

Backyard chickens in the United States: A survey of flock owners

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ABSTRACT Although it has become increasingly popular to keep backyard chickens in the United States, few studies have provided information about these flocks. An online survey of backyard chicken owners was conducted, advertised through Master Gardeners' websites, social platforms, and other sites. The survey had 56 questions about flock history, husbandry, health care, and owner attitudes and demographics. Surveys received ($n = 1,487$) came almost equally from urban, suburban, and rural areas. Most (71%) respondents owned fewer than 10 chickens and had kept chickens for less than 5 yr (70%). Major reasons for keeping chickens were as food for home use (95%), gardening partners (63%), pets (57%), or a combination of these. Rural respondents had larger flocks ($P \leq 0.001$) and were more likely to keep chickens as a source of income or for show ($P \leq 0.001$) than urban and suburban respondents. Owners thought that eggs/meat from their chickens were more nutritious (86%), safer to consume (84%), and tasted better (95%) than store-bought

products, and also that the health and welfare of their chickens was better (95%) than on commercial farms. The majority (59%) indicated no flock health problems in the last 12 mo. However, there was a lack of awareness about some poultry health conditions. Many knew either little or nothing about exotic Newcastle or Marek's disease, and most (61%) did not vaccinate against Marek's. Respondents wanted to learn more about various flock management topics, especially how to detect (64%) and treat (66%) health problems. The Internet was the main source of information (87%) used by backyard flock owners, followed by books/magazines (62%) and feed stores (40%). Minimizing predation was the most cited challenge (49%), followed by providing adequate feed at low cost (28%), dealing with soil management (25%), and complying with zoning regulations (23%). The evidence obtained from this survey will help to determine what information and resources are needed to maintain good biosecurity and improve the health and welfare of backyard flocks.

Key words: chicken, backyard, survey, welfare, disease

2014 Poultry Science 93:2920–2931
<http://dx.doi.org/10.3382/ps.2014-04154>

INTRODUCTION

In recent years, there has been a growing interest in keeping poultry in urban or suburban neighborhoods in the United States (US). Because backyard chickens are privately owned and the resulting products (eggs and meat) are typically not marketed to the general public, there is very little information available about these flocks. In the US, the National Animal Health Monitoring System (NAHMS) conducted 2 cross-sectional studies in 2004 and in 2010 (USDA, 2005, 2011, 2013). Both were aimed at evaluating various aspects of backyard chickens' health, biosecurity practices, and bird movement in rural backyard flocks. The flocks surveyed were located within 1 mile (1.61 km) of commercial

poultry operations throughout the US and in 4 metro areas (New York, Los Angeles, Miami, and Denver). Additionally, some recent work aimed at determining particular epidemiological characteristics of backyard flocks, such as the prevalence of antibodies to low-pathogenicity avian influenza, was carried out in Colorado (Smith et al., 2012), Maryland (Madsen et al., 2013), Minnesota (Yendell et al., 2012), and Wisconsin (Donahue et al., 2011).

Outside of the US, smaller-scale studies have also been conducted in the Fraser Valley in Canada (Burns et al., 2011), in 2 areas of Palmerston North in New Zealand (Lockhart et al., 2010), and in the greater London area in the United Kingdom (UK; Karabozhilova et al., 2012) to obtain information about the prevalence, health, and husbandry of backyard flocks.

Because backyard poultry keeping is rather recent in the United States, very little is known about the demographic profile of backyard owners and information on flocks' characteristics, husbandry, and welfare is still lacking. Moreover, the 2 large-scale previously cited

©2014 Poultry Science Association Inc.

Received April 29, 2014.

Accepted July 10, 2014.

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studies only covered specific areas of the country and were mostly focused on evaluating biosecurity practices and bird health. Very little information about the sociological profile of backyard flock owners or their attitudes toward keeping poultry was obtained. The main objectives of the current study were to survey backyard flock owners about their perceived flock health and welfare issues, obtain information about flocks' characteristics and husbandry practices, gain a better understanding of the reasons people keep backyard flocks and what resources they might benefit from to improve flock management, and obtain detailed demographic information about flock owners and an overview of their attitudes about chickens and chicken-derived products.

MATERIALS AND METHODS

Study Design

Participation in an online questionnaire using Survey Monkey (<http://www.SurveyMonkey.com>) was advertised through the following websites: University of California–Davis Department of Animal Science, University of California–Davis Center for Animal Welfare, eXtension, California Farm Bureau Association, California Department of Food and Agriculture, and California Master Gardeners. Other online platforms such as the National Master Gardener listserve, Twitter, Facebook, and Google Groups were later added to recruit participants living in states other than California. Eligibility requirements for participation were to be at least 18 yr old, to live in the US, and to keep between 1 and 50 chickens at the time of the survey. The advertisement stated that information received would be kept confidential and that anonymity would be guaranteed at all times. Respondents could provide their contact information to win a gift card or a California Department of Food and Agriculture poultry calendar. The survey was open from February 11, 2013, to March 31, 2013. The Institutional Review Board at the University of California–Davis (protocol #425699–1) reviewed and approved the use of human participants for this study.

Survey

The 56-question survey was developed and pilot-tested on 5 flock owners known to the research team, and subsequently modified to its final form. Respondents were asked to provide a detailed description and history of their current flock and to answer various questions related to biosecurity, husbandry, health, and welfare issues of relevance to backyard flocks. The questionnaire also asked about owners' attitudes regarding chickens and chicken-derived products, as well as demographic information. The majority of questions (38) were closed or semi-closed multiple choice questions; for 16 of these questions, respondents could select more than 1 answer. For the semi-closed questions, respondents could provide brief information if they had selected the answer

choice "other." The rest of the questions either asked for a yes/no answer (11 questions), required participants to enter a number (4 questions), or asked them to select a preference on a Likert scale (Babbie, 2005; 3 questions).

