



Available online at <http://scik.org>

European Journal of Veterinary Medicine, 2014, 2014:7

ISSN 2051-297X

ECTOPARASITES AND THEIR DAMAGE IN BACKYARD TURKEYS IN OAXACA'S COAST, MEXICO

MARCO ANTONIO CAMACHO-ESCOBAR^{1,*}, JAIME ARROYO-LEDEZMA¹, NARCISO YSAC ÁVILA-SERRANO¹, MARTHA PATRICIA JEREZ-SALAS², EDGAR IVÁN SÁNCHEZ-BERNAL¹, JUAN CARLOS GARCÍA-LÓPEZ³

¹Cuerpo Académico Ciencias Agropecuarias. Universidad del Mar. Puerto Escondido, Oaxaca 71980, México

²Instituto Tecnológico del Valle de Oaxaca, Ex Hacienda de Nazareno Xoxocotlán, Oaxaca

³Instituto de Investigación en Zonas Desérticas, Universidad Autónoma de San Luis Potosí, San Luis Potosí, México

Copyright © 2014 Camacho-Escobar et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Abstract: The ectoparasites are major animal health problems in poultry farms, can be a health problem for themselves or vectors of various etiologic agents of disease. Therefore, the objective of this paper is to describe the main effects of the domestic turkey ectoparasites obtained from traditional breeding in backyard. Seventy five turkeys were examined backyard; the ectoparasites were collected for identification. *Menopon gallinae*, *Menacanthus cornutus*, *Oxylipеurus polytrapezius*, *Menacanthus stramineus*, *Chelopistes meleagridis*, *Oxylipеurus corpulentus*, and *Colpocephalum turbinatum*, lice species are identified. The last two are reported for the first time in domestic turkeys. Mites identified were *Dermanyssus gallinae*, *Megninia ginglymura*, *Ornithonyssus sylviarum*, and *Knemidokoptes mutans*. This is the largest list of ectoparasites in turkeys wild or domesticated reported until today. The lesions found were plucking dermatitis, skin irritation, mild to moderate, in the case of avian scabies severe injuries below the scaly skin of legs and tarsi. During the investigation there were two outbreaks of avian pox, related to the presence of ectoparasites. The backyard turkeys are hosts of a greater amount of ectoparasites, than those recorded for wild turkeys or turkey reared intensively, indicating that they are exposed to increased parasitic burden and this increases your chance of getting infectious diseases where external parasites act as vectors.

Keywords: backyard poultry, fowl pox, guajolotes, lice, mites, parasites.

*Corresponding author

Received January 15, 2014

1. Introduction

External parasites are of major animal health problems in modern poultry farms, backyard flocks and wild birds.^[1-5] In Mexico there has been little studied ectoparasites affecting birds in backyard conditions and economic damage they cause,^[6] but have been identified as potentially dangerous disease carriers for intensive poultry farming. Ectoparasites infestations are one of the leading causes of losses in egg production, weight gain and even mortality in poultry.^[3,7-8] Generally, in birds, the ectoparasites cause feather loss, irritation, injury to head, neck and back, nervousness, pruritus and 10 % reduction in egg production,^[1,5] some species are capable to parasitize in humans being able to be public health problem.^[9]

For poultry, ectoparasites can be a health problem for themselves, but additionally are vectors of various etiologic agents of bacterial diseases such as *Erysipelothrix rhusiopathiae* etiologic agent of avian erysipelas, *Pausterella multocida*, *Aegyptinella* spp., *Borrelia* spp., as well as viral diseases such as eastern equine encephalitis, Newcastle disease and Fowl Pox.^[10-13] These parasites are also involved in the spread of other parasites, acting as intermediate host vector or a host of helminthic infectious to poultry as *Heterakis gallinarum*, *Choanotaenia infundibulum*, *Hymenolepis* spp., among others,^[14-16] and various blood intracellular parasites such as *Plasmodium* spp. and *Leucocytozoon* spp.:

The backyard turkeys raised traditionally, have been little studied from the point of view of external parasites, but have reported the presence of mites: *Pteriolichus obtusus*,^[17] *Megninia ginglymura* and *Ornithonyssus sylviarum*.^[18] With respect to the domestic turkey lice identified in the backyards of the Mexican state of Coahuila have been reported to *Menacanthus stramineus*, *Chelopistes meleagridis*, *Cuclotogaster heterogrsphus*, *Gonoides dissimilis*, *G. gigas*, and *Bovicola caprae*.^[6]

The presence of these parasites causes the productive parameters in backyard turkeys are not adequate, and that the cost of producing each bird unprofitable.^[19] This situation leads to abandon the raising of the specie^[20] and possibly losing valuable and diverse native genetic resources.^[21] Therefore, the purpose of the study was to describe the main effects of ectoparasites of domestic turkeys obtained from traditional breeding in backyard.

