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Predations on honey bees (Arthropoda) by vertebrate pests (Chordata) and control of nuisance

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Abstract
The purpose of this article is to improve management of established vertebrate pests, as well as increase the alertness about exotic threats to honey bee industry. Large numbers of vertebrate animals such as amphibians, reptiles, birds, mammals like to feed on honey and are recognized to predate upon honey bees contributing as most damaging group of pests. Honey bees and colonies are not immune to predators from predation and it can take a variety of forms, from destruction of comb to physical dismembering of colony by hungry pests. The principal method of damage prevention is use of electric fencing for bears, while trapping is mostly used method for control of skunks. Establish the apiary away from trees, which will prevent bears from climbing and dropping inside the fence. A piece of chicken wire can be stapled to the bottom board and stretched in front of hive to discourage skunks and other animals. Exclusion is considered the best means of resolving mouse problems, and birds can be repelled by hanging video tape and elect the apiary site carefully to avoid home ranges and visiting. Mice also nest in stored bee equipment resulting in same kind of damage, therefore care is needed to keep these pests away from stored equipment and also retain grasses mowed for a distance around hives. Add an upper entrance, install a fence around bee yard, keep colonies on stands, cover top and bottom of combs with a pile of supers and a queen excluder, wire screen, or telescoping lid to prevent other predators. Although beekeepers want a hive in dappled sunlight, avoid placing hives near the woods. These mammals can be kept out of colonies by reducing the size of the entrance as the weather begins to cool down.

Keywords: Vertebrate pests, Amphibians, Reptiles, Birds, Mammals

Introduction

Bees are of commercial value today as pollinators of forests, horticultural and agricultural crops, and for their marketable products such as honey and wax. The most important species for bee keeping is the *Apis mellifera scutellata* Lepeletier. Honey is mostly sugar with an average composition of 38.5 percent fructose, 31.0 percent glucose, 17.1 percent water, 12.9 percent maltose, sucrose and other sugars, and 0.5 percent proteins, amino acids, vitamins and minerals. Over the past some years, honey bees have been faced with many threats including pest and diseases. Bees are found to infect with different pathogenic organisms such as fungi, virus, bacteria and protozoan organisms. In many states, the land is favorable to bees, but also for different kinds of honeybee pests and predators. Pests and predators result in a great damage on honey bee colonies with in short period of time and identified as major problem for the adoption of improved honey bee keeping. Several surveys have been made on the existence of honey bee diseases, several pests and predators found that many of honey bee diseases and pests have been reported in various countries. Honey bees predators are causing a significance economic loss in honey bees and their products. Historical evidence from various countries suggests that there is a significant relationship between the success of apiculture industry and the control of honey bee pests [1, 2].

A pest can be as an organism that causes or is perceived to cause, or is likely to cause economic or aesthetic damage to humans or their property. Many introduced and native animals have turned to pests and established large populations across many states. Many vertebrate animals expose humans to dangerous pathogens that have public-health significance, and also cause damage to agricultural crops. Vertebrate pests including birds, mammals, or reptiles and a number of introduced animals have established large and widespread populations. Total estimated losses reported amounted to millions of dollars annually and loss estimates for the various pest species are probably grossly underestimated because many states with problems could not or did not provide loss estimates. Bears represent the major vertebrate pest as based on severity of damage to colonies. Although bears prefer immature bees, they also will eat honey, depending upon the alternatives. Skunks and house mice represent the next most important species from a damage point of view, with annual damage averaging to several million dollars. Skunk and house mouse damage, although less severe than that of bears, is far more frequent and widespread. These and a variety of minor vertebrate pests are discussed along with methods or techniques used for their prevention and control. The principal method of damage prevention is the use of electric fencing for bears, while trapping is the most used method for control of skunks. Exclusion is considered the best means of resolving house mouse problems. In this article, information concerning vertebrate pests of beekeeping has been gathered and assembled from published articles [3, 4].