Statistical Analysis

All surveys received ($n = 1,487$) were included in the analysis. Because not all questions were answered by each participant, the denominator used in the calculations was the total number of responses collected for each question, which ranged from 308 to 1,470. This wide range can be partly explained by the fact that respondents did not have to answer particular questions if they had answered "no" to the question above. Microsoft Excel (2010, Microsoft Corp., Redmond, WA) was used to calculate the descriptive statistics. Because the data set obtained did not follow a normal distribution and most of the questions were multinomial choices, associations between categorical variables were determined using nonparametric statistical tests with SAS 9.3 for Windows (SAS Institute Inc., Cary, NC). For questions that allowed respondents to select more than 1 answer (dependent variable), a logistic regression with a Tukey adjustment, which treated each dependent variable as a dichotomy (yes/no), was used and chi-squared tests were conducted. The dependent variable was a binary response variable, coded 0 for no and 1 for yes. When comparing 2 categorical variables with only 1 possible dependent variable, the Kruskal-Wallis test with a comparison procedure for all treatment pairs was used. When significant differences were found, the Dwass, Steele, Critchlow, and Fligner post hoc test was performed (Hollander and Wolfe, 1999). Although statistics were performed on least squares means, the results are presented as the original percentages of respondents for clarity. For all tests, significance was defined as $P < 0.05$.

RESULTS AND DISCUSSION

Demographics

The ZIP codes collected as part of the demographic information showed that respondents originated from 47 states (Figure 1), with the majority (61%) from California, followed by North Carolina (2.5%) and Connecticut (2.4%). Only Hawaii, South Dakota, and Kentucky were not represented in the sample. California was overrepresented; 61% of the participants came from this state, whereas only 12% of the US population resides in California. This overrepresentation can be explained by the fact that the survey was advertised most heavily in California. Because the type of living environment can vary within the same ZIP code, respondents were asked to designate whether the area in which they lived was urban, suburban, or rural. Results showed that respondents were almost equally

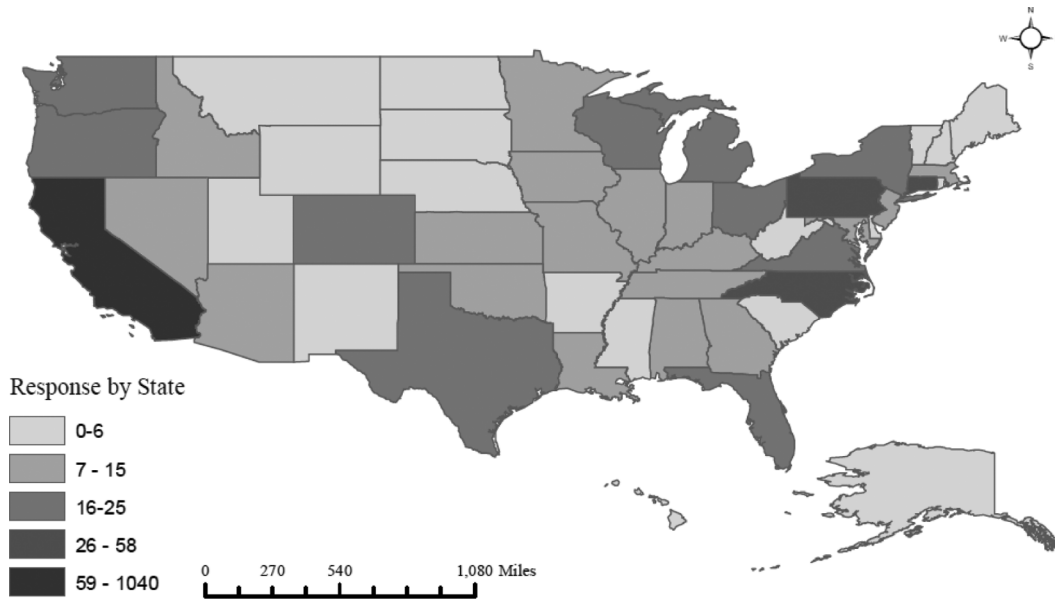


Figure 1. Distribution of survey respondents by state.

distributed among living areas: 38.4% described their living environment as rural, 31.5% as urban, and 30.1% as suburban. Respondents, who self-identified as the chickens' primary caregiver in 86.5% of cases, indicated that flock caregivers were mainly married (80%) adult females (70.7%). They were well-educated, with 32.7% having a 4-yr college degree and an additional 34.3% having a graduate or professional degree. The majority of caregivers being female and the high educational level confirm previous findings in the UK (Karabozhlova et al., 2012).

A large percentage of respondents were high-earners, with 41.2% indicating that their annual household gross income was more than \$100,000 (Figure 2). They worked mainly in the professional sector (44.1%) or

were retired/not employed outside of the home (21.4%). Only 4.1% were involved in agriculture. Backyard keepers in rural areas tended to have somewhat lower household incomes than their suburban and urban counterparts (Table 1).

When asked to state their ethnicity, 91.1% of respondents self-identified as European (Caucasian), followed by "other" (3.6%) and Hispanic/Latino (3.5%). Only 0.7% identified themselves as African-American. The avenues of recruitment used in this study help explain these results. Because the Master Gardeners were responsible for most of the advertising, it was expected that a large majority of respondents would have the typical sociological profile of the Master Gardeners' training program participants, who are primarily fe-

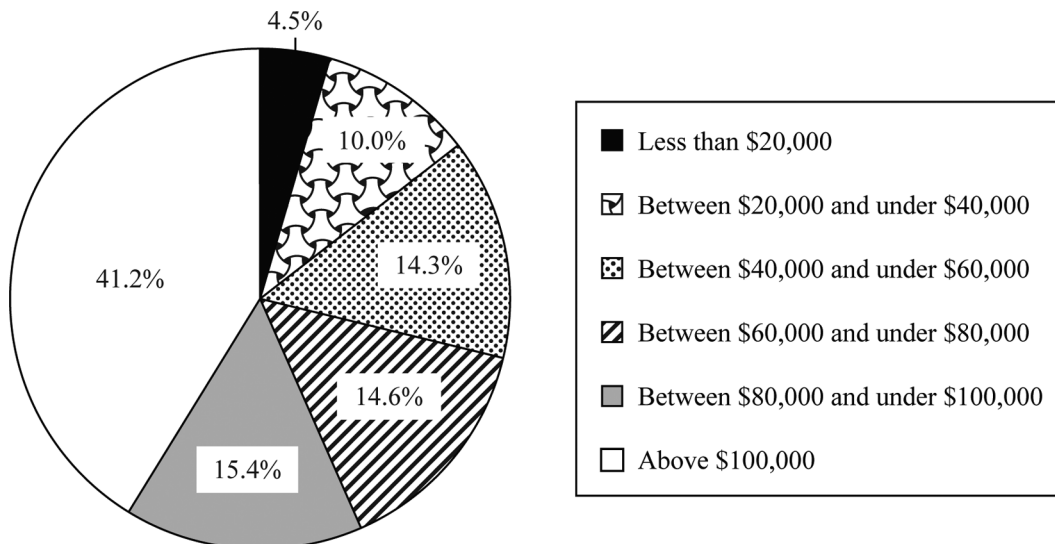


Figure 2. Distribution of survey respondents by annual household income level before taxes.

