KAZI NAZRUL UNIVERSITY

BSC. ZOOLOGY HONS. 4th SEM

Name – Uday Goswami

University Reg. No. – 1032111220027

Course Code – BSCHZOOC401

Course Name – Behaviour & Chronobiology

Project Topic – Light variant affecting the sleep in mammals

College – Bidhan Chandra College, Asansol

Acknowledgement

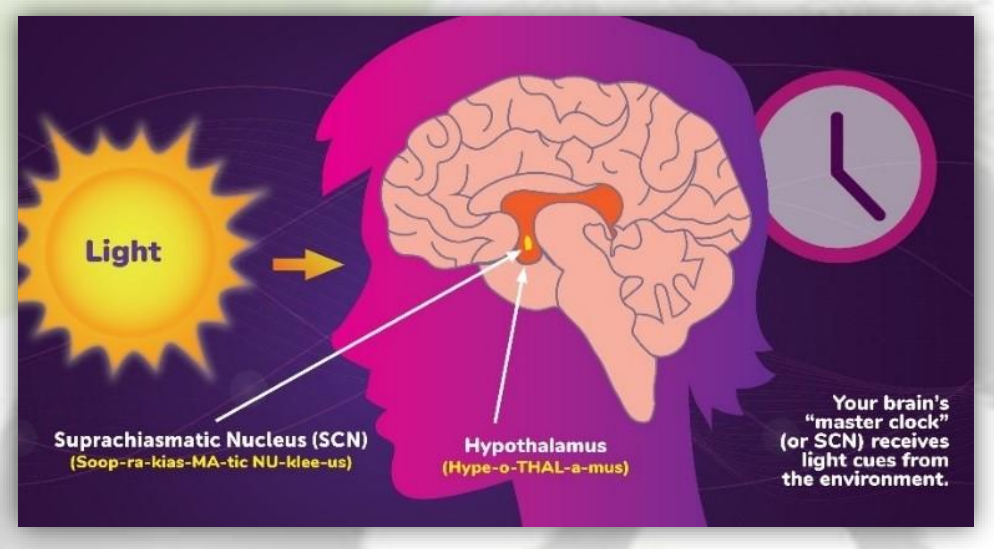
I would like to express my greatest appreciation to our respected Zoology teacher "Dr. Sriparna Ray" who gave me a wonderful opportunity to work on the project **"Light variant affecting the sleep in mammals."**

A special thank goes to my parents who supported me and encouraged me to complete this project on time. I also cannot forget to thank my friends who have always been with me to finish this project.

Index

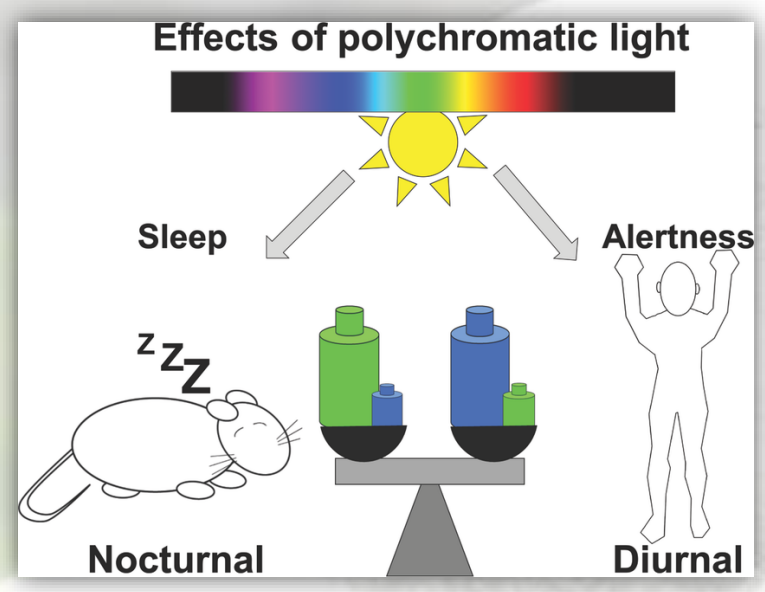
Introduction

Life on Earth has evolved under light days and dark nights over the course of millions of years thus, biological systems have evolved in a way that the overall health and well-being of organism depends on its physiology and behavior following this rhythmic environment.



