of adult P. mucosa*

Note: *T_F: parameters activity frequency of snakes (times); T_{GF}: general activity frequency of snakes (times); K_{DS}: Activity Index of snakes in the morning, afternoon and evening (%); K_H: activity index in hours (%); K_{DS}: Summary activity index of snakes in the morning, afternoon and evening*

Month	**Hours of the day**	**Morning**							**Noon**							**Night**	**Sumary**
	Hour	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	> 20	
March, April	T_F (Times)	0	3	11	42	76	109	158	176	124	72	31	10	4	0	0	816
	K_H (%)	0	0.37	1.35	5.15	9.31	13.36	19.36	21.57	15.20	8.82	3.80	1.23	0.49	0	0	100
	K_D (%)	48.90							51.10							0	100
May, June, July	T_F (Times)	39	91	183	290	305	236	109	80	89	105	129	176	143	63	41	2079
	K_H (%)	1.88	4.38	8.80	13.95	14,67	11,35	5,24	3.85	4.28	5.05	6.20	8.47	6.88	3.03	1,97	100
	K_D (%)	60.27							37.76							1.97	100
August, September	T_F (Times)	24	48	105	157	208	236	134	87	88	118	131	152	130	43	21	1682
	K_H (%)	1.43	2.85	6.24	9.33	12.37	14.03	7.97	5.17	5.23	7.02	7.79	9.04	7.73	2.56	1,25	100
	K_D(%)	54.22							44.53							1.25	100
October, November, December	T_F (Times)	0	5	26	43	80	126	194	204	117	77	47	22	8	3	0	952
	K_H (%)	0	0.53	2.73	4.52	8.40	13.24	20.38	21.43	12.29	8.09	4.94	2.31	0.84	0.32	0	100
	K_D(%)	49.79							50.21							0	100
Sumary	T_{FG} (Times)	3038							2429							62	5529
	K_{DS}(%)	54.95							43.93							1.12	100

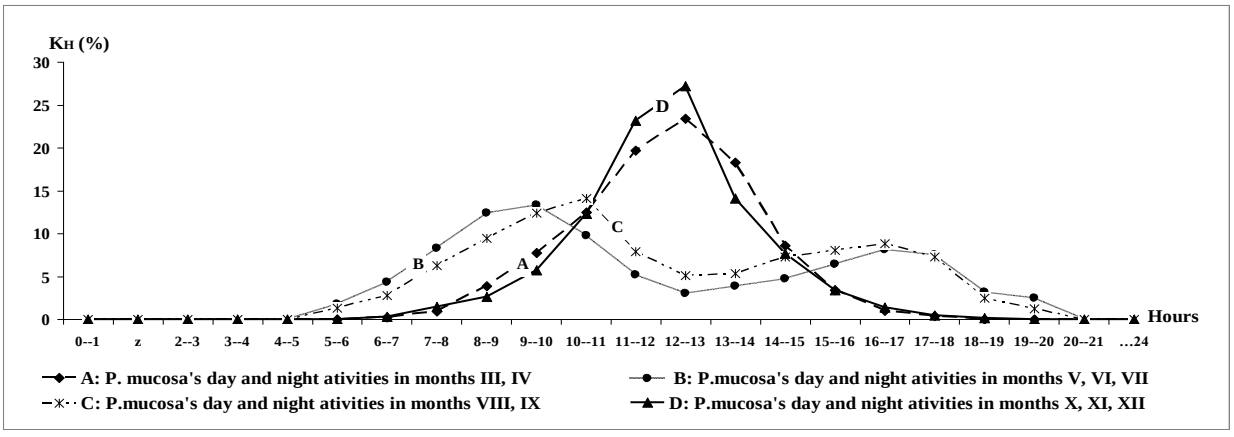

Figure 13: *The diagram of adult P. mucosa's activities in the daytime*

In Cua Lo, adult *P. mucosa* is mainly active during the day from 5 - 20h (K_{DS} = 98.88%) and less active at night (after 20h; K_{DS} =1.12%).

