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Evolution ofthe Daily Activity of Species Achatinaachatina Linné, 1758 and Archachatinaventricosa Gould, 1850: Influence Of Temperature And Relative Humidity

Jean-Didié Memel[1*], Moussa Komara[2], Mamadou Karamoko[3] et Atcho Otchoumou[4]
[1,2,3,4](Training and Research Unit of Natural Sciences/ NanguiAbrogoua University, Abidjan-Ivory coast)
Corresponding Author: Jean-Didié Memel[1]

ABSTRACT:*The studies took place inside the Banco National Park (Abidjan-Ivory Coast) and were aimed at finding, during the day, the conditions of temperature and relative humidity necessary for the start of activity of two species, namely A. achatina and Arch. ventricosa. The results of this study showed that these snails have their maximum activity during the cool moments of the day, especially at dawn (5h-9h) and at dusk (beyond 18h).Indeed, A. achatina is active when average daily temperatures vary between 25.2 ± 1.2 ° C (22h-24h) and 29.5 ± 2.8 ° C (11h-13h), hygrometry meanwhile oscillates between 76.5 ± 2.1% (11h-13h) and 93.1 ± 3.0% (20h-22h). The species Arch. ventricosa is active for mean daily temperatures ranging from 23.0 ± 4.1 ° C (05h-07h) to 29.5 ± 1.0 ° C (13h-16h) with hygrometry ranging from 87.3 ± 0 , 4% (22h-24h) and 93.9 ± 5.8% (05h-07h). This could explain the absence in the environment of specimens of A. achatina and Arch. ventricosa at certain times of the day, the animal adopting conservatory strategies and adaptation to survive adverse weather conditions.*
Keywords*:achatine,activity, temperature, relative humidity, day*

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I. INTRODUCTION

Achatinesor giant African snails are gastropod molluscs whose flesh is highly appreciated by African consumers (Zongo 1995, Stievenart and Hardouin 1990), especially Ivorians. This flesh contains a protein content between 37 and 51% of the dry matter (Hardouin and Stievenart, 1991). Because of its nutritional qualities, the Achatine is the subject of a thriving trade mainly by women.Land snails, Achatinesare found in a range of habitats ranging from closed habitats to degraded areas (Otchoumou, 2005). They live naturally in the tropics, where the day-night cycle is very little away from 12 hours / 12 hours (Otchoumou, 2005), and occupy various microhabitats (undergrowth of rainforests, forest-savanna transition zones, wooded savannahs, etc.). Like many invertebrates, Achatines are cold-blooded animals. This means that they do not control their body temperature. Also, they are called poïkilothermes (Hardouin et al., 1995). Indeed, their main vital functions are very dependent on environmental conditions, including day-night cycles, humidity and the temperature of the environment in which they live. They do not have an integument to fight effectively against dehydration.

So, to withstand dry atmospheres, they should adopt a conservatory strategy. This consists in secreting at the opening of the shell a film more or less calcareous called epiphragm. During this unfavorable time, the growth of the snail is stopped. The animal lives in slow motion, exhausts its reserves and loses weight. It is the slowed life called "estivation" in tropical countries. In the temperate zone, this corresponds to the "hibernation" caused by the cold (Ghose 1963, Hodasi 1979, Stievenart 1996, Stievenart&Hardouin 1990).

Snails prefer a high rate of humidity (80-90%). They are very active during the wet periods of the day, especially at dawn and dusk (Hardouin et al., 1995, Stievenart, 1996) and during the night (Hodasi, 1979, Otchoumou et al., 1989-1990, Zongo et al., 1990). Outside these wet periods, they shelter under the natural vegetation.

Water is thus at the origin of most of the vital activities of Achatines (outings, foraging, mating, all without exception occurs on the wet ground).

mollusks seems to detect the hygrometric degree of the air. Any excess humidity is harmful to Achatines. The temperature also regulates the activity of the snail. Molluscs always feel the middle temperatures directly and die as soon as they fall below a threshold or reach too high values.In the present study, we will try to find atmospheric temperature and humidity values of the periods of the day that are essential for the snail to come into activity. This investigation will be done in the Banco National Park, a forest ecosystem hosting a variety of Achatine, including Achatinaachatina and Archachatinaventricosa, which constitute the biological material of our study.