Table 1. Variation in husbandry practices and demographics across different living environments

Survey question	Living environment			Statistics	
	% Urban	% Suburban	% Rural	Test statistic	P-value
Rationale for keeping chickens					
Pets	65 ^a	60 ^a	55 ^b	OR ¹ = 0.52 and 0.61	<0.001
Gardening partners	68 ^a	66 ^a	62 ^b	OR = 0.62 and 0.68	<0.001
Income	3 ^a	6 ^a	13 ^b	OR = 4.37 and 2.29	<0.001
Shows	4 ^a	5 ^a	10 ^b	OR = 2.61 and 2.10	<0.001
Presence of 1 or more roosters in flock	10 ^a	16 ^b	52 ^c	KW, ² df = 2	<0.001
Income of respondents >\$100,000	43 ^a	51 ^a	32 ^b	KW, df = 2	<0.001
Flock size >20 chickens	4 ^a	6 ^a	27 ^b	KW, df = 2	<0.001
Vegetation covered area >two-thirds of total area	25 ^a	30 ^a	47 ^b	KW, df = 2	<0.001
Likelihood of breeding	8 ^a	13 ^a	36 ^b	KW, df = 2	<0.001
Carcass disposal methods					
Incineration	2 ^a	2 ^a	10 ^b	KW, df = 2	0.002
Bury on premises	30 ^a	32 ^a	43 ^b	KW, df = 2	0.002
Source of information					
General/avian veterinarian	20 ^{ab}	24 ^a	16 ^b	OR = 0.75 and 0.64	0.028
Internet	90 ^a	89 ^{ab}	87 ^b	OR = 0.59 and 0.64	0.012
Agricultural organizations (e.g., 4-H)	7 ^a	7 ^a	13 ^b	OR = 1.28 and 1.60	0.002
Likelihood of killing chickens	27 ^a	31 ^{ab}	35 ^b	OR = 0.66 and 0.79	0.011
Challenges in keeping chickens					
Zoning regulations	33 ^a	28 ^a	9 ^b	OR = 0.21 and 0.25	<0.001
Soil and vegetation management	28 ^a	27 ^a	19 ^b	OR = 0.55 and 0.58	<0.001
Minimizing predation	38 ^a	45 ^a	56 ^b	OR = 1.96 and 1.49	<0.001
Providing adequate feed	20 ^a	20 ^a	38 ^b	OR = 2.42 and 2.42	<0.001

^{a-c}Different superscripts within a question indicate significant differences for that particular question, $P < 0.05$.

¹OR = odds ratios from logistic regression.

²KW = Kruskal-Wallis test.

males aged between 40 and 59 yr old. It is likely that this study underrepresents the prevalence of backyard flocks in Latino/Hispanic communities (Beam et al., 2013). Because the survey was in English only, and because of the recruitment routes described above, it is possible that it did not reach this particular community (Beam et al., 2013). The findings obtained in this survey also seem to confirm the very low prevalence of flock-keeping among African-Americans already observed in a previous study (USDA, 2013), although this finding may also have been biased by the recruitment methods used. Recent data on computer and Internet trends in the US (United States Census Bureau, 2012) show that home Internet availability and usage in the US overall is very high, but that there is a “digital divide” across communities; whereas 83% of Asian and 80% of White non-Hispanic homes have Internet, only 68% of African-American and 64% of Hispanic homes do, which could partly explain the low percentage of survey responses from these communities.

When asked about the length of time that they had kept chickens, 37.7% stated 2 to 5 yr, followed by less than 2 yr (32.5%). These results indicate the relative recency of and growing interest in backyard chicken keeping. Respondents were also asked how much knowledge and expertise they had in keeping chickens: 32.3% of them said “a great deal,” 54.3% said “fair,” and 10.7 and 2.7% said “some” and “limited,” respectively. Whereas the living environment of respondents had no significant effects on this self-evaluation of knowledge, the length of time that respondents had kept backyard flocks did. Those relatively new to chicken-keeping were

less likely to self-evaluate as knowing “a great deal” about chickens (Kruskal-Wallis: $df = 3$, $P < 0.001$). For example, among people owning chickens for less than 2 yr, only 16% said they had a “great deal” of knowledge, whereas 60% of them evaluated their expertise as “fair,” 19% as “some,” and 6% as “limited.”

Motivation for Keeping Chickens

When asked about the major reasons they kept backyard chickens, respondents mentioned first food for home use (eggs or meat or both; 95.2%), followed by as gardening “partners” (e.g., pest control, manure as fertilizer; 62.8%), and pets (57.4%). The remaining possible answers were source of income, family tradition, shows (4-H), and “other,” which were together cited by less than 35% of respondents. As this question (and various others) allowed respondents to select multiple answers, the total percentages do not add up to 100%. Even though this question did not specifically ask if chickens were kept for eggs only, meat only, or both, the breeds favored by respondents indicate that almost all individuals surveyed kept at least some egg-laying hens. This finding was also confirmed by the fact that only 13 of the respondents stated that they did not keep laying hens in a subsequent question inquiring whether calcium supplements were given to laying hens.

As previously described, the Master Gardeners heavily advertised the survey, which might explain the large number of respondents using their birds as gardening “partners.” Among the category “other,” the most common answers were fun/hobby, educational tool for

children, and therapy tool. The living environment of respondents had a significant effect on their rationale for keeping chickens (Table 1); rural respondents were less likely than their urban and suburban counterparts to keep them as pets or gardening “partners” and more likely to keep them as a source of income or for shows. There were no significant differences between urban and suburban respondents. The first and third reasons cited (food for home use and pets) agree with previous findings in the US (USDA, 2005, 2013; Smith et al., 2012; Yendell et al., 2012), UK (Karabozhilova et al., 2012), and Canada (Burns et al., 2012) about the popularity of backyard chickens as pets and food providers.