Locomotor activity and sleep are the behaviors with the most obvious circadian patterns, but hormones, core body temperature in endotherms, metabolism, immune function, and several other physiological and behavioral processes critical for survival also have rhythms coordinated by light/dark exposure. Strict adherence to this biological schedule is adaptive for wild animals for example, most rodent species forage under protection of darkness to reduce the likelihood of predation. Chances of survival are significantly increased when a free-living animal's light days or dark nights can disturb these critical survival behaviors as well as indirectly cause harm through misalignment of the circadian clock.

Depending on cloud cover and time of day, the sun provides up to 100,000 lux of light at Earth's surface, whereas a full moon on a cloudless night casts off less than 2 lux of light. Until approximately 140 years ago, when electric lighting was introduced, the sun was solely responsible for the demarcation between day and night. Today, >99% of people living on the United States and Europe reside in regions with significant nighttime artificial light pollution. Initially astronomers raised the alarms about light pollution, and subsequently nighttime light exposure has been correlated with several concerning physical and mental health trends in humans such as depression, increased risk of cancer, immune suppression, and obesity. Ecologist have likewise documented physiological and behavioral changes in free-living animals and researchers studying biological rhythms in wild and laboratory animals have recapitulated and expanded these observations.



Effects of Light Variants

There are many variants which affect mammals' behavior. In this project we have discussed about few of them and these are as follows-

- **Circadian Rhythms**

Circadian rhythms are endogenous biological rhythms with periods of approximately 24 hours that persist in the absence of environmental cues. In mammals, circadian rhythms are organized by a master biological clock located in the suprachiasmatic nucleus (SCN) of the anterior hypothalamus. Environmental cues, such as light, precisely entrain circadian rhythms to the 24-h solar day. This entraining mechanism allows organisms to synchronize their physiology and behavior with the environment for optimal functioning as well as for survival.

- **Light at Night (LAN)**

Because light plays such a significant role in circadian clock entrainment, the timekeeping system is vulnerable to aberrant lighting outside the solar day. Humans are potentially exposed to light at night during hospital stays, night shift work, or from artificial light pollution in the environment. Likewise, laboratory animals are potentially subjected to light exposure at night from vivarium light sources. Exposure to constant light can disrupt circadian rhythms by desynchronizing clock neurons, although the ability to generate rhythms remains intact. This may result in "splitting" behavioral rhythms into two bouts of activity and rest within 24-h, phase shifting to shorter or longer periods, or a flattening/complete loss of rhythms.

- **Metabolism and Obesity**

There are compelling data available regarding the relationship between circadian and metabolic disruption. Rodents that lack expression of normal circadian clock genes have abnormal metabolic phenotypes. Laboratory animals exposed to dLAN have elevated body mass and body fat and impaired glucose tolerance compared to those with dark nights. Exposing mice to dLAN for just two weeks reduces energy expenditure and increases carbohydrate over fat oxidation, resulting in an overall increase in body mass.

- **Immune System**

The immune system is vulnerable to circadian disruption due to clock control of immune cell counts and function. Immune cell and cytokine/chemokine levels fluctuate according to the time of day and the sleep-wake cycle. Specially, rodent studies describe increased levels of lymphocytes, granulocytes, neutrophils, and monocytes during the day compared to at night.

Immune responses often vary depending on time of day due to these daily oscillations in immune cell activity, therefore circadian disruption from LAN has the potential to alter immune function.

Anatomy and Physiology of Vision in Mammals

How various mammals respond to light depends, among other things, on the architecture of the eye, including its pupil, type of lens, and especially whether the photosensitive cells in the retina are dominated by rods or cones. Nocturnal mammals have large pupils to admit more light, huge lenses to minimize spherical aberration, and rod-rich retinas. The rod system has high sensitivity but low acuity; that is, it can be stimulated by a few photons, but ability to see detail is poor because many rod cells connect to a single neuron. This means that small stimuli from several rods can act in concert to stimulate a neuron and thus deliver a signal to the brain. Because the brain is unable to determine exactly which rids were stimulated, however, it cannot discern the exact size and shape of the perceived object. In contrast, there is little summation among neurons where cones and neurons approach a 1:1 ration in parts of some mammalian retinas.