II. MATERIAL AND METHOD OF STUDY

2.1. Study area

Our study took place in the Banco National Park.The Banco National Park is located on the north shore of the Ebrié Lagoon northwest of Abidjan, between 05 ° 21 'and 05 ° 25' north latitude and between 04 ° 10 'and 04 ° 50' west longitude . It covers an area of 3,474 hectares (Da, 1992, M.E.F., 1999, Kouadio, 2000).

The Banco National Park is bounded to the north by the Abobo commune, to the south by the North Highway, to the west by the Yopougon industrial zone and to the east by the Adjamé commune (Figure 1).

2.2. Biological material

The study focused on two species of Achatines: A. achatina and Arch. ventricosa (Figures 2 and 3).

2.3 - Method of study

2.3.1- Sampling

The study was carried out on sample surfaces and for each species of swine encountered, the following information was recorded: the time of collection, the temperature, the hygrometry and the physiological state of the animal. (active or in a slower state of life).

2.3.2 - Statistical analyzes

Mean values of temperature and hygrometry of different times of the day were determined. Also, the relationship between the relative abundance of active snails,and collecting times is established with Excel software

III. RESULTS AND DISCUSSION

3.1- Results

3.1.1- Daily variation in mean temperature and hygrometry in the collection areas of the studied species

The average temperature and hygrometry data recorded in the locations where the species studied were collected are shown in Tables I and II.In the areas where individuals of the A. achatina species were collected, mean daily temperatures ranged from 25.2 ± 1.2 ° C (22h-24h) to 29.5 ± 2.8 ° C (11h- 13h); atmospheric humidities oscillate between 76.5 ± 2.1% (11h-13h) and 93.1 ± 3.0% (20h-22h).Concerning the species Arch. ventricosa, individuals were collected in areas with mean daily temperatures ranging from 23.0 ± 4.1 ° C (05h-07h) to 29.5 ± 1.0 ° C (13h-16h); the atmospheric humidities oscillating between 87.3 ± 0.4% (22h-24h) and 93.9 ± 5.8% (05h-07h).

3.1.2- Daily variation in the activity of Achatinaachatina

The daily evolution of the activity of the species A. achatina from 05h to 24h is presented in the graph below (figure 4):

The analysis of this graph shows that the activity of the species A. achatina is initially weak (5h-7h). Then, it rises to reach its maximum around 7h-9h, then decreases gradually to cancel between 13h-16h, before resuming its rise from 16h, to reach again its maximum around 22h-24h

3.1.3- Daily variation of the activity of the species Arch. ventricosa

The daily evolution of the activity of the species Arch. ventricosa from 05h to 24h is shown in the graph below (figure 5):

The analysis of this graph reveals that the activity of the species Arch. ventricosa is first raised (5h-9h), then decreases sharply (9h-13h) and reaches its maximum value (18h-20h). Then she undergoes a regression from 20h until 24h

3.1.4- Comparison of the daily activity of species A. achatina and Arch. ventricosa

Daily activities of species A. achatina and Arch. ventricosa from 05h to 24h are presented in the graph below (figure 6):

The analysis of this chart reveals the following information:
- The species A. achatina is more active than the species Arch. ventricosa from 07h-13h and from 22h-24h ;
- The species Arch. ventricosa, on the other hand, has a higher activity than the species A. achatina from 05h-07h, from 13h-16h and 16h-20h.

