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Sonia B. Canavelli ^{a b}, Marilyn E. Swisher ^c & Lyn C. Branch ^a

^a Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, Florida, USA

^b EEA Paraná, Factores Bióticos y Protección Vegetal, Instituto Nacional de Tecnología Agropecuaria (INTA), Entre Ríos, Argentina

^c Family Youth and Community Sciences, University of Florida, Gainesville, Florida, USA

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Factors Related to Farmers' Preferences to Decrease Monk Parakeet Damage to Crops

SONIA B. CANAVELLI,^{1,2} MARILYN E. SWISHER,³ AND LYN C. BRANCH¹

¹Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, Florida, USA

²EEA Paraná, Factores Bióticos y Protección Vegetal, Instituto Nacional de Tecnología Agropecuaria (INTA), Entre Ríos, Argentina

³Family Youth and Community Sciences, University of Florida, Gainesville, Florida, USA

*The monk parakeet (*Myiopsitta monachus*) is among the most important bird pest species causing damage to crops in Argentina and neighboring countries. Traditionally, lethal control has been applied for decreasing monk parakeet damage to crops, but objections are increasing and new methods are required. In this article, we examined farmers' preferences for management of monk parakeet damage to crops in relation to sociopsychological and sociodemographic factors. We conducted 111 personal interviews using face-to-face questionnaires. Farmers preferred reproductive and lethal control for decreasing monk parakeet damage to crops. Attitudes toward monk parakeets were related more strongly to preferences than any other factor considered in this study. Other important sociopsychological factors were perceived efficacy and previous knowledge about management strategies. Perceptions of magnitude of damage had little relation to preferences. Sociodemographic factors, such as age and education, differed in their relationship to preferences, depending on the management strategy.*

Keywords Argentina, crop damage, lethal control, *Myiopsitta monachus*, parrot

Introduction

Granivorous bird species associated with agroecosystems cause damage to crops, feedlots, and stored grains worldwide. The number of species causing damage is relatively small, but their impacts are significant (De Grazio, 1978; Pinowski & Kendeigh, 1977). Losses are often overestimated by farmers (Bucher, 1992, 1998; Dyer & Ward, 1977), however, because of the conspicuousness of the birds and high variability in the damage they cause, which make objective estimates of damage difficult (Conover, 2002). Consequently,

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Address correspondence to Sonia B. Canavelli, Instituto Nacional de Tecnología Agropecuaria (INTA), EEA Paraná, Factores Bióticos y Protección Vegetal, Ruta 11 Km 12.7, 3101 Oro Verde, Entre Ríos, Argentina. E-mail: scana@parana.inta.gov.ar

farmers frequently apply management measures to decrease bird damage that are not economically effective or are contrary to research findings (Bomford & Sinclair, 2002).

Sociopsychological factors, such as perceptions of pest damage and attitudes toward control, can influence farmers' decisions about pest management more than economics (Heong & Escalada, 1999; Mumford & Norton, 1984). Despite potential importance of sociopsychological factors in explaining management decisions to reduce bird damage to crops, research in this area is relatively scarce (Timm, 1991). Studies evaluating the influence of sociopsychological factors on tolerance levels of farmers to wildlife damage or decisions about management measures to decrease wildlife damage have focused in conflicts involving mammals, generally deer (e.g., Campa, Winterstein, Peyton, Dudderar, & Leefers, 1997; Decker & Brown, 1982; West & Parkhurst, 2002). No studies could be identified that have examined the relationship of other sociopsychological factors influencing behavior, such as subjective norms (i.e., perception of social pressure to perform a particular behavior) (Ajzen, 1991; Fishbein & Ajzen, 1975) or perceived behavioral control (i.e., perception of ability to perform a particular behavior) (Ajzen, 1991) on management decisions to decrease bird damage to crops. Finally, sociodemographic factors that influence preferences for management alternatives to decrease human-wildlife conflicts, such as age and education (Bjerke, Reitan, & Kellert, 1998; Koval & Mertig, 2004; Loyd & Miller, 2010), have not been studied in relation to farmers' preferences for management strategies to decrease bird damage to crops. Research on factors underlying farmers' preferences for alternative management measures to decrease bird damage to crops is needed to develop effective extension actions by agricultural support agencies, such as producing and communicating information about management tools and working in cooperation with farmers to improve management of bird damage to crops (Bomford & Sinclair, 2002).