Discussion

For small, nocturnal, herbivorous mammals, artificial night lighting increases risk of being killed by a predator and decreases food consumption. Such lighting probably also disrupts circadian rhythms and melatonin production of mammals. Most research has documented the response of individual wild animals to moonlight or of laboratory animals to artificial light, however. Research on how artificial lights affect wild mammals at the population level is lacking. Significant progress relevant to management decisions will entail collaboration between ecologists and laboratory physiologists and assessment of population-level responses (e.g., rates of survival and reproduction) as well as individual behavioral and physiological responses (e.g., food consumption, avoidance of lighted areas, and melatonin levels). Given the preponderance of evidence from previous studies and known cause–effect relationships, statistical procedures should test the null hypothesis that artificial night lighting has a biologically significant negative effect on survival and reproduction, appropriately placing the burden of proof on proponents of the idea that such lighting is benign.

Reference

1. Wikipedia
2. YouTube
3. Google

KAZI NAZRUL UNIVERSITY

B.Sc HONOURS (ZOOLOGY), 5th SEMESTER

BIDHAN CHANDRA COLLEGE, ASANSOL

Name - Arnab Roy and Srimanta Mukherjee

Roll No: 3002 (Arnab) and 3015 (Srimanta)

Registration No: KNU19103001608 (Arnab) and KNU19103001383 (Srimanta)

Session: 2019-20

Paper: DSE I

Project Name: Difference between Domesticated Guinea Pig and Wild Cavies

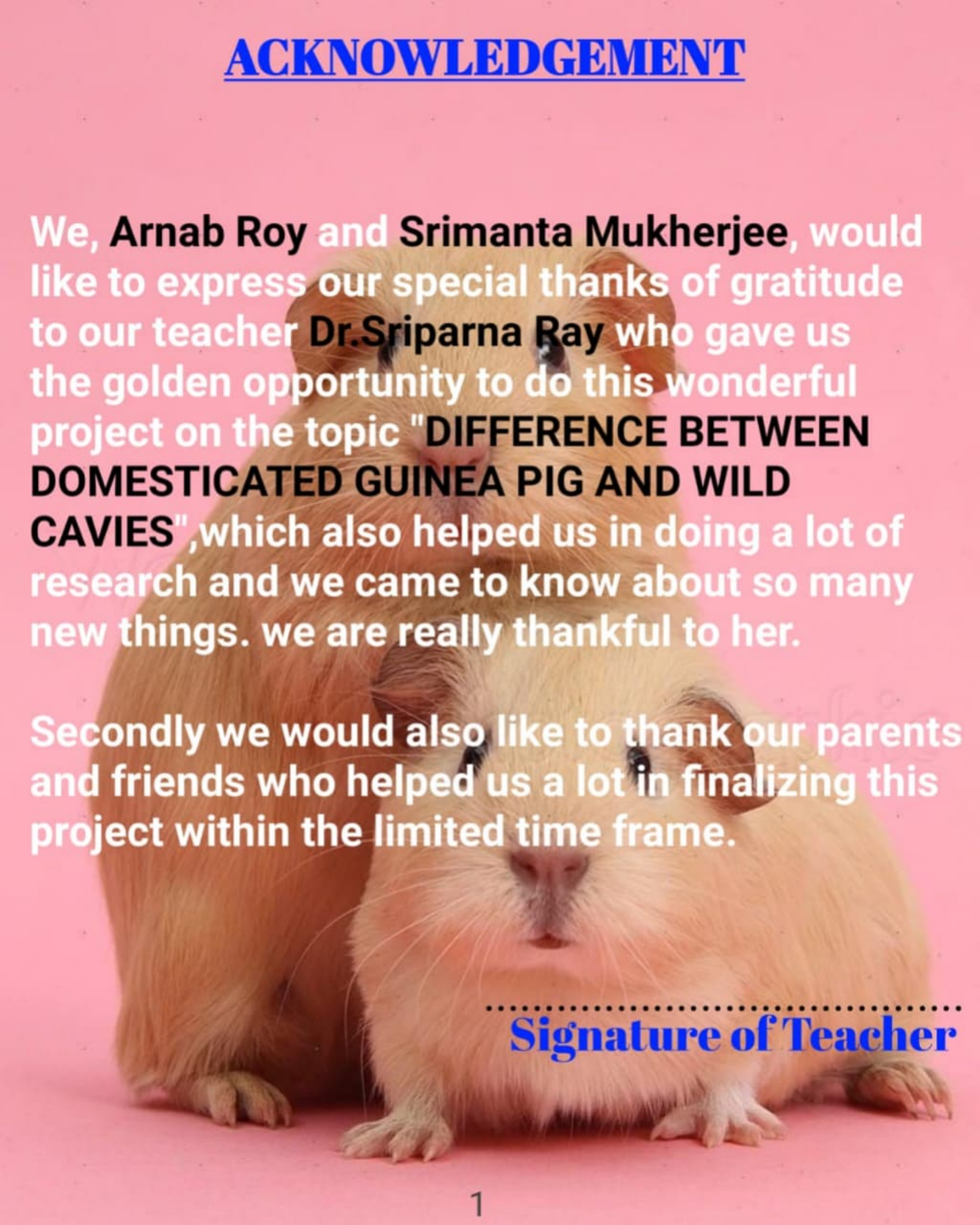
ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

