

BASKING BEHAVIOR OF BURMESE STAR TORTOISES *GEOCHELONE PLATYNOTA* (BLYTH, 1863) IN MINZONTAUNG WILDLIFE SANCTUARY, MYANMAR

Khaing Khaing Thu¹, Su Su Naing², San San Oo³

Abstract

Basking behavior of Burmese Star Tortoises *Geochelone platynota* from Natogyi Township, Myingyan District, Mandalay Region in Minzontaung Wildlife Sanctuary were conducted March 2019 to February 2020. The observed number was total of 122 star tortoises including 54 males and 68 females. The basking duration of each turtle was an average of 25.69 minutes per day. The female was more basking time than the males, 26.27 min per day and 25.00 min per day respectively. The seasonal variation of the basking time was observed, the lowest time was in rainy season and highest in winter season in both sexes. The female basking time was the lowest in rainy season (24.00 min), the highest was in winter season (40.80 min) and moderate in the summer season (24.49 min). For the male, the lowest in rainy season, (22.71 min) the highest was in winter season, (33.29 min) and moderate in the summer season (23.17 min). In this research 33.91% of total observed female number were coming out and 38.49 % of total observed male number were coming out for basking each day. The percent of basking tortoises was also correlated with cloudy conditions, highest percentage was ranked depending basking activity as under 1) partly sunny, 2) sunny, 3), mostly sunny partly cloudy, 4) cloudy, 5), mostly cloudy 6)Thunderstorm , 7) rain and 8) shower . During the study period the highest temperature is 41 °C and the lowest temperature is 18°C. The basking activity is predominantly utilized to meet physiological needs (i.e., reproductive effort, metabolism, digestion, growth) via thermoregulation.

Keywords: Basking, *Geochelone platynota*, temperature, ectothermic

Introduction

Turtles, like other reptiles, are ectothermic, and their body temperature is largely dependent on that of their environment. Some turtles can maintain a fairly precise and constant body temperature if a heat source is available (Cossins and Bowler Auth, 1975; Crawford *et al.*, 1983). By increasing their body temperatures, there is a corresponding increase in the rate of physiological processes (Crawford *et al.*, 1983; Hammond *et al.*, 1988), such as metabolic rate (Bennet, 1982), digestion speed, and digestion efficiency (Kepenish and McManus, 1974; Parmenter, 1981). The thermoregulatory behavior of reproductively active females is important in turtles and other reptiles. For example, increases in body temperature of female turtles can result in a greater rate of follicular development (Ganzhorn and Licht, 1983; Mendonca, 1987). Basking activity is one of the most conspicuous daily behaviors exhibited by aquatic emydid turtles. Early studies suggested that the primary physiological role of basking in turtles was to regulate body temperatures, as well as condition the skin and shell (Cagle 1950; Boyer 1965; Auth 1975). Others also hypothesized that basking increases metabolic and digestion rates (Moll and Legler 1971; Parmenter 1980; Hammond *et al.* 1988; Avery *et al.* 1993), aids in vitamin K synthesis (Pritchard and Greenwood 1968), increases follicular and egg production in female turtles during the nesting season (Vogt 1980; Krawchuk and Brooks 1998), allows turtles to rest (Boyer 1965; Waters 1974), fights infection by “behavioral fever” (Monagas and Gatten 1983), and rids turtles of ectoparasites (Cagle 1950; Neill and Allen 1954; Shealy 1976; Vogt 1979). Moll and Legler (1971) stated that basking is likely initiated by a single impulse, which is either triggered by an external factor or

¹ PhD Candidate, Department of Zoology, University of Yangon

² Associate Professor, Department of Zoology, Dawei University

³ Professor, Department of Zoology, University of Yangon

internal physiological need, while other secondary benefits are thereafter gained. The present research is carried out with the following objectives are:

- To investigate the basking time duration
- To number of male and female tortoises
- To study monthly and seasonal variation of the basking
- To correlate the basking behavior with the weather parameters

Materials and Methods

Study site and study period

Minzontaung Wildlife Sanctuary is a protected area of Myanmar. It is located in the Natogyi Township, Myingyan District, Mandalay Region. It occupies an area of 22.6 square kilometres (8.7 sq mi) and was established in 1998-99. The study was undertaken between March 2019 to February 2020.