The monk parakeet (*Myiopsitta monachus*) is a medium-size (90–120 g) neotropical parrot species often involved in human-wildlife conflicts in its native range (South America) and non-native areas of distribution (North America and Europe, Spreyer & Bucher, 1998). In South America, particularly in Argentina and Uruguay, the monk parakeet is considered one of the most important bird pest species causing damage to grain crops (Bruggers, Rodriguez, & Zaccagnini, 1998; Bucher, 1992; Spreyer & Bucher, 1998). Their status as a pest likely is linked to their ability to adapt to changing landscapes. Monk parakeets have morphological traits and behaviors that facilitate the use of plentiful but ephemeral resources, such as grain crops (Bucher, 1992; Spreyer & Bucher, 1998). For example, monk parakeets have a strong beak and a flexible foot structure that help them hang in crop plants. They also exhibit dietary opportunism, feeding on seeds, fruits, buds, and insects in trees and on the ground (Bucher, 1992; Spreyer & Bucher, 1998). Unlike other parrot species, monk parakeets construct their nests in trees or in man-made structures, and thus are not constrained to areas with natural cavities (Bucher, 1992; Spreyer & Bucher, 1998).

Parakeet damage primarily affects sunflower and corn, with occasional damage to sorghum, wheat, and rice (Spreyer & Bucher, 1998). Quantification of damage to crops by monk parakeets is scarce, but it has been estimated to range between low (<5%) to moderate (up to 20%) crop loss (Bucher, 1992; Canavelli, González, Cavallero, & Zaccagnini, 2008). However, there is a tendency to overstate damage (Bucher, 1992; Canavelli & Aramburú, in press; Spreyer & Bucher, 1998). Consequently, conflicts between farmers and parakeets are common in the region (Bucher 1992; Canavelli & Aramburú, in press; Spreyer & Bucher, 1998).

Traditionally, lethal control has been applied by government agencies, agricultural professionals, and farmers as the most effective method for decreasing monk parakeet

damage to crops in Argentina with the assumption of a direct relationship between monk parakeet populations and crop damage (Bucher, 1992). Several methods have been used, including burning or destroying nests, shooting, trapping, killing, and paying bounties for dead birds, dispersing toxic baits, and spraying nests with insecticides. Since the 1980s, the primary lethal control method has been application of insecticides mixed with grease on nest openings to produce intoxication and potentially death of birds entering nests.

Use of lethal control as the main strategy for decreasing monk parakeet damage to crops has been challenged by wildlife biologists and some groups of farmers. Although intense campaigns of lethal control, where the birds are killed in the nests with pesticides, could produce considerable reductions in monk parakeet populations (Bucher, 1992), information is not available about the effectiveness of such methods to reduce crop damage. Population simulation studies, however, suggest that massive management efforts with lethal control would be necessary to decrease monk parakeet populations significantly, and this might not be practical or sustainable (Canavelli, 2011; Pruett-Jones, Newman, Newman, Avery, & Lindsay, 2007). Chemical methods used for lethal control in Argentina are not environmentally safe, either for monk parakeets or other species (Bucher, 1992; Keith, 1991). Lethal control of monk parakeets with chemical methods has been questioned by organic farmers in Buenos Aires province (Argentina) (Canavelli & Aramburú, in press). Alternative management strategies to population control are required.

The overall goal of our study was to understand farmers' preferences for management strategies to decrease monk parakeet damage to crops to manage conflict between monk parakeets and crop production in Argentina. Specific objectives were to determine farmers' preferences for seven different management strategies and to evaluate factors related to those preferences. Specifically, we examined the relationships of sociopsychological factors (e.g., perceptions of damage by monk parakeets, attitudes toward monk parakeets), and sociodemographic factors (e.g., age, education), to preferences for management strategies. We expected preferences to be high for population control methods, such as lethal and reproductive control, based on the historical context of bird damage management in Argentina (Bucher, 1992), but relative preferences for other strategies were unknown.

