American Journal of Economics, Finance and Management
Vol. 4, No. 4, 2018, pp. 116-123
http://www.aiscience.org/journal/ajefm
ISSN: 2381-6864 (Print); ISSN: 2381-6902 (Online)

Ectoparasitic Insects Genera of Veterinary Importance and Some Aspects of Their Control

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Abstract

Agricultural animals (those used for production of food and fibre- livestock) and companion animals (pets such as dogs and cats) may be affected by arthropod pests. Insects as veterinary ectoparasites have a significant impact on the health, wellbeing and productivity of their animal vertebrate hosts. These impacts can be either direct, through tissue damage and blood loss, or indirect, through their role as vectors of viral, bacterial, protozoa and helminth pathogens. A second category of indirect effects are those that result from the alteration of host behaviour induced by arthropod attack and blood-feeding activity. So, the present article aims to contribute fundamental scientific knowledge in the areas of insects as veterinary ectoparasites and also the processes ensuring to the public for underlying the protection from biting and diseases borne. The insect ectoparasites include flies (Diptera), lice (Mallophaga), fleas (Siphonaptera) and bugs (Hemiptera). These insects have a profound impact on the health of animals by causing annoyance, inflicting bites and stings, and transmitting of diseases. Animals can be greatly annoyed by the presence and activity of certain insects. For example, cattle will bunch up and put their lowered heads together to seek relief when fly strike is severe; scratching may be symptoms of fleas or lice; and head shaking may indicate the presence of insects in ear. Animal owners or veterinarians may make medical judgments on the basis of symptoms caused by insects to use as a basis for management decisions. These pests often must be managed, controlled or prevented to improve the living conditions, health and wellbeing of animals. Early pests detection can reduce or prevent the discomfort that would be caused by the insects. When preventive methods are not sufficient to keep nuisance species away, animal owners can choose the methods which have low health and environmental impacts. The principles of integrated pest management (IPM) apply to the operational practice of pest control for animals, whether the pests are actually on the animals or in the environment the animals occupy. Integrated pest management strategies include biological, cultural, mechanical, physical, chemical (pesticides), use of resistant breeds, sanitation in the animal's environment and legal quarantines to prevent spread of pests. Always consult a licensed veterinarian to find or identify the pest problem and never attempt a diagnosis that should be made by a veterinarian.

Keywords

Veterinary Entomology, Blood-Feeding, Disease Potential, Insect Parasite

Received: March 7, 2018 / Accepted: April 3, 2018 / Published online: December 21, 2018

1. Introduction

The field of veterinary entomology deals with arthropod pests and vectors of disease transmitting agents to livestock, poultry, pets and wildlife. Relatively few insect species are involved, but their serious social and economic consequences occur. Insects have a huge impact on the health of domestic animals. They cause irritation and diseases, transmit diseases (vectors), inject venoms and transmit allergens, cause

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wounds, and cause nuisance. There are four orders (a major taxonomic grouping) of insects with species of veterinary importance. The main insect pests of veterinary concern in these orders are sucking and biting lice, biting flies, nonbiting muscoid flies, bot flies and fleas [1-2].

Veterinary ectoparasitic insects have a significant impact on the health, wellbeing and productivity of their vertebrate animal hosts. These impacts can be either direct, through tissue damage and blood loss, or indirect through their role as vectors of viral, bacterial, protozoa and helminth pathogens. A second category of indirect effects are those that result from the alteration of host behaviour induced by arthropod attack and blood-feeding activity. The insect ectoparasites that affect animals can be categorized by the intimacy of their host association, and these range from permanent ectoparasites to pests that contact the vertebrate only briefly once every few days. Veterinary ectoparasites may also be classified according to several criteria; the body site they occupy, the rigor of the host association and the duration of the host association. Ectoparasites thus may be internal, burrowing into host tissues or living in body cavities (e.g. myiasis producing fly larvae), or external, living on the host skin for various periods where they either feed on blood obtained through piercing/ sucking mouthparts or they live on skin debris, hair, sebaceous secretions and plasma [3].

Ectoparasites are known mainly from insect orders Diptera (flies), Siphonaptera (fleas), Mallophaga (lice) and Hemiptera (true bugs). Occasional ectoparasitic species are found in other orders, including Coleoptera (beetles) and Lepidoptera (butterflies and moths). Rare occurrences of animal parasites are also noted in these orders; e.g., *Platypsyllus castoris* Ritsema the beaver beetle (Coleoptera) found on the North American beaver (*Castor canadensis* Kuhl) and several examples in the Lepidoptera where blood feeding or feeding on lachrymal secretions are known [4].

