The Bobiri Forest Reserve and Butterfly Sanctuary – A home of colour and beauty

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Abstract

The Bobiri Forest is blessed with a rich diversity of colourful butterflies. However, their vast ecotourism potential has not been optimally explored by the government of Ghana and the Management of the site. The intent of this article is to create awareness about the only Butterfly Sanctuary in West Africa to create an enabling environment for man, business opportunities as well as promote the development of forest fringe communities while conserving forest resources. Each stage of the butterflies' life cycle presents great lessons for man especially the pupa stage where the butterfly is emancipated. Their global distribution, prevalence in the Bobiri Butterfly Sanctuary, life expectancy and migration has been presented. Research shows that caterpillar production has the potential to prevent forest degradation and also improve the livelihood of people engaged in it with Tanzania as a model.

1 Introduction

Ghana has different species of insects which include butterfly species. According to research there are over 860 species of butterflies in Ghana of which 23 are endemic. The Bobiri Forest Reserve and Butterfly Sanctuary is located in the Juaben Municipality in Ghana. It is in the Moist Semi-Deciduous South-East sub-type ecological zone. It has an area of 54.65 km2 (21.10 square miles). It was established on 11th November, 1939 under the forest ordinance act 1939. It is approximately 20 km away from Kumasi and close to Kubease along the Kumasi-Accra highway (c.f. Opoku-Kwarteng, 2014; Hawthorne and Abu-Juam, 1995; Hall and Swaine, 1981). The Butterfly Sanctuary was established in the year 1998 near the guesthouse through the joint initiative of two Entomologists, Prof. Joseph Rexford Cobbinah (A former Director of CSIR-FORIG) and his friend, Prof. Michael Wagner (North Arizona University). Host plants with nectar producing flowers such as clerodendron, hibiscus, and wandering jew were planted to attract the butterflies closer to the guesthouse from the forest. The forest hosts over 400 different species of butterflies and more than 120 different species of birds. It is the only butterfly sanctuary in West Africa. A most recent diversity assessment of the sanctuary revealed that the most common butterfly species are Bicyclus istaris, Bicyclus funebris, Bicyclus sandace, Bicyclus sangmelinae, Gnophodes chelys, Melantis libya and Melantis leda (Agyemang-Badu, 2020). Over 90% of the butterflies sampled are forest dwellers. Less than 10% are urban dwellers and these were found close to the guesthouse. Generally, butterflies are biological indicators of ecosystem health and stability. They inhabit the Bobiri Forest Reserve mainly because it has been preserved in a near-primary forest condition since 1939 when it was gazetted in its primary/ pristine state. The beautiful and pleasant nature of butterflies has aided enormous tourist attraction of both indigenes and foreign tourists to the site. It has been scientifically proven that butterflies are one of the few insects that do not look after their young ones. The lifespan of the adult butterfly ranges between 3 months and 15 months after laying their eggs. The natural process sets in for the next stage of evolution from cocoon to the outside world. This short essay is about the beautiful world of butterflies, the story of each stage of their evolutionary cycle and its significance and correspondence with development and growth, the economic potential of the butterfly family beyond eco-tourism and the preservation and sustainability of the Butterfly Sanctuary.

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Figure 1. Butterflies mating for procreation and to sustain their progeny

One of the beautiful things observed in the Butterfly Sanctuary is the cycle of life. The butterfly goes through a very intricate pattern of creation to spun the most beautiful colours expressed in the colour spectrum. Butterfly life cycle begins with a thought, to borrow the human expression, and laying of eggs. The adult butterfly lays the eggs on the underside of carefully selected leaves of host plants. This is to hide the eggs from parasitoids who prey on butterfly eggs. The mature egg that hatches becomes a caterpillar in the next stage of development. The caterpillar (larvae) feeds on the leaves of the host plant. It takes about four to five days for the eggs to hatch.