Methods

Study Area

Our study was conducted in Paraná Department (Entre Ríos Province, Argentina), where cattle, milk and crops are the major production activities (Engler & Vicente, 2009). Paraná Department contains 2,314 farms, totaling 488,558 ha (National Agricultural Survey database, 2002). Most farms (58%) are smaller than 100 ha, following in frequency 100–300 ha (25%), 300–500 ha (7%), 500–1,000 (5%), and >1,000 ha (4%). Farm size is correlated with area devoted to crops within the farm, and commonly is related to sociodemographic variables, such as land ownership (Engler & Vicente, 2009).

Sampling and Questionnaire Design

We applied a cross-sectional study design based on personal interviews to examine farmers' preferences, perceptions, and attitudes regarding management strategies (see Canavelli, 2011, for more details). Twenty-four farmers with corn or sunflower fields in the 2007 crop season (August 2006–May 2007) were randomly selected for evaluation of damage (Canavelli, 2011) and inclusion in this study. An additional 91 farmers were randomly

selected from the National Agricultural Survey database (2002) after stratifying by area devoted to crops within each farm into four categories: 0.5–20 ha, 20–80 ha, 80–300 ha, and >300 ha, and ranking farmers within each stratum based on that area. Individual farmers within each stratum were selected using a systematic sampling with a random start to cover the size distribution of crop area within each stratum. The number of farmers selected in each stratum ($n = 24, 24, 22,$ and $17,$ respectively) was proportional to the total number of farmers in the stratum. Only questionnaires that were fully answered were used in the analysis and thus, the study is based on 111 interviews.

The questionnaire included 45 questions about preferences for management strategies to decrease monk parakeet damage to crops (dependent variable) and sociopsychological and sociodemographic factors (independent variables). A trained assistant recorded the farmers' answers. The questionnaire was pretested with a sample of seven farmers and reviewed by extension agents (i.e., agents employed by the National Institute of Agricultural Technology to work with farmers) to determine clarity of questions, completion time, and other aspects of survey completion, and adjusted subsequently.

Variable Measurement

Preferences for Management Strategies. We evaluated farmers' preferences for the following management strategies: (a) lethal control (LC), by shooting, trapping, or poisoning; (b) reproductive control (RC), by removing or burning nests, egg oiling; (c) crop protection (CP), with physical or chemical deterrents; (d) agricultural practices (AP), such as early planting, high crop density; (e) habitat management (HM), by modifying tree structure, using decoy plots; (f) capture of birds and relocation (CR); and (g) integrated pest management (IPM), defined as the integration of two or more management strategies combined. The first two strategies (a and b) as well as capture and relocation of birds (strategy f) are directed at decreasing monk parakeet populations, either on a broad scale (strategies a and b) or at the sites where crops occur (strategy f), and other strategies (c, d, e, and g) focus on decreasing damage to the crop.

To evaluate farmers' preferences for management strategies to decrease monk parakeet damage to crops, we employed paired comparisons by offering the respondent items from a choice set in pairs (Brown & Peterson, 2003). For each pair of options (21 total), the respondent choose the most preferred item. Each choice was assumed to be independent of all other choices (Brown & Peterson, 2003). Additionally, we had two repeated pairs of choices randomly selected from the full set of pairs, in which the order of items was reversed, as a short-term measure of reliability of the answers. We randomly sorted the 23 pairs, made 10 versions of the questionnaire that differed only in the order of the presentation of pairs, and randomly chose the version to use in a given interview (Brown & Peterson, 2003).

Sociopsychological Factors Potentially Related to Preferences.