Living in harmony with nature is all very well, but some insect species simply are not welcome in our homes. With that in mind, this article has outlined various ectoparasitic insects, their annoyance and methods for minimizing their presence.

2. Different Types of Ectoparasites

An ectoparasite lives externally on another animal, but does not kill it. Most common insect ectoparasites are divided into following groups:-

2.1. Permanent Ectoparasites

Some arthropods, such as lice, complete their entire life cycle on the host. All stages of sucking lice (Phthiraptera, suborder Anoplura) are mammal parasites and feed on blood. Biting lice (suborders Amblycera and Ischnocera) use either mammal or bird hosts. They feed mostly on skin, hair and feather debris, but sometimes feed on blood as well. Lice tend to be abundant in cool weather or on animals stressed by poor nutrition or overcrowding. Many lice are specific to one or a few closely related hosts and cannot survive more than one to a few days away from the host. Their transmission from host to host is mostly by direct contact. Some of the more advanced flies are also permanent parasites and a number of species in three families hardly resemble flies at all because they have secondarily lost their wings (apterous). Members of the dipteran families Streblidae and Nycteribiidae live on bats, whereas members of the Hippoboscidae parasitize various birds and mammals. Some hippoboscids are economically important, such as the sheep ked, *Mallophagus ovinus* L. In all these families, the adult females nurture a single larva within her body until it is mature; this is a very unusual pattern for insects. After the mature larva exits the female, it promptly pupates on the host or nearby. Within Mallophaga order, lice are included, but the most importantly, Anoplura (sub-Order) sucking lice [Hog louse (*Haematopinus suis* L.)], Ischnocera (sub-Order) and Amblycera (sub-Order) chewing lice [cattle biting louse (*Bovicola bovis* L.)] are significant parasites [5].

2.2. Semi-permanent Ectoparasites

The semipermanent ectoparasitic arthropods do not complete their entire life cycle on the host, but they do spend at least several days at a time on a vertebrate. Fleas (Siphonaptera) generally are on a host for most or all of the adult stage and feed on blood. Flea eggs fall from the host pelage into a nest environment, where the larvae feed on organic debris and sometimes on excess blood produced by the adults. Fleas thus are often lacking on hosts that do not return to long-term bedding areas or nests. The Siphonaptera fleas are a cosmopolitan group of obligatory parasitic insects of birds and mammals. About 94% of flea species live on mammals and the rest on birds. Important species are Oriental rat flea (*Xenopsylla cheopis* Rothschild), the northern rat flea (*Nosopsyllus fasciatus* Bose), cat and dog fleas (genus Ctenocephalides), ground squirrel flea (*Diamanus montanus* Baker), European mouse flea (*Leptopsylla segnis*), rabbit flea (*Cediopsylla simplex*), sticktight flea (*Echidnophaga gallinacean* Westwood), *Tunga penetrans* L., and *Tunga trimamillata* Bose (Chigoe Fleas). Cat flea (*Ctenocephalides felis* Bouche) of Pulicidae Family, and dog flea (*Ctenocephalides canis* Curtis) are cosmopolitan parasites of various mammals, including cats, dogs, foxes, raccoons and rodents. Their infestations in households are common. Both fleas can serve as intermediate hosts of the cestodes

Dipylidium caninum (dog tapeworm) and *Hymenolepis nana* (dwarf tapeworm), and may occasionally bite [6].

Among the Diptera the vast majority of species are free-living; however, there are several taxa whose larval stages (maggots) feed on the living tissues of hosts. There are a diverse group of dipterans whose adult stages are blood-feeders and which are vectors of significant veterinary diseases. Among Diptera, all flies are included in this order, for instance, Nematocera (sub-Order), Culicidae (Family) mosquitoes, Ceratopogonidae (Family) midges, Psychodidae (Family) sandflies, Simuliidae (Family) blackflies, Brachycera (sub-Order), Tabanidae (Family) horse-flies, Muscidae (Family) house-flies, etc., Calliphoridae (family) blowflies, Glossinidae (Family) tsetse-flies, Oestridae (Family) bot-flies, and Hippoboscidae (Family) louse-flies. Among the flies these may be biting flies [stable fly, dog fly (*Stomoxys calcitrans* L.), mosquito, black fly, horse fly, deer fly, horn fly, biting midges, sheep ked]; non-biting flies [house fly (*Musca domestica* L.), face fly, eye gnats, other filth flies (flies associated with unsanitary conditions)]; and invasive flies (flies whose maggots invade and infest animal flesh). House flies (*M. domestica*) and face fly (*Musca autumnalis* De Geer), can be a nuisance when large numbers of flies disperse from fly development sites (e. g., animal facilities or waste management facilities) and accumulate in areas where they impact animal activities. When stable fly (*Stomoxys calcitrans* L.), numbers are high, they have been shown to reduce weight gains and feed efficiency in confined and grazing beef cattle, and may similarly affect milk production in dairy cows. It is estimated that significant economic losses can be expected when the number of stable flies on cattle exceeds 5 flies per leg [7].