The larval stage is also referred to as the feeding stage. During the feeding stage the caterpillar spends about two to five weeks depending on their size. In the forest different animal and plant species find alternative ways of adapting to strange situations, the harsh environment and most importantly, predators. Creatures such as lizards, birds, wasps, snakes, dragonflies, toads and rats may terminate the life of a developing butterfly by preying on them. When the hunter learn how to shoot without missing, the bird must learn how to fly without perching. The butterfly at the caterpillar stage therefore develops resistance to predators using different defensive mechanism such as consuming poisonous plants that in future enable them to produce poisonous chemicals to protect themselves. Others are able to mimic already poisonous caterpillars to deter their prey. Mimicry is the extensive adaptation of a protective mechanism adopted by a butterfly. The next stage is the Chrysalis (Pupa) stage. The Chrysalis stage is also known as the resting period. The caterpillar produces silk which is used to make a shelter called cocoon. The caterpillar lives inside the cocoon approximately twenty one (21) days and this depends on the species. Some species stay inside for only five days before the physical changes or metamorphosis occur. The Chrysalis metamorphoses into adult butterfly upon development of four coloured and scaly wings arranged in two pairs.

The adult butterfly is the final stage of its life cycle. This can be one of the most intense stages in the life of a butterfly. For it to experience the beauty and freedom of the outer world, it must give away the restrictions of the cocoon. For it to grow, it must dismantle the comfortable but limiting world of the cocoon. This comes with pain as with any positive transformative event. The cocoon shell will then burst open via pressure from the developing butterfly within. At this stage the butterfly emerges from the pupa with wet and winkled wings. The butterfly hangs with its wings down and

starts pumping a liquid known as hemolymph to their wings so that they become big and strong. When the wings get dry enough, the young butterfly will fly out on a "nuptial flight". And it pays to fly in pairs as this keep the group culture and mind alive and mating becomes easier.

The adult butterfly develops a very good vision after metamorphosing from the pupa stage especially within short distances. They are able to fly with precision in areas of many obstacles.

2 Butterfly Species in the Bobiri Butterfly Sanctuary

Butterflies are insects in the macro lepidopteran clade Rhopalocera from the order Lepidoptera, which includes moths. The adult butterflies have large, most often brightly coloured wings, and conspicuous fluttering flight. Butterflies are cold-blooded insects that mostly depend on the sun energy to propel their movement. They are very active during the day and most especially when the clouds are clear with high temperature. In the night they are less effective comparing to moth.

Butterfly species are evenly spread across the length and breadth globally with the exception of Antarctica. The estimated butterfly species worldwide is about 18,500. The distribution of the butterfly species is dependent on the availability of the habitat and geographical location. They are insects that are good indicators of climate change and therefore most of the species migrate in search of conducive habitats. Notwithstanding most of the butterfly species around the Afrotropical region is about 3,650. The Nearctic region also has about 775, Neotropical region with about 7,700 and the Palearctic region has more than 3,600 species of butterflies. It is significant to add that about 4,800 butterfly species are scattered across the combined Oriental and Australian or the Oceania region. Butterfly migration is best attributed to the Monarch, which is widely known to migrate in the fall to overwintering sites in California and Mexico. But in the United States, several other butterfly species engage in lesser migration distances. Some of these are the Painted Lady, the Purple Wing, Buckeye, the Great Southern White, and the Little Sulphur and the Cloudless Sulphur (Lewis, 1974).

Butterflies mainly develop wing colours that appears in two types, pigment and structural, mostly combined in one individual butterfly species. Pigment colours are familiar in paints, dyes, and inks, and are defined as specific substances with definite chemical composition. Structural colours are instead produced in a physical manner, similar to a rainbow. Morpho butterflies are the typical illustration of butterflies with structural colour.