2. Vertebrate Pests of Honey Bees

Bee keeping in tropical climates frequently suffers from damage caused by different vertebrate pests. In many countries honey bee predators have been reported from all the classes of vertebrate animals. Reptiles, frogs, toads, birds, lizards, mammals like, monkey or apes, mice and honey badger are reported as predators of honey bees in several studies by bee keepers. According of the respondents these honeybee enemies are causing great losses (40.7%) of total honey production per

annum. In few localities, there are reported honey badgers (*Mellivora capensis*) as a series predator causing considerable amount of honey lost and causing absconding. The predator also reported causing damage in colony of honey bees in month of November and April. Bees are virtually defenseless against predation of by birds. The heavy traffic of bee flying in out of hive provides as source of food for different bird species. For example birds such as: bee- eaters (*Merops apiaster, Merops orientalis*), swifts (*Cypselus* species, *Apus* species), drongos (*Dicurus* species), Shrikes (*Lanius* species) and wood peckers (*Picus* species) are reported as predators of honey bees. Bee eating birds are described as problem in colony of honey bees. In few local zones birds are reported to eat bees by breaking the hives at night and other bird predate bees by waiting around the hive. These birds weaken the hive and reduce the quantity of honey harvested, for instance, bee eating birds such Aardvark (Orycteropusafer) [5, 6].

2.1. Human and Beekeeping

Conceivably, the greatest destroyers of honey bees are man and can vandalize, steal and burn the bees. In the some regions of few countries hunting of wild honey bees is practiced frequently. Peoples never keep bees, but harvest wild bees from caves o cracks using indicator birds and numbers of bees are burned through fires. Man is also reported as predators or robbery of bees in rural bee keeping areas of developing countries. Peoples are probably the most destructive wherein honey crops may be stolen, or brood and combs can be consumed on the spot. Occasionally, entire hives are made off by man in bee keeping areas. Finally, note the areas where intensive modern agriculture is practiced or the loss of bees through human misuse of pesticides is probably greater than loss from all other causes taken together. Further, some addition or reduction of bee forage by large-scale urbanization is deleterious to bee populations [7].

2.2. Amphibians and Control

Animals in the class Amphibia spend part of their lives under water and part on land, and amphibians must keep their skin moist by periodically returning to wet areas as well as to reproduce because their eggs would dry out otherwise. Frequently, beekeeping in tropical climates suffers from damage caused by amphibians such as toads including *Bufo melanostictus* and *Kaloula pulchra*, and frogs including *Rana limnocharis* and *Rana tigrina*. The detection of this problem generally requires close observation and beekeepers are normally unable to observe intense predation by amphibians on honey bees in the daytime, when they are at work in their apiaries, because the heaviest attacks occur at night. Often the problem goes unrecognized until a substantial fall in colony populations is perceived. One sign indicating that toads and frogs are praying heavily on the colonies is the presence of the predator's dark brown droppings, scattered in front of the hive entrance. If the dry fecal deposits are spread apart (e.g., with a twig), the remains of bee parts can be seen. Continuous predation by toads and frogs, if not prevented, it results in a loss of colony strength. While colonies with moderate or larger worker populations can withstand the predation and subsequently recover their full strength, weaker colonies are at considerable risk. Toads and frogs have similar attacking patterns and on arriving at the colony, the amphibians wait in the vicinity of the hive entrance, preying on passing bees. Colonies close to the ground provide easy access to the predators, for which guard bees at the hive entrance are easy prey. If the attackers are small enough to squeeze through the hive entrance of a weak colony, the outcome can be devastating severely. In some circumstances, although predation on honey bee colonies by amphibians cannot be overlooked most beekeepers perceive the problem as minor. Placing the hives on stands from 40 to 60 cm high is usually a sufficient protective measure. Where large numbers of the predators tend to congregate near an apiary, it may be necessary to fence it with fine-mesh chicken wire. Other methods such as trapping, baiting or poisoning have not been advocated [8].