Perceptions of monk parakeet abundance and attitudes toward monk parakeets. We asked farmers about their qualitative perception of monk parakeet abundance (a few, some, or many parakeets) and population trends (decreasing, equal, increasing). However, because measures of perceptions of monk parakeet abundance and population trends were significantly related to perceptions of monk parakeet damage and trends in damage (Fisher Exact Test $p = .025$ and $p < .001$, respectively), we focused the analysis on perception of damage (see below). Attitudes toward monk parakeets were measured using a scale developed following DeVellis (2003). We asked farmers to respond on a 3-point scale (Table 1) for

Table 1

Categories used for the measurement of sociopsychological and sociodemographic factors evaluated in relation to preferences for management strategies

Variable name	Categories ¹
Sociopsychological factors	
Attitudes toward monk parakeets ²	Disagree, Don't know, Agree
Perception of damage by monk parakeets:	
Qualitative perception of monk parakeet damage in the last 3 yr	Insignificant, Moderate, Severe, Total
Quantitative perception of damage in the 2007 crop season	<5%, 5–10%, 10–25%, 25–50%, 50–75%, 75–100%
Perception of damage trend in the last 3 yr	Decreasing, Equal, Increasing
Tolerance to damage on different crops	Tolerable, Intolerable
Relative importance of crop losses by monk parakeets	Less, Equally, More important than other losses
Knowledge about management strategies and beliefs about their effectiveness:	
Previous knowledge about management strategies	No, Yes
Perceived effectiveness of each management strategy	None, Slightly, Very effective
Ranking of perceived effectiveness	First, Second, Third
Internal and external influences on application of management strategies:	
Perceived confidence of farmers in their abilities to apply management strategies to decrease bird damage	Insecure, Moderately secure, Very secure
Influence of external factors limiting their abilities	None, Moderately, Highly limiting
Expectation from reference groups about monk parakeet control (norm belief)	Never, Once every other year, Once a year, Every season
Influence of opinion from reference groups (motivation to comply)	Does not care, Cares moderately, Cares a great deal
Sociodemographic factors	
Age of farmers (yr)	<18, 18–29, 30–39, 40–49, 50–59, 59–65, >65
Education of farmers	Incomplete primary school, Primary, Secondary, Tertiary school, Graduate, Postgraduate education
Area of farm (ha)	<50, 50–99, 100–299, 300–499, 500–999, ≥1,000
Area of farm devoted to crops (ha)	<50, 50–99, 100–299, 300–499, 500–999, ≥1,000
Affiliation with a farmers' organization	No, 1, 2–3, 4–5, >5
Participation in farmers' meetings	No, Less than once every 2 months, Once every 1–2 months, More than once a month

¹For analysis, we re-categorized independent variables with more than four levels and/or uneven distribution of cases among categories to three or four levels using probabilistic methods based on frequency distribution (e.g., quartiles) and/or social-based criteria (e.g., age = <40, 40–49, 50–59, ≥60 years old) in order to increase the number of responses per category.

²Statements used for evaluating attitudes toward monk parakeets are given in Table 2.

Table 2

Statements used for evaluating attitudes toward monk parakeets

1	Monk parakeets make us happy with their presence.
2	Fortunately, we can coexist with monk parakeets.
3	Monk parakeets are creatures that should be protected.
4	Monk parakeets bother me because they decrease my production.
5	Monk parakeets make my production of corn and sunflower impossible.
6	I detest the noise of monk parakeets.
7	Monk parakeets are useless.
8	I like monk parakeets.
9	People who protect monk parakeets annoy me.
10	I like to see monk parakeets on my farm.
11	The persecution of monk parakeets causes me grief.
12	I value monk parakeets a lot.
13	Monk parakeets only make me lose money.
14	I hate monk parakeets.

14 attitude statements (Table 2). Attitudes ranged from 14, indicating farmers had the least favorable or “negative” attitude toward monk parakeets, to 42, indicating farmers had the most favorable or “positive” attitude toward monk parakeets.

Perceptions of damage by monk parakeets. We asked farmers about their qualitative and quantitative perception of damage and trend of monk parakeet damage (Table 1). We also asked farmers about occurrence of damage on different crops (corn, sunflower, soybean, wheat, sorghum, alfalfa, millet) and, if damage occurred, whether it was tolerable or intolerable. We then averaged tolerance levels among the crops for which farmers reported damage, to obtain an index of tolerance of damage for each farmer. Finally, we asked farmers about their perception of the importance of losses by monk parakeets compared with losses caused by other factors (climate, insects, weed, diseases, and harvesting machinery) and assigned a score from one to three in increasing order of importance. To have a single value of relative importance of monk parakeet damage for each farmer, we added the importance value of monk parakeet damage for all factors [index range: 5 (monk parakeet damage considered lower in importance than any other factor) to 15 (monk parakeet damage considered higher in importance than any other factor)].