* In March and April, they are active from 6 - 18h, most often at 10 - 14h (K_{BC} = 69.49%).

* In May, June and July, they are mainly active in the morning (K_{BC} = 60.27%) and afternoon (K_{BC} = 37.76%), in the evening they are less active (K_{BC} = 1 .97%).

* In August and September, they are still active in the morning (K_{BC} = 54.22%) and afternoon (K_{BC} = 44.53% and very little in the evening (K_{BC} = 1.25%).

* In October, November and December, adult *P. mucosa* activity gradually increases from 6h, the most at 11 - 13h (K_{BC} = 41.81%) and gradually decreases towards the end of the afternoon.

3.2.2. Correlation between temperature, humidity and the activity time of adult P. mucosa

The relationship between the time of activity of adult *P. mucosa* and the ambient temperature and humidity (Table 4, Figures 14 and 15) is non - linear, with correlation coefficient with temperature R^2 = 0.916 - 0.922 and with moisture R^2 = 0.695 - 0.698. The time and level of activity of them depend on the change of temperature and humidity during the identified days of the months in their activity season.

* From March to December: Adult *P. mucosa* is active at times with temperatures ranging from 20.5^{o}C - 40^{o}C. The most favorable temperature range is 27^{o}C - 31^{o}C.

* Adult *P. mucosa* is active with a wide range of humidity of 40% - 100%: In March, they are active when the humidity is from 65% - 92%; From April to October, they are active at all times with humidity from 40 - 100%. When the environmental humidity is less than 50%, they often come out to soak. Humidity favorable for their activity of them ranges from 76% - 92% (encountered 3353 times, accounting for 60.64% of the total number of observations).

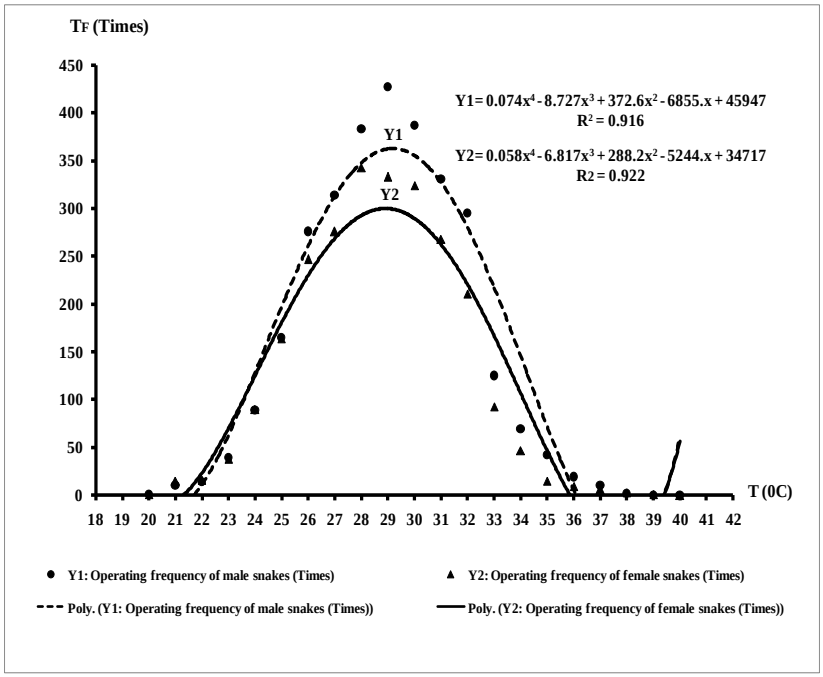

Figure 14: *Correlation between environmental temperature and acitvity frequency of adult P. mucosa*

