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Short Communication

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Diversity and Prevalence of Ectoparasites on Backyard Chicken Flocks in California

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Abstract

Peridomestic ("backyard") chicken flocks are gaining popularity in the developed world (e.g., North America or Europe), yet little is known regarding prevalence or severity of their ectoparasites. Therefore, five birds on each of 20 properties throughout southern California were surveyed in summer for on-host (permanent) and off-host dwelling (temporary) ectoparasites. Only four premises (20%) were entirely free of ectoparasites. In declining order of prevalence (% of premises), permanent ectoparasites included six chicken louse species: *Menacanthus stramineus* (Nitzsch) (50%), *Goniocotes gallinae* (De Geer) (35%), *Lipeurus caponis* (L.) (20%), *Menopon gallinae* (L.) (15%), *Menacanthus cornutus* (Schömmer) (5%), and *Cuclotogaster heterographus* (Nitzsch) (5%). Only one flea species, *Echidnophaga gallinacea* (Westwood) (20%), was found. Three parasitic mite species were observed: *Ornithonyssus sylviarum* (Canestrini & Fanzago) (15%), *Knemidocoptes mutans* (Robin & Lanquetin) (10%), and *Dermanyssus gallinae* (De Geer) (5%). Many infestations consisted of a few to a dozen individuals per bird, but *M. stramineus*, *G. gallinae*, *M. cornutus*, and *E. gallinacea* were abundant (dozens to hundreds of individuals) on some birds, and damage by *K. mutans* was severe on two premises. Off-host dwelling ectoparasites were rare (*D. gallinae*) or absent (*Cimex lectularius* L., *Argasidae*). Parasite diversity in peridomestic flocks greatly exceeds that is routinely observed on commercial chicken flocks and highlights a need for increased biosecurity and development of ectoparasite control options for homeowners.

Key words: poultry, louse, mite, flea, *Menacanthus*

Peridomestic, or "backyard," poultry flocks have been steadily increasing in popularity in the United States (Elkhorabi et al. 2014). Some arthropod parasites, such as the northern fowl mite (*Ornithonyssus sylviarum* (Canestrini & Fanzago)), chicken body louse (*Menacanthus stramineus* (Nitzsch)), and chicken red mite (*Dermanyssus gallinae* (De Geer)), are listed as common pests in commercial chicken flocks (Axtell and Arends 1990). However, one would expect a different ectoparasite fauna among backyard flocks due to many factors including 1) biosecurity and housing differences, 2) bird age and strain mixing, 3) decreased prevalence of pesticide use, 4) ready exchange of birds among owners or feed stores selling or showing birds, and 5) lack of experience with poultry parasites by homeowners. Free-ranging birds often have a greater chance of acquiring a more diverse parasite population (Lay et al. 2011). The aim of this study was to gather information regarding parasite diversity and relative abundance on backyard chicken flocks in southern California.

Materials and Methods

A survey was advertised at backyard flock workshops in San Bernardino and Pomona, CA, as well as at local feed stores (Riverside and San Jacinto, CA). Survey participants had to have 5–50 birds for at least 6 mo. The survey was not random, and such a survey probably could not have been conducted. The occurrence of backyard flocks is not well known or monitored, and some owners might consider such an activity a governmental intrusion. This survey instead relied on interested and willing homeowners. Only adult female birds at or near egg-laying age (≥ ca. 20 wk) were included in the study.

Five birds on each of 20 different properties were surveyed in summer (June–September 2015) throughout southern California (Fig. 1). We never visited multiple flocks per day, and strict sanitation and biosecurity protocols were followed. Five birds from each flock were arbitrarily selected for ectoparasite collections, and birds were handled and parasites collected in accordance with UCR animal use protocol A-20150009. First the animal was examined visually by looking closely at the skin and feathers. When appropriate, individual parasites were collected by forceps and placed into 70% EtOH. After notation of general parasite numbers and likely species observed, ectoparasites were removed using one of two methods, according to the owner's preference: Method number 1 included spraying the chicken's feathers in 8–10 body locations with a total of ca. 10 ml of liquid pyrethrin solution (0.18% pyrethrins, Bayer,