Flock Characteristics

When asked about the origin of their current flock, 53% of respondents listed the feed store, followed by the hatchery (27%). The remaining 20% obtained their birds mostly from friends, family members, neighbors, and Internet sources. The age range of chickens in the flocks surveyed was 0 to 11 yr. The sex composition of the flocks was, as expected, predominantly female: 68% of flocks had no rooster, although 15% had 1 and 17% more than 1. The living environment of respondents had a significant effect on the likelihood of keeping roosters (Table 1), with flock keepers owning roosters living more frequently in rural than in suburban or urban environments. Flock size ranged from 1 to 5 birds in 43.5% of cases, 6 to 10 in 28.3%, and 11 to 20 in 15.7%. Only 12.5% of respondents indicated that they kept more than 20 chickens. Living environment had a significant effect on flock size (Table 2), with rural respondents keeping larger flocks than their urban and suburban counterparts. The fact that flocks were rather small and consisted mostly of hens is similar to results of previous studies conducted in the US (Garber et al.,

2007; Beam et al., 2013), New Zealand (Lockhart et al., 2010), and the UK (Karabozhilova et al., 2012).

The 5 breeds most favored by respondents were Rhode Island Red, Plymouth Rock, Ameraucana, Orpington, and Wyandotte, all egg-laying breeds. Flock owners also appeared sensitive to egg color, as all of the 5 most frequently cited breeds lay colored eggs. Other “blue-green egg” layers (Araucana and “Easter Egger”) and chocolate egg layers (Marans and Wellsummer) were also popular. This high prevalence of colored egg layers could possibly be partly explained by their color dissimilarity with the predominantly white eggs laid by commercially raised hens.

A minority (15.4%) of individuals mentioned keeping other poultry species besides chickens. This occurred more frequently in rural areas (24%) than in suburban (11%) and urban (8%) areas. Nevertheless, 82.1% of them did not allow contact between their chicken flock and the other poultry. The most commonly kept species were ducks (55%) and turkeys (29%).

Husbandry

Almost all backyard flock owners housed their birds in a shed/coop and also provided either an enclosed run (35.5%), free-range access during the daytime (49.4%), or both (7.7%). Very few participants used mobile/portable housing, cages, or no housing at all. The approximate size of the total area available to the flock (shed/coop included) varied widely: between 9.3 and 46 m² (33.6%), more than 46 m² (32.1%), between 4.6 and 9.3 m² (23.3%), and less than 4.6 m² (11.0%). Rural respondents offered a larger vegetation-covered area to their flocks than respondents living in other environments (Table 1). The survey also inquired about precautions taken to prevent predation. The 3 most frequently cited methods were fencing around poultry

Table 2. Variation in husbandry practices across different chicken flock sizes

Survey question	Flock size				Statistics	
	% 1 to 5 chickens	% 6 to 10 chickens	% 11 to 20 chickens	% >20 chickens	Test statistic	P-value
Likelihood to breed	3 ^a	13 ^b	41 ^c	58 ^d	KW, ¹ df = 3	<0.001
Medication usage						
Do not receive	78 ^a	65 ^{bc}	68 ^b	55 ^c	All OR ² ≤ 0.66	<0.010
Coccidiosis preventative	5 ^a	9 ^b	8 ^{ab}	12 ^b	All OR ≥ 1.44	0.005
Dewormer	5 ^a	11 ^b	10 ^{ab}	20 ^c	All OR ≥ 2.03	<0.001
Behavior problem						
No behavior problems	75 ^a	66 ^b	72 ^{ab}	67 ^{ab}	All OR ≥ 0.66	0.010
Feather pecking	14 ^a	19 ^{ab}	17 ^{ab}	22 ^b	All OR ≥ 1.17	0.036
Killing method						
Killing cone	2 ^a	8 ^b	11 ^{bc}	17 ^c	All OR ≥ 1.67	<0.001
Decapitation	2 ^a	6 ^b	10 ^{bc}	16 ^c	All OR ≥ 1.62	<0.001
Cervical dislocation	2 ^a	6 ^b	7 ^b	9 ^b	All OR ≤ 0.18	<0.001
Challenges in keeping chickens						
Zoning regulations	25 ^a	22 ^a	17 ^{ab}	12 ^b	All OR ≤ 0.65	0.002
Providing adequate feed	15 ^a	23 ^b	34 ^c	55 ^d	All OR ≥ 2.35	<0.001
Lack of slaughter facilities	14 ^a	21 ^a	20 ^a	28 ^b	All OR ≥ 2.33	<0.001

^{a-c}Different superscripts within a question indicate significant differences for that particular question, $P < 0.05$.

¹KW = Kruskal-Wallis test.

²OR = odds ratios from logistic regression.

area (82%), closing birds inside at night (78.7%), and overhead fencing/cover (52.4%). About 20% of respondents also selected “other” and most frequently mentioned guard animals (primarily dogs, but also donkeys, geese, and guinea fowl).

When asked about the availability of 2 behaviorally important housing features, roosting space and secluded space for laying, almost all respondents answered positively: 92.8% of them provided perches as roosting space and 98.8% provided nest boxes for egg laying. About three-quarters (75.4%) of flocks surveyed received a mixed ration of feed (purchased and kitchen scraps), followed by a ration purchased at the feed store (21.2%), a grain-based homemade formulated ration (2.5%) or kitchen scraps only (0.4%). In 0.5% of cases, no feed was provided at all and birds were expected to obtain all of their feed from the range. Similarly, only 0.3% of chickens obtained all of the water needed from natural sources, whereas 81.8% of them were provided with fresh water daily and 17.9% only as needed. Moreover, one-half of the respondents indicated that they provided supplemental grit to their birds at least weekly, as well as calcium supplements if they kept laying hens.

Regarding breeding practices, almost three-quarters (72.5%) of individuals had not/were not planning on breeding any of their chickens. Among those who did plan to breed their chickens, 58.8% indicated that they would use natural incubation with broody hens instead of an incubator (41.2%). Again, the living environment had a significant effect on the likelihood that respondents would breed their chickens (Table 1), with rural respondents more likely to breed than their suburban and urban counterparts. Flock size also had an effect (Table 2); as flocks became larger, the likelihood that they would be bred increased. As expected, when asked about where flock replacement would likely originate from, 52.1% of respondents cited the feed store, followed by the hatchery (30.7%). This is consistent with the relatively small number of individuals wanting to breed their flocks and the scarcity of roosters in backyard flocks, and suggests that respondents favor sources of replacement with which they are already familiar.

To conclude, the high percentage of birds allowed to freely range during the day and the fact that most backyard keepers provide their flocks with a living environment that provides features for foraging, roosting, and nesting, confirm previous findings from New Zealand (Lockhart et al., 2010) and the UK (Karabozhilova et al., 2012) about flock keepers' interest in allowing their flocks to perform natural behaviors.