2. Material and Methods

Clinical cases and parasites obtained for the study come from 750 backyard turkeys examined during the dry season (November to May) and rains (June to October) in the coastal region of the state of Oaxaca, Mexico. The observation of the presence of parasites was from routine monitoring to determine the general health status of the birds. It was found that 97.3 % of the birds showed different degree of plucking dermatitis, skin irritation, mild to moderate injuries, pecking at base of the feathers. Additionally 5.3 % of the birds, all breeding over two years old, had severe lesions under the skin scales in legs and tarsus. Severe irritation was evident, abundant purulent serous exudates, which caused the appearance of scabs and areas of necrosis. As a result of the infestation, the legs appeared swollen and deformed (Figure 1). It was not possible to obtain tissue samples for histopathology and direct identification of the parasite.

The ectoparasites were collected to put the body of the bird in a plastic bag with chloroform,^[22] which caused the bird to fall off later were recovered and observed with an optical microscope for Digital Blue™ computer model brand QX5™^[23] Photographic images were obtained with the microscope software. Subsequently, using the Screen Calipers Version 4.0 software,^[24] we calculated the size of the parasites from the number of pixels of the image related to a known measure. This as part of the identification of the species found.^[23]

For the identification of ectoparasites used various taxonomic keys, records and descriptions in specialized articles on the subject.^[25-40]

In cases where it was not possible to isolate the parasite, its presence was determined from the integrated field clinical diagnosis by anamnesis, signs and lesions characteristic of the disease, using pathophysiological descriptions.^[7]

3. Results and Discussion

In total we identified seven different species of lice (Table 1) and four species of mites (Table 2).

Regarding lice, all belong to the suborder known as chewing lice Phthraptera: *Menopon gallinae*, *Menacanthus cornutus*, *Colpocephalum turbinatum*, *Menacanthus stramineus*,

Chelopistes meleagridis, *Oxylipеurus corpulentus*, and *Oxylipеurus polytrapezius* (Figure 2).

The four mites identified in backyard turkeys on the coast of Oaxaca, were previously reported: *Dermanyssus gallinae*, *Megninia ginglymura*, and *Ornithonyssus sylviarum*,^[18,23] the presence of *Knemidokoptes mutans* was identified by clinical diagnosis.^[7]

The most affected were the poults and young birds. There was no mortality, although in one of the outbreaks was presented the wet form of the disease, which affects the oral cavity and endangers the life of the bird.

All lice identified, have the characteristic of feed dander and skin secretions, barrel and chin feathers;^[41] however, they all cause plucking dermatitis, pruritus, cachexia and decreased egg production.^[40,42-43] Skin lesions associated with parasitic diseases, can be infected by *Staphylococcus* spp. bacteria mainly because these bacteria are abundant in this type of lice.^[44]

In commercial hens, it has been estimated lice infestations can cause weight loss of 711 g per bird per year and a reduction in posture 66 eggs per bird in a year,^[45] which represents a loss of 42 % of body weight and 27.5 % reduction in total egg production in the first laying cycle. Of all the lice identified *Menacanthus stramineus*, *Chelopistes meleagridis*, *Oxylipеurus corpulentus*, and *Oxylipеurus polytrapezius* are species that parasitize wild turkeys and are believed to be the original hosts of this insects.^[37,46] It is important to note that this is the first report of *Oxylipеurus corpulentus* in domestic turkeys. Similarly, it is the first time reported the presence of *Colpocephalum turbinatum* in turkeys, this being a parasite which has been reported to pigeons *Columba livia* as their original host.^[25,27] Apparently, turkeys can be temporary host some specific species of lice reported for other hosts, such as is the case of *Bovicola caprae* that its presence has been reported in backyard turkeys.^[6]

Previously, has been reported that wild turkeys can be parasitized by the mite *Megninia* sp.; well as lice: *Chelopistes meleagridis*, *Menacanthus stramineus*, *Oxylipеurus corpulentus*, and *O. polytrapezius*.^[37,46] The domestic turkey can be infested with five species of lice: lice ventilation (*Menacanthus stramineus*),^[47] large turkey louse (*Chelopistes meleagridis*), lean turkey louse (*Oxylipеurus polytrapezius*),^[48] the shaft louse pen (*Menopon gallinae*) and the head louse of chickens (*Cuclotogaster heterographus*).^[49] In Mexico only had reported the presence of *Oxylipеurus polytrapezius* and *Chelopistes meleagridis* on the coast of

Oaxaca.^[48] This listing shows the largest number of parasites reported for backyard or wild turkeys.