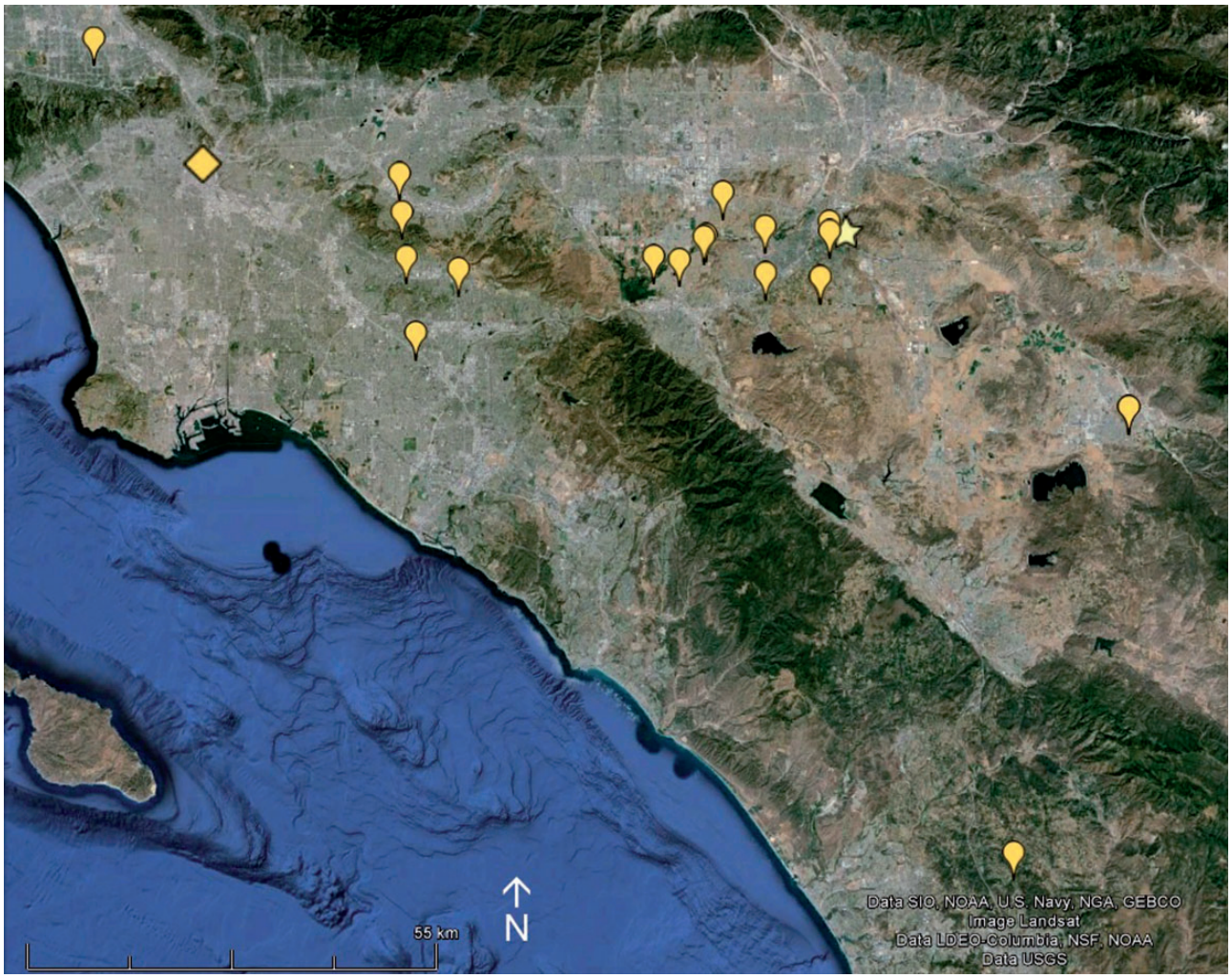

Fig. 1. Map (via Google Earth) of southern California showing study sites (pins) relative to the University of California, Riverside (star) and Los Angeles (diamond).