2.3. Reptiles and Control

The class Reptilia has lungs to breathe on land and skin that does not need to be kept wet, and amniote egg shell protects the embryo from drying out. Geckos, skinks and other lizards are among the most commonly found reptiles in tropical jungles, woods, grasslands and urban areas. Among the reptile species that are regularly recorded as present in commercial apiaries are the tokay (*Gecko gecko*), which can be as much as 35 cm long, *Calotes* spp., *Acanthosaura* spp., and the skink *Sphenomorphus* spp. Arboreal reptiles such as many geckos and skinks can attack bees either near the hive entrance or on the limbs of flowering trees visited by forager bees. Smaller lizards, such as the gecko *Hemidactylus frenatus*, often hide in the empty space between the outer and inner covers of the hive. In tropical areas, this type of predator frequently causes the sudden loss of the queen from a weak colony. The beekeepers can do little efforts to prevent the loss of foragers to the highly mobile arboreal reptiles, usually well hidden in the trees. Beekeepers can destroy as many of bee as possible when they are encountered, though this method is not recommended nor is it efficient. Hives placed on stands that are about 40-60 cm high are reasonably safe from reptiles attacking from the ground; coating the legs of the stands with used engine oil or grease may deter the reptiles from climbing up to the hive entrance. A well-kept bee yard that is frequently mowed, without dense bushes, shrubs and tall grass, that can provide safe hiding places to the predators, has less chance of suffering losses from reptiles than an untended one. No reliable chemical control of reptiles is available for use in apiaries [9].

2.4. Birds and Control

The class Aves includes all the birds and they also produce amniote eggs, but usually try to give bees with the greater protection from predators by laying them high off of the ground or in other relatively inaccessible locations. Birds prey upon many insect species and honey bees are no exception. Once airborne, the bees are virtually defenseless against birds, several species of which can tolerate their venomous stinging defense. The heavy traffic of bees flying in and out of the hives of commercial apiaries provides an exceptional opportunity for insectivorous birds, large numbers of which may be attracted by this situation. Birds that have been listed as attacking honey bees in include bee-eaters (*Merops apiaster*, *Merops orientalis*), swifts (*Cypselus* spp., *Apus* spp.), drongos (*Dicurus* spp.), shrikes (*Lanius* spp.), woodpeckers (*Picus* spp.), and honey guides (Indicatoridae). The level of damage caused by apivorous birds varies. An attack by a single bird or by a few together rarely constitutes a serious problem, but when a large flock descends upon a few colonies or an apiary, a substantial decline in the workers population in some or all the hives may be observed. Whereas the degree of damage to commercial apiaries caused by

predatory birds depends largely on the number of the predators and the intensity of the attack, the mere presence of a few predators in apiaries engaged in queen rearing can inflict serious losses. While beekeepers regard insectivorous birds as pests, sometimes serious, other branches of agriculture generally do not consider them as problematic. In fact, birds that prey on insects are mostly considered to be beneficial to farming, in that they help in the control of insect pests. For this reason, before any attempt is made to solve the apiary's bird problems by mass killing of the predators, whether by chemical or physical means or by gunshot, the implications of this action on the environment must be seriously taken into account. Where heavy predation by birds on apiary bees tends to occur at fixed periods (e.g., during the migration season of swifts), the most practical means of solving the problem is usually to avoid the birds, through careful site selection and by temporary relocation of the apiaries, at least until the migration period is over [10].

2.5. Mammals and Control

All members of mammalia conceive their young within the reproductive tract of the mother and after birth nourish them with milk produced by their mammary glands, and they have a variety of specialized teeth. Many groups of mammals may be considered as enemies of the honey bees. In general, they prey on colonies for honey or brood; some attacks are purely accidental or the result of animal curiosity. Such cases usually occur when apiaries are placed in or near forests and are not properly protected. In Asia, as well as in most other parts of the world, beekeepers face the problem of colony destruction by bears. It has been said that once a bear has tasted honey and brood, it is almost impossible to keep it away from apiaries. Protecting colonies from bear attack is usually difficult, particularly when the animals are large and strong. Electrified barbed-wire fences are often used where bears represent a common problem; shooting and trapping them are other possible but very temporary control measures, which may go very much against efforts by others to manage and conserve sufficient numbers of large mammals in mostly declining populations. Moving hives closer to human habitation may be much more effective.

In several tropical countries of Asia, monkeys and other primates have been mentioned as pests of honey bees, opening hives and consuming honey and brood. As a result, frames are destroyed and colonies may abscond. Discouraging such behavior by wiring lids to boxes and boxes to each other may be a solution. Other options may include suspension of the colonies, particularly for small-scale beekeepers. It is important to note that among the primate pests of honey bees, peoples are probably the most destructive [11].