All lice found in the present study, feeding on the feathers. Reported mites only, *Megninia ginglymura* feathers feeds (Table 2), but the presence of this mite in hens has been associated with loss of feathers, skin irritation in head, neck and upper back, pruritus, nervousness and reduced egg production between 10 to 20 %.^[1,5,50] The reduction in production, may be related to energy expenditure need to do to renew their feathers more often.^[51] The parasite load, always have a physiological cost to the host, which can be from food compensation for the replacement of feathers,^[52] or decrease in growth, egg production, to reduce total life cycle.^[53]

Because there is a relationship between the size of the feathers of the host and the degree of parasitic infestation^[54] and host size is positively correlated with the abundance of parasites,^[55-56] it is normal to find that older birds and males are more likely to infestations,^[57] these being those who reported the most problems in production. Therefore, one can predict that the turkeys will be those who developing the highest parasite load in backyard flocks, because they are larger birds within that traditional breeding system.

The other two species of mites identified in turkeys, are blood-sucking parasites, *Dermanyssus gallinae* and *Ornithonyssus sylviarum*. These mites have been described as parasites common in domestic and wild birds.^[11,58-60] Its presence has been associated with weight loss and reduction in the posture of eggs in poultry flocks, produce irritation and generalized malaise also cause immunosuppression with consequent lower resistance to disease.^[7] It has been reported that the parasites that cause lacerations of the skin, can provide input to secondary bacterial infections.^[61] Additionally, they can be vectors of some diseases (Table 3). It is important, the role that some species of arthropods who act as reservoirs of avian pox, because this disease is common in the region, particularly affecting turkeys and is often presented as wet pox, high virulence and reserved prognosis (Figure 3).

Is important to consider that parasitic blood-sucking lice and mites, are vertically transmitted while sucking mites are horizontally transmitted,^[62] using night immobility times of birds, or by using blood-sucking mosquitos and transporting one bird to another.^[63] For both types of parasites, he favors the traditional management of turkeys comprising access to grazing

during the morning and night confinement,^[64] which explains the presence of different types of parasites from different hosts in a single bird.

From the standpoint of veterinarian science, the ectoparasites identified in turkeys, causing considerable losses in intensive conditions. The effects caused by the presence of parasitic arthropods, ranging from plucking and skin irritation, until anemia, cachexia or reduced one fifth of egg production. It is generally considered that host with nutritional deficiencies are more likely to pest infestation,^[57] however, backyard birds have a resistance to the presence of parasites, acquired by natural selection. These parasitic resistances in conjunction with other adverse environmental conditions together form the feature known as rusticity.

In turkeys the coast of Oaxaca, was common to find more than three different species of lice and two mites, in each turkey studied with a mean abundance (101 - 1000 parasites) considering a criterion previously established infestation.^[65]

It has been postulated that the exchange of parasites between different host species, is an important aspect of host-parasite relationships,^[66] an idea that was previously rejected because it argued that it was a rare situation.^[67] Ectoparasites are organisms semi-independent life laying on the surface of the host, but have the ability to free life for short periods, this situation allows them to move from one host to another,^[57] which explains the diversity of parasites found in turkeys. Because of their access to outdoor areas for grazing,^[68] by direct contact with other birds or people who act as vectors of parasites,^[69] or previously infested installations remain.^[70] It is important to consider that it has proved possible exchange of parasites between domestic and wild birds,^[71] as well as vermin like rats and mice,^[72] which is of animal health importance because of the possibility of transmission of infectious diseases of wild birds into the domestic birds or vice versa,^[73] such as avian influenza.

The use of phenolic or cresylic insecticides^[43] and other chemical formulas as carbaryl or coumaphos, have been the routine treatment for ectoparasites control,^[74] however, the use of these products does not eradicate the problem and may cause parasitic resistance to the principles active.^[75] A useful option in the conditions of backyard production, to control these parasites is the use of botanical extracts,^[76-82] which are readily available and can be applied in the form of baths for the birds, in the traditional production system. It is also important to

develop deworm programs in the rainy season, because it has been reported that it is during this period of the year when the parasite load increases.^[83]

4. Conclusions

The backyard turkeys are hosts of a greater amount of ectoparasites that recorded for wild turkeys or commercial, which indicates that they are exposed to increased parasite load. This situation increases the possibility of the birds contracting infectious diseases, where ectoparasites have the vectors function. This partly explains the low productivity that has backyard turkeys, also confers greater resilience inherent to the production system to which they belong, which reinforces its hardiness. The control of these parasites should be made considering the time of year and the availability of resources to use products recommended for the control of these parasites, or the application of botanical extracts that are compatible with the mode of production in which these birds are reared.

5. Acknowledgements

The authors thank Elizabeth Perez-Lara support in collecting, and photography of parasites.

Conflict of Interests

The author declares that there is no conflict of interests.