Whippany, NJ). Body locations included anterior, lateral, and posterior sides of the abdomen, under each wing, base and anterior back of neck, and central-rear dorsum. The solution was gently distributed into the surrounding few centimeters of skin and feathers using a gloved hand. This method killed or stunned the parasites, which could then be dislodged by gently ruffling the feathers over a dry, clean, plastic dishpan. This debris was searched visually, and all suspect arthropods were collected using a small paintbrush or forceps and placed in a vial of 70% EtOH labeled by chicken number and premise. Method number 1 was most often used. Method number 2 included gently bathing the chicken (except for the head), disturbing the feathers and skin for ca. 2 min in a dishpan with ca. 1.5–2 liters of water containing 1 ml of dishwashing soap (Dawn, Proctor & Gamble, Cincinnati, OH). The hens were then rinsed in fresh water, and parasites in the pan were separated with a fine mesh sieve (150 µm opening) and then backwashed into a clean pan for collection as above. All parasites collected were placed into 70% EtOH.

In addition to on-host collections, chicken nestboxes and coops were examined. Cracks and crevices were especially searched for evidence of temporary, blood-feeding parasites. At least four environmental samples of ~1 liter each were collected near likely parasite harborage (nestboxes, food and water, perches) into plastic bags, which were sealed and transported to the laboratory in an ice chest. Samples often included straw or other bedding material (e.g., from the edges of nestboxes), litter, or moist soil under feed or water containers. Berlese funnels (25-W incandescent light) were used for 24 h to separate live arthropods from collected debris into 70% EtOH.

Species identification was confirmed using a dissection microscope and when necessary specimens were slide-mounted, cleared in Hoyer's medium, and identified using phase-contrast microscopy and the keys and illustrations in Emerson (1956), Furman and Catts (1982), and Price and Graham (1997). Voucher specimens were deposited in the UC Riverside Entomology Museum. Birds ranged from quite large (e.g., >2–3 kg meat hens) to smaller bantam breeds (<0.5 kg). Therefore, parasite loads for each individual bird were not strictly quantitative or comparable; for example, a higher proportion of parasites were likely removed from smaller hosts. Field notes were made to include parasite abundance on individual birds.

Results and Discussion

Overall, the diversity and prevalence of observed ectoparasites is presented in Table 1. Surveys of four sites revealed no parasites on or around the birds. Parasites collected on the remaining premises (80%) included lice (Phthiraptera: Ischnocera and Amblycera), fleas