2.5.1. Black Bear and Control

Bears are the most notorious of all the mammalian bee pests because they can literally wipe out an entire apiary in one night. However, bear risks depend largely on where beekeepers live. In majority areas, bears are primarily a problem in the mountains and sears enter a bee yard to feed on the honey and brood. Bears can usually only affect one to three colonies a night, but may continue to return until all the colonies in the apiary have been destroyed. Bears are very attracted to honey and bee brood, and may suddenly decide a hive is worth visiting if they cannot find adequate food during a lean season. During spring, when hungry bears awake from their winter hibernation, and fall when bears are building fat reserves in preparation for winter, are the most likely times for a bear to visit bee hives, but bee yard is vulnerable almost any time of year.

If a bear visits bee hive, the damage might be minimal, such as just scattered boxes, and few claw swipes across frames are seen in the, or it can be more extensive, with hive boxes destroyed and frames ripped apart or even missing. But the worse is that once a bear develops a taste for bees and bee brood, he will be back for having more even visiting the same hive several nights in a row [12].

As bears eat bees, brood and honey, and destroy hives, so, these are sometimes hard to control. Select apiary site to avoid home range of bears and away from trees. Electric fences are one solution against a hungry bear, but depending on its determination, nothing may deter him from getting to the hives and destroying them. So for a beekeeper, one of the most effective ways to prevent black bears from damaging beehives is to put up electric net fencing. Install baited (some beekeepers recommend baiting the fence with bacon to get the bear to stop long enough), electric fence (at least 2,000 volts) around bee yard and fences can be charged with batteries, solar or electricity directly. Beekeepers must keep vegetation clear under the fence, or else the charge will not be significant enough. Bears can sense from some distance whether a fence is charged or not, and they can walk right through it if it is not charged. In fact, once a bear acquires a taste for honey, sometimes the best defense is just to move the colonies to another site [13].

2.5.2. Mice Damage to Combs

Mice nest in hives and destroy combs or build nests in corners away from the bee cluster as they do not like to be stung. Mice are primarily a problem in fall and winter, with hives located near woodlots or fields and bees would not clean out mouse urine, which they find repellant. Adult mice move into bee colonies in the fall and usually nest in the corners of the lower hive body, away from the winter cluster. Bee colonies located near fields or at the edge of wood lots where mice are common are especially vulnerable. Mice can build a nest successfully even in a strong colony, and they move in and out of the colony while the bees are clustered. Their activity may disturb the bees, but their nest building causes the greater damage to combs and equipment [14, 15].

Mice are a pest of stored combs and unoccupied combs in bee hives, usually in the fall and winter. They chew the combs, eat pollen, and build nests among the combs. In the late fall, hive entrances should be reduced to 3/8 inch in depth either by entrance cleats or by reversing the bottom board to the shallow side. Excluders or tight covers on stacks of stored combs will help to keep them mouse-free. Since mice may chew into the supers, storage areas should be protected with bait boxes containing an effective mouse poison. In apiaries where mice are a serious problem, poison bait may be placed beneath the hives or in bait boxes within an empty hive. Use all poisons with care, keep them out of reach of children, and follow the directions on the labels.

Mice are a serious pest of stored comb and wintering honey bee colonies. These rodents chew combs and frames to make room for building their nests. They also urinate on combs and frames, making bees reluctant to use the combs or clean out these nests in the spring [16, 17].

For keeping the mice out, beekeepers should restrict the entrance to bee colonies with entrance cleats or three-mesh-to-the inch

hardware cloth early in the fall. Chase out any mice found inside a colony, then remove the nest and insert the hardware cloth. If comb chewing is extensive, replace the frames. When bees repair damaged beeswax comb, they often replace worker-sized cells with drone comb. For better mouse control, reduce the lower hive entrance in fall, chase away mice already in or around hive, destroy nests, replace chewed frames so bees would not replace worker cells with drone cells, and take care to exclude mice from stored frames and hives as well [18].