REFERENCES

- [1] A. Santa Cruz, M.C. Agüero, J.A. González, et al., Descripción de la morfología externa por microscopía de luz y electrónica de barrido de *Megninia ginglymura*, Megnin, 1877 en faisán de collar (*Phasianus torquatus*), en un criadero de Corrientes, Argentina, Revista Electrónica de Veterinaria Vol. IX Num. 8 Agust Available online at: <http://www.veterinaria.org/revistas/redvet/n090908/090902.pdf> accessed 13 October 2008.
- [2] D. Jansson, O. Fossum, P.E. Engelsen, et al., Parasitförekomst hos tamhöns I svenska hobbyflockar, Svensk 2 (2004), 11-17.
- [3] A. González, R. Larramendy, B. Szczypei, M. Hernández, Distribución actual de los ectoparásitos en aves comerciales en Cuba, Revista Electrónica de Veterinaria, 5 (2003), available online at: <http://comunidad.veterinaria.org/articulos/articulo.cfm?articulo=35009&pag=1&area=1&buscar=&donde=1> Accessed 08 September 2008.

- [4] W.R. Payne, D.W. Oates, G.E. Dappen, Ectoparasites of Ring-necked Pheasants in Nebraska, *Journal of Wildlife Diseases* 26 (1990), 407-409.
- [5] S. Rosen, A. Hadani, Z. Perlstein, The occurrence of *Megninia hologastra* (Analgidae Guad, 1974) on poultry in Israel, *Avian Pathology* 17 (1988), 921-923.
- [6] S. A. Losoya, L. S. Quiñones, U. L. A. Aguirre, R. E. Guerrero, Malófagos de las aves domésticas en 4 municipios del sureste del estado de Coahuila, *Agraria Revista Científica UAAAN* 2 (1986), 203-221.
- [7] J. J. Arends. External Parasites and Poultry Pests, In: Y. M. Said, ed. *Diseases of Poultry*, 11th Edition, Iowa State Press, USA, 2003: 919-925.
- [8] H. Santos-Protozo, M. Oliveira-Silva, E. Daemon, M. D'Agosto, F. Prezoto, Sitios de localização de ectoparasitos em *Gallus gallus* Linnaeus, 1758, *Rev. Bras. Zootecnia* Juiz de Fora 5 (2003), 129-135.
- [9] O. Calderón-Arguedas, A. Troyo, J. Castro-Ugalde, Ectoparasitosis por ácaros Macronísidos (Gamasida: Macronyssidae), *Revista Costarricense de Ciencias Médicas* 25 (2004), 35-39.
- [10] R. S. Lane, T. F. Kucera, R. H. Barrett, et al., Wild turkey (*Meleagris gallopavo*) as a host of ixodid ticks, lice and Lyme disease spirochetes (*Borrelia burgdorferi* sensu lato) in California State parks, *J. Wildlife Diseases* 42 (2006), 759-771.
- [11] M. G. Garvin, L. C. Scheidler, D. G. Cantor, K. E. Bell, Abundance and temporal distribution of *Ornithonyssus sylviarum* Canestrini and Fanzago (Acarina: Mesostigmata) in gray carbird (*Dumetella carolinensis*) nests, *Journal of Vector Ecology* 29 (2004), 62-65.
- [12] J. Chirico, H. Eriksson, O. Fossum, D. Jansson, The poultry red mite, *Dermanyssus gallinae*, a potential vector of *Erysipelothrix rhusiopathiae* causing erysipelas in hens, *Medical and Veterinary Entomology* 17 (2003), 232-234.
- [13] M. G. Smith, R. J. Blattner, F. M. Heys, St. Louis Encephalitis infection of chicken mites, *Dermanyssus gallinae*, by feeding on chickens with viremia; transovarian passage of virus into the second generation, *J. Exp. Med.* 84 (1946), 1-6.
- [14] A. Permin, J. W. Hansen, *Epidemiology, diagnosis and control of poultry parasites*, FAO, Rome, Italy. 1998.
- [15] T. Lehmann, Ectoparasites: direct impact on host fitness, *Parasitol. Today* 9 (1993), 8-13.
- [16] A. G. Marshall, *The ecology of ectoparasitic insects*, Academic Press, London, UK. 1981.
- [17] M. M. T. Quintero, Hallazgo de ácaros *Pteriolichus obtusus* en guajolotes del estado de Tabasco, *Proceedings of XVII ANECA Annual Convention*. 1993:232-234.