In the Bobiri Butterfly Sanctuary is found over four hundred species of butterflies. A most recent diversity assessment of the sanctuary revealed that the most common butterfly species are *Bicyclus istaris, Bicyclus funebris, Bicyclus sandace, Bicyclus sangmelinae, Gnophodes chelys, Melantis libya and Melantis leda* (Agyemang-Badu, 2020). These butterfly species have been grouped into four types. The categories are based on their mode of feeding. Some species feed on decomposing organic matter, nectar, fruits and others "puddle", that is, suck mineral salts and amino acids from the soil. The Graphium antheus is one of the several butterfly species normally found in tropical and sub-Saharan Africa. They are common butterfly species found in Bobiri Butterfly Sanctuary. They belong to the family Papilionidae (swallowtails). The wingspan of the males is between 65-70mm and 70-75 in females. The flight period of the swordtail butterfly is year-round and mainly common in November and December.

3 Life span of butterfly at Bobiri butterfly sanctuary

Butterflies by nature have a very short lifespan compared to other animals in the wild. Their glowing colours and beautiful appearance give men unique kind of ecstasy whenever butterflies are sighted in the Sanctuary or spotted anywhere in their various communities. There are numerous factors that accounts for why they live short on earth even though science has proven that some species of butterflies have the tendency to live more than twelve months.

It is important to understand the dynamics of their growth and life expectancy and how it can help shape the mind-set of individuals venturing into butterfly studies (Lepidopterology). The life span of a butterfly depends on the species. For instance the Painted Lady Species can live up to a maximum of twelve months whiles the Monarch species have the tendency to live within six to seven months. The rest of the species have a month to live and in some occasions those with small size have two

Figure 2. Large striped swordtail sipping nectar, Graphium antheus species found in Bobiri Butterfly Sanctuary.

weeks life expectancy.

Larval food accumulation in butterflies affects adult resource allocation body size, fitness and lifespan (Boggs et al., 2005).Thus, the size of a butterfly is a factor to determine whether the butterfly will live long or not. That is to say if the caterpillar is small in size, it would have stored just a little food for the sustenance of the chrysalis. Similarly, if the caterpillar is big in size, it would have stored enough for the sustenance of the chrysalis. It is also important to state that the size of the butterfly is not going to be the only factor that will determine its lifespan, but it thus contribute to it. There is an average lifespan of a butterfly which is about one month. The smallest butterfly you spot around your backyard garden or the Butterfly Sanctuary at the Bobiri Forest Reserve sipping nectar or fruit juice spend only one week to live.

The climatic conditions in a semi-deciduous tropical rain forest such as Bobiri Forest represents the kind of weather pattern for the survival of some butterflies. Most of the migrant butterflies fly from their geographical area to another conducive habitat when they are hit with the winter or wet season. Some of the longest lived butterflies, such as the mourning cloak, spend their winters in the tropics before mating in the spring. The eggs of a butterfly laid during the winter period mostly remained redundantly until the winter period is over. The migrant species tends to live longer on earth since they are always able to search for the appropriate environmental conditions that supports life. Tropical butterfly species of the genera Heliconius, Ithominae, Morpho and Battus each live for several months in tropical habitat than the other species that do not migrate over longer distances when there is a change in weather. Others, like the tortoise shell and angle wings hibernate through cold climate winters in holes found in trees and man-made structures.

However, butterflies in the wild are exposed to many dangers and predators. Butterflies living in the wild mostly turn to have a shorter lifespan because they are usually exposed to the elements of nature. There are predators such as the praying mantis, birds and many other bigger insects. Also, unexpected change in temperature and/or habitat shifts can cause an abrupt end to the life of a butterfly.

3.1 *Male Butterflies*

The adult male butterfly dies six to eight weeks after all of the sperm has been depleted from their body. Male butterflies are ready to mate one hour after emerging from the pupa. They frequently will mate with a female butterfly as soon as she begins emerging from her pupa, even helping her to remove herself from it. The male mates with her immediately. This tactic of mating is easier on the male. The female is not able to fly away yet, it takes about one hour for her wings to dry after

emerging from the pupa, giving the male the opportunity to mate with her. Adult male butterflies use up their sperm during adulthood by mating with a variety of female butterflies (Alyssa, 2017).