IV. DISCUSSION

Studies carried out on the daily evolution of the activity of the species A. achatina and Arch. ventricosa in relation to temperature and average hygrometry have shown that these two species have their maximum activity during the cool moments of the day, especially at dawn (5h-9h) and at dusk (other than beyond 18h). At these times in particular, the temperatures are low (around 27° C) and the hygrometry is high (around 90%). This is consistent with Memel (2009) who argues that Achatinidae are abundant in the environment when climatic conditions are better (temperature between 26.4 ± 1.4 ° C and 27.7 ± 0.1 ° C and relative humidity between 88,6 ± 0.9% and 89.3 ± 2.8%). It is the same for Daguzan (1981) who argues that the preferential humidity of snails is 75 to 95%.Studies on the ethology of African giant snails have revealed that these animals have nocturnal activities (Hodasi, 1979, Otchoumou et al., 1989-1990, Zongo et al., 1990), but also diurnal especially at dusk and at dawn as well as in very wet periods (Hardouin et al., 1995, Stievenart, 1996), for example immediately after rains. This explains the high abundance of species studied between 5h-9h and beyond 18h and that could also justify the strong presence of Achatinidae in humid regions (West and East of Côte d'Ivoire).Indeed, the Achatines are poïkilothermes (Hardouin et al., 1995), that is to say animals with cold blood. This means that they do not control their body temperature. As a result, their main life functions are highly dependent on environmental conditions, including day-night cycles, humidity and the temperature of the environment in which they live.

Thus, to support the dry atmospheres, they must adopt a conservatory strategy (Bonavita et al., 1962, Bonavita, 1964, Chevallier, 1977, 1982, Daguzan, 1981, Ricou, 1964 and Sacchi, 1971). This results in adaptation phenomena allowing them to lead a slower life. This adaptation strategy is to secrete at the opening of the shell, a more or less calcareous film called epiphragm. During this unfavorable time, the growth of the snail is stopped. The animal lives in slow motion, exhausts its reserves and loses weight. It is the slowed life called "estivation" in tropical countries. In the temperate zone, this corresponds to the "hibernation" caused by the cold (Ghose 1963, Hodasi 1979, Stievenart 1996, Stievenart&Hardouin 1990). This could explain why in the hot period of the day (13h-16h), it is difficult to see specimens of purchase, including Achatinaachatina, active in the area. When normal conditions return, the animals resume their activity.

V. CONCLUSION

This study confirms that snails in general and Achatines in particular are active during the cool times of the day, especially at dusk and dawn. However, during the course of the day, at certain periods, Achatines (A. achatina and Arch ventricosa) are active (looking for food or sexual partners, etc.). Also, it is important to take this information into account in the domestication (breeding behavior) of snails, especially with regard to the selection of the times of the day when they have to present their food. This could avoids overeating which could be harmful for their survival.

REFERENCES

[1]. Aboua F. (1990). Chemical composition of Achatinafulica.Tropicultura, 8 (3) : 121-122.
[2]. Aupinel P. &Daguzan J. (1987). Study of the role of photoperiod on the metabolic activity of juvenile snails "Petit-gris" (Helix aspersa Müller) and demonstration of a photosensitive phase.Haliotis, 19: 47-55.
[3]. Bernhard F. (1966). Problems posed by vegetation structure and litter production in the Banco forest (lower Ivory Coast), Report Adiopodoumé, 54 p.
[4]. Bonavita D. (1964). Ecological Conditions of the Formation of Epiphragm in Some Helicidae of Provence, Life and Environment, 15 (3): 21-755.
[5]. Bonavita A. &Bonavita D. (1962) .Contribution to the Ecological Study of Euparyphapisana Müller of the Mediterranean Shores of Provence, Preliminary Note, Publ. Staz. Zool., Napoli, 32 Suppl.: 189 – 204.
[6]. Bonnet J.C., Aupinel P. &Vrillon J. L. (1990). Snail Helix aspersa: biology, breeding. National Institute of Agronomic Research, 124 p.
[7]. Chevallier H. (1977). Observations on the Polymorphism of the Red Slugs (ArionrufusLinné and ArionlusitanicusMabille) and the Little Gray Snail (Helix aspersa Müller), Haliotis, 6: 41-48.
[8]. Chevallier H. (1982). Growth Factors in Palearctic Terrestrial Lung Gastropods in Breeding, Haliotis, 12: 29-46.
[9]. Codjia J. T. C. &Noumonvi R. G. C. (2002). Technical guide for breeding African giant snails [Technical Guide for African Breeding Giants Snails]; SNV (Dutch Organization for Development), 52 p. Retrieved March 9, 2008 from http://www.bib.fsagx.ac.be/bedim/production/guide/pdf/2.pdf
[10]. Da K. P. (1992). Contribution to the knowledge of the phytoplankton of the pond and the fish complex of Banco (Ivory Coast).PhD thesis.National University of Ivory Coast, Abidjan, 405p.
[11]. Daguzan J. (1981). Breeding Snail or Heliciculture, Interviews Bourgelat, Lyon, T.1, 235 - 241,