Study method

The total numbers of 122 tortoises and the numbers of males are 54 and females are 68. Observer location was chosen based upon preliminary observation of turtle behavior, and focused on turtle basking behavior. Data collection was conducted from 7:00 am to 5:00 pm at every day and seven days of every month. During each observation period, detailed information on basking behavior was recorded. Information of basking behavior included about numbers of tortoises, sexes, numbers of male and female, starting and ending of individual basking time. These data were noted hourly. Basking behavior was studied in the captive farm of Minzontaung Wildlife Sanctuary.

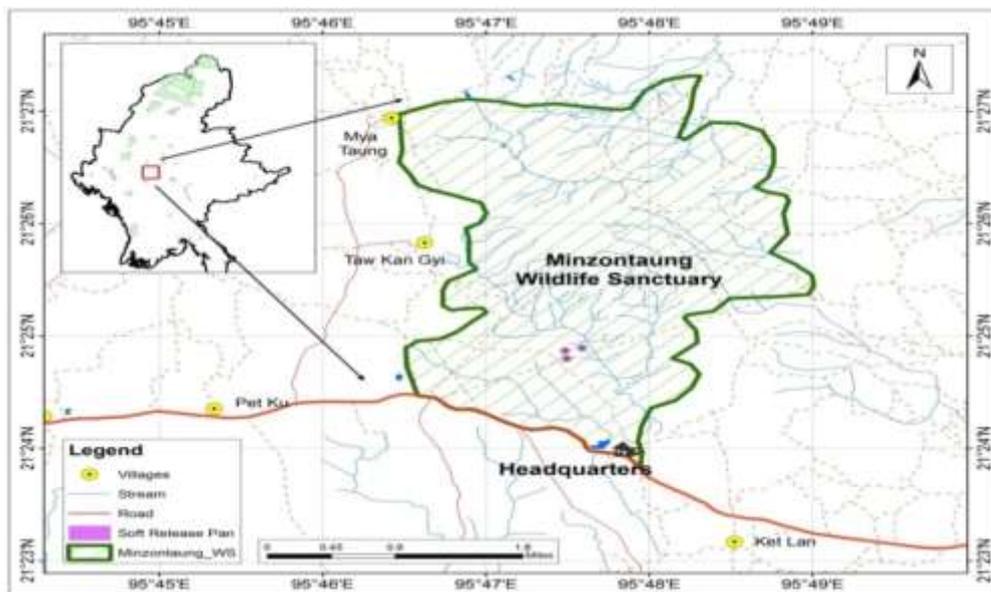


Figure 1 Map of the study area (Source: Minzontaung wildlife Sanctuary)



Plate 1 Captive farm in Minzontaung Wildlife Sanctuary



Plate 2 Marking system in the study site



A. Group of basking male and female Star tortoises



B. Colonial basking type of Burmese Star tortoise



C. Some male and female Star tortoises staying in the shade at afternoon

D. Some male and female Star tortoises staying in the shade at afternoon

Plate 3 Basking behavior of *Geochelone platynota*

Results

In Burmese star tortoise, time duration of basking in both sexes was found to varies in different season, the highest in winter season (37.04 min per day), the lowest in rainy season (23.35 min per day), while in summer season, it was little more than that of rainy (23.83 min per day). The basking time of male and female was found differences. The mean of basking time is 28.07 min per day), while the mean of male basking time is (26.39 min per day) and the mean of female basking time is (29.76 min per day) (Table 1) and (Figure 2).