Bot flies include important species in the dipteran families Oestridae, Gasterophilidae and Cuteribridae. They spend nearly the entire year as immatures within the vertebrate's body. Eggs, are often laid on hairs, which hatch and enter the host body. Horse bot larvae (Gasterophilus) attach to the wall of the gastrointestinal tract for several months before they pass from the host with feces to pupate in soil. Cattle grubs (Hypoderma) migrate through the lining of the esophagus or spinal cord, depending on the species and eventually form a cyst in the back. After a final period of maturation, larvae exit the cyst and fall into the soil to pupate. Bot fly adults lack functional mouthparts and depend entirely on reserves from the larval stage to sustain them for several days, and in this brief time they must find mates and hosts. The invasion of vertebrate tissues by fly larvae is known as myiasis. Certain other flies also are semipermanent parasites. Among muscoid Diptera, the horn fly *Haematobia irritans* L., is most damaging to cattle during its adult life, where adults of both sexes take many small blood meals each day. This distinguishes them from the vast majority of blood-feeding flies, which feed far less often. Horn flies leave the host to disperse and to lay eggs in very fresh dung and then return to the host [8].

Within Hemiptera (Order) bed bugs are intermittent feeders and do not reside on the host for prolonged lengths of time. Some members of the Hemiptera (true bugs) are important blood feeders as well as being vectors for protozoan diseases. Important members of the Hemiptera are Reduviidae (Family) assassin-bugs and Cimicidae (Family) bed-bugs. Adults bed bug are 4.0 to 5.0 mm in length when unengorged, reach nearly 1.0 cm when fully engorged and are broadly oval. They are dorsoventrally flattened and have an explanate (outwardly expanded and flattened) pronotum. Adults are flightless and have only the remnants of wing buds. They possess well-developed eyes and antennae and have piercing-sucking mouthparts [9].

2.3. Occasional Ectoparasites

The broad category of occasional parasites includes a range of insects. Their nymphs or adults hide in or near nest areas, shelter in cracks and crevices or under debris, thus, they are closely associated with animals, although they contact them only periodically. Many serious biting fly pests spend the immature period away from the host, exploiting an entirely different resource base. It is common for larvae to feed on detritus in wet habitats, whereas the adults use plant nectar for energy and blood for egg development. For example, larvae of stable flies live in rotting vegetation, black flies in running water, horse flies and biting midges in swampy mud, or mosquitoes in ponded or slowly moving water. When the adults emerge, they take blood meals at intervals of 1-4 days, but they typically are in contact with the host for only a few minutes at a time. They leave the host to digest the blood in some sheltered resting location. For the higher Diptera (Cyclorrhapha), such as stable flies or tsetse flies, both sexes feed on blood, and multiple blood meals usually are needed to develop a batch of eggs (or for tsetse, a single mature larva). In the lower Diptera (basal Brachycera and Nematocera) such as horse flies, blackflies, or mosquitoes, only females take blood, and most species require only a single large blood meal to develop an entire batch of eggs numbering 50-300. Some other pests in this general category do not feed on blood, but visit the host to take meals of tears or other protein-rich secretions that are also used to develop eggs. A good example is the face fly *M. autumnalis* [10].