Knowledge about management strategies and beliefs about their effectiveness. We evaluated knowledge of farmers about management strategies, in general, and for each of seven management strategies as a binary variable (Table 1). Based on strategies known by each farmer, we also determined the perceived effectiveness for each strategy separately, as well as, which strategy farmers considered the first-, second- and third-most effective strategies (Table 1).

Internal and external influences on application of management strategies. Perceived behavioral control of bird pest management (Table 1) was evaluated as: (a) perceived confidence of farmers in various aspects of their own abilities to apply management strategies to decrease bird damage to crops (internal factors) and (b) influence of external factors limiting these abilities (e.g., limited access to control devices, cost of techniques). Both variables were captured in three categories (Table 1), scored from one to three. A composite

measure of perceived behavioral control was estimated for each farmer by summing values for all measures of perceived confidence and values for all external factors limiting these abilities, and then multiplying these two sums. Composite scores of perceived behavioral control ranged from 42, indicating farmers perceived low behavioral control of bird pest management, to 336, indicating farmers perceived high behavioral control.

To determine subjective norms, we asked farmers to state what they thought specific reference groups expected the farmer to do about monk parakeet control (norm belief), and how much the farmer cared about expectations of each reference group (motivation to comply, Table 1). The six reference groups were neighbors, spouse, sales agents from chemical companies, extension agents from a cooperative, national government, and state government. Each category had a score (one to four for norm belief and one to three for motivation to comply, Table 1) and a composite measure of subjective norm was estimated for each farmer as the product of normative belief and motivation to comply for each reference group, added for all groups (Heong & Escalada, 1999). Scores ranged from 1, indicating farmers experienced no social pressure to control monk parakeets, to 61, indicating farmers experienced strong social pressure to control monk parakeets.

Sociodemographic Factors Potentially Related to Preferences. We measured six sociodemographic variables (Table 1). Social participation was evaluated as affiliation of each farmer with one or more farmers' organizations (scored from zero to four, Table 1) and degree of participation in farmers' meetings (scored from zero to three, Table 1). A composite index of social participation was built by adding the scores of affiliation with farmers' organizations and degree of participation in farmers' meetings (range: 0–7).

Statistical Analyses

Preference Values. With data from all respondents, we estimated scale values of preference for each management strategy and developed a scale of preferences. We constructed preference matrices for each farmer with the full set of choices (i.e., 7 management strategies, 21 pairs) and estimated a preference score for each strategy, representing the number of times a strategy was preferred to all other strategies in the set of choices (Brown & Peterson, 2003). Then, we estimated a scale value of preference for each management strategy and its associated standard error by applying the Bradley-Terry (BT) model for pair-comparison data to the aggregated preference matrix for the sample of farmers (Agresti, 2007; Bradley & Terry, 1952). The BT model was run in R with the BradleyTerry2 add-on package (version 0.9-2, 2010, Turner & Firth, 2011). As a measure of reliability of responses, we calculated the coefficient of consistency for each respondent using the number of circular triads (i.e., number of intransitive responses) for each individual (Brown & Peterson, 2003). The coefficient of consistency varies between 1 (no circular triads) and 0 (maximum possible number of triads, Brown & Peterson, 2003).