[12]. Ebenso I. E. &Okafor N. M. (2002). Alternative diets for growing Archachatinamarginata snails in south-eastern Nigeria. Tropical Science, 42 (3): 144-145.
[13]. Ghose K. C. (1963). The early stages of development in Achatinafulica (Bowdich) (Mollusca, Gastropoda). Journal of the Bombay Natural History Society, 60: 228-238.
[14]. Gomot A., Gomot L., Boukraa S. &Bruckert S. (1989).Influence of soil on the growth of the snail Helix aspersa: an experimental study of the absorption route for stimulating factors. Journal of Molluscan Studies, 55: 1-7.
[15]. Guillaumet J. L. &Adjanohoun E. (1971).The vegetation of Ivory Coast.In: The natural environment of Côte d'Ivoire.ORSTOM Papers, 50 : 156-263.
[16]. Hardouin and Stievenart, 1991
[17]. Hardouin J., Stievenart C. &Codjia J. T. C. (1995).The achatiniculture. World Animal Review, 83 : 29-39.
[18]. Hodasi J. K. M. (1979). Life history studies of Achatinaachatina (Linnaeus). Journal of Molluscan Studies, 45 : 328-339.
[19]. Hotopp K. P. (2002). Land snail and soil calcium in central appalachian mountain forest. Southeastern Naturalist, 1 (1) : 27-44.
[20]. Huttel C. (1972). Estimation of the water balance in an evergreen forest of lower Ivory Coast.IAEA Proc. Symposium: 439-452.
[21]. Ireland M. P. (1991). The effect of dietary calcium on growth, shell thickness and tissue calcium distribution in the snail Achatinaachatina. Comparative Biochemistry and Physiology, 98 (1) : 111-116.
[22]. Ireland M.P. &Marigomez I. (1991). The influence of dietary calcium on the tissue distribution of Cu, Zn, Mg and the histological changes in the digestive gland cells of the snail Achatinafulica (Bowdich). Journal of Molluscan Studies, 58 (2): 157-168.
[23]. Jess M. R. J. (1989). The interaction of the diet and substrate on the growth of Helix aspersa (Müller) var. maxima.Slues and snails in word agriculture. (1): 311-317
[24]. Kouadio B. (2000). Akwaba at the Banco National Park. Report of studies conducted at the Banco National Park, Abidjan, 45 p.
[25]. Lachenaud O. (2006). Birds of the Banco National Park and the Anguélédou classified forest, Ivory Coast. Malimbus, 28: 107-133.
[26]. Mangenot G. (1955). Study on the forests of the plains and plateaus of Côte d'Ivoire. Eburnian Studies, 4: 5-61.
[27]. Marche-Marchad J. (1965). The plant world in Intertropical Africa, Paris, Editions of the school, 608 p.
[28]. M.E.F. (1999).Biological Diversity of Côte d'Ivoire - Synthesis Report - United Nations Environment Program, 273 p.
