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Climatic Impact Assessment of Grasscutter (*Thryonomis swinderianus* - Temminck 1872) Under Captive Rearing

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Abstract

The significant role of animal production and its utilization in the economics of any society cannot be over emphasized. An animal adaptation, survival and productivity are no doubt influenced by climate and weather. Three categories of grasscutters: the adults, sub-adults and weaners, were selected to assess climatic impact under captive rearing. The relative humidity of the housing units was highest in unit Awiththepeak values of 96% and 98% recorded in the months of July and August, respectively. The ambient temperature of the units was highest in B within the six months of study and the month of March recorded the highest with 37°C. Also, the body temperature of male weaners was the highest recorded. Advance weather conditions if not well managed brings about heat stress, increased spread of wildlife diseases, parasites, and zoonoses. Analyzing for the effect of climate on animal production and how animals respond during extreme weather events, through data collection, monitoring and research will help in knowing possible effects of global change as extreme events are expected to increase their frequency and severity. This analysis can also be used to examine the dependency between the weather and disorders. To achieve success, improve production and efficiency particularly in the tropics, there is a need to follow a rational approach. The microclimate of the housing unit and the environment was effectively modified to alterand/reduce the adverse effects of factors like: temperature and/or emissivity of the surroundings; air temperature; air velocity; air vapour pressure; radiation or shade factors; and conductivity of surfaces that animals might contact.

Keywords

Grasscutter, Climate, Temperature, Holding Cages

1. Introduction

Climate is changing both naturally and due to human exploitation. There is already undesirable evidence that animals, birds and plants are being affected by climate change and global warming in both their distribution and behaviour. Unless greenhouse gas emissions are severely reduced, climate change could cause a quarter of land animals, bird's life and plants to become extinct. The Intergovernmental Panel on Climate Change (IPCC) [1] noted that human induced climate change could bring about losses in biological diversity and in goods and services that ecosystems produce to the society. The link between biodiversity and climate change runs both ways: biodiversity is threatened by climate change, but proper management of biodiversity can reduce the impacts of climate change.

Climate affects animal production in four ways: (a) the impact of changes in livestock feed-grain availability and price; (b) impacts on livestock pastures and forage crop production and quality; (c) changes in the distribution of livestock diseases and pests; and (d) the direct effects of weather and extreme events on animal health, growth and reproduction [2]. Surrounding environmental conditions directly affect mechanisms and rates of heat gain or heat loss by all animals [3]. The risk potential associated with livestock production system due to global warming can be characterised by levels of vulnerability, as influenced by animal performance and environmental parameters [4]. When combined performance level and environmental influences create a low level of vulnerability, there is little risk. As performance levels (e.g rate of weight gain milk production per day, egg production per day) increases, the vulnerability of the animal increases and when coupled with the adverse environment; the animal is at greater risk. Inherent genetics characteristics or management scenarios that limit the animal's ability to adapt to or cope with environmental factors also puts the animal at risk.

The impact of climate change on overall performances of domestic animals can be determined using defined relationship between climatic conditions and voluntary feed intake, climatological data and GCM output. Food ingestion is directly related to heat production and as such, any change involuntary feed intake and or energy density of the diet will change the amount of heat produced by the animal [5]. Ambient temperature has the greatest influence on voluntary feed intake. However, individual animals exposed to the same ambient temperature will not exhibit the same reduction in voluntary feed intake. Common stress factors in grasscutter production include high ambient temperature and humidity, which often occur, concurrently with other stress factors, especially, during the hot dry season in the Northern Guinea Savannah zone of Nigeria. The intensity and duration of the stress factors may vary with hours of the day and their actions on grasscutters may induce heat stress, which adversely affects their production.

Animal production generally plays an important role in the economics of any society; therefore the problems hampering the development of these animals should not be overlooked. For animals to perform well, the interaction between husbandry, health, nutrition and environment must be well managed especially in humid climates. The interaction of unfavourable environmental temperature and relative humidity often results in thermal stress which could be a major problem in grasscutter captive rearing. Extremes of ambient temperature, relative humidity and daylight are known to affect the performance of layers unfavourably, in terms of feed and water consumption [6] and immune response [7].

Recent publications have identified husbandry, health and reproductive biology as the areas that need to be investigated for the successful domestication of the grasscutter [8, 9]. Analysing how animals respond during extreme weather events, such as heat waves will help in knowing possible effects of global change as extreme events are expected to increase their frequency and severity [10]. The analyses and interpretation of past weather data can predict the future risks and its probabilities. This analysis can be used to examine the dependency between weather and disorders [11]. In order to optimize the breeding of grasscutter in captivity, the impact of climate change which is the order of the day globally should not be left out.