Assessment of the Relationship Between Preferences for Management Strategies and Sociopsychological and Sociodemographic Factors. For analyses, we re-categorized preference scores for each management strategy as: 1 = low preference (scores 0, 1, and 2); 2 = medium preference (scores 3 and 4); and 3 = high preference (scores 5 and 6). We compared each sociopsychological and sociodemographic factor with preferences for each management strategy using bivariate Chi-square analyses. For cell counts of expected values below five, we used Fisher's exact test to evaluate statistical significance. We used proportional odds logistic regression models in SAS (v.8, 2006) to determine

which sociopsychological and sociodemographic factors were most strongly related with preferences for each management strategy. The relative importance of each variable for predicting preferences for each management strategy was evaluated with Akaike's Information Criterion (AIC) (Burnham & Anderson, 2002). Models with Δ AIC scores of ≤ 2 were considered competitive models. We estimated model weight (Akaike weight, ω_i) as an indicator of weight of evidence in favor of each model (Burnham & Anderson, 2002). Finally, we used percent concordance, a measure of association of predicted probabilities and observed responses, as a complementary measure of model fit (Agresti, 2007). We modeled each management strategy separately because evaluation of all strategies simultaneously was too complex.

Results

Preferences for Management Strategies

Reproductive and lethal control were most preferred strategies by farmers, followed by integrated pest management, crop protection, agricultural practices, habitat management, and capture-relocation (scale values: 6.60, 5.05, 4.69, 3.53, 3.09, 2.63, and 1, respectively). Farmers were highly consistent in their preferences for management strategies (average coefficient of consistency = 0.91 ± 0.01 SE). Only 24% of farmers ($n = 27$) showed inconsistencies in their preferences for extra-pair of choices included in the questionnaire.

Sociopsychological Factors

Attitudes Toward Monk Parakeets. Attitude scores indicated that farmers predominantly have a negative attitude toward monk parakeets ($M = 24$, median = 22, range = 14–42). Most farmers (>60%) disagreed with all positive statements about monk parakeets. Additionally, most farmers agreed with the following statements: "Monk parakeets only make me lose money" (65% of farmers) and "Monk parakeets bother me because they decrease my production" (83% of farmers).

Perceptions of Damage. Most farmers (68%) had experienced damage by monk parakeets in their crops in the last three years, particularly on corn, sunflower, and sorghum (>60% of farmers on each case). However, damage was considered insignificant (32% of farmers) or moderate (49% of farmers). Only 19% of affected farmers (equivalent to 13% of all farmers) considered damage severe, and no farmer experienced total damage. Also, damage was reported to be less than 10% crop loss by 58 farmers (52% of all farmers), with only 8 farmers (7%) reporting damage to be greater than 25% crop loss in the 2007 crop season. Most farmers (76%) who experienced damage by monk parakeets on corn, sunflower or sorghum considered damage as tolerable. However, farmers perceived losses by monk parakeets to be relatively important when damage by parakeets was compared to other causes of crop loss. The mean and median scores of perception of importance of monk parakeets were identical and relatively high (11; range = 5–15).

Knowledge About Management Strategies and Beliefs About Their Effectiveness. Most farmers (88%) knew some control strategies for decreasing monk parakeet damage before they were interviewed. Lethal control, reproductive control, and agricultural practices were commonly known by farmers (98%, 76%, and 66% of farmers, respectively). Lethal (58%) and reproductive (19%) controls also were considered the most effective strategies

by most farmers (77% of all farmers), whereas agricultural practices and integrated pest management followed those (7% and 6% of farmers, respectively).

Behavioral Control and Social Norms. Farmers felt moderate control in applying management strategies to decrease bird damage (mean score of perceived behavioral control = 162.45, median = 153, range: 42–336). Farmers experienced moderate social pressure regarding management of monk parakeet problems (mean score of subjective norms = 29.33, median = 28, range: 1–61).

Sociodemographic Factors

Most farmers were male (97%). All were 18 years old and older, with 71% between 30 and 59 years old. Most farmers had finished primary school (54%) but fewer finished secondary school (16%) or university (17%). Area under management by each farmer varied from 16–3,200 ha, with most farmers (60%) making decisions for 300 ha or less. Only 49% of the farmers had more than 25% of the farm area with crops. Most farmers (60%) did not belong to any farmer organization, but most farmers (80%) participated in farmers' meetings and conferences.