[29]. Memel J. D. (2009). Diversity, abundance and spatial and temporal distribution of land snails from a tropical rainforest: the Banco National Park (Abidjan-Ivory Coast). Unique Thesis, UFR Science of Nature, NanguiAbrogoua University, 124p
[30]. N'da K., Otchoumou A. &Koffi K. J. C. (2004). Diet based on papaya products and oocyte maturation at Achatinafulica (Bowdich, 1820) in Ivory Coast. Tropicultura, 22 (4): 168-172.
[31]. Ogbéïdé O. (1974). "Nutritional hazards of foods taboos and preferences in MidWest Nigeria. American Journal of Clinical Nutrition, 27: 213-216.
[32]. Otchoumou A. (2005). Effect of calcium content of compound feeds and photoperiod on biological performance in three Côte d'Ivoire Achatinidae snail species reared in buildings. State thesis in natural sciences, mention Biology and Animal Ecology. University of Abobo-Adjamé (Ivory Coast), 178 p.
[33]. Otchoumou A., Zongo D. &Dosso H. (1989-1990). Contribution to the study of the giant African snail Achatinaachatina (Linné).Annals of ecology. XXI: 31-58.
[34]. Pilsbry H. A. (1919). A review of the land molluscs of the Belgian Congo chiefly based on the collections of the American Museum Congo expedition, 1909- 1915. Bulletin of the American Museum of Natural History.XL :1-369.
[35]. G. Ricou (1964). Relationships between Gray Slug Activity and Temperature ', Overdr.Mededel from LandbouWhogeschoolOpzoekings, staatGent., 29: 1071 - 1080,
[36]. Sacchi C. F. (1971). Comparative Ecology of the Pulmonary Gastropods of the Mediterranean and Atlantic Dunes, Nature. Soc. It. Nat. Musco, Civ. St, nat. e AquarioCio., Milano, Vol. 62, No. 3: 277-358.
[37]. Stievenart C. (1996). Shell morphology, growth, reproduction and estivation in African giant snails: laboratory observations on Archachatinamarginata Suturalis, Achatinaachatina and Achatinafulica. PhD Thesis, Prince Leopold Institute of Tropical Medicine, Antwerpen, Belgium, 204 p.
[38]. Stievenart C. &Hardouin J. (1990).Manual for breeding African giant snails in the tropics.CTA, Wageningen (The Netherlands), 40p.
[39]. Tomiyama K. (1996). Mate-choice criteria in a protandrous simultaneously hermaphroditic land snail Achatinafulica (Ferussac) (Stylmmatophora: Achatinidae). Journal of Molluscan Studies, 62 (1) :101-111.
[40]. Waitkuwait E. (1987). Nützungsmöglichkeiten der WestafricanischenRiesenschnecken (Achatinidae).Rapport LACENA / GTZ, 80p.
[41]. Zongo D. (1994): The breeding of snails, an unsuspected source of proteins of high nutritional value.Technical sheet n ° 2 ENSA / LACENA, 5-9.
[42]. Zongo D., Coulibaly M., DiambraO.H. &Adjiri E. (1990). Note on the breeding of the giant African snail Achatinaachatina. Nature and Wildlife, 6 (2): 32-44.