2.5.3. Skunks, Raccoons, Opposums and Control

Skunks, Raccoons and Opposums feed at beehive entrances at night, when they are less likely to be stung, and it is not unusual to find several in one apiary. Primarily these are a problem in spring, Scratch at entrance where they eat the defending bees, known to feed for an hour or more, and cause bees to become more defensive. Skunks feed on bees at night by scratching at the front of the hive and eating the bees as they come out to investigate the disturbance. Peoples rarely trap skunks for their pelts, so the animals are increasing in numbers in many areas. The skunks weaken the colonies by eating large numbers of bees and are most damaging in the fall and winter after brood rearing has ceased. They also make the colonies mean and difficult to handle. If a colony suddenly stings more often and more bees fly around veil, look for scratching in the soil at the front corners of the hives. Where skunks are numerous, they may dig enough to leave a trench in front of the hive. Their presence can also be detected by fecal pellets that are composed largely of honey bee remains. Control of skunks is by trapping or poisoning them according to recommendations of the county agent or extension adviser. Exclusion and prevention include habitat modification, snap traps, glue traps and live traps, and poison baits in tamper-resistant bait stations (the last option for an occupied structure). Look for animal scat and bee parts near hive, staple chicken wire to bottom board and stretch in front of hive to discourage. Add an upper entrance, install a fence around bee yard and keep colonies on stands more than 1.5 inches high [19].

2.5.4. Badgers and Beekeepers

This animal got its name because one of its favorite meals is bee larvae, which is even deeper inside the hive than honey. The energy a badger can get from chowing on larvae is worth the possibility of being stung to death. Honey badgers favor bee honey and will often search for beehives to get it, and they can and do cause substantial losses to both traditional and commercial beekeepers. Apart from man, they are the most destructive mammalian predators of honeybees. While honey is not a necessary part of a honey badger's diet, the highly nutritious bee brood is a sought after delicacy, and this brings them into conflict with beekeepers. They are also carnivorous, and can also eat insects, frogs, tortoises, rodents, turtles, lizards, snakes, eggs and birds. Predictably, hives are most frequently damaged by badgers in areas where they are placed on the ground in indigenous vegetation that supports both good bee forage (flowering plants) and healthy populations of badgers. Throughout areas, where badgers still occur, traditional beekeepers hang their bark hives from trees to minimize damage from pest as they have done for generations. Most beekeepers prefer to raise their hives on stands or trestles at least a meter off the ground to keep them out of reach of the badgers, and they can also be secured on the ground with metal straps, pallets or wire [20].

2.5.5. Problems from Livestock

Honeybees have a terrible time when livestock like cattle, goats, horses, etc. may try to scratch against hives or accidentally knock them over while browsing. As a consequence, locate hives outside of grazing pastures or fence them to protect from animals.

3. General Measures for Bee Protection

In tropical regions, it is virtually impossible to keep honey bee colonies free of vertebrate pests for long periods of time. The vast land-mass carries millions of feral nests of native species, constituting great reservoirs of pathogenic microorganisms and parasites almost certain to be transmitted or transferred to commercial hives whenever the ranges of distribution of the bees overlap. Drifting, robbing and foraging on the same blossoms are among the most common means of pest's transmission and parasite transfer. While each specific honey bee vertebrate pest calls for its own specific control methods, the subsequent general recommendations, if properly adopted, can assist in preventing or at least reducing damage to honey bee colonies. The strenuous efforts should be made to maintain vigorous colonies, with large, healthy worker populations, good laying queens and adequate honey and pollen stores. This is only possible with a constant sufficient pollen and nectar supply. The number of hive boxes and combs should be adapted to the colony strength. Predators are likely to significantly weaken colonies that should be properly controlled. Apiary sites should be selected with much care wherein strong winds, damp, unhygienic conditions and lack of food should be avoided. Colonies must be protected against poisoning by pesticides, and frequent surveys should be made of the level and types of pesticides used within the foraging range of the bees. All hive parts and equipment should be kept clean and in good working order. Hives should be kept on stands, and apiaries should be securely fenced, whenever the danger of predators renders these precautions necessary. Hives should be manipulated with great care and all practices likely to induce robbing or cause bees to drift should be avoided, including overcrowded apiaries [21].