Relationships of Preferences for Management Strategies to Sociopsychological and Sociodemographic Factors

Sociopsychological factors, such as attitudes toward monk parakeets, previous knowledge of each strategy and beliefs about effectiveness of each strategy, were related strongly to preferences for management strategies. Attitude was the most important factor explaining preferences for management strategies to decrease monk parakeet damage to crops for five out of seven strategies evaluated (Table 3). Previous knowledge and perceived efficacy of the strategies were important variables explaining preferences for integrated pest management (Table 3), and previous knowledge was one of the two most important variables explaining preferences for capture and relocation (Table 3). Other sociopsychological factors, such as subjective norms about monk parakeet control and perceived control about bird pest management, were related to preferences for management strategies to a much lesser extent (Table 3). No variable representing sociodemographic factors was included among the most important variables explaining preferences for any management alternative (Table 3).

Preferences for reproductive and lethal control to decrease monk parakeet damage increased with farmers negative attitudes, perceived social pressure, age, and lower education (Table 4). Reproductive control also was preferred when farmers had smaller farms, a smaller amount of area devoted to crops, and higher levels of social participation (Table 4). Lethal control was more preferred when farmers perceived monk parakeet damage was more important than other crop losses (Table 4).

In contrast, preferences for alternative management strategies to population control, such as crop protection and agricultural practices, increased as farmers had a more positive attitude toward monk parakeets (Table 4). Additionally, farmers tended to prefer agricultural practices for management as age decreased and levels of formal education increased (Table 4). Finally, preferences for integrated pest management increased as perception of behavioral control to apply management strategies to decrease bird damage increased (Table 4). In all cases, farmers tended to prefer strategies already known to them or perceived as more effective (Table 4).

Table 3

Top performing variables related to preferences of farmers for management strategies to decrease monk parakeet damage to crops based on the AIC value and percent concordance, which represents the association of predicted probabilities and observed responses. Models with $\Delta AIC \leq 2$ are considered competitive models and are presented here. AIC values are not comparable among strategies, because they correspond to different data sets (one for each management strategy)

Management strategies*	Variable name	AIC	Akaike weights (w_i)	Percent concordance
Reproductive control (RC)	Attitudes toward monk parakeets	203.93	1.00	54.40
Lethal control (LC)	Attitudes toward monk parakeets	192.81	1.00	59.20
Integrated Pest Management (IPM)	Previous knowledge of each strategy	229.41	0.39	20.00
	Beliefs about effectiveness of each strategy	230.67	0.21	20.30
Crop protection (CP)	Attitudes toward monk parakeets	222.77	1.00	49.70
Agricultural practices (AP)	Attitudes toward monk parakeets	226.58	0.99	48.30
Habitat management (HM)	Perception of damage trend	218.37	0.23	45.70
	Subjective norms about monk parakeet control	218.97	0.17	42.90
	Tolerance to damage	220.17	0.09	37.90
Capture and relocation (CR)	Attitudes toward monk parakeets	140.55	0.53	48.70
	Previous knowledge of each strategy	142.36	0.22	32.10

*Management strategies are ordered high to low based on farmers' preferences.

Discussion

Preferences of farmers for management strategies were more strongly related to attitudes toward monk parakeets than to any other sociopsychological or sociodemographic factor. Similar to other studies with wildlife species, in which people with more negative attitudes usually prefer more invasive control methods (Bjerke et al., 1998; Don Carlos, Bright, Teel, & Vaske, 2009; Loyd & Miller, 2010; Stout, Knuth, & Curtis, 1997), farmers with negative attitudes toward monk parakeets preferred invasive population control methods, such as lethal and reproductive control. Given crop damage from monk parakeets was considered tolerable, the predominantly negative attitudes toward monk parakeets may be related to previous experiences and/or worries about possible damage in the future (Brown, Decker, & Dawson, 1978; Zinn & Andelt, 1999). Additionally, because control of monk parakeet damage is under volitional control, moral and ethical issues involving the prioritization of different values could influence attitudes and override other factors (Hrubec, Ajzen, & Daigle, 2001; Stout et al., 1997).