- [18] M. A. Camacho-Escobar, E. Pérez-Lara, J. Arroyo-Ledezma, E. I. Sánchez-Bernal, J. C. García-López, Parasitic mites in backyard turkeys, *Tropical and subtropical Agroecosystems* 12 (2010), 675-679.
- [19] M. A. Camacho-Escobar, V. Hernandez-Sanchez, L. Ramirez-Cancino, E. I. Sánchez-Bernal, J. Arroyo-Ledezma, Characterization of backyard guajolotes (*Meleagris gallopavo gallopavo*) in tropical zones of Mexico, *Livestock Research for Rural Development*, Volume 20, Article #50 2008. Available online at: <http://www.cipav.org.co/lrrd/lrrd20/4/cama20050.htm>
- [20] R. E. Aquino, L. A. Arroyo, H. G. Torres, et al., El guajolote criollo (*Meleagris gallipavo* L.) y la ganadería familiar en la zona centro del estado de Veracruz, *Técnica Pecuaria México* 41 (2003), 165–173.
- [21] M. A. Camacho-Escobar MA, L. Ramírez-Cancino, I. Lira-Torres, V. Hernández-Sánchez, Phenotypic characterization of the guajolote (*Meleagris gallopavo gallopavo*) in Mexico, *Animal Genetic Resources Information* 46 (2008), 59-66.
- [22] C. Esquivel, Estudio preeliminar de la dinámica de poblaciones del piojo de aves *Menopon gallinae* (Mallophaga: Menoponidae) en una granja avícola del valle central de Costa Rica, *Agronomía Costarricense* 21 (1997), 255-258.
- [23] M. A. Camacho-Escobar, E. Pérez-Lara, H. F. Magaña-Sevilla, J. Arroyo-Ledezma, E. I. Sánchez-Bernal, Técnica para identificación de ácaros in vivo con microscopio óptico de computadora, *Proceedings of XXXIV ANECA Annual Convention*. 2009.
- [24] Iconicos. Screen Calipers Versión 4.0. Iconico, Inc., USA. www.iconico.com. 2006.
- [25] S. Naz, O. Sychra, S. A. Rizvi, New records and a new species of chewing lice (Phthiraptera, Amblycera, Ischnocera) found on Columbidae (Columbiformes) in Pakistan, *Zookeys* 174 (2012), 79-93.
- [26] Prelezov and Koinarski, Species, variety and population structure of mallophaga (insecta: phthiraptera) on chickens in the region of Stara Zagora, *Bulgarian Journal of Veterinary Medicine* 9 (2006), 193-200.
- [27] M. M. P. Martín, Mallophaga: Amblycera, In: M. A. Ramos et al. eds. *Fauna Ibérica Vol. 20*. Museo Nacional de Ciencias Naturales. CSIC. Madrid. 2002.
- [28] G. R. Mullen, B. M. Oconnor, Mites (Acari), In: G. Mullen and L. Durden (editors), *Medical and Veterinary Entomology*. Academic Press, USA. 2002:449-516.
- [29] L. A. Durden, Lice (Phthiraptera). In: G. Mullen, L. Durden eds., *Medical and Veterinary Entomology*, Academic Press, USA. 2002:45-65.
- [30] E. C. Greiner, Arthropods of Veterinary Importance in North America. In: M. W. Sloss, M. W. Kemp, A. M. Zajac eds., *Veterinary Clinical Parasitology*, 6th Ed., Blackwell Publishing, USA. 1994:121-175.