Table 1 Seasonal variation of basking time duration (min) of male and female tortoises (March 2019 to February 2020)

Sex	Season			Mean (min)
	Summer (min)	Rainy (min)	Winter (min)	
Male	23.71 ± 2.30	22.71± 2.59	33.29± 4.34	26.39 ± 3.09
Female	24.49± 4.67	24.00± 1.72	40.80± 2.82	29.76 ± 3.07
Mean	23.83 ± 3.4	23.35 ± 2.15	37.04 ± 3.58	28.07 ± 3.08

Monthly variation of basking time duration of male and female tortoises was found varies in different, the lowest basking time duration was occurred in September (19.99 min per day in male and 22.38 min per day in female). The highest basking time occurred in December (31.51 min per day in male and 33.54 min per day in female) (Table 2) and (Figure 3).

Table 2 Monthly variation of basking time duration (min) of male and female tortoise (March 2019 to February 2020)

Monthly	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mean
Male (min)	22.72	22.87	21.93	24.15	21.76	21.14	19.99	26.53	30.59	31.51	28.57	27.22	25.00
SD	± 1.60	± 2.87	± 2.16	± 3.01	± 1.52	± 2.12	± 2.86	± 3.48	± 4.51	± 4.88	± 4.53	± 3.61	± 1.53
Female (min)	22.98	25.10	23.74	25.55	23.09	22.72	22.38	28.75	30.94	33.54	29.19	28.67	26.27
SD	± 1.60	± 1.75	± 1.62	± 1.78	± 1.61	± 1.64	± 1.56	± 2.01	± 2.16	± 2.34	± 3.98	± 2.07	± 1.83

Not all observed tortoises were coming out to bask under the sun light, some are still hide in the shading places. Hence, the number of basking tortoises vary in different months. In all month, the basking time of females are higher than males. The highest percentage of basking was occurred in December (50.51 % in male and 52.08 %in female) (Table 3) and (Figure 4).

Table 3 Monthly mean and percent of basking numbers of male and female tortoises (March 2019 to February 2020)

Month	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mean
Male no.	28.14	22.12	20.42	17.85	18.43	14.28	8.00	21.14	25.28	27.28	23.42	23.12	20.79
Male no. in %	52.00	41.00	37.81	33.05	34.12	26.44	14.81	39.14	46.81	50.51	43.37	42.81	38.49
Female no.	25.42	23.42	21.38	19.28	18.57	15.42	8.85	27.71	34.42	35.42	24.28	22.71	21.05
Female in %	37.38	34.44	31.29	28.35	27.30	22.67	13.01	40.75	50.61	52.08	35.70	33.39	33.91
Total %	44.69	32.21	34.55	30.70	30.71	24.55	13.91	39.94	48.71	51.29	39.53	38.10	36.20

Emergent time of basking tortoises coming out to bask under the sun light was at 6:00 am in the morning and end at 4:00 pm in the afternoon. Mean basking duration was seen to peak early in the morning and gradually decreases in the afternoon of the day. For both males and females, basking number (i.e., raw basking data) showed a clear bimodal pattern with peaks around 8:00hrs first time and 12:00 hours second time across all seasons, but there were differences on basking numbers among the three seasons. The highest basking number occurred in December and the lowest basking number occurred in September. There were 918 turtles basked during summer (March, April, May), 1184 turtles basked during rainy season (June, July, August, September, October) and 1547 turtles basked during the winter months (November, December, January, February) (Table 4) and (Figure 5).

Table 4 Basking numbers of star tortoise with time line of the star tortoises (March 2019 to February 2020)

Month	6:00 am	7:00 am	8:00 am	9:00 am	10:00 am	11:00 am	12:00 am	1:00 pm	2:00 pm	3:00 pm	4:00 pm	Total
Mar	9	20	38	45	44	58	50	31	11	6		323
Apr	7	14	34	45	50	48	45	19	14	7		283
May	6	20	38	45	44	54	50	32	18	5		312
Jun	2	14	32	40	42	47	40	28	12	8		265
Jul	0	11	19	38	42	45	40	28	11	9		243
Aug	0	10	26	31	35	41	37	24	1	2		207
Sep	0	13	13	15	19	17	15	12	9	6		119
Oct	4	34	42	47	49	56	43	38	22	10	5	350
Nov	12	42	50	57	67	70	52	39	30	20	2	441
Dec	21	45	48	61	65	67	50	40	28	22	1	448
Jan	16	35	40	38	42	46	40	32	28	23		343
Feb	19	40	42	40	43	38	40	35	30	18		315