INDEX

ACKNOWLEDGEMENT

We, **Arnab Roy** and **Srimanta Mukherjee**, would like to express our special thanks of gratitude to our teacher **Dr.Sriparna Ray** who gave us the golden opportunity to do this wonderful project on the topic "**DIFFERENCE BETWEEN DOMESTICATED GUINEA PIG AND WILD CAVIES**",which also helped us in doing a lot of research and we came to know about so many new things. we are really thankful to her.

Secondly we would also like to thank our parents and friends who helped us a lot in finalizing this project within the limited time frame.



.....

Signature of Teacher

INTRODUCTION

The domestication of animals is the mutual relationship between animals and the humans who have influence on their care.Charles Darwin recognized a small number of traits that made domesticated species different from their wild ancestors. He was also the first to recognize the difference between conscious selective breeding in which humans directly select for desirable traits, and unconscious selection where traits evolve as a by-product of natural selection or from selection on other traits.Domestication should not be confused with taming. Taming is the conditioned behavioral modification of a wild-born animal when its natural avoidance of humans is reduced and it accepts the presence of humans, but domestication is the permanent genetic modification of a bred lineage that leads to an inherited predisposition toward humans.

Wildlife traditionally refers to undomesticated animal species, but has come to include all organisms that grow or live wild in an area without being introduced by humans.Wildlife can be found in all ecosystems. Deserts, forests, rainforests, plains, grasslands, and other areas, including the most developed urban areas, all have distinct forms of wildlife.

DOMESTIC GUINEA PIG

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Rodentia
Genus: Cavia
Species: porcellus

The guinea pig or domestic guinea pig, also known as the cavy or domestic cavy is a species of rodent belonging to the genus Cavia in the family Caviidae.

DISTRIBUTION

Domestic guinea pigs are not found naturally in the wild; it is likely descended from closely related species of cavies, such as Brazilian guinea pig, Shiny guinea pig and Montane guinea pig, which are still commonly found in various regions of South America. Now they are introduced as pets in Europe and all over the world. These animals are native to grassland habits. However, they were very adaptable and could survive in different environments.

HABIT

Domestic guinea pigs are social and thrive in groups of two or more individuals. Groups of females, or groups of one or more females and a neutered male are common, but males can sometimes live together. They are crepuscular animals, being active during dusk and dawn. Guinea pigs can jump small obstacles but are poor climbers, and are not agile. When they sense danger these animals either freeze in place for long periods or run for cover with rapid. When happily excited, guinea pigs may repeatedly perform little hops in the air (known as "popcorning"). They are also good swimmers. Guinea pigs often self-groom and may sometimes participate in social grooming.

WILD CAVIES

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Rodentia
Genus: Cavia
Species: porcellus

DISTRIBUTION

Wild cavies are found on grassy plains and occupy an ecological niche similar to that of cattle. They are social animals, living in the wild in small groups ("herds") that consist of several females ("sows"), a male ("boar"), and their young ("pups" not "piglets", a break with the preceding porcine nomenclature). Herds of animals move together, eating grass or other vegetation, yet do not store food.While they do not burrow themselves or build nests, they frequently seek shelter in the burrows of other animals, as well as in crevices and tunnels formed by vegetation.They are crepuscular and tend to be most active during dawn and dusk, when it is harder for predators to spot them.