- [31] H. Mehlhorn, G. Piekarski, *Fundamentos de Parasitología, parásitos del hombre y de los animales domésticos*, 3ra Ed. Traducido al español por O. D. Torres-Quevedo, Acribia, España. 1989:291-308.
- [32] T. C. Cheng, *General Parasitology*, 2nd ed, Academic Press College Division, USA. 1986.
- [33] J. F. Butler, Lice affecting livestock, In: R. E. Williams, R. D. Hall, A. B. Broce, P. P. School, eds. *Livestock Entomology*, Wiley-Interscience Publication, USA. 1985:101-127.
- [34] R. D. Hall, Mites of Veterinary Importance, In: R. E. Williams RE, R. D. Hall, A. B. Broce, P. J. School, eds., *Livestock Entomology*, Wiley-Interscience Publication, USA. 1985:151-181.
- [35] T. Clay, A key to the genera of the Menoponidae (Amblycera: Mallophaga: Insecta), *Bulletin of the British Museum (Natural History) Entomology* 24 (1969), 3-26.
- [36] T. Clay, C. Moreby, Mallophaga (biting lice) and anoplura (sucking lice) part II: keys and locality lists of mallophaga and anoplura. *Antarctic Research Series* 10 (1967), 157-196.
- [37] K. C. Emerson, Mallophaga (chewing lice) occurring on the turkey, *J. Kansas Entomol. Soc.* 35 (1962), 198-201.
- [38] Emerson KC. Mallophaga (chewing lice) occurring on the domestic chicken. *J. Kansas Entomol. Soc.* 1956; 29(2):63-79.
- [39] H. E. Fairchild, P. A. Dahm, A taxonomic study of adult chicken lice found in the United States, *J. Kansas Entomol. Soc.* 27 (1954), 106-111.
- [40] D. MacCreary, M. P. Catts, Ectoparasites of Delaware poultry including a study of litter fauna, *Bulletin Technical No. 307*, Agricultural Experiment Station, University of Delaware, Newark, Delaware. 1954.
- [41] C. M. Crutchfield, H. Hixson, Food habits of several species of poultry lice with special reference to blood consumption, *The Florida Entomologist* 26 (1943), 63-66.
- [42] I. Shanta, S. Begum, N. Anisuzzaman, A. S. M. Bari, M. J. Karim, Prevalence and clinic-pathological effects of ectoparasites in backyard poultry, *Bang. J. Vet. Med.* 4 (2006), 19-26.
- [43] M. N. Khan, M. Nadeem, Z. Iqbal, M. S. Sajid, R. Z. Abbas, Lice infestation in poultry, *Int. J. Agri. Biol.* 5 (2003), 213-216.
- [44] D. L. Reed, M. S. Hafner, Phylogenetic analysis of bacterial communities associated with ectoparasitic chewing lice of pocket gophers: a culture-independent approach, *Microbial Ecol.* 44 (2002), 78-93.
- [45] A. H. El-Kifl, A. Wahab, M. K. Kamel, W. A. E. Abdel, Poultry ectoparasites in Sharikia Governorate, *Agri. Rev.* 51 (1973), 113-120.
- [46] F. E. Kellogg, A. K. Prestwood, R. R. Gerrish, G. L. Doster, Wild turkey ectoparasites collected in the

southeastern United States, *Journal of Medical Entomology* 6 (1969), 329-330.

[47] D. González-Acuña, J. Lara, A. Cicchino, Nuevos registros de piojos (Insecta: Phthiraptera) en aves domésticas y ornamentales en Chile, *Arch. Med. Vet.* 41 (2009), 181-184.

[48] M. A. Camacho-Escobar, J. Arroyo-Ledezma, E. Pérez-Lara, E. I. Sánchez-Bernal, J. C. García-López, Enfermedades y parasitosis asociadas a una explotación intensiva de guajolotes nativos, *Ciencias Agrícolas Informa* 19 (2009-2010), 56-61.

[49] I. H. Roberts, C. L. Smith, Poultry Lice, In: *Animal Diseases part of the Agriculture Series*,

Library4Science Publisher, UK. 2009. Available online at:

<http://animal-health.library4farming.org/Animal-Swine-Rabbits/DISEASES-AND-PARASITES-AFFECTING-poultry/Poultry-Lice.html> Accessed 25 October 2012.

[50] E. C. Tucci, E. A. L. Guastali, M. M. Rebouças, M. C. Mendes, N. M. S. Q. Gama, Infestação por *Megninia* spp. Em criação industrial de aves productoras de ovos para consumo, *Arquivos do Instituto Biológico São Paulo* 72 (2005), 121-124.

[51] D. H. Clayton, J. A. H. Koop, C. H. Harbison, B. R. Moyer, S. E. Bush, How birds combat ectoparasites, *The Open Ornithology Journal* 3 (2010), 41-71.

[52] F. Tripet, H. Richmer, Host responses to ectoparasites: food compensation by parent blue tits, *Oikos* 78 (1997), 557-561.

[53] C. R. Brown, M. B. Brown, B. Rannala, Ectoparasites reduce long-term survival of their avian host, *Proc. R. Soc. Lond. B* 262 (1995), 313-319.

[54] S. E. Bush, E. Sohn, D. H. Clayton, Ecomorphology of parasite attachment: experiments with feather lice, *J. Parasitol.* 92 (2006), 25-31.

[55] S. E. Bush, D. H. Clayton, The role of body size in host specificity: reciprocal transfer experiments with feather lice, *Evolution* 60 (2006), 2158-2167.

[56] L. Rozsa, Patterns in the abundance of avian lice (Phthiraptera: Amblycera, Ischnocera), *Journal of Avian Biology* 28 (1997), 249-254.

[57] W. A. Nelson, J. E. Keirans, J. F. Bell, C. M. Clifford, Host-ectoparasite relationships, *J. Med. Ent.* 12 (1975), 143-166.

[58] S. M. Hernández-Divers, P. Villegas, F. Prieto, et al., A survey of selected avian pathogens of backyard poultry in Northwestern Ecuador, *Journal of Avian Medicine and Surgery* 20 (2006), 147-158.

[59] R. C. Axtell, Poultry integrated pest Management: status and future, *Integrated Pest Management Reviews*

4 (1999), 53-73.

[60] M. L. Estébanez-González, Acarofauna en nidos de aves silvestres en México, *Acta Zoológica Mexicana* (n. s.) 71 (1997), 1-5.