3.2 *Female Butterflies*

Female butterflies die after they have laid all of their eggs. Female butterflies are ready to mate immediately after emerging from the pupa. When they mate they remain together from one afternoon until early the next morning—often up to 16 hours! Females begin laying eggs immediately after their first mating, and both sexes can mate several times during their lives. They lay up to 100 eggs in their life time. It is common for her to lay single eggs or clusters. They lay the eggs on host plants that are also a food source for the developing egg. If a female doesn't mate immediately, she most likely never will. Not mating will prolong the female's life. She will then die from natural causes or succumb to a predator attack (Alyssa, 2017).

3.3 *Economic Potential of Butterfly Keeping*

Butterflies have enormous economic potential to man, yet this remains to be fully harnessed. The efficient exploitation of butterflies in the ecosystem is of great benefit to the economy. Nature's most beautiful insects are seasonal creatures. They appear in large numbers during the major fruiting season (from March to August) to feast on the ripe mangoes, water melons, pawpaw, bananas and other fruits. To harness the tourism potential therefore, careful intervention ought to be put in place. One solution could be butterfly farming, a concept that is currently alien in our land yet holds great potential for job creation and sustainable local development (Melanie et al., 2019). Apart from the priceless ecosystem services such as pollination leading to fertilization, being pests of crops and other plants through herbivory of the caterpillar leading to reduction in their quality, market value and abundance. The aesthetic beauty of their wings is the inspiration behind most of the wax print designs in Ghana and all over the world. The conscious rearing of these colourful and charismatic organisms can mitigate the perennial challenges associated with the "seasonal scarcity" of butterflies which are one of the major "unique selling" points of ecotourism at the Butterfly Sanctuary. This will ensure availability of abundant butterflies for viewing by tourists all year round. With private s mall scale orchards and fruit gardens, the economic benefits of the butterfly can be increased. Every stage of the butterfly's evolution has economic potential which indigenous societies have known for aeons. Sale and exhibition of caterpillars is a lucrative business, with some Tanzanian butterfly farmers earning as much as $250 from this trade of caterpillars per month. For rural communities, this is a great earning ability to scale out of income poverty.

The butterfly business can spun alternative industries in the supply chain. Majority of butterflies depend on nectar for survival. Farmers can be encouraged to cultivate nectar producing flowering plants such as hibiscus, clerodendron, wandering Jew and lantana to serve as food source for nectar feeding butterflies. Furthermore, these serve as host plants for the eggs and caterpillar. The farmer needs to keep and raise the caterpillars 'larvae' after the eggs hatch. There is an attractive market for caterpillar commerce globally. The caterpillar can be sold to local and foreign exhibitors and the cycle continues endlessly. Whether it is in the forest reserve, backyard, and/or spaces around a piece of land, butterfly farming can be engaged in the community.

Butterfly farming is a lucrative alternative livelihood which doubles as a recipe for sustainable forest resource management. The farmers and charcoal producers living around Zanzibar's Jozani forest after going through orientation by a community-run initiative has helped them shift focus from forest degradation to forest conservation. This means that butterfly farming does not only help the farmers and charcoal producers to make money but also help them in protecting and utilizing the forest resource sustainably. This is a wholesome practice that should be encouraged here in Ghana and the rest of the world. This in effect curbs illegal chainsaw operation, deforestation and mitigates climate change. In ultimate pursuit of achieving the sustainable development goals (SDGs), butterfly farming can be beneficial to ecosystem health and stability, enhancing SDG 15: protection, restoration and promotion of sustainable use of terrestrial ecosystems, sustainably manage forests, halt and reverse land degradation and halt biodiversity loss.