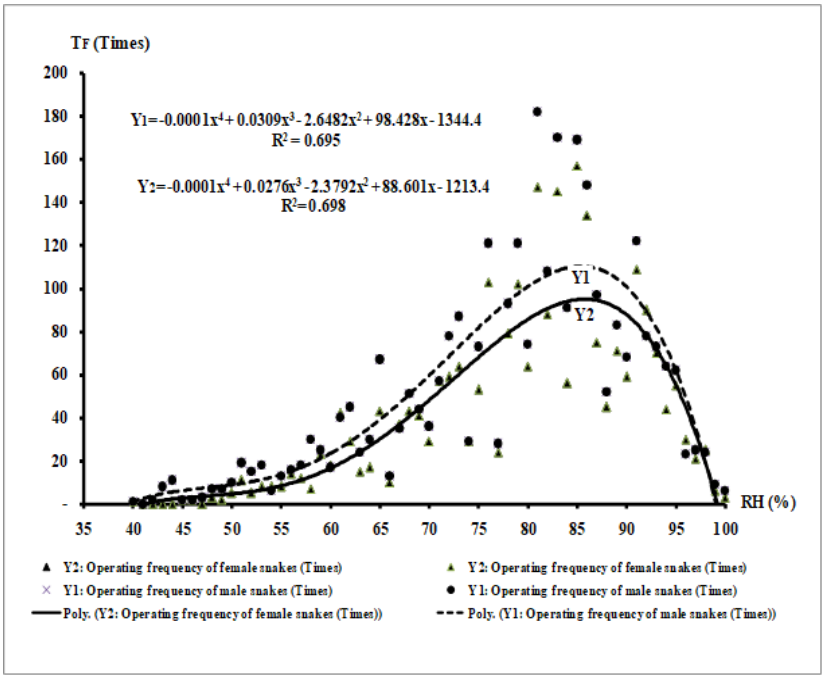

Figure 15: *Correlation between environmental humidity and activity frequency of adult P. mucosa*

* Adult *P. mucosa* is active mainly during the day (98.82%). This is completely consistent with Tran Kien's research [17, 18] on the differentiation of activity time of species with the same type of food (*Naja naja and P. mucosa*) to reduce competition for food and at the same time. At the same time, we can avoid the harm of nocturnal carnivores such as *Naja naja*, *Bungarus fasciatus*, *Bungarus candidus* [17, 19]. Perhaps this is an adaptive trait to increase the species' chances of survival. According to Wall [15, 16], Tran Kien [17, 18], adult *P. mucosa* operates both day and night. To confirm, we let them starve for 5 - 6 days, then fed them at night, and have seen them coming out to eat their prey at the same time. This proves that *P. mucosa* is active day and night when hungry, especially after the breeding season.

The relationship between temperature and adult *P.mucosa's* activity is very tight (R^2 = 0.916 - 0.922); while the relationship between humidity and their operating frequency is relatively close (R^2 = 0.695 - 0.698): In March, April and October, November, December, they are most active at times with similar high temperatures to compensate for their body heat; In months with too high daytime temperatures (June - September), they are active from early morning and late afternoon to avoid the sun and to match the activity cycle of the Amphibians that are their prey.

3.2.3 Regulating body temperature of adult P. mucosa under the rearing conditions

Under farming conditions in Nghe An, adult *P. mucosa* uses water in the following cases: drinking, bathing and soaking on days with ambient temperature of 32^{o}C - 39^{o}C (Figure 16). Herklosts (1934) and Van Hoesel (1959) also recorded in Indonesia *P. mucosa* soaking or swimming underwater when it is hot [3]. *Ptyas korros* also has water use habits [20] similar to adult *P. mucosa*. Drinking water and soaking to regulate body temperature are adaptive features of land snakes.