Table 4

β -regression coefficients and respective standard errors (in parentheses) for models of sociopsychological and sociodemographic variables and preferences for management strategies. The table only includes variables with statistically significant relationships with preferences, either in the bivariate Chi-square tests (*) or the regression models (**) or both (no *). Significance was set as $p = .05$ for both tests

Variable name	Management strategies*						
	Reproductive control	Lethal control	Integrated pest management	Crop protection	Agricultural practices	Habitat management	Capture and relocation
Sociopsychological factors							
Previous knowledge of each strategy	0.94 (0.38)	1.13 (0.55)**	1.33 (0.53)				1.35 (0.52)
Beliefs about effectiveness of each strategy	0.44 (0.16)	0.71 (0.20)	0.50 (0.23)**	0.01 (0.20)	0.18 (0.26)		0.58 (0.25)**
Perception of importance of monk parakeet damage		0.38 (0.16)					
Attitudes toward monk parakeets	-1.26 (0.25)	-1.53 (0.29)		1.07 (0.24)	0.96 (0.24)		0.80 (0.28)
Subjective norms about monk parakeet control	0.57 (0.23)	0.01 (0.01)*					0.45 (0.23)**
Perceived control of bird pest management			0.33 (0.23)*				
Sociodemographic factors							
Age	0.34 (0.17)**	0.34 (0.17)			-0.41 (0.16)**		
Education	-0.56 (0.20)	-0.44 (0.20)**			0.41 (0.20)**		
Farm area	-0.31 (0.23)*						0.29 (0.23)*
Percentage area devoted to crops	-0.18 (0.22)*						
Social participation	0.57 (0.24)*						

*Management strategies are ordered based on farmers' preferences (left to right = high to low).

Contrary to what we expected, preferences for management strategies, including lethal or reproductive control, were not much related to perceptions of magnitude of damage by monk parakeets. The only aspect of damage perception that was significantly related with preferences for lethal control was the belief about the importance of damage by monk parakeets compared to other crop losses, suggesting that when damage from parakeets is considered greater than other causes of crop loss, farmers prefer a management strategy that decreases the bird population. Previous studies also have found that people are more willing to accept invasive population control methods, particularly lethal control, when the severity of incidents with wildlife increases (Bjerke et al., 1998; Don Carlos et al., 2009).

Attitudes also may be important in the apparent influence of sociodemographic factors, such as age and education, on preferences of farmers for management strategies to decrease monk parakeet damage to crops. Similar to previous studies (Bjerke et al., 1998; Loyd & Miller, 2010), older and less formally educated farmers highly preferred population control methods. Attitudes toward wildlife generally are related to educational level and age (Kellert, 1980; Koval & Mertig, 2004; Loyd & Miller, 2010). The relationship between preferences for management strategies and age and education may have been mediated through a direct relationship of attitudes with these factors (Canavelli, 2011), as has been proposed for behavioral intentions in general (Ajzen, 1991; Fishbein & Ajzen, 1975).

Results from this article indicate the importance of understanding farmers' attitudes and underlying factors supporting them to develop acceptable alternative approaches for reducing damage and to determine how to target programs to focus on changing preferences. If programs are developed to promote alternative management strategies to population control, they would have to address the heterogeneity in farmers' attitudes toward monk parakeets in order to avoid public controversies about management. If reduction of lethal control of parakeets is a management goal for wildlife managers because of the potential negative impact of these practices on other species, as well as parakeet populations, research and extension actions need to be proactive so that intolerable losses are anticipated and avoided.

Given the relationships of previous knowledge and perceived efficacy of management strategies with preferences for these strategies, particularly the most complex strategy (IPM), and the current uncertainties in the outcome of management actions, adoption of an adaptive management approach would be useful to test strategies other than population control (Holling, 1978; Parkes, Robley, Forsyth, & Choquenot, 2006). Involving stakeholders, farmers in this case, in management actions and decisions in the field would increase ownership of stakeholders in the results and enhance credibility of management agencies coordinating the activities (Messmer, Cornicelli, Decker, & Hewitt, 1997). Additionally, field projects demonstrating effectiveness of different practices to decrease monk parakeet damage to crops likely would stimulate opinion changes about management and encourage adoption of new practices (Stout et al. 1997; Tracey, Bomford, Hart, Saunders, & Sinclair, 2007).

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