In furtherance to butterfly farming, the tourism sector has to be considered by putting in much attention through adequate investment. The sector has the potential to generate much revenue for the government and also provide financial support to the communities that host the site of tourism through benefit sharing schemes. Bobiri Butterfly Sanctuary has helped to project the image of Ghana globally through its ecotourism and butterfly exhibition to tourists that visit the site. Most tourist' sites in Ghana are not well developed: poor road network, telecommunication service, lack of habitable and recreational facilities, inadequate visibility on the internet etc. It is important that those in charge of management of these tourist sites find a modern way of projecting the existing sites and new developments to the outside world. The Bobiri Forest Reserve and Butterfly Sanctuary is the largest and only one of its kind in West Africa yet bedeviled with the same problems which has dwindled patronage and affected revenue mobilization. Many people prefer living in an area where butterflies are in abundance due to their aesthetic beauty. It is not uncommon for tourists from Europe, America, Asia and all around Ghana to come for a day tour or stay overnight to enjoy the seemingly pleasant atmosphere within the ecosystem of the butterflies. A priority of concern is needed by the government, wildlife agencies, Non-Governmental Organizations (NGO) and private philanthropists to channel their efforts and financial resources into tourism site development. Better tourism information flow by management of the Bobiri Butterfly Sanctuary, good residential and communication facilities, improvement in the signs and directions leading to the sanctuary, dedicated resources for research, exhibition, souvenirs, repair of the roads leading to the forest will open this nice enclave for the enjoyment of the world while conserving nature.

Moreover, research has it that more than two billion people eat insects every day, globally. The taste of butterflies to some nationalities including Japanese is of no exemption. Aside the butterfly exhibition, butterflies such as the monarch, swallowtail, *Bicyclus sangemlinae* and many other species are part of the menu of some people. According to Dr. Jaskuta who is a zoologist, insects including butterflies are rich in amino acids, fats, sugars, and have high concentration of vitamins B and K. Butterflies are harvested as food source due to their nutritional value. Butterfly eaters are predominantly found in Vietnam, Thailand and Africa.

4 Concluding remarks

The economic potential of ecotourism to the Ghanaian economy coupled with the effects of biodiversity loss and climate change requires concerted efforts towards forest and biodiversity conservation. This is being impeded by the nefarious activities of indigenes which endangers wildlife including the charismatic butterflies such as the Karner Blue Butterfly, the Goliathus beetles, other species of plants and animals. The key to enhanced human wellbeing is harmonious co-existence with other life forms. Butterfly metamorphosis presents amazing cues for improved quality of human life. Thus, it undergoes changes in order to ultimately enjoy an exciting life.

Authors' Biography

Christian Opoku-Kwarteng is a Principal Technologist at the CSIR-Forestry Research Institute of Ghana and the Manager of the Bobiri Forest Reserve and Butterfly Sanctuary. He holds a Master of Science degree in Environmental Science and a Bachelor of Science degree in Natural Resource Management from the Kwame Nkrumah University of Science and Technology (KNUST) as well as a Diploma in Education from the University of Education-Winneba (UEW). His area of professional interests include Entomology, Biodiversity Conservation, Agroforestry, Ecosystem services and climate change issues, Schools' Outreach and Climate Change Sensitization programmes, Management of forest resources in agricultural landscapes, Natural resource management, Forest transitions, Forest plantations, Alternative livelihood for forest fringe communities, and Ecotourism. He is a member of the Ghana Institute of Foresters and the CSIR-Research Staff Association of Ghana. He has been involved in several research projects and other studies such as the "Unravelling the role of animals in African soils" (SOFIA), Tree Conservation research projects, Phenology of woody plants etc. He has experience in stakeholder engagements at the international and national levels. He has facilitated several alternative livelihood training workshops for forest fringe communities, supervises

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Evans Nii Ayi Tagoe is a Research Assistant at CSIR-FORIG, and a forest tour guide at Bobiri Research Centre. He received his pre-university education in the Eastern Region and Bachelor's degree in Political Science and Information Studies from the University of Ghana. After his undergraduate studies he joined CSIR-FORIG to undertake research in flora and fauna aimed at unravelling the secrets of nature and a deep understanding of forest ecology. He has participated in numerous research projects, including but not limited to "Unravelling the role of animals in African soils" (SOFIA), and diversity of ants along the forest-savannah/ rainfall gradient in Ghana. The research interest of Evans is geared towards International Relations and flora and fauna disciplines. His most recent research looks at butterfly species in Bobiri Butterfly sanctuary. Mr. Tagoe is a very experienced teacher who has taught for seven years of his career.

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