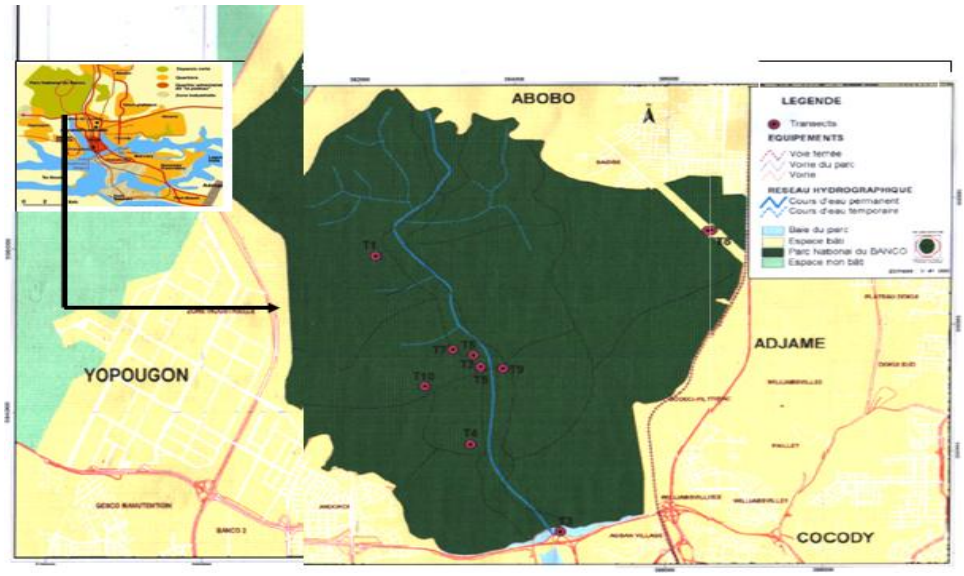

Figure 1: Location of the Banco National Park
(Source: National Committee for Remote Sensing and Geographic Information, modified)

Figure 2- Achatinaachatina
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Figure 3- Archachatinaventricosa
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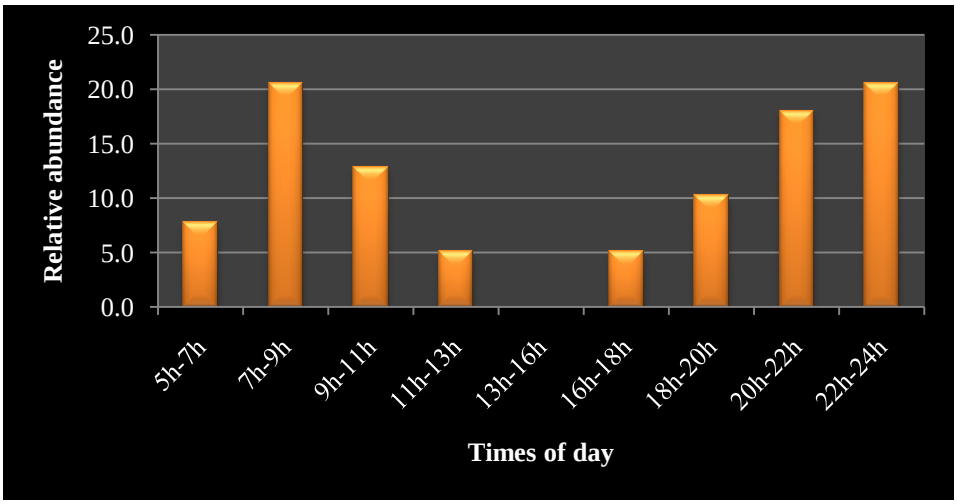

Figure 4: Daily evolution of the activity (relative abundance) of the species A. achatina

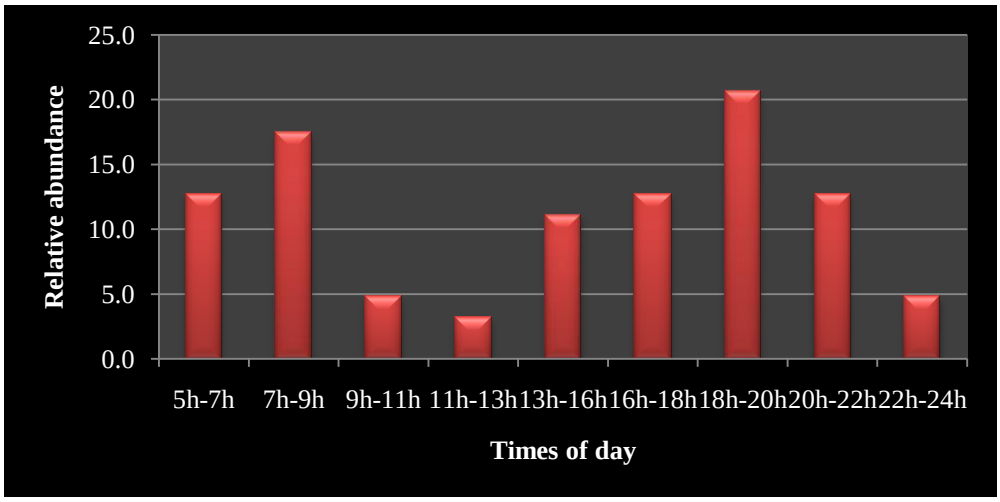

Figure 5: Daily evolution of the activity (relative abundance) of the species Arch. ventricosa