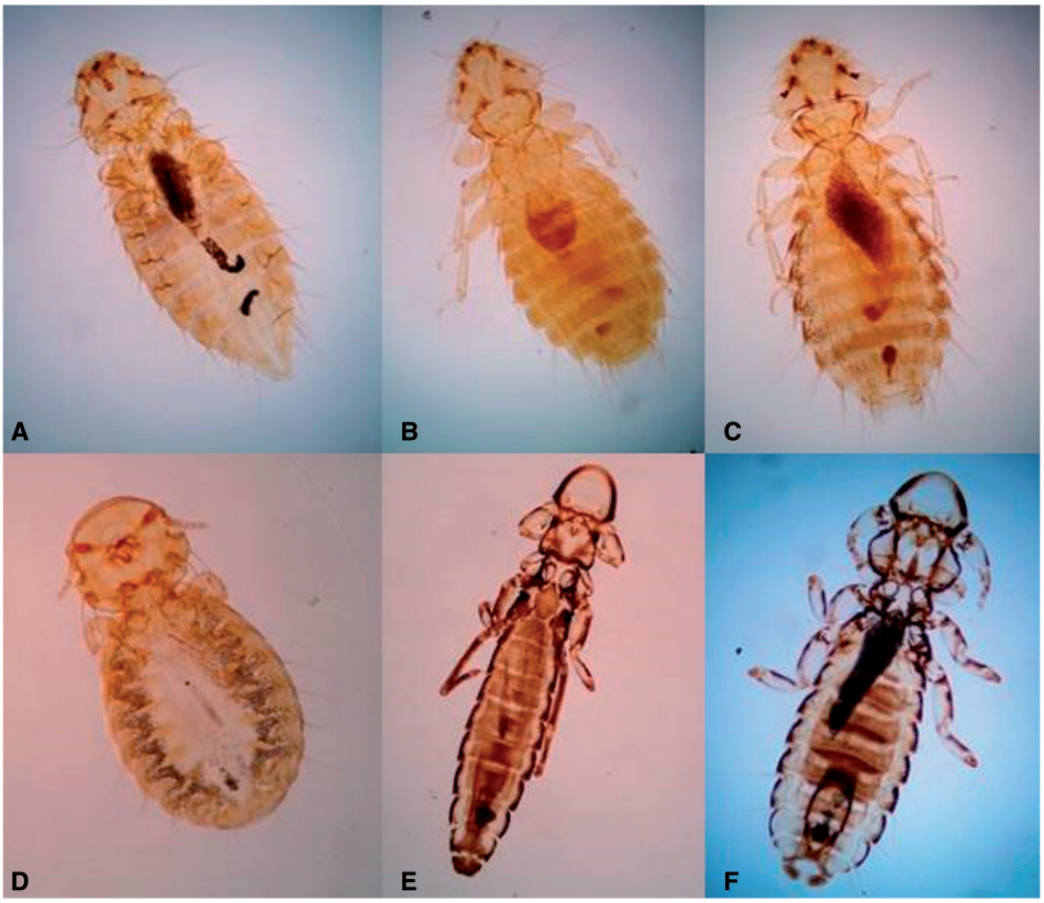

Fig. 2. Chicken lice (not to scale) collected in survey. (**A**) *Menopon gallinae;* (**B**) *Menacanthus cornutus;* (**C**) *Menacanthus stramineus;* (**D**) *Goniocotes gallinae;* (**E**) *Lipeurus caponis;* and (**F**) *Cuclotogaster heterographus.*

Table 1. Prevalence (%) of ectoparasites found on peridomestic (backyard) flocks and birds in southern California (2015)

	Flock prevalence (%)[a] $n = 20$	Bird prevalence (%)[b] $n = 100$
Phthiraptera		
Menacanthus stramineus	50	36
Menacanthus cornutus	5	5
Menopon gallinae	15	11
Cuclotogaster heterographus	5	5
Goniocotes gallinae	35	20
Lipeurus caponis	20	8
Siphonaptera		
Echidnophaga gallinacea	20	18
Acari		
Ornithonyssus sylviarum	15	7
Dermanyssus gallinae	5	–
Knemidocoptes mutans	10	–

[a] Four flocks with no ectoparasites.

[b] Infestation with *K. mutans* was not confirmed on individual birds. *Dermanyssus gallinae* is a temporary parasite and is not reported on individual birds.

(Siphonaptera), and mites (Acari: Astigmata and Mesostigmata). Lice were the most prevalent and abundant of all ectoparasite groups (Fig. 2). The chicken body louse, *M. stramineus*, was collected on 50% of premises and 36% of birds. It was the most abundant species recovered and sometimes was quite dense on individual birds, with dozens to hundreds of specimens seen. This species was followed in abundance by the fluff louse, *Goniocotes gallinae* (De Geer), collected on 35% of premises and 20% of all birds. It was found in numbers up to hundreds per hen and was most often observed in the fluffy vent feathers. The wing louse (*Lipeurus caponis* (L.)) was most often collected in the primary wing feathers, when backlit with natural light. Rarely were more than a dozen or so collected from any one bird. The shaft louse (*Menopon gallinae* (L.)) was collected on multiple properties. It may have been common (dozens per hen), but superficially resembled *M. stramineus*, making it difficult to differentiate from the body louse. The head louse (*Cuclotogaster heterographus* (Nitzsch)) was collected on bird head feathers (dozens per bird) in one flock. Some *Menacanthus cornutus* (Schömmer) were observed in only one flock, with dozens to hundreds per bird.

Sticktight fleas (*Echidnophaga gallinacea* (Westwood)) were found on 20% of properties, and this was the only flea species recovered. Some birds had up to hundreds of fleas attached to areas with little to no feather coverage such as the comb, wattles, and around the eye.

The northern fowl mite (*O. sylviarum*) was the most common parasitic mite encountered (15% of premises and 7% of birds). It was usually present in the vent region and at densities of <20 mites on a bird, but this was summer and the mite is more successful in cooler weather (Hall 1979). The scaly leg mite (*Knemidocoptes mutans* (Robin & Lanquetin)) was identified on two properties with

Table 2. Species richness on individual chickens which had infestations of multiple ectoparasite species

No. of birds	*Menacanthus stramineus*	*Menopon gallinae*	*Cuclotogaster heterographus*	*Goniocotes gallinae*	*Lipeurus caponis*	*Echidnophaga gallinacea*	*Ornithonyssus sylviarum*
6	×			×			
3	×		×				
3	×					×	
4		×				×	
3				×		×	
1					×	×	
1	×			×	×		
1	×	×				×	
2	×			×		×	
1		×		×	×		
2	×	×		×	×		
3	×	×		×		×	
1	×				×	×	×