2. Materials and Methods

2.1. Study Area

The study was conducted at the Grasscutter Research and Domestication Unit of Forestry Research Institute of Nigeria (FRIN). FRIN is located within latitude 7° 23'N and longitude 3° 51'E in the rain forest zone of Ibadan. The mean annual rainfall is about 420 mm in 109 days, maximum temperature of 34°C and minimum temperature of 24°C. Relative humidity rages from about 82% between June and September, to approximately 60% between December and February [12, 13].

2.2. Site Selection

The animal housing unit is fundamentally located in a site with flat terrain, with properly moist soil, tree shades, enhanced heat dissipation (minimal radiation, air temperature and humidity, maximal air velocity) and devoid of active human activities.

2.3. Thermometer Installation

The single bulb thermometers were installed on the doors of the experimental hutches and fastened with thick rubber bands and nails. The maxima and minima thermometer, wet and dry bulb thermometer were hung on the sides of the stable.

2.4. Animals Housing and Management

The animals were housed in concrete floor hutches. Each hutch is made up of two compartments with a hole in between to allow easy accessibility of animals. The hutch doors are positioned at the top of the compartments. The building is netted round with wire mesh, covered with cellophane nylon which aids in the regulation of the ambient temperature. The animals were served with forage (*Pennisetum purpureum*) once daily *ad libitum* between 0800hrs-1000hrs and concentrate supplements mixed with multivitamin and little water added (to eliminate respiratory tract infection by reducing dustiness) at 1400hrs. Routine check of animals was done every morning before the cages were cleaned of remnants of the previous day and fresh ones served. Mineral lick was served continually. Tables 1 and 2 shows the proximate compositions of the forages and concentrates served, respectively.

Table 1. *Proximate Composition of Elephant Grass (P. purpureum).*

Parameter	Percentage (%)
Moisture	15.65
Crude Protein	7.38
Crude fibre	29.65
Ether extract	0.42
Ash	6.45
Nitrogen free extract	40.75

Table 2. Proximate Composition of Concentrate Supplement.

Ingredient	Percentage
Crude protein	14.76
Crude fibre	7.01
Ether extract	4.40
Metabolizable energy (kcal/g)	2422.98
Energy:protein	164:16

2.5. Statistical Analysis

The data was analysed using descriptive statistics in Statistical Package for Social Science (SPSS) version 20.0 software and the result was presented in form of tables and chart.

3. Results and Discussion

The relative humidity of the housing units is as shown in figure 1; where both 98% and 96% being the peak was recorded in unit A, respectively. This is in correlation with figure 2 where the lowest ambient temperature was recorded in the months of August with the values of 22.0°C for minimum and 27.0°C for maximum temperature, respectively. However, the housing unit was modified continuously to cushion the effect of adverse weather conditions on the animals. In hot weather condition, the cellophane nylon covering the wire mesh was raised up to allow free flow of air. In addition, water was administered to the grasscutters. For cold weather condition, besides the cellophane nylon not being raised, electric bulbs were switched on and charcoal chips put into coal burners were lit to generate heat particularly in severe cases. It is important to note that neonates of all species are vulnerable, and require some protection for survival even when growing and mature animals can survive relatively severe cold if adequately fed and disease problems are absent but, production efficiency can be markedly reduced [8].

In a biological environment, high humidity or solar radiation worsens the effect of high temperature. While high humidity reduces the potential for skin and respiratory evaporation by the animal, solar radiation adds to the heat from metabolic processes which must be dissipated to maintain body temperature and strong winds or drafts, especially in combination with precipitation, amplify adverse effects of cold temperature. Conversely, thermal radiation from warmer surroundings can offset the effects of cold temperature to some extent.

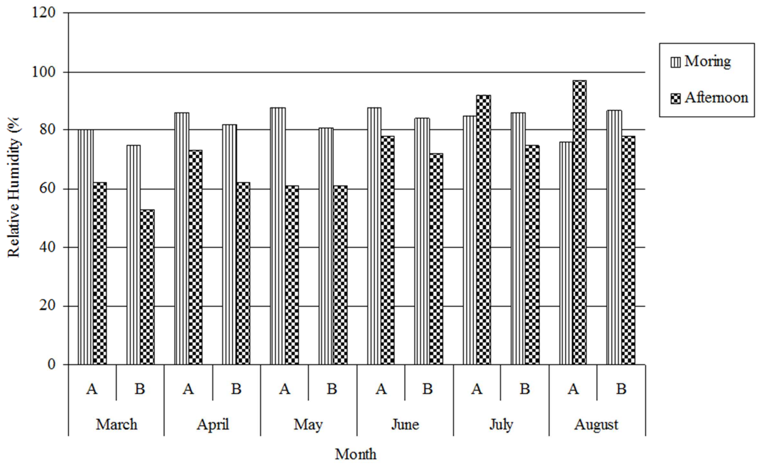

Fig. 1. Mean relative humidity.