2.4. Rare Ectoparasites

Rare occurrences of animal parasites are noted in other Orders e.g., *Platypsyllus castoris* the beaver beetle (Coleoptera) found on the North American beaver (*Castor*

canadensis) and the Eurasian beaver (*Castor fiber*), and several examples in the Lepidoptera where blood feeding or feeding on lachrymal secretions are known. Stinging wasps and ants sometimes bother animals, while some animals develop extreme allergies to insect bites, stings or secretions. Beaver beetle is placed in the family Leiodidae, it resembles a flea or a louse in appearance, flattened and eyeless, has no wings and no eyes, and its antennal clubs have the antennomeres numbered 3 to 11 shortened and partly enclosed in a scoop-shaped antennomere. Both adult beetles and larvae feed on epidermal tissue, and also perhaps on skin secretions and liquids oozing from wounds [11]. Although adult Lepidoptera are not often considered relevant, some butterflies and moths are notorious for their consumption of mammalian body fluids. These Lepidoptera are either blood-feeding or tear-feeding. Blood-feeding (hematophagous) Lepidoptera have been observed piercing the skin of their hosts during feeding, while tear-feeding (lachryphagous) Lepidoptera have been observed frequenting the eyes of hosts in order to directly obtain lachrymal fluid and can be sweat-feeding (sudophagous). Observations on feeding habits of the Lepidoptera genus *Arcyophora* have shown adult moths feeding nocturnally on the lachrymal secretions of cattle, horses, mules, donkeys and wounded antelopes, where many moths found sucking fluid, but no blood, from the eyes of a wounded animal [12].

3. Insects Damage to Animals

There are several basic ways in which insects cause damage to animals and through different mechanisms interact to impact livestock production. Insects damage to plant crops is often evident to consumers, but in contrast, insects damage to animal production tends to be hidden from the consumer because the product is purchased in the form of jugs of milk or wrapped packages of butchered meat. Nevertheless, insects losses are serious for producers and costs are passed on to consumers.

3.1. Loss of Blood and Tissue Fluids

Many insects ingest blood of hosts usually for eggs development. Impact of blood loss on the animal reflects the style of feeding and the number of arthropods. Mosquitoes may cannulate a vessel and hosts generally lose only the blood that mosquitoes ingest. In contrast, some biting flies macerate the capillary beds of the skin to feed from blood pools. They not only tend to inflict more painful bites, but the bites themselves also lead to a larger quantity of blood loss per feeding insect. For example, horse flies (Tabanidae) may directly remove over 200 ml day^{-1} from a host in a pasture, but blood continues to run from the wound for a period of time, often being fed on by other flies. Blood or fluids such as lymph are metabolically expensive for a vertebrate to produce. Such loss is reflected in reduced feed conversion efficiency, which occurs when animals eat more for a given yield of meat or eggs. Insect feeding also causes significantly lower weight gains or milk production. Losses of 10-20% feed conversion, 0.1-0.2 kg day^{-1} weight gain (cattle) and 5-10% loss in milk yield are not uncommon for animals under heavy attack [13].

3.2. Pain and Interference with Activities

Pain and irritation caused by insects attack force animals to alter their feeding or activity patterns and to engage in a number of sometimes vigorous behaviors to defend themselves. There may be economic loss as well, since animals are not feeding normally and must expend energy that might otherwise be directed toward growth or reproduction. For example, stable flies (Stomoxys) and face flies, as well as other biting flies, can cause animals to retreat into groups for refuge. In groups, insect attack rates usually are lower per host (the herd dilution effect), particularly for the animals that occupy the interior of an aggregation. Animals also may enter woods or bodies of water in an apparent attempt to escape insects. Cattle pursued by adults of cattle grubs (Hypoderma) experience no immediate pain from the flies, which cannot bite. The female flies try merely to deposit eggs on the cattle hair at the base of the legs. Still, cattle exhibit an interesting, stereotypical behavior known as ‘gadding’. The animals run at full speed with tails raised straight into the air, which expends energy and may cause accidental injury. So, vertebrate host behavior can be altered by parasites as in gadding behavior by a calf being attacked by cattle grub flies (Hypoderma spp.), wherein the tail is held up in the air. Although pests such as house flies may not cause direct losses to the animals, they are produced near animal operations and thus are a veterinary entomology problem. Animals can be greatly annoyed by the presence and activity of certain insects. For example, cattle will bunch up and put their lowered heads together to seek relief when fly strike is severe; scratching may be symptoms of fleas or lice; and head shaking may indicate the presence of insects in ear [14].

3.3. Allergic Responses to Saliva

Blood-feeding arthropods possess a potent arsenal of chemicals in their saliva to maintain blood flow (vasodilators, anticoagulants) and sometimes have anesthetics to reduce hosts defensive response. Like humans, animals can develop allergies to these compounds. Horses commonly react to biting midge (Culicoides) feeding with an allergic reaction called Queensland itch or sweet itch, resulting in skin inflammation and hair loss. Mass

emergences of the blackflies *Simulium arcticum* can result in the deaths of livestock, probably from allergic responses as well as blood loss. Larvae of sheep blowfly (Lucilia) feed near the skin surface, especially where the wool is wet and can contribute to a toxic shock-type syndrome fatal to infested sheep. Pets may develop serious allergies to fleas, resulting with hair loss and other symptoms [15].