Biosecurity

In a grid listing various biosecurity practices (Figure 3), survey participants were asked how often they implemented any of them on a Likert preference scale. The majority of respondents always/often isolated

newly arrived chickens as well as chickens they suspected were sick, and also wore different shoes/clothes when cleaning the poultry area. However, most did not wear different clothes/shoes when simply entering the poultry area, and a majority sometimes or always/often allowed guests into the poultry area. Biosecurity measures were influenced by the motivation for keeping chickens. Respondents were more likely to allow visitors into the poultry area if they kept their chickens as pets (logistic regression: odds ratio = 1.70, $P < 0.001$) or for food (logistic regression: odds ratio = 1.84, $P = 0.009$) than if chickens were kept for any other reasons. They were also more likely to wear a specific set of clothes/shoes when entering the poultry area if they kept their birds for food (logistic regression: odds ratio = 2.47, $P < 0.001$) or as a source of income (logistic regression: odds ratio = 1.50, $P = 0.046$). However, almost one-half of the respondents were not aware of the risks encountered by exposing their flocks to wild birds, as 44.1% had a wild bird feeder on their property and 47.6% mentioned that wild birds, rodents, or both, could access their chickens' feed and water.

When asked about cleaning practices, results were very varied: 31.1% of respondents indicated that they removed soiled litter, fecal material, or both, weekly; 30.7% when needed; 21.1% monthly; 13.8% daily; 2.5% once a year; and 0.9% never. The most common litter materials used were wood shavings (46.7%) and straw (30%).

Carcass disposal methods were mainly divided between burial on premises (40.9%), put in trash (30.7%), or “other” (16.9%). Among “other,” the most frequently cited methods were to bring the carcass to a diagnostic laboratory or a veterinarian, or to feed it to wildlife. The living environment of respondents had a significant effect on disposal methods (Table 1): rural respondents were more likely to incinerate carcasses than their urban and suburban counterparts, as well as to bury the carcass on their premises.

To conclude, the results demonstrate a certain level of awareness of the need for biosecurity practices. However, respondents appear to lack knowledge of the risks of disease transmission associated with the presence of wild birds or the burial of carcasses on their property. This gap in knowledge was similarly reflected in previous studies (Garber et al., 2007; Lockhart et al., 2010; Burns et al., 2012; Karabozhilova et al., 2012; Beam et al., 2013), where biosecurity precautions were also lacking and carcass disposal methods were almost identical to the ones reported in this survey. Furthermore, there is apparently an opportunity for better outreach and visibility of services offered by diagnostic laboratories. In this survey, only 1.7% of respondents mentioned using such services as the most common carcass disposal method, whereas in a study conducted in Canada (Burns et al., 2012), all survey participants ($n = 18$) were aware of the pathology services offered by the provincial diagnostic laboratory.

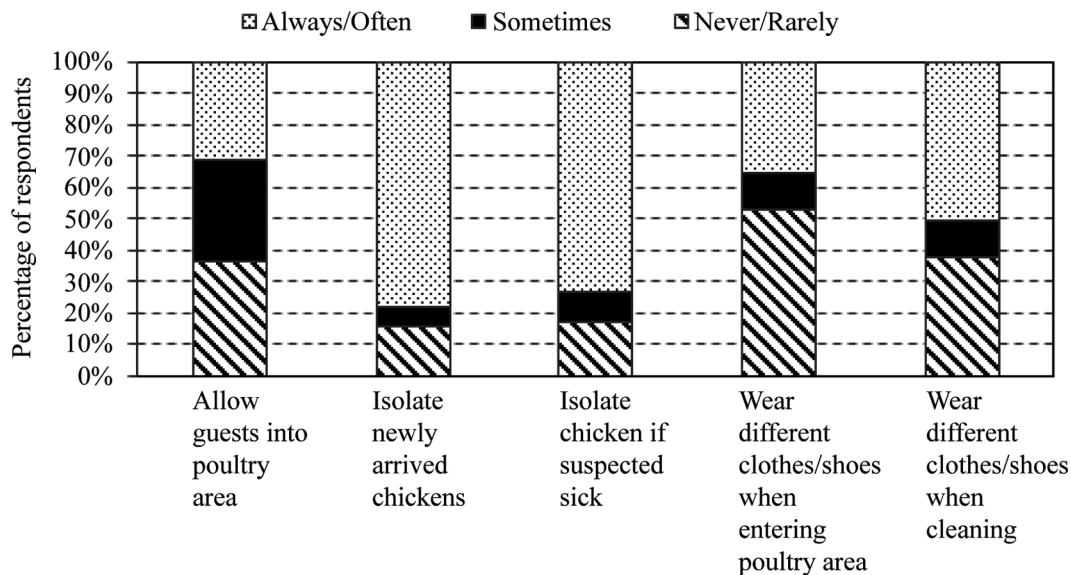


Figure 3. Frequency of biosecurity practices. Respondents were asked to indicate how often they carried out the above measures on a 1 to 5 Likert scale, with 1 indicating always and 5 indicating never. Categories 1 to 2 and 4 to 5 are grouped for presentation.

Sources of Information and Flock Owners' Attitudes

Because there has been an increasing amount of information available on backyard chicken husbandry, this study inquired what information sources the respondents generally used. Overall the Internet was preferred, selected by 87.4% of participants, followed by books/magazines (62.5%), feed stores (40.2%), and university poultry extension specialists/extension publications (28.2%). The attractiveness of the Internet as a primary source of information confirms previous findings (Burns et al., 2012; Karabozhilova et al., 2012). Only 18.8% of respondents listed a general/avian veterinarian as a source of information and even fewer (1.7%) mentioned commercial poultry veterinarians. The lack of use of veterinarians as sources of information confirms similar results obtained previously in the US (Garber et al., 2007), Canada (Burns et al., 2012), and the UK (Karabozhilova et al., 2012). Even though the current survey did not specifically inquire about why veterinarians were not consulted, this phenomenon might be explained by the lack of availability and expertise of general veterinary professionals in treating chickens. Moreover, commercial poultry veterinarians might be largely inaccessible in various areas or not willing to treat backyard chickens. Lastly, the apparent lack of trust in the poultry industry, as discussed below, might also explain the respondents' not seeking help from commercial poultry veterinarians.

About 18% of respondents also listed "other" as source of information, and in this category the most frequent answers were family/friend/neighbor, as well as other online platforms such as Facebook and various blogs. Living environment affected the choice of information source (Table 1). Rural respondents mentioned consulting general/avian veterinarians less frequently

than their suburban counterparts, with urban respondents intermediate. Rural respondents also listed the Internet less frequently than their urban counterparts, with suburban respondents intermediate. Finally, rural respondents were more likely to obtain information from 4-H than respondents from either urban or suburban areas.