3.1. Other Measures

Generally, good beekeeping practices are the best prevention than drugs. Mechanical control may be the best first and second choice, and certainly it is the safest where contamination or risk to human health is concerned. Raising awareness of neighbors, farmers and others about the benefits of the bees for health products and pollination may create better agricultural practices and thus better foraging and less toxicity to bees. Awareness rising could therefore be considered a very effective preventive method as well as one that increases productivity. Hive disturbance, by beekeepers, outsiders and other non-beekeepers, should be kept to the absolute minimum. The utmost care in the choice and use of chemicals for pests control cannot be over emphasized, as most of these substances easily contaminate hive equipment and honey, create resistance in the pathogens and weaken the bees. Organic beekeeping methods rely on control methods that are beneficial to the bees, bee products and human health [22].

3.2. Providing Education to Bee Keepers

Controlling of honey bee pests require intensive knowledge of recognizing and detection of these different damage causing organisms and pests in colony of honey bees. It is recommended

to provide educational delivery through extension service to bee keepers on management of honey bees, detection of pests in and around brood, and how to manage the problems [23].

4. Conclusion

Honeybees have a terrible time, actually bees are perfectly happy by feeding from probably the commonest flower and it may be that these are healthier when they feed on a wider range of nectar and pollen sources. Vertebrate pests, while are not as numerous or pervasive as disease or invertebrate problems, they can occasionally be a real concern to bees from time to time. Many hives have lost their bees over the past many months, and bears pose the greatest threat to honey bee colonies since they can destroy an entire bee yard in their quest for honey and brood. Bears eat bees, brood and honey, and they destroy hives and are very hard to control. Generally, mice, skunks, raccoons, opossums, birds, amphibians and reptiles are considered only minor pests of honey bees. Mice make nests in hives and destroy combs during the fall and winter months. Rodents build their nests in corners away from the bee cluster so they do not get stung by bees. Mouse urine is partially repellent and will not be cleaned out by the bees in the spring. Mouse problems in beehives are most likely to occur in apiaries located near woodlots or in fields. Skunks, raccoons and opossums feed at beehive entrances at night (when bees are less likely to sting) primarily during the spring, but also during summer and fall. They scratch at the entrance and when bees come to defend the colony, the invaders eat the bees. These mammals have been known to feed for an hour or more and this feeding activity causes bee colonies to become more defensive and aggressive. Insectivorous birds, blue jays in particular, eat honey bees as they are entering or leaving the hive and they can be a severe problem in queen-rearing operations. Amphibians and reptiles can also eat honey bees, but they are not so serious pests. When attempting to manage a vertebrate pest there are many things the beekeepers need to be considered first. Before beginning any direct control action, such as the use of traps or poison baits, think if there are alternative ways the animals can be managed. First, is control really necessary, as there are several variables that should affect beekeepers decision, for example, what kind of animal is it because positive identification of the pest is essential for effective management. This must often be done by studying the signs left by the animal as most vertebrates are nocturnal or difficult to observe. How much damage might occur without any control and what are the benefits of control versus the cost of damage. In other words, take into accounts which are the economic or aesthetic thresholds of pest. Is there any aesthetic or recreational value of the species involved, or are they legally protected that may limit the action beekeepers would otherwise take. Finally, consider what can be the effect of a control program on non-target animals and the environment. Once beekeepers have considered these things, and they still believe that a control program is called for, there are usually several options depending on the pest to be managed. Ideally, the steps that beekeepers want to do for eliminating or repelling the pest animal, or change its bad habits might be in a way that should not endanger humans, other non-target animals or the environment. The program should be underpinned by a beekeeping code of practice, as well as a bee biosecurity officer in each state to conduct inspections, as well as educate and train beekeepers in best biosecurity practice.