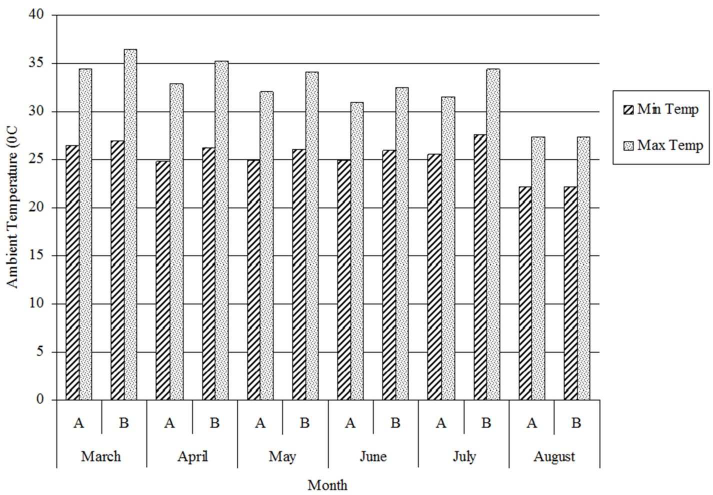

Fig. 2. Mean ambient temperature.

The ambient temperature of holding cages in figures3 and 4was higher in unit B than unit A throughout the six months. The lower temperature recorded in unit A could be attributed to the higher number of trees forming canopies and shading the roof from direct and intense sun rays. The housing site selected fundamental minimized the adverse effect of local weather. It is important to note that climatic factors vary with height above the ground at a specific location and with varying terrain features, differential exposure, wetlands, rivers, type and height of vegetation, human activities, and other factors in a general location.