Highest percentage of basking tortoises were ranked during basking activity as under 1) partly sunny, 2) sunny, 3) mostly sunny partly cloudy, 4) cloudy, 5), mostly cloudy 6) Thunder storm, 7) rain and 8) shower. During the study period the highest temperature is 41 °C and the lowest temperature is 18°C. Weather conditions and basking duration were directly correlated. Tortoises were never almost observed to bask when it was raining. They do more basking in sunny days (Table5) and (Figure 6).

Table 5 Monthly range of Temperature (°C) and cloudy condition of the sky at study area (March 2019 to February 2020)

Weather conditions	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Freq.
Range of Temp.	26 – 38	27 – 39	27 – 41	27 – 41	27 – 41	26 – 35	27 – 36	23 – 32	18 – 32	18 – 31	18 – 34	19 – 34	-
Av. Temp	32.00	33.00	34.00	34.00	34.00	30.50	33.00	27.50	25.00	24.50	27.00	26.50	-
Partly Sunny											√		1
sunny	√					√	√	√	√		√	√	7
Mostly Sunny		√	√			√			√	√	√		6
Cloudy				√	√	√	√	√					5
Mostly Cloudy	√	√	√	√		√							5
Weather conditions	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Freq.
Thunder storm				√	√	√	√						4
Rain					√			√					2
Shower					√		√		√				3
Freq.	2	2	2	3	4	5	4	3	3	1	3	1	33

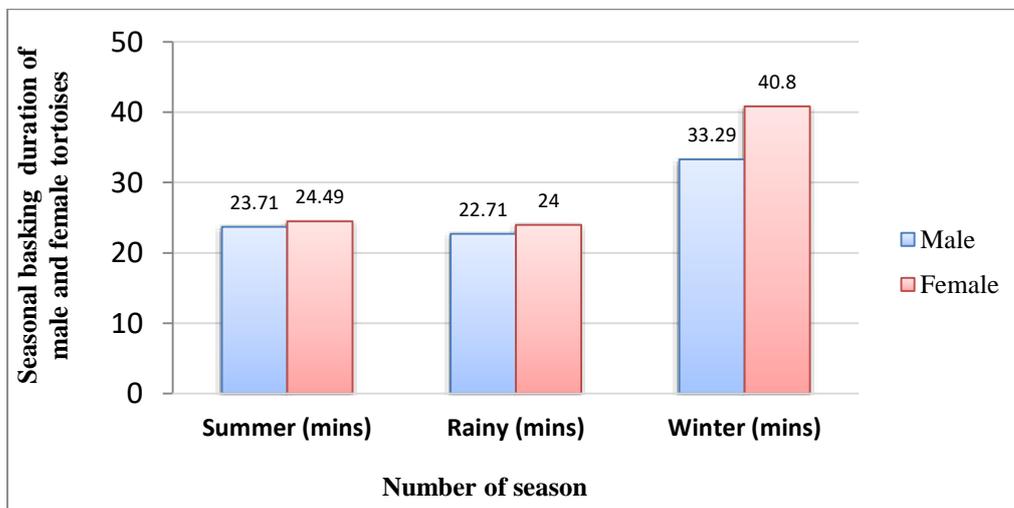


Figure 2 Comparison between seasonal basking duration of male and female tortoises