3.4. Product Damage

Insects sometimes cause direct damage to body parts of the animal desired by people. For example, cattle grub (Hypoderma) larvae form large cysts in the backs of cattle, they cut a hole in the skin to breathe, and this skin is the thickest on the animal. Although the holes heal after the larva exits, the scarred skin is less valuable for leather. The presence of larvae also can affect the quality of the meat in this area of the animal, which is the part where the best steaks come from and damaged meat sometimes must be trimmed at the slaughterhouse. Many lice, often result in irritation, rubbing, and gross loss or damage to hair and wool. Cosmetic damage, including rashes or minor hair loss, can be predictably serious to the owner of a pet or a show animal [16].

3.5. Restricted Trade

Many insects have distinctive distributions and their preventing movement or dispersal into new areas is of paramount importance. Without complex systems of animal quarantine, treatment and examination, it is certain these pests would reestablish in an area. Exotic insects pose a great threat either as direct pests or vectors of disease agents such as those that cause heartwater or African swine fever. Bluetongue is a viral disease of ruminants, such as cattle and sheep, which is transmitted by biting midges, and trade restrictions from bluetongue cost to the cattle industry many millions of dollars annually, even though cattle themselves do not usually develop obvious disease. Some major trading partners lack bluetongue and their agricultural authorities fear an impact of bluetongue on their sheep industries, because sheep are more susceptible than cattle. Certain states are struggling with trade issues especially due to a persistent spreading outbreak of bluetongue extending as far other regions [17].

3.6. Transmission of Diseases

A number of serious animal disease agents are transmitted by insects. The worst of these are tropical regions and they cause death and heavy production losses in the affected countries. African trypano-somiasis causes a wasting-type disease known as nagana in animals and sleeping sickness in humans, and *Theileria parva* parasites cause East Coast fever (theileriosis), which can result 90-100% mortality in affected cattle. People in developed countries tend to underestimate the true value of animals in the developing world. Animals are vital there not only for protein-rich food, but for draft and transportation purposes, and as wealth. They are the basis of many pastoral peoples, economies, and the economic impact of some of these animal diseases can exceed even the impact of similar, serious human pathogens. Temperate zones also have some rather important insects-transmitted animal disease agents, including Anaplasma, dog heart-worm and equine infectious anemia virus. In certain states, the direct effects of arthropods on animal production generally exceed losses caused by insects-transmitted diseases. However, the role of wild animals as natural reservoirs of pathogens that incidentally infect people is very important in both temperate and tropical zones. Diseases that cycle naturally in animal populations and occasionally infect people are called zoonoses. Zoonoses comprise some of the more notorious arthropod-related human health problems. They include plague (maintained in rodents and transmitted by fleas), Lyme disease (maintained in rodents and transmitted by ticks [18], and St. Louis encephalitis (maintained in birds and transmitted by mosquitoes) [19].

4. Control of Ectoparasites

Ectoparasites control can be one of the most expensive and time consuming parts of being a livestock farmer. It is important to raise healthy animals for food and supplies. When working hard to prevent and fight ectoparasites from harming to livestock, many factors need to be considered, such as, the time of year, the type of animal and the conditions where it lives and is raised. It is important to realize that ectoparasites are not only an annoyance, but they can also transmit diseases and have an impact on the bottom line.

Flies are the most common ectoparasites affecting cattle in warmer climates. Flies that cause irritation and economic loss include the house fly, the heel fly, the horn fly and the stable fly. Horn flies are very costly to control, but cannot be ignored because horn flies consume up to a pint of blood each day. The heel fly, also known as cattle grubs, have a major impact on the economic value of cattle. The adult flies disrupt the cattle while they attach eggs to their fur. The larvae then burrow through the tissues, muscles and eventually the hide, causing considerable damage to the meat and hides. Flies can be controlled or limited with the use of sprayers, dust bags, back rubs, ear tags and mineral blocks. Louse populations can cause problems amongst a herd, but are usually kept under control with the use of preventive measures and insecticides. It helps to keep areas clean and

ventilated, and treat immediately when lice are detected. The spread of lice can be quick, so all newly acquired cattle should be checked and sprayed before being introduced to the herd. Winter months appear to have more lice infestations than the summer months [20].