[61] E. M. Boyd, The external parasites of birds: a review, *The Wilson Bulletin* 63 (1951), 363-369.

[62] D. H. Clayton, D. M. Tompkins, Ectoparasite virulence is linked to mode of transmission, *Proc. R. Soc. Lond. B.* 256 (1994), 211-217.

[63] C. W. Harbison, M. V. Jacobsen, D. H. Clayton, A hitchhiker's guide to parasite transmission: the phoretic behavior of feather lice, *International Journal of Parasitology* 39 (2009), 569-575.

[64] M. A. Camacho-Escobar, P. R. Lezama-Nuñez, M. P. Jerez-Salas, et al., Avicultura indígena mexicana: sabiduría milenaria en extinción, *Actas Iberoamericanas de Conservación Animal* 1 (2011), 375-379.

[65] O. Sychra, P. Harmat, I. Literák, Chewing lice (Phthiraptera) on chickens (*Gallus gallus*) from small backyard flocks in the eastern part of the Czech Republic, *Veterinary Parasitology* 152 (2008), 344-348.

[66] F. Valera, A. Casas-Crivillé, H. Hol, Interspecific parasite exchange in mixed colony of birds, *J. Parasitol.* 89 (2003), 245-250.

[67] T. Clay, Some problems in the evolution of a group of ectoparasites, *Evolution* VIII (1949), 279-299.

[68] W. Abebe, T. Asfaw, B. Genete, B. Kassa, P. H. Dorchie, Comparative studies of external parasites and gastrointestinal helminthes of chickens kept under different management system in and around Addis Ababa (Ethiopia), *Review on Med. Vet.* 148 (1997), 497-500.

[69] W. D. Ryder, The dispersal of certain species of Mallophaga which infest de domestic fowl, *Gallus domesticus*, *The Journal of Applied Ecology* 4 (1967), 309-323.

[70] B. A. Mullens, N. C. Hinkle, L. J. Robinson, C. E. Szijj, Dispersal of northern fowl mites, *Ornithosyssus sylviarum*, among hens in an experimental poultry house, *J. Appl. Poultry Res.* 10 (2001), 60-64.

[71] W. L. Hoyle, Transmission of poultry parasites by birds with special reference to the "English" or house sparrow and chickens, *Transactions of the Kansas Academy of Science* 41 (1938), 379-384.

[72] S. A. Kells, G. A. Surgeoner, Sources of Northern Fowl Mite (*Ornithonyssus sylviarum*) infestation in Ontario egg production facilities, *J. Appl. Poultry Res.* 6 (1997), 221-228.

[73] M. A. Camacho-Escobar, E. Pérez-Lara, J. Arroyo-Ledezma, E. I. Sánchez-Bernal, M. M. Galicia-Jiménez, Guajolotes de traspatio como reservorios de enfermedades de aves domésticas y silvestres en tres ecosistemas de la costa mexicana, *Tropical and Subtropical Agroecosystems* 10 (2009), 109-115.

[74] R. S. Beyer, D. Mock, Eliminating mites in poultry flocks, *Agricultural Experiment station and cooperative*

extension service MF-2387 Kansas State University, USA. 1999.

[75] B. A. Mullens, R. K. Velten, N. C. Hinkle, D. R. Kunej, C. E. Szijj, Acaricide resistance in Northern Fowl Mite (*Ornithonyssys sylviarum*) populations on caged layer operations in Southern California, *Poult. Sci.* 83 (2004), 365-374.

[76] F. J. Naranjo-Luna, C. A. Chalé-Rivera, M. A. Camacho-Escobar, B. A. Rodas-Junco, Evaluación in vitro del efecto insecticida de diferentes extractos de hojas de *Azadirachta indica* a. Juss y *Guazuma ulmifolia* Lam., *Proceedings of V Regional Congress of Biotechnology and Bioingeniery, of southeast.* 2010:135.

[77] S. E. Pablo, M. A. L. Sandoval, B. E. Morales, et al., Evaluación del efecto insecticida de *Metarhizium anisopliae* y extractos botánicos sobre el piojo de la gallina (*Menacanthus stramineus*), *Proceedings of XXXIV ANECA Annual Convention.* 2009.

[78] I. Zarins, M. Daugavietis, J. Halimona, Biological activity of plants extracts and their application as ecologically harmless biopesticide, *Sodininkystė ir Daržininkystė* 28 (2009), 269-280.

[79] R. Larramendy, B. Szczypel, A. Pérez, A. Gonzales, J. Estrada, Efectividad de distintos derivados del árbol del Nim (*Azadirachta indica* A. Juss) en gallinas naturalmente infectadas con ectoparásitos, *Comunidad Virtual de Veterinaria.org.* Centro de Documentación del Instituto de Investigaciones Avícolas de la Habana, Cuba 2003. Available online at: <http://comunidad.veterinaria.org/articulos/articulos.cfm?articulo=35008&pag=1> Accessed 08 October 2012.