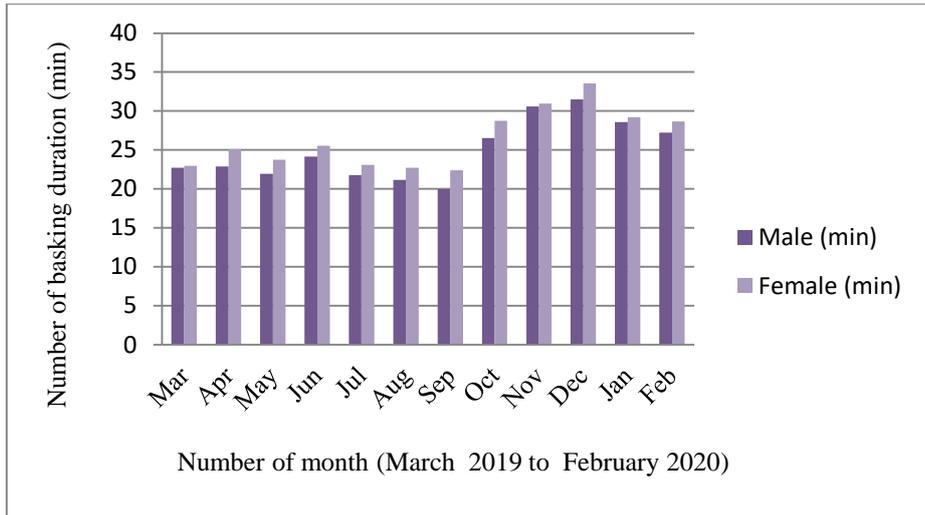


Figure 3 Monthly mean basking duration of male and female tortoises

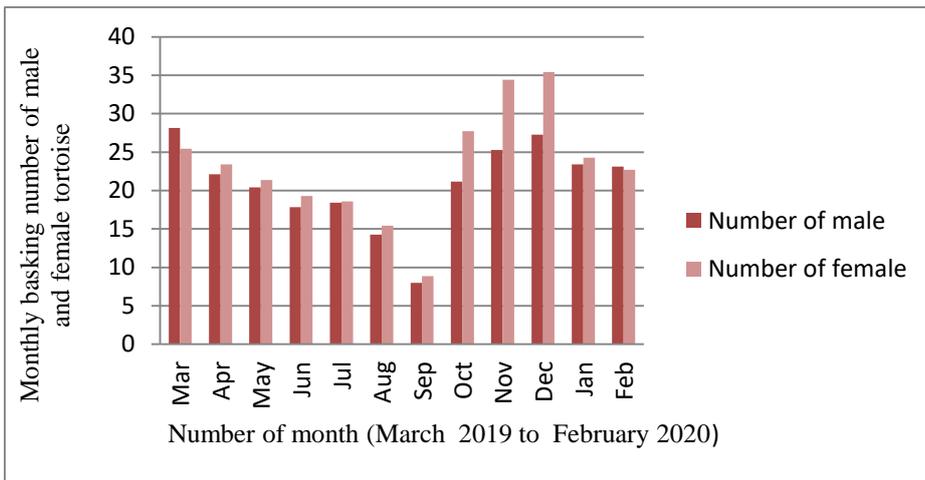


Figure 4 Monthly basking number of male and female tortoises

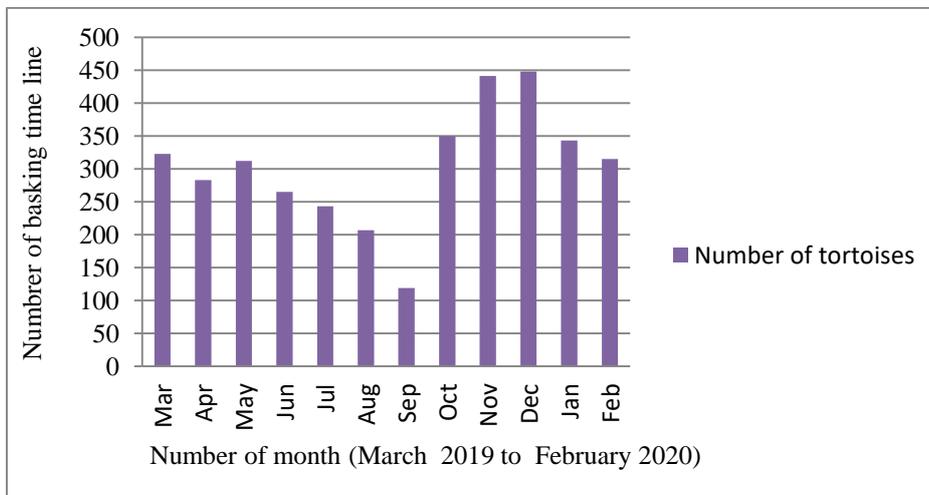


Figure 5 Monthly basking time line of *Geochelone platynota*

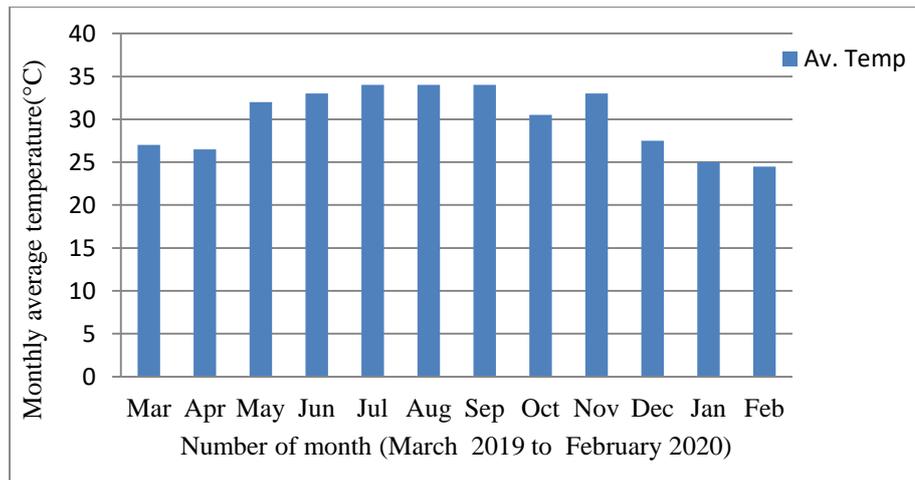


Figure 6 Monthly average temperature in the study area

Discussion

The number of basking turtles significantly differed among months with more turtles basking from October through December than in other months. The number of males and females basking also differed between months with a significantly higher percentage of females basking than males during October-December, which coincides with the breeding season. For both males and females, basking numbers showed a clear bimodal pattern with peaks around 10:00 am –13:00 pm across all seasons, but there were differences of numbers among the three seasons. The basking behavior of *Geochelone platynota* had not yet recorded in Myanmar. Thus this research suggests to relate the concerning of egg laying, hatchling and sex differentiation.

The longest duration of males and females were observed in the winter season. In viviparous lizards, females that increase basking duration during periods when energy is being allocated to developing embryos may be capable of devoting more stored energy to reproduction (Wapstra, 2000). The rate at which energy is allocated to developing follicles may be especially important for females in populations occupying the northern limit of their species' range, because the amount of thermal energy that they experience during the short active season may set strict limits on the amount of harvested energy that can be allocated to egg production (Rollinson and Brooks, 2007).

Therefore, during the winter, *G. platynota* basking is predominantly utilized to meet physiological needs (i.e., reproductive effort, metabolism, digestion, growth) via thermoregulation. According to the present research, the nesting season of *Geochelone platynota* is September to February. The numbers of basking turtles were observed to increase when close to nesting time. During that time, the winter season, when temperature is cold, more basking turtles were encountered because of turtles raised their body temperature by basking.

Conclusion

The basking time duration of Star Tortoise was for (28.07 min per day) and female was more bask (29.76 min per day) than that of the male (26.39 min per day). The mean basking time duration was found to differ significantly in seasonally (23.83 min in summer), (23.35 min in rainy) and (37.04 min in winter). According to the monthly variation, more turtles were basking from October through December than in other months. The peak of the basking tortoises occurred during the winter season. They do more basking in sunny days. Turtles like the sunlight to increase fat mobilization and reproduction.

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