Difference between Domesticated Guinea-pig and Wild Cavies

Domestication has a considerable effect on the behavior of animals, which is not very surprising. The dramatic change in their environment and provision of food and shelter alter the need for behaviors such as exploration and social behaviors.

Exploration and anxiety

The wild cavies showed explorative and anxiety-like behavior less than the guinea pigs did, especially during early adolescence. They also showed more risk-taking, but only during late adolescence.Over the course of adolescence, exploration decreased in both species. Evolutionarily, risk-taking and exploration are important in order to obtain water, food, shelter, and mates.

Obviously, these are less of an issue in guinea pigs. The decrease in exploration and risk-taking as seen in guinea pigs can thus very well be a consequence of removal of this selection pressure.

Consequences of domestication

This is a logical consequence of the domestication process: the first breeders selected for the least aggressive cavies so they would reproduce easily and could be kept in large groups.But in case of wild Cavies they have to go through a competition to reproduce.

Social attraction

The guinea pigs and the cavies took the same time approaching the unfamiliar subjects in both the infant and the female interaction test, during both phases of adolescence. Both were more interested the social stimulus than the empty cage.

However, there was a substantial difference in the amount of social interaction: guinea pigs showed more interest in both the infant and the female adolescents. This is in line with the literature; domesticated animals show higher degrees of agreeableness and sexual behavior and lower levels of aggression.

Aggressive behaviour

The domesticated animals displayed less aggressive but more sociopositive and more male courtship behavior than their wild ancestors. In addition, they were distinctly less attentive to their physical environment than the wild cavies.

Physiological adaptations

Evolutionarily, wild cavies require appropriate physiological adaptations to provide the necessary energy quickly when the situation calls for it - this is the main function of the stress system.

So the high reactivity of the stress axis as found in the wild cavies does not necessarily have a detrimental effect on the animal. Rather it provides the energy necessary to adapt to their demanding life in the wild. Contrasting, guinea pigs have a much less demanding everyday life.

Testosterone and cortisol

Testosterone levels were higher in guinea pigs, which seems a logical cause of the increase in social behavior. Indeed, this correlation is often found in literature.

Testosterone levels also organize the reactivity of the cortisol system, and acute cortisol reactivity can trigger aggression. So the lower amount of agonistic behavior found in guinea pigs compared to cavies is in agreement with their behavioral profiles.

CONCLUSION

Domestication can lead to marked alterations in the biobehavioural profile of a species. Furthermore, during ontogeny, the individual phenotype of an animal can be shaped by the environment in important phases such as adolescence. We investigated differences in biobehavioural profiles between domestic guinea pigs and their ancestor, the wild cavy, over the course of adolescence.

Domestication led to a substantial shift in the biobehavioural profile of the guinea pig regarding all investigated domains in early and late adolescence. Hence, the differentiation between guinea pigs and cavies emerges early in ontogeny, well before the attainment of sexual maturity. The young individuals already show adaptations that reflect the differences between the natural habitat of cavies and the man-made housing conditions guinea pigs are exposed to. Higher levels of exploration and risk-taking and lower levels of anxiety-like behaviour are necessary for cavies in order to cope with their challenging environment. Their high cortisol reactivity can be interpreted as an energy provisioning mechanism that is needed to meet these demands. By contrast, guinea pigs are adapted to a less challenging environment with much higher population densities. Hence, their biobehavioural profile is characterised by higher levels of social activity and lower levels of exploration, risk-taking, and cortisol reactivity.

RESOURCES

1. Dr. P. S. VERMA and E.L. JORDAN, 2018, Chordate Zoology, S Chand and company limited, India, Page no.- 553-639.

2. R.L. KOTPAL, 2014, Modern text book of zoology VERTEBRATES, Rastogi Publications, India, Page no.- 472-540.

3. Some Websites:-

a. www.noteszoology.com

b. www.zoologycourse.com

c. www.sapiensian.in

d. www.IASzoology.com