Figure 16: *Adult P. mucosa is soaking in water when the ambient temperature is too high (at 39°C)*

Figure 17: *Adult P. mucosa is sunbathing when ambient temperature is too low (at 22°C)*

Figure 18: *Adult P. mucosa are mating at 32°C*

Figure 19: *Adult P. mucosa are eating at 31°C*

Adult *P. mucosa* bask in the sun after hibernating or after days of monsoon or long rains. They stretch their body in response to sunlight, and the snake warms each part of its body (Figure 17). In *Pyas korros*, they are found lying on trees to bask in the sun [20] and *Naja naja* curls up in concentric circles right in front of the cave entrance to bask in the sun [17, 18]. According to veterans' snake catcher, it is common to see *P. mucosa* basking in the sun after long rains (most often in September and October). According to Bogert (1949), Ningus (1967) [21], and Ong Vinh An et al. [22], reptiles always have a body temperature balance, they need to maintain a body temperature from 30°C - 37°C. Thus, sunbathing is an activity that compensates for heat for the body to maintain normal physiological processes (Figures 18, 19).

4. Conclusion

In Nghe An province, adult *P. mucosa* is active from March to December and hibernates in January and February. Their activity is closely related to changes in environmental temperature and humidity. They are most active during the day (98.82%) and have very little activity at night (1.18%). Adult *P. mucosa* is active at temperatures

ranging from 20°C - 40°C and humidity from 40% - 100%. The most optimal temperature and humidity ranges for adult *P. mucosa* are 27°C - 31°C and 76% - 92%. They will hibernate if the ambient temperature drops below 17°C for several days.

Acknowledgement

This article is written to express my deep and sincere respect for the late Professor, Doctor of Science Tran Kien, who guided me in conducting this research.

REFERENCES

[1] Manthey U., Grossmann W., *Amphibien & Reptilien Südosta-siens,* Natur Tier - Verlag, pp. 386- 387, 1994.

[2] Ananjeva N. B., Orlov N. L., Khalikov R. G., Darevsky I. S., Ryabov S. A., Barabanov A. V., *Атлас пресмыкающихся северной евразии*. Зоологический институт, Санкт - Петервург, стр. 172, 2004.

[3] Traffic, "Case study on *Ptyas mucosus* - A proposed NDF method for Indonesia (JaVa)," *Workshop Case Studies. WG7 - Reptiles and Amphibians*, 2004.

[4] Sidik Irvan, "Anasilis Isi Perut Dan Uuburan Ular Jali (*Ptyas mucosus*)," Zoo Indonesia, Jurnal Fauna Tropica, vol.15(2). pp. 121-127, 2006. DOI: https://doi.org/10.52508/zi.v15i2.113.

[5] Boeadi, Shine, Sugardiito R., Sinaga, "Biology of the Commencially - Harvested Rat snake (*Ptyas mucosus*) and Cobra (*Naja sputaris*) in Central Java," Mertensiella, vol. 9. pp. 99 -104, 1998.

[6] Nguyen Van Sang, Ho Thu Cuc, Nguyen Quang Truong, *Herpetofauna of Vietnam*, Edition Chimaira, Frankfurt, p. 337, 2009.

[7] Parliament of India, *The Wildlife Protection Act of the Parliament of India The wildlife Protection,* part II, pp. 81-84, 1972

[8] Traffic, *Identification of Trafficked Wild Animals (In Vietnamese),* Hanoi: Agricultural Publishing House, p 20, 2000.

[9] Ministry of Science and Technology, Vietnam Academy of Science and Technology, *Vietnam Red Data Book, (Part I. Animals) (In Vietnamese),* Hanoi: Natural Science and Technology Publishing House, pp. 243-235, 2007.

[10] Decree of government No.84/2021/ND - CP Viet Nam, *On management of endangered, precious and rare forest plants and animals (In Vietnamese)*, 2021.

[11] http://www.catalogueoflife.org/col/details/species/id/889320ffac621ab2e34b370954b954a7.

[12] https://www.iucnredlist.org/search?query=Ptyas%20mucosa&searchType=species.