The primary approach for management of ectoparasites is the application of insecticides to the animals, to their housing or to the environment in which the animals live. However, most of the economically important arthropods which have faced the onslaught of synthetic chemical control products have eventually developed resistance to those products. Resistance has often been the driving factor for the animal health industry to develop new classes of active ingredient, but with the staggering costs for development and registration, coupled with relatively small markets, the appearance of new classes has slowed or been focused on the companion animal sector. Management of resistance now largely involves planned alternation of insecticide classes or the use of products with combinations of classes. The logic behind these approaches is that the evolution of resistant genotypes against two distinct chemicals in sequence or in combination will be unlikely to occur [21].

4.1. Flies and Chicken Houses

Poultry operations have a tendency to attract lots of house flies. House fly levels must be maintained at low levels to prevent the disturbance of neighbors (humans). The best way to control house fly populations in poultry operations is by proper and concise manure management in order to rid a location of breeding material. Keeping manure dry or spreading it out on a field in a thin layer are successful ways of preventing fly breeding [22].

4.2. Companion Animals

Fleas can reach to high numbers very quickly during the warmer months throughout the year. Fleas are blood feeders that can cause anemia and even disease transmission. Mosquitoes are transmitters of dog heartworm disease, a deadly worm that move from the mouthparts of the mosquito into the body of cats and dogs. The adult worm grows inside the heart and will lead to animal death if left untreated. Organophosphate (OP) based dips offer a broad spectrum control against all major ectoparasites. However, there is continuing controversy over the safety to dip operators and the environment. The use of OPs is prohibited by organic standards, primarily because of concerns about mammalian toxicity. Organic farmers are permitted to use synthetic pyrethroids (SPs) (dip products and pour-on products) and or macrocyclic lactones (injectable products) to treat/ control ectoparasites providing a derogation has been obtained from the certifying body [23].

The practicality of genetic methods for control of arthropods that affect livestock production in the tropics is best documented in the results of the screwworms eradication program. The screwworm eradication program integrates the use of insect sterility with other appropriate measures to obtain population elimination. The basic sterilization mechanism utilized for control of screwworm reproduction is the induction of dominant lethality in the chromosomes of the released insects by irradiation. As a result of the practical success of that program, a substantial amount of laboratory and field study has been conducted on the use of artificially induced dominant lethality for control of tsetse flies, house flies, the stable fly, the horn fly, cattle grubs and mosquitoes. As an alternative to dominant lethality, the use of chromosome rearrangements (translocations, compound chromosomes, etc.), or hybrid sterility has been studied in mosquitoes, the sheep blowfly and ticks. The potential for substantial economic impact by the increased use of these techniques for control of arthropod pests of livestock in the tropics is very promising [24].

Effective, sustainable management of insects requires more thoughtful and planned integrated approaches that combine several techniques in a coordinated fashion. The integrated approach will reduce use of synthetic insecticides, reduced environmental contamination and non-target effects as well as reduce the development of insecticide resistance by the target insects. Consider all types of pest management strategies that protect animals from insect pests. Combining of several strategies achieves the most effective and efficient control. Integrated pest management strategies include biological, cultural, mechanical, physical, chemical (pesticides), use of resistant breeds, sanitation in the animal's environment and legal quarantines to prevent spread of pests [25-33].

5. Conclusion

Undoubtedly, insects are the most adaptable form of life living on earth habitats, oceans, swamps, jungles, deserts and even in highly harsh environments such as pools of crude petroleum. Among the insects, there are members of four orders that are considered ectoparasites. The insect ectoparasites include flies (Diptera), lice (Mallophaga), fleas (Siphonaptera) and bugs (Hemiptera). In this article, lifecycle information along with a description of the impact and approaches for control are provided for each group. Beside, a summary of diseases and disease agents vectored by arthropod parasites is also included. It is important to realize that ectoparasites are not only an annoyance, but they can also transmit diseases and have an impact on the bottom line. Insects management is a complicated business, but any

intervention must be well thought out, because some actions can have grave consequences for animals life or even humans. Ectoparasite control can be one of the most expensive and time consuming parts of being a livestock farmer. It is important to raise healthy animals for food and supplies. When working hard to prevent and fight ectoparasites from harming livestock, many factors need to be considered, such as, the time of year, the type of animal and the conditions where it lives and is raised. Livestock farmer should prefer preventive methods to get out the heavy artillery. And if drastic methods do prove to be indispensable, then livestock farmers must ensure that their impacts on health and the environment are minimal.

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