Based on these findings, it is interesting to consider flock owners' attitudes regarding the role of chickens, the health and welfare of their flocks, and the attributes of chicken-derived products. For that purpose, respondents were provided with a Likert preference scale grid listing 7 statements and asked how much they agreed with each of them (Figure 4). The majority of respondents agreed that they enjoy watching chickens' behavior and that their birds represent a useful teaching aid for children while also providing companionship. Almost all respondents also stated that their birds' health and welfare are better than on commercial poultry farms and that the eggs or meat produced by their flocks are tastier, more nutritious, and safer to consume than purchased poultry products. Interestingly, these results did not significantly differ between different living environments.

Because the majority of respondents mentioned that they kept chickens as pets, it was not surprising that so many said that they enjoy watching their chickens' behavior and use them to teach family members about proper animal care. The fact that a large majority of survey participants believe that their poultry are better cared for and provide better products than commercial poultry seem to reflect some common public perceptions of the commercial egg industry. As a whole, US consumers are concerned about food animal welfare (Bennett, 1998), and a recent telephone survey (Prickett et al., 2010) revealed that a large proportion indicated that they considered welfare in their purchas-

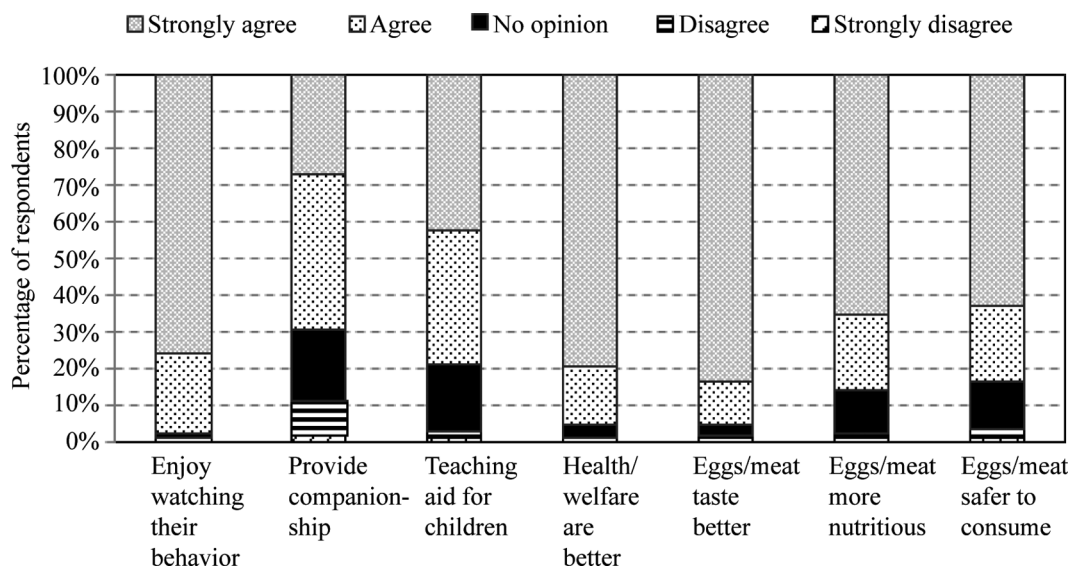


Figure 4. Backyard flock owners' attitudes about their chickens and how their home-produced poultry products compare with commercial products. Respondents were asked to indicate how much they agreed with each of the statements on a 1 to 5 Likert scale, with 1 indicating strongly agree and 5 indicating strongly disagree.

ing decisions, although these statements are not necessarily reliable predictors of actual purchasing behavior (Thompson et al., 2011). Nevertheless, recent studies have shown that consumers sampled indicate willingness to pay a premium for eggs from an aviary free-range system as compared with a conventional cage system (Norwood and Lusk, 2011), and that providing the opportunity for animals to exhibit natural behaviors and exercise outdoors is much more important to consumers than providing shelter to maintain a comfortable temperature (Lusk et al., 2007). This finding might explain why most backyard flocks are allowed to free-range, at least during the daytime.

In terms of food quality, a Canadian study (Bejaei et al., 2011) aimed at identifying associations between the consumption of "specialty" eggs (cage-free, free-range, organic, and nutrient-enhanced) and consumers' attitudes found that "specialty" eggs were rated as having a higher nutritional value than regular white eggs; most consumers also preferred a darker yolk color, which was described as "tasting better." Besides the nutritional and health benefits, major reasons cited by respondents for purchasing "specialty" eggs were concerns for animal welfare and the environment. These beliefs expressed by a sample of the Canadian population also confirm similar views expressed by US backyard flock owners in a previous study (USDA, 2011): about one-half of respondents in the 4 metro areas surveyed rated food quality (e.g., freshness, health), concerns about animal welfare and concerns about the environment as very important reasons for having chickens. Similarly, about two-thirds of respondents also believed that eggs from home-raised chickens are better for you than eggs purchased at a grocery store (USDA, 2011). Therefore, backyard flock owners might want to produce their own eggs and meat to achieve greater self-sufficiency

in a manner they consider more "sustainable," "safer," "healthier," and more "humane" than the alternatives offered at the store.

Bird Health

The majority of respondents (58.6%) reported no health-related conditions in their flock within the past year and no visit to a veterinarian (89.1%). Among those reporting health issues, the most commonly cited issues were external parasites (11.4%), "other" (10.9%), diarrhea (10.6%), and injuries (8.1%). In the "other" category, the most frequently mentioned conditions were prolapsed vent and sour crop. About three-quarters (73.8%) of respondents had not administered any medications (excluding vaccines) to their birds within the past 12 mo, and among the few who did, the most common medications were dewormers (10.1%) and antibiotics (9.8%). Flock size had a significant effect on the likelihood that medications would be administered (Table 2). Generally, flocks with 1 to 5 birds were given fewer medications than larger flocks and flocks with >20 chickens were more likely to receive coccidiostats and dewormers than flocks with 1 to 5 birds. Overall, the few health issues reported, with the most common being external parasites, confirm previous findings obtained in the US (Garber et al., 2007) and Canada (Burns et al., 2012).

