CONTRIBUTIONS AND PROSPECTS FROM INSECT BIRD RELATIONSHIPS.

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The environment has never been challenged in the history of man like now; this is evidenced in the overall global environmental degradation and biodiversity decline resultant almost completely from humans often from their activities and or lifestyles. Human activities such as deforestation, firewood collection, land clearing for agricultural and structural development purposes and pollution have been particularly high within the past five decades with attendant deleterious impacts on the environment. High extinction vortices are glaring consequences, climate change which is also an easily identifiable footprint of human activities over the years promises to further erode the genetic diversity of species on earth.Astronomical rate of increase in human populations and technological developments have been widely blamed as the main driver of the negative impacts on the environment.

Conservation biology was hatched about three decades ago as a practical response to curb these challenges; this science operates on the concept of sustainability in the management of the environment and biodiversity generally. The concept of sustainable environment seeks to provide environmental benefits needed at present not jeopardizing future needs.Accepted and implemented protected area networks on global and local bases have contributed significantly to the global convention of sustaining the environment, thus, have proven a very effective conservation tool.

The environment thrives on diverse naturally occurring relationships between different components of ecosystems. These wide range of relationships are very important in different ecosystem processes, a key example is insect-bird relationships. These species are important players in the environment with numerous contributions to the environment when considered as single species plus several prospects when relationships between the two species are considered.

Apart from being major pests of several agricultural products with consequent economic importance, insects and birds have contributed to the environment as good pollination agents. Insects and birds have served as importantvectors of vector-borne humandiseases, these areknown to cause human morbidity and mortality more than all other causes of diseases put together.

For example, mosquitoes transmit malaria fever, yellow fever and dengue fever. It is known that Malaria accounts for the highest human deaths more than any human vector-borne disease, malaria fever which is caused by *Plasmodium spp.,* is known to cause between 1 to 3 million deaths per year and largely in sub-Saharan Africa. Swamps, ditches and wet environments are the key requirements for mosquitoes to breed, hence, a critical factor in the epidemiology of the disease. Interestingly, birds and several other animal taxa are known to be infected by malaria.

H5N1 highly pathogenic Avian influenza (HPAI) is a disease of bird origin. Though known over two decades, it is currently a common daily parlance due to the enormous impact of outbreaks in poultry across Asia, Africa and Europe since2003, such as deaths of over 200 human, 230 million poultry and thousands of wildbirds. Presently, *H5N1* HPAI is still being contained globally and particularly in Nigeria.CommonAvian influenza strains and their wild host populations have developed an evolutionary equilibrium over time whereby the virus does not cause serious disease or mortality. Periodically, wild birds, particularly ducks and geese, have been identified as the source of virus introductions to domesticpoultry.

Our research experiences over the years have shown that insect and birds respond in similar ways to environmental factors and disturbances. We have found that the diversity and abundance of insects and birds responded in

similar ways to rainfall, humidity, temperature and fire. The results are consistent with reports from other authors. Living organisms will generally integrate the effect of environmental changes over a period of time and their reactions may reveal quiet novel and unexpected changes in the environment. Insects and birds are therefore, good biomonitors of the environment.Our findings have also shown that relationships between insects and birds have direct consequences to the transference of fitness to future generations of both species.

The most important and prospective insect-bird relationships we have learned so far are the symbiotic and predatory relationships between the two groups because of the crucial role these play inthe recruitment of populations into the environment. Wasps of the family Cynipidae have demonstrated a symbiotic relationship with diverse bird species during breeding seasons. For example Gall wasps have offered defense to the nest of Red Cheeked Cordon blue *Uraeginthus bengalus* while it uses food remains and materials from the bird to service its own nearby nest. Bird nests' guarding bywasps enhances nest success for both speciessuggesting that synchronized breeding seasons have been selected as nest success behaviour. Predatory relationship is probably the most important relationship between insects and birds, especially where the former is the prey while the latter is the predator.This is because food has been identified as the most important factor in the breeding success of living organisms. It is known that all birds regardless of their feeding guilds require a good proportion of animal protein in the diet of their young which is chiefly from insect sources, Insectivory have also been identified as the most common dietary strategy in birds.We have evidence substantiating the food availability-breeding time hypothesis between insects and insectivorous birds, hence, predicting breeding seasons of the bird species. Evidence also abounds on how environmental pollution has been deciphered through the feeding of insectivorous birds on insects in polluted areas.

Insect-bird relationships promises to be a novel tool for ensuring a sustainable environment especially now that emphasis is on using environmentally friendly measures of mitigation.Relationships between organisms which borders on critical aspects of their ecologies are key in pest and or vector management. Therefore, we believe that insect-bird relationships research offers greater prospects than already explored, for example as a Biological Control component of Integrated Pest Management (IPM) and or Integrated Vector Management (IVM).