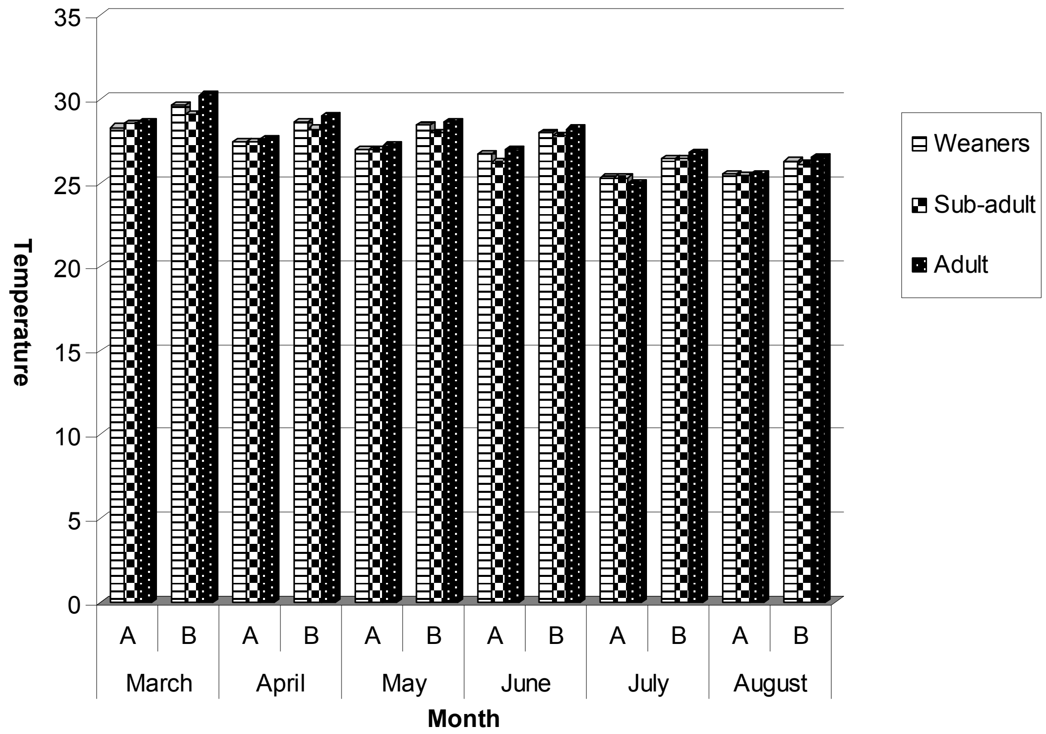

Fig. 3. *Mean ambient morning temperature of holding cages (°C).*

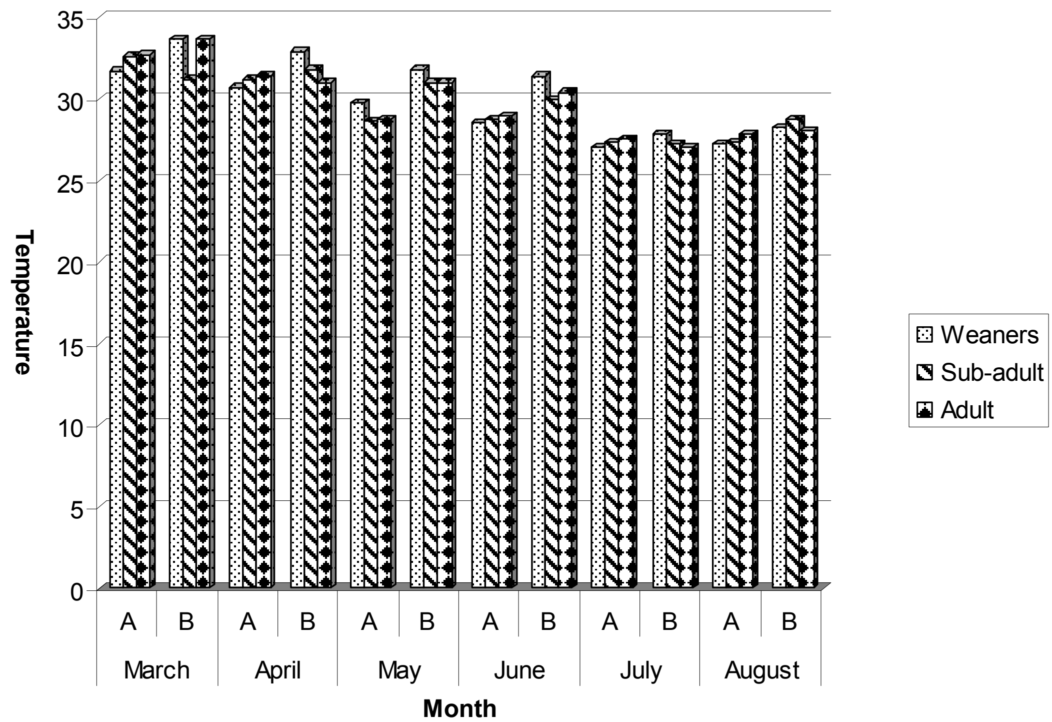

Fig. 4. *Ambient afternoon temperature (°C) of holding cages.*

In figure 5, the body temperature of male weaners was highest in almost all the months except in the month of March. This could be as a result of the restless and super active nature observed in them unlike their female counterparts particularly as they tend towards puberty. It is also important to note that the state of nervous disposition of an animal to an extent determines its body temperature.

There is a need for animals irrespective of the different and variable size, shape and structure to acclimatize and adapt to their environment particularly, that of the ambient. A report by Nienaber *et al*. [14] proves that animals are considered acclimated to a given ambient when body temperature returns to pre-stress levels. As such, systemic, tissue, and cellular responses associated with acclimation are coordinated, require several days or weeks to occur and are therefore not homeostatic in nature [15] and furthermore, when stress is removed these changes decay. A measure of animal's performance beit internally or externally is influenced greatly by environmental factors. This is reflected in the area of growth, milk, eggs, wool, reproduction, feed intake and conversion, energetic and mortality and according to Hahn *et al*. [16], thermoregulatory measures (e.g., body temperature rhythms) have recently been used to establish thresholds for disruptions in feeding activities during hot weather, which ultimately affects performance.

However, of great importance are the characteristics of the outer surface of an animal's body in relations to its ambient. Tropical animals must be able to dissipate excess heat through the skin and from the respiratory surfaces, at the same time they must avoid thermal energy incoming from the environment. Such protective properties depend on the morphological characteristics of the skin (colour, thickness, sweat glands, etc.) and of the hair coat (especially the thickness of the coat, number of hairs per unit area, diameter of the hairs, length of the hairs, and angle of the hairs to the skin surface), which allow the animal to exchange heat with the environment through the four transfer modes: radiation, conduction, convention. Skin pigmentation and its role as studied by Hamilton and Heppner [17], Hutchinson and Brown [18] and Hillman *et al*. [19], cannot be over emphasised because of its uttermost importance to protect deep tissues against excess exposure to solar short-wave radiation in tropical zones.