5. References

1. Lowe SJ, Browne M, Boudjelas S. 100 of the World's Worst Invasive Alien Species. The Invasive Species Specialist Group (ISSG), a specialist group of the Species Survival Commission (SSC) of the World Conservation Union (IUCN), Auckland, New Zealand, 2000, 12.
2. Veitch CR, Clout MN. Turning the Tide: The Eradication of Invasive Species. Proceedings of the International Conference on Eradication of Island Invasives. Publisher IUCN, Switzerland, 2002, 414.
3. Clout MN, Williams PA. Invasive Species Management: A handbook of principles and techniques. Oxford University Press, 2009, 332.
4. Veitch CR, Clout MN, Towns DR. Island Invasives: Eradication and Management. Proceedings of the International Conference on Island Invasives. Gland, Switzerland: IUCN and Auckland, New Zealand: CBB, 2011, 542.
5. Desalegn B. Some major pests and predators of honeybees in Ethiopia. Published in 3rd Proceedings National Conference of Ethiopian Beekeeping Association. Addis Ababa, Ethiopia, 2001, 59-67.
6. Desalegn B, Yosef K. Survey of honeybee pests & pathogens in Addis Ababa region. Published in 5th Proceedings National Conference of Ethiopian Beekeeping Association. Addis Ababa, Ethiopia, 2005.
7. Solomon B. Indigenous knowledge and its relevance for sustainable beekeeping development: A case study in the Highlands of Southeast Ethiopia. Livestock Research for Rural Development. 2009; 22(11):11.
8. Krochmal A. The cane toad - a future threat to Florida's Beekeepers? Am. Bee J. 1986; 126:451.
9. Sanford T. Diseases and Pests of the Honey Bee. Florida Cooperative Extension Service. Institute of Food and Agricultural Sciences, University of Florida, 2003, 13.
10. Johannsmeier M. Some Bee Diseases & Pests Affecting Beekeeping in Southern Africa. Plant Protection Research Institute, 1995, 3.
11. Tesfay H. Honey Bee Diseases, Pest and Their Economic Importance in Ethiopia. International Journal of Innovation and Scientific Research. 2014; 10(2):527-535.
12. Maehr DS. Black bear depredation on bee yards in Florida. In: Proc. 1st Eastern Wildl. Damage Conf. (DJ. Decker, ed.), Cornell Univ., Ithaca, N, 1984, 379.
13. Garshelis DL. Nuisance bear activity and management in Minnesota. In: Bear-people conflicts: Proceedings of a symposium on management strategies (M. Bromley, ed.), Northwest Territories Dept. Renew. Resour, Yellowknife, Northwest Territories, 1989, 246.
14. Sarwar M, Ashfaq M, Baig MY. The Species Complex, Damage Pattern and Control of Rodents (Mammalia: Rodentia) in Sugarcane (*Saccharum officinarum* L.) Fields. International Journal of Agronomy and Plant Production. 2011; 2(4):145-150.
15. Sarwar M. Pattern of Damage by Rodent (Rodentia: Muridae) Pests in Wheat in Conjunction with Their Comparative Densities throughout Growth Phase of Crop. International Journal of Scientific Research in Environmental Sciences. 2015; 3(4):159-166.
16. Sarwar M. The Species Diversity, Seasonal Variation and Abundance of Rodents (Mammalia: Rodentia) Along With Their Burrows Distribution Pattern in Wheat Farmland.

Journal of Basic and Applied Research International. 2015; 5(1):48-55.
17. Sarwar M. Species Complex, Damage Pattern and Efficiency of Rodenticides in Controlling Rodents Attacking Rice (*Oryza sativa* L.) Fields. International Journal of Animal Biology. 2015; 1(5):202-208.
18. Sarwar M. The Rodents (Mammalia: Rodentia) - Gnawing Away on Crops and Options for the Integrated Pest Management at Field. American Journal of Marketing Research. 2015; 1(3):136-141.
19. El-Niweiri MA, El-Sarrag MSA, Satti AA. Survey of vertebrate pests and predators of honeybees (*Apis mellifera* L.) in Sudan. Albuhuth, 2008; 12(2):11-22.
20. Baryshnikov G. A new subspecies of the honey badger *Mellivora capensis* from Central Asia. Acta Theriologica. 2000; 45(1):45-55.
21. O'Brien JM, Marsh RE. Vertebrate pests of beekeeping. Proceedings of the 1990 fall Annual Conference, Apiary Inspectors of America, Tucson, Arizona, 1990, 25-29.
22. Hans Hunter K, Hunted. Relationships between Carnivores and People. Cambridge University Press, 2002, 94.
23. Suresh E, Zethner O, Wren S. Forest habitat conservation in Africa using commercially important insects. 2010, 468.