About three-quarters (76.6%) of respondents reported no behavior-related problems (such as feather pecking, cannibalism, piling, or excessive noise or aggression) within the past year. Among the quarter that did, the most frequently cited problem was feather pecking (18.2%), which was more prevalent in flocks with >20 chickens than in flocks of 1 to 5 birds (Table 2). Overall, flocks with 6 to 10 birds were more prone to

behavior-related problems than flocks with 1 to 5 birds (Table 2).

Consistent with these overall findings, survey participants reported very little mortality in their flocks: 64% stated that none of their birds had died (except for those slaughtered for human consumption) within the past year. Predation was the most common cause of mortality cited by respondents and affected 30% of flocks, which reflects previous findings obtained in the UK (Karabozhilova et al., 2012). Finally, very few (8.8%) respondents had ever used the necropsy services offered by state/university diagnostic laboratories; however, the survey did not inquire if flock owners were aware of such services but only if they had used them.

To evaluate how familiar backyard owners were with the main health conditions that could affect their flocks, they were provided with a Likert preference scale grid listing various health issues and asked how aware they were of each of them. Results showed (Figure 5) that survey respondents were the most familiar with external and internal parasites. When asked about important infectious diseases, results were more variable; a large percentage of respondents were not familiar with avian influenza (AI) and about one-half were not familiar with Marek's disease. Respondents were also asked if they were aware of the vaccine against Marek's; whereas 39.1% were and had their chickens vaccinated, 41.8% of them were not familiar with it. Interestingly, respondents' familiarity with the diseases previously mentioned correlated with their self-evaluation of their general knowledge and expertise in keeping chickens. For example, among people describing themselves as having "a great deal" of knowledge, 71% of them were familiar with AI (logistic regression: odds ratio = 8.06, $P < 0.001$), compared with only 27% of those describing their knowledge as "limited." In the middle of the spectrum, 54% of respondents who described their knowledge as "fair" were familiar with it, as were about 41% of those who described themselves as having "some" expertise. Similar results were obtained for other illnesses such as Marek's (logistic regression: odds ratio = 6.17, $P < 0.001$) and Newcastle disease (logistic regression: odds ratio = 14.2, $P < 0.001$).

To conclude, survey participants were generally quite aware of common health conditions such as parasites. However, the relatively high percentage of backyard owners not familiar with important and highly transmissible infectious diseases, such as AI and Newcastle disease, is concerning, especially taking into account the recent outbreaks that have occurred in the US. In 2002–2003, an outbreak of exotic Newcastle disease, originally confirmed in a California backyard flock, spread to commercial poultry operations in California as well as to backyard flocks in other states (CDC, 2012). This epidemic led to the depopulation of 3.16 million birds at a cost, from discovery to eradication, of \$161 million (CDFA, 2013). Regarding AI, it is believed that the potential for backyard poultry flocks to contribute to the transmission of this disease to com-

mercial flocks is rather modest (Smith and Dunipace, 2011). In a recent study of 150 backyard flocks in Minnesota, only one flock, which included chickens, waterfowl, and other birds, tested positive for AI (Yendell et al., 2012). Similarly, blood samples from 717 backyard birds in Wisconsin all tested seronegative for AI (Donahue et al., 2011). Nevertheless, a cross-sectional study of backyard poultry flocks in Maryland (Madsen et al., 2013) revealed that 11 of the 262 birds sampled tested seropositive for AI. In this case, seroprevalence was positively associated with exposure to waterfowl, the absence of pest control, and geographic location. Therefore, backyard flocks could still potentially serve as a source of contamination of commercial flocks under some circumstances, and survey participants' deficiency in knowledge emphasizes the importance of providing reliable sources of information and prevention strategies.

Rationale for Killing Chickens

Respondents were asked if they had killed any of their chickens within the past 12 mo. As expected, about three-quarters (74.4%) had not. Among the remaining quarter who had, the most common reasons cited were to consume the meat (12.0%), because the chicken was sick or injured (8.7%), or to get rid of male chicks/roosters (8.4%). Very few backyard owners (2.5%) culled hens that had decreased or stopped laying. The most frequently cited reason for killing chickens among the 5% of respondents who selected "other" was that a particular bird was overly aggressive. Living environment had an effect on the likelihood of respondents killing their chickens (Table 1), with urban respondents less likely to have done so than their rural counterparts,

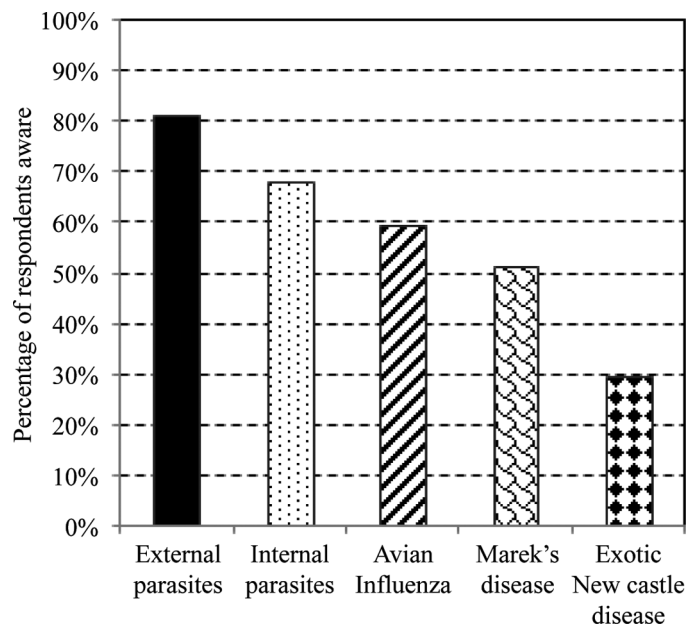


Figure 5. Respondents self-reported familiarity with some common health issues that can affect backyard flocks.

whereas suburban residents did not significantly differ from either.

Second, respondents were asked what killing method(s) they had used within the last 12 mo. The killing cone (or another method involving severing the neck veins with a knife) was the method most frequently cited by respondents (34.1%), followed by decapitation (28.9%), cervical dislocation (21.8%), and "other" (19.5%). In the "other" category, the methods most often mentioned were gunshot and gas. It was hypothesized that killing methods would vary depending on the respondents' self-evaluation of knowledge and expertise in keeping chickens, but this was not the case. However, another factor, flock size, did affect the killing methods preferred (Table 2): killing cone and decapitation were used more frequently in larger flocks. This could be because respondents keeping larger flocks might raise some birds for meat consumption and therefore use rapid and sanitary slaughter methods such as the cone or decapitation. On the other hand, smaller flocks with 1 to 5 birds were less likely to be killed by cervical dislocation than flocks of any other sizes (Table 2). A possible explanation for that result might be that respondents that have very small flocks might not have the necessary skills to perform dislocation.