Specific responses of an individual animal are influenced by many factors, both internal and external. Growth, milk, eggs, wool, reproduction, feed intake and conversion, energetic and mortality have traditionally served as integrative performance measures of response to environmental factors. The aggressivebehaviour or disposition (either forcefull, hostile or attacking)of an animal which according to Van Staaden *et al.* [20], caninvolve bodily contact such as biting, hitting or pushing, but most conflicts are settled by threat displays and intimidating thrust that cause no physical harm. These may include a display of body size, antlers, claws or teeth, stereotyped signals including facial expressions, vocalizations such as bird song, the release of chemicals and change in colouration.

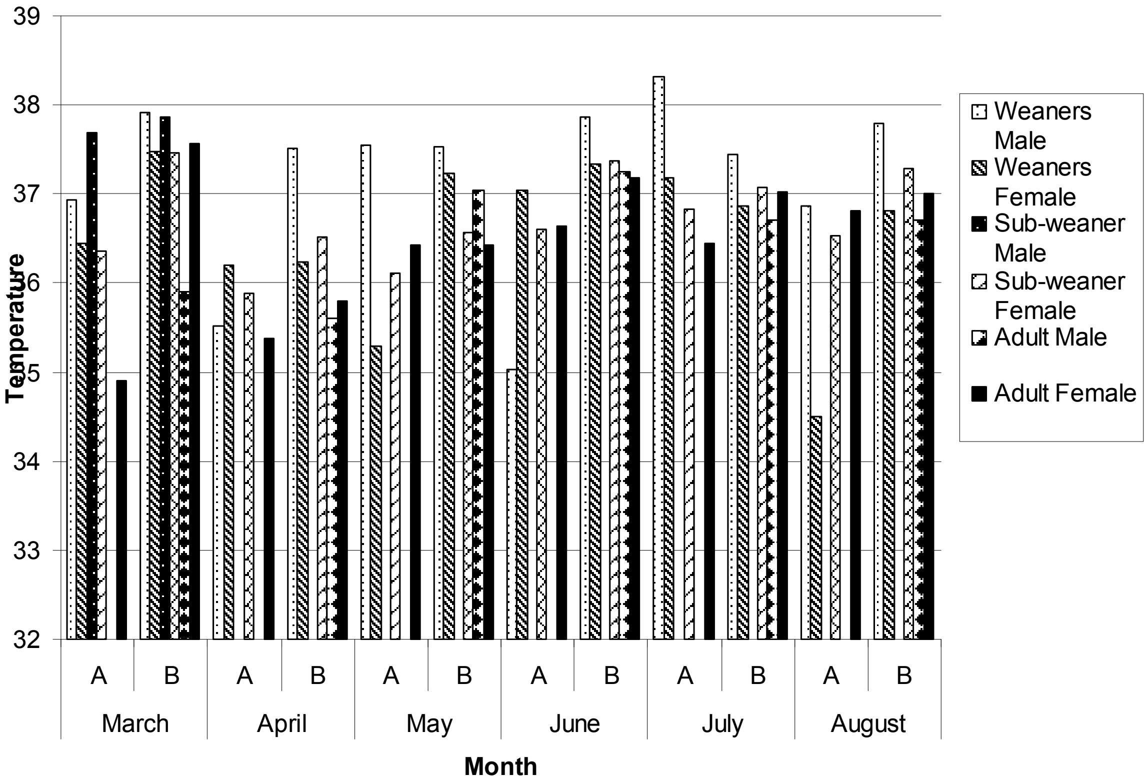

Fig. 5. *Body temperature (°C).*

4. Conclusion

Captive rearing of grasscutter is aimed at effectively domesticating them so that they lose their ability to live in the wild. To achieve success, improve production and efficiency particularly in the tropics, there is a need to follow a rational approach. The microclimate of the housing unit and the environment should be effectively modified to alterand/reduce the adverse effects of factors like: temperature and/or emissivity of the surroundings; air temperature; air velocity; air vapour pressure; radiation or shade factors; and conductivity of surfaces that animals might have contact with. Adaptive strategies and measures through effective data collection, monitoring and research can be used to predict the future risk, its possibilities so as to forestall disorders.

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