[13] Chu Van Man, Dao Huu Ho, *Biostatistics curriculum (In Vietnamese),* Hanoi: Science and Technology Publishing House. 162 p., 2000.

[14] Nguyen Van Tuan, *Curriculum Analyze data charts with R (In Vietnamese),* Australia: Garvan Institute of Medical Research Sydney, 2009.

[15] Wall C. F., "A population treatise on the common Indian snakes," *Journal of the Bombay*, no. 2, vol. XVII, pp. 261-273, 1921.

[16] Wall C. F., *The snakes of Ceylon*, Colombo, pp. 171-191, 1921.

[17] Tran Kien, "Ecology and economic significance of Asian cobra in northern Vietnam (In Vietnamese)," *Proceedings of the Scientific Research and Agricultural Engineering (1981- 1985*), Hanoi, pp: 128-130, 1985.

[18] Tran Kien, *The life of the reptiles (In Vietnamese),* Hanoi: Science and Technology Publishing House, 99 p., 1983.

[19] Hoang Nguyen Binh, Tran Kien, "*Bungarus fasciatus* and snakes (*Bungarus multicinctus*) in some northern provinces of Vietnam (In Vietnam)," *Journal of Biology*, Vietnammese Academy of science and Technology Publishing House, vol. 11 (2). pp. 20-26,1989.

[20] Dinh Thi Phuong Anh, *Study on ecological characteristics of adult snake (Ptyas korros) cultured in Quang Nam provice, Vietnam (In Vietnamese)*, PhD thesis in biological sciences, Hanoi Pedagogical University, 178 p., 1994.

[21] Odum E. P., *Ecological Basis (I) (Vietnamese translation)*, Hanoi University of Science and Technology, p. 423, 1978.

[22] Ong Vinh An, Dang Huy Huynh, Tran Kien, Hoang Xuan Quang, "Data about reproduction of the Oriental rat snake *Ptyas mucosa* (Linnaeus, 1758) in feeding condition at the Nghe An province, Vietnam," *Journal of Biology*, Vietnammese Academy of science and Technology Publishing House, vol. 31(4). pp. 11-18, 2009.

TÓM TẮT

QUY LUẬT HOẠT ĐỘNG CỦA RẮN RÁO TRÂU *PTYAS MUCOSA* (LINNAEUS, 1758) TRƯỞNG THÀNH TRONG ĐIỀU KIỆN NUÔI TẠI TỈNH NGHỆ AN, VIỆT NAM

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Ngày nhận bài 16/8/2023, ngày nhận đăng 24/10/2023

Trong điều kiện nuôi tại Cửa Lò, Nghệ An Việt Nam, Rắn ráo trâu *P. mucosa* trưởng thành hoạt động có tính quy luật: Hoạt động theo mùa và hoạt động ngày đêm. Rắn hoạt động từ tháng III đến tháng XII hàng năm; Mùa trú đông từ tháng I, II. Hoạt động ngày đêm của *P. mucosa* trưởng thành: Tháng III, IV hoạt động chủ yếu từ 6-18h; Tháng V, VI, VII hoạt động vào hai thời điểm (buổi sáng 7-11h, buổi chiều 15-20h); Tháng VIII hoạt động 2 thời điểm (buổi sáng 5-11h, buổi chiều 14-20h); Tháng IX, X, XI, XII rắn hoạt động từ 6 hoặc 7-19h, không hoạt động về đêm. Hoạt động của Rắn ráo trâu trưởng thành phụ thuộc chặt chẽ vào nhiệt độ, độ ẩm môi trường (từ 20-40^{o}C; 40-100%), thuận lợi nhất là 27-31^{o}C, độ ẩm 76-92%. Chúng chính thức ngủ đông khi nhiệt độ môi trường dưới 17^{o}C kéo dài sau nhiều ngày.

Từ khóa: Thị xã Cửa Lò; Việt Nam; Rắn ráo trâu; *Ptyas mucosa.*