From a welfare perspective, the killing methods described above are all acceptable if performed correctly by a trained individual (AVMA, 2013). However, some of the ones that respondents listed under "other," such as gassing using the solid form of carbon dioxide (dry ice) or drowning, constitute serious welfare concerns and are not considered acceptable by the AVMA (AVMA, 2013).

Challenges

Even though backyard chicken keeping has grown in popularity over the last few years, there is currently not much information available on the difficulties encountered by flock owners and the possible means to reduce them. Therefore, survey respondents were asked about what they perceived as the major challenges in flock keeping. It was hypothesized that predation, zoning regulations, manure management, adequate nutrition, and euthanasia/culling would be problematic issues. As predicted, results showed that among the 13 possible challenges listed, minimizing predation was by far the most frequently selected one (48.8%), followed by providing adequate feed at reasonable cost (28.1%), soil and vegetation management (25.2%), and complying with zoning regulations (23.4%). The other potential challenges listed were complaints by neighbors about noises and smells; manure management; flock size management; handling aggressive chickens; lack of veterinarians trained in treating chickens; lack of good information about poultry health problems, husbandry, and behavior; and lack of slaughter facilities for processing small numbers of birds. About 13% of respondents also selected the "other" category and most often mentioned

the lack of reliable "chicken sitters" when going on vacation.

The living environment of respondents had significant effects on the challenges faced (Table 1): zoning regulations and soil and vegetation management were less of a concern for rural respondents than their urban and suburban counterparts. On the other hand, individuals living in rural areas found minimizing predation and providing adequate feed more challenging than their urban and suburban counterparts (Table 1). The latter result is difficult to interpret as it was expected that there would be greater feed availability in rural areas; a possible explanation might be that, as previously described, rural respondents tend to keep larger flocks that are more expensive to maintain, or that they are more likely to raise their birds for meat production and have to purchase more feed because of faster growth rates of their birds.

Flock size also influenced the major challenges perceived (Table 2); zoning regulations were less challenging for those individuals with flocks >20 birds than those with flocks of <10 birds. These results can be explained by linking flock size to the respondents' living environment; because rural respondents tend to keep larger flocks and provide them with a larger range area, they are less likely to be concerned about zoning and neighboring issues. On the other hand, urban or suburban respondents that keep smaller flocks in more restricted areas will be more challenged by soil and vegetation management. Additionally, adequate feed provision at reasonable cost was cited more frequently as flock size increased (Table 2), which confirms the previously cited hypothesis. Finally, the lack of slaughter facilities for processing small numbers of birds was a greater challenge for respondents keeping large flocks of >20 chickens (Table 2), which confirms the hypothesis that respondents keeping larger flocks consume the meat from their chickens.

In another question, respondents were asked whether any egg-related issues had occurred in their flocks within the last 12 mo. About half (53.1%) stated that none had occurred, whereas 32.0% mentioned having issues with eggs laid outside of nests, 18.2% with egg-eating by the chickens, and 10.2% having a sudden decrease in laying rate not related to molting.

Overall, survey respondents appeared satisfied with their backyard chicken-keeping experience because almost 90% of them stated that they will likely keep chickens in the next decade.

Topics of Interest

To evaluate additional resources from which backyard flock owners might benefit, survey participants were asked about what topics they would find it helpful to have more information about. Among the 10 subjects listed, 66.2% were interested in how to appropriately treat injuries and health problems and 64% in how to detect health issues. Improving egg laying rate year-

round was selected by 43.9% of respondents, followed by how to ensure sufficient sanitation (41.1%) and how to humanely euthanize a chicken (38.2%). The fact that health-related topics were the most favored by respondents was unexpected, considering the relatively low number of health issues reported by the respondents. This finding suggests that many flock keepers might be somewhat aware of their limited knowledge in disease detection and treatment and would like to remediate it. The topics of interest did not vary depending on the respondents' living environment.

When asked about their preferred communication avenues, about three-quarters (76.5%) of respondents opted for a website, followed by newsletter via email (63.6%), and hands-on workshop (37.6%). These findings reflect again the importance of the Internet as an information medium, but also the relatively high number of participants interested in attending educational workshops or webinars, especially on topics such as humane euthanasia and disease detection. Overall, the results obtained might help extension professionals in developing educational opportunities for backyard flock owners, which should contribute to improving biosecurity, disease prevention, and flock well-being.

Conclusion

Despite having been administered exclusively online, this survey confirmed some findings from previous studies that were conducted using in-person interviews or paper surveys, suggesting that the Web can be a reliable survey vehicle that allows sample size to be increased. This is the only published large-scale survey of backyard owners that statistically analyzed the effects of factors such as living environment, knowledge about poultry-keeping, and living environment on survey responses. Moreover, this study was the first to reveal the necessity for a better availability of services and supplies related to backyard chicken keeping. Proper veterinary care by providers trained and willing to treat small chicken flocks and vaccines in quantities that are small enough for use in noncommercial flocks were frequently cited as needs by the survey participants. Overall, most of the flock owners surveyed showed enthusiasm and interest in ensuring the well-being of their birds and might benefit from additional information on relevant topics such as biosecurity precautions, disease detection, and humane culling methods. Additional outreach efforts should also be considered; a large percentage of respondents were not aware of the vaccine against Marek's disease or had never used the services offered by the state diagnostic laboratory.

Because backyard chicken keeping, especially in urban and suburban areas, is a relatively recent phenomenon and is likely to expand in the next decade, there is an opportunity and need for extension professionals and veterinarians to develop resources to improve the health and welfare of backyard flocks, as well as to safe-

guard food safety and public health and contribute to disease prevention in commercial poultry flocks.

ACKNOWLEDGMENTS

This research was supported by the W.K. Kellogg Endowment and the Swingle Fellowship offered by the Department of Animal Science. We gratefully acknowledge the infrastructure support of the Department of Animal Science, the College of Agricultural and Environmental Sciences, and the California Agricultural Experiment Station of the University of California–Davis. The authors also thank Pamela Geisel for facilitating the advertisement of this survey via the Master Gardeners; Carolyn Stull, UC Davis School of Veterinary Medicine Cooperative Extension specialist, for her advice and valuable input on the survey; Neil Willits, UC Davis Department of Statistics, for his help with data analysis; and the California Department of Food and Agriculture for donating poultry calendars.

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