The left hand column shows the number of birds with each parasite combination. The table is organized in ascending order from least (two) to most (four) parasite species per host.

the assistance of a veterinarian. Signs of scaly leg mite infestation are not absolutely characteristic and are complicated by factors such as secondary infections and gross tissue inflammation. Therefore, positive diagnosis is invasive and difficult to confirm. We report here only the properties where the mite was confirmed and do not present data on individual birds, although several birds exhibited what appeared to be severe scaly leg infestations (swollen and deformed toes and shanks) on each of those sites. The chicken red mite (*D. gallinae*), collected on one property closer to the coast (cooler temperature) and in the nestbox area, is not reported on individual birds because it is only a temporary parasite, found off-host during the day. It was abundant at the infested site, with a hundred or more in the one nestbox.

Dermanyssus gallinae is a very common and devastating poultry parasite in European flocks (Sparagano et al. 2014) but seems uncommon in commercial caged-layer egg flocks in the United States, probably due to lack of sufficient harborages in battery-style cages. As flock producers in the United States move toward furnished and cage-free housing, it may provide an opportunity for *D. gallinae* to become problematic. This is true also for the sticktight flea, which to our knowledge is not a major pest in commercial caged flocks. This flea requires organic material (soil or litter) for immature development. This may be available in cage-free or free-range flocks, but is prevented in suspended battery cage systems.

The louse diversity observed on backyard birds was high and resembles louse diversity found in previous surveys of backyard chicken flocks in other countries (Permin et al. 2002, Shanta et al. 2006, Syrcha et al. 2008). These species are described in the earlier literature (Emerson 1956), but little or no economic data are available for most of them. Most of these louse species are probably not of serious economic importance, with the exception of those that can blood feed (*Menacanthus* and possibly *Menopon*; Crutchfield and Hixson 1943, Price and Graham 1997).

Nearly a third (31%) of birds surveyed were infested with at least two species of ectoparasites (Table 2). Most coinfested chickens had only two species collected from them (65%), with a maximum diversity of four ectoparasite species on one bird. Most coinfestation was with multiple louse species and the sticktight flea, though one single bird had both northern fowl mites and lice. This is consistent with previous work that suggests mites have a difficult time surviving on chickens infested with large numbers of body lice (Chen et al. 2011).

Absent from our survey were argasid ticks or bed bugs, which can be found in cracks and crevices during the day and feeding on birds at night. The hot, dry weather may have influenced these findings. However, discussions with local poultry veterinarians suggest that *Argas* spp. do become problems at times in inland southern California for chickens in backyard settings.

Backyard flock surveys in other countries have been conducted (Permin et al. 2002, Shanta et al. 2006, Syrcha et al. 2008), but we are not aware of published, scientific backyard ectoparasite surveys in the United States. Rather, our knowledge is based on self-reporting of ectoparasite problems by owners (Garber et al. 2007, Elkhorabi et al. 2014). In this survey, experienced entomologists conducted all collections and identification.

Backyard flocks can be used as an indicator of potential species richness and diversity on chickens in an area. With the exception of *O. sylviarum* and *M. stramineus*, the species we collected in backyard flocks have been rare or absent in commercial battery-cage layer flocks in southern California over the past 30 years (Mullens, personal observation). Most commercial egg-laying chickens over the past several decades have been primarily maintained in battery or conventional cages, although this is changing. Increased consumer awareness and new animal welfare legislation are driving changes in chicken housing in the United States, especially in commercial industries. For example, Proposition 2 in California, requiring enhanced space per bird, was passed in 2008 and implemented in 2015. Subsequently chicken egg production is shifting to furnished cage, cage-free, free-range, or pasture operations, with the latter mimicking many backyard flock habitats. These more open habitats will likely increase the risk of ectoparasite acquisition and transmission. Ectoparasite infestation increases bird stress and perhaps economic damage such as decreased egg production and feed conversion efficiency (Mullens et al. 2009). Backyard chicken flocks are likely to continue increasing in popularity. Therefore, more information regarding the biology and ecology of these lesser-known parasites is critical to developing effective management options.

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