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ASPECTS OF ENTREPRENEURSHIP IN ENTOMOLOGY

The green areas of investment in entomology begging for attention in Nigeria include:

i. Entomophagy (rearing of edible insects);
ii. Mulberry sericulture;
iii. Apiculture;
iv. Maggot Production and;
v. Pest control and Fumigation

Entomophagy

Entomophagy is simply defined as the consumption of insects as food by man. It is sometimes referred to as mini-livestock which has become an emerging ecological concept in animal husbandry. The prospects of edible insects (e.g. African Silkworm, *Anaphe venata*) to the national food security as food and feed cannot be overemphasized. Promoting edible insects as alternative candidate to conventional production of meat may mitigate crises such as land pressure, deforestation and environmental degradation. About 1900 species of insects are eating worldwide, mainly in developing countries. In Africa, especially in Nigeria, over 470 insects are eating. The insects mostly eaten in the continent are dominated by the orders Lepidoptera, Orthoptera and Coleoptera. These edible insects constitute high quality food for humans, livestock, poultry and fish. Since insects are cold blooded, they have a high quality food conversion rate than conventional livestock and emit less green house gases. However, edible insects are important alternative for other animal based protein sources either for direct human consumption, or indirectly as feedstock. They also provide environmental friendly source of dietary protein because they produce much lower amounts of ammonia than conventional livestock. Eating nutritious insects could help fight obesity, reduce protein deficiency and end national hunger. The roles of entomologists in this business involves rearing edible insects for food and feed, identification and differentiation of edible species, studying biology of edible insects, sexing of edible insects and; mass rearing of edible insects.

Mulberry sericulture

Mulberry sericulture is the rearing of insect called silkworms on mulberry plant to produce silk. This method of silk production is found in the temperate countries but with the advancement in research, it is now possible to grow different species of mulberry in different agro-ecological zones of the tropical countries thereby making mulberry sericulture possible in Nigeria. In mulberry sericulture, farmer produces mulberry leaf and sells both the leaf and the eggs of cotton silkworm (*Bombyx mori*) to the cocoon producer. The eggs hatch into larvae which are fed with the mulberry leaf. The cocoon is then sold to the final producer to produce yarn which could be exported directly or reeled to produce silk. The most interesting thing in mulberry sericulture is that, at every stage of the production, chain employment opportunities and incomes are generated. In addition to silk production, the cotton silkworm insects are also edible, hence serving dual purposes.

Apiculture

Apiculture is defined as the artificial rearing and management of honey bee for commercial production of honey and other products of the beehive. Bees may travel as far as 55,000 miles and visit more than two million flowers to gather enough nectar to make just a pound of honey. Honey bee produces up to six different products of lucrative potentials and high demand (in the market) in a range of industries from food processing to medicine. These products are honey, bee wax, propolis (bee glue), pollen, royal jelly (bee's milk) and honey bee venom (apitoxin). It is interesting to know that a litre of pure honey now goes for between N1000 to N2000. In the recent time, pollination service is gaining ground especially in the western world where farmers are demanding for bumpy harvest. Pollination service involves location of bee hives within orchards, plantation and farms and the bee activities are monitored by an expert (beekeeper) especially entomologist. However, during flowering, the expert releases bees to the farmer's field to encourage pollination which brings about higher yield and the beekeeper are paid in return.

Maggot Production

Maggot production as a business, deals with the breeding of maggot. A maggot is the larva of a fly (order Diptera); it is applied in particular to the larvae of Brachyceran flies such as houseflies, cheese flies and blowflies rather than larvae of the Numatocera such as mosquitoes and crane flies. Maggot farming is a viable and profitable business as it has several uses such as feed for fish and poultry, bait for fishes, therapy for treating small wound, and estimation of time elapsed since death among others.

Pest control and Fumigation

Pest control and fumigation is the act of controlling and eradicating harmful insect/pests in our surroundings using chemicals and machines. The importance of pest control and fumigation in our environment cannot be over-emphasized. Pest and insects are deadly and can cause severe harm to humans and properties. Most sickness today is as a result of deadly pest/insects that inhabits our environment. Mosquitoes, cockroaches, snakes, rats, termites, bedbugs, tick etc are very harmful and could cause severe damage to our health and properties if they are not controlled. Therefore, it is recommended that our environment should be fumigated once in every three months in order to get rid of these deadly pests. In the past, farmers and agricultural fumigators relied on the use of gases such methyl bromide as fumigant for controlling insects and diseases affecting harvested crop. But these products have broad spectrum effect and as a result pose numerous environmental and health hazards. For instance, methyl bromide which was used primarily for soil fumigation and as a fumigant in the control of insects, nematodes, pathogens, and rodents and weeds is being phased out due to its high ozone-depletion potential. However, carbon dioxide (CO_2) and nitrogen (N_2), which are natural products, have been found incredibly effective against pest and insect infestation in dry ingredients.

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