[80] M. Hernández, R. Larramendy, B. Szczypel, Incidencia de parásitos en aves de producción alternativa y recomendaciones para su control, *Rev. Cubana de Ciencia Avícola* 26 (2002), 141-144.

[81] L. A. Ramírez-Moreno, L. E. García-Barrios, C. Rodríguez-Hernández, H. E. Morales, A. E. Cástro-Ramírez, Evaluación del efecto insecticida de extractos de plantas sobre *Leptophobia aripa* elidía, *Manejo Integrado de Plagas* 60 (2001), 50-56.

[82] M. B. Isman, Plant essential oils for pest and disease management, *Crop Protection* 19 (2000), 603-608.

[83] B. R. Moyer, D. M. Drown, D. H. Clayton, Low humidity reduces ectoparasite pressure: implications for host life history evolution, *Oikos* 97 (2002), 223-228.

Table 1. Lice Mallophaga present in backyard turkeys on the coast of Oaxaca, Mexico.

Ectoparasite	Other hosts
<i>Menopon gallinae</i>	Chickens, pigeons.
<i>Menacanthus cornutus</i>	Chickens.
<i>Colpocephalum turbinatum</i>	Pigeons. ^[1,3]
<i>Menacanthus stramineus</i>	Wild turkey, ^[2] chickens, pigeons, guinea fowl, pheasant domestic, peacock, quail, ducks and geese.
<i>Chelopistes meleagridis</i>	Wild turkey, ^[2] ocellated turkey, chicken.
<i>Oxylipeurus corpulentus</i>	Wild turkey. ^[2,3]
<i>Oxylipeurus polytrapezius</i>	Wild turkey, ^[2] ocellated turkey.

¹Columba livia is reported as the original host parasite.

²Meleagris gallopavo wild is reported as the original host parasite.

³First report of the parasite in domestic turkeys.

Table 2. Mites present in backyard turkeys in the coastal region of Oaxaca, Mexico.

Ectoparasite	Feeding kind
<i>Dermanyssus gallinae</i>	Blood-sucking.
<i>Megninia ginglymura</i>	Feeds on feathers.
<i>Ornithonyssus sylviarum</i>	Blood-sucking.
<i>Knemidokoptes mutans</i>	Material dissolved scaly stratum corneum of legs and tarsi.

Table 3. Main effects caused by ectoparasites identified in turkeys off the coast of Oaxaca, Mexico.

Disease	Signs and lesions	Causal Agent
Plucking dermatosis	Pruritus, cachexia and reduced egg production	<i>Menopon gallinae</i> , <i>Menacanthus cornutus</i> <i>Colpocephalum turbinatum</i> <i>Menacanthus stramineus</i> <i>Chelopistes meleagridis</i> <i>Oxylipеurus corpulentus</i> <i>Oxylipеurus polytrapezius</i>
Avian mites	Dermatitis, cachexia, wasting, anemia, lethargy, darkening of the feathers or lose color, crusty appearance of the head and neck, reduced egg production. <i>Dermanyssus gallinae</i> can be fowl pox vector, St. Louis encephalitis, eastern equine encephalitis and <i>Erysipelothrix rhusiopathiae</i> etiologic agent of avian erysipelas.	<i>Dermanyssus gallinae</i> <i>Ornithonyssus sylviarum</i>
Plucking mites	Causes loss of feathers, skin irritation in head, neck and upper back, itching, nervousness. Reduced egg production.	<i>Megninia ginglymura</i>
Scabies of the legs, scaly legs ascariasis, avian scabies.	Dermatitis on the scales of legs and tarsi, purulent necrosis in the infested area, large scabs, lameness, emaciation, cachexia.	<i>Knemidokoptes mutans</i>



Figure 1. The acariasis scaly legs, or bird scabies, is caused by the mite *Knemidokoptes mutans*, and causes damage to legs, feet and tarsi in adult birds.



Menacanthus stramineus or chicken body louse.



Chelopistes meleagridis or large turkey louse.



Oxylipeurus corpulentus.



Oxylipeurus polytrapezius.



Menopon gallinae or louse feather stem.



Menacanthus cornutus.



Colpocephalum turbinatum.

Figure 2. Lice Mallophaga present in backyard turkeys, observation by computer microscope 60X magnification.



Head and face injuries, typical cases of avian pox.



Caseous exudate in oral cavity, frequent in cases of "wet pox".

Figure 3. Avian pox is a viral disease that is transmitted to birds by arthropod vectors such as insects and mites.