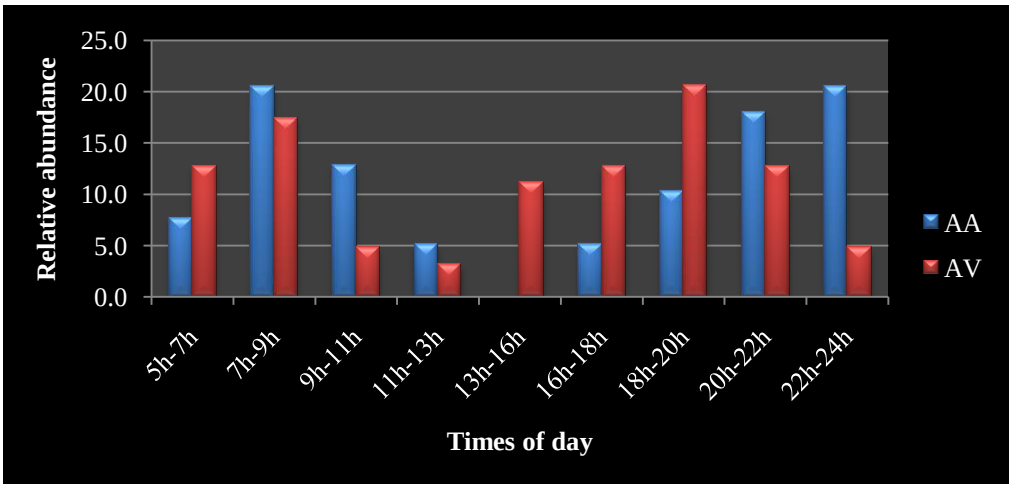

Figure 6: Comparison of daily activities of species A. achatina and Arch. ventricosa

Table I: Mean temperature and relative humidity recorded in the locations where individuals of the species A. achatina were collected

Measuredparameters	5h-7h	7h-9h	9h-11h	11h-13h	13h-16h	16h-18h	18h-20h	20h-22h	22h-24h
Température (°C)	27,0 ± 1,2	27,7 ± 1,4	28,3 ± 0,6	29,5 ± 2,8	29,5 ± 0,9	27,0 ± 0,0	26,5 ± 0,5	26,5 ± 1,3	25,2 ± 1,2
Hum. Relative (%)	90,8 ± 5,5	87,2 ± 6,1	87,7 ± 2,3	76,5 ± 2,1	88,7 ± 1,2	88,2 ± 4,1	88,4 ± 0,5	93,1 ± 3,0	89,9 ± 3,4

Table II*:* Mean temperature and relative humidity recorded in the locations where individuals of the species Arch. Ventricosawere collected

Mesured parameters	5h-7h	7h-9h	9h-11h	11h-13h	13h-16h	16h-18h	18h-20h	20h-22h	22h-24h
Température (°C)	23,0 ± 4,1	26,5 ± 1,4	28,7 ± 1,5	28,2 ± 1,3	29,5 ± 1,0	27,0 ± 0,2	28,0 ± 1,2	25,3 ± 0,4	26,0 ± 0,2
Hum. Relative (%)	93,9 ± 5,8	89,9 ± 3,9	89,7 ± 4,5	88,0 ± 2,6	90,0 ± 0,2	92,2 ± 1,1	89,3 ± 4,3	95,1 ± 1,0	87,3 ± 0,4

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