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Research Paper

A mismatch of community attitudes and actions: A study of koalas

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HIGHLIGHTS

- Three areas (suburban, peri-urban, eco-village) of one community were surveyed.
- Attitudes toward koalas were correlated to area of residence within the community.
- Peri-urban residents likely to have positive attitudes toward koala conservation.
- Suburban residents unlikely to participate in koala conservation measures.
- Area of residence is important in involving local community in wildlife management.

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ABSTRACT

Many wildlife populations, particularly in urban areas, are in decline. This is in part due to a disconnection between the lives of urban residents and native wildlife. The reconnection of social and ecological systems by understanding the linkages between people's attitudes and conservation behavior will help improve conservation outcomes. This study investigated the attitudes of local communities toward koala populations and sustainable wildlife conservation in southeast Queensland, Australia. Data was collected using a questionnaire in face-to-face surveys ($n = 102$). Principal Component Analysis was used to quantify attitude and action statements into key components. Further analysis of demographics and knowledge of koalas was performed using analysis of variance and regression analysis. Results suggested that residents' attitude toward koala conservation was strongly correlated with their home's proximity to relatively intact habitat. Residents living in peri-urban areas were significantly more likely than suburban residents to have a positive attitude toward koala conservation, and be willing to participate in actions to conserve koalas, such as traffic calming measures, community conservation schemes and support for council-led conservation actions. These results highlight the importance of understanding variations in community behavior toward biodiversity conservation in urban and peri-urban neighborhoods and suggest that local governments and conservation groups use area of residence to target urban planning and conservation initiatives more effectively.

1. Introduction

Human induced land use change threatens the viability of many wildlife species around the world, not only from habitat loss but also through exposure to a range of threatening processes (Brook, Sodhi, & Bradshaw, 2008). This is particularly true for fauna populations in urban areas, which may become isolated in habitat fragments surrounded by a relatively impermeable matrix (Fischer & Lindenmayer, 2007; Garden, McAlpine, Peterson, Jones, & Possingham, 2006; McKinney, 2002; Miller & Hobbs, 2002). However, maintaining native ecosystems in urban areas is important to protect local biodiversity, facilitate the movement of fauna to non-urban habitat, improve human well-being and to conduct environmental education (Dearborn & Kark, 2010). There is a growing recognition that the disconnection of urban populations from the natural world is a result of their declining daily exposure to wildlife (Deruiter & Donnelly, 2002). This disconnection means that there is less understanding of the needs and value of local species, and their basic requirements may go unrecognized, compromising

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species survival (Deruiter & Donnelly, 2002). Increasing the connection between humans and wildlife, especially in urban areas, is a key component for the continued survival of many species.

Understanding which factors influence an individual's appreciation and concern for wildlife conservation is essential. Wildlife managers are increasingly confronted with the task of successfully representing a diverse number of public interests and, often, conservation of species hinges on the effectiveness of this task (Teel & Manfredo, 2009). Personal wildlife perspectives are unavoidably tied to many components including world views, culture and understanding (Aslin & Bennett, 2000); past experience and demographics (Miller, 2009); and values, attitudes and beliefs shaped by ideology that give meaning to values in regard to nature (Teel & Manfredo, 2009). Furthermore, behavior is not always reflective of public attitudes, especially where wildlife conservation is concerned. Human dimensions research seeks to form a baseline to identify the relationship between values, beliefs and attitudes regarding nature and its conservation and therefore offer a 'social science' approach to wildlife management (Teel & Manfredo, 2009).

Human behavior is complex both in its number of influences and diversity, and is driven by multiple factors that are often difficult to quantify and define (Stern, 2002). Predicting behavior in a specific instance from attitudes, values and beliefs can be problematic, but Ajzen (1991) found that general attitudes and personality traits can be linked to behavior. More specifically, the Theory of Planned Behavior states that some function of perceived control over behavior and behavioral intention can be used to predict actual behavior (Ajzen, 1991). Behavioral intention is made up of three components: the attitude or favorability toward the behavior; the perceived social pressure to perform the behavior; and the perceived difficulty or ease of performing the behavior (e.g. opportunity and resources) (Ajzen, 1991). This is supported by research by Boyes and Stanisstreet (2012) who found that in general the degree of willingness to act is influenced by the perceived effectiveness of the action; though in some circumstances there can be a natural reluctance to act due to disincentives such as inconvenience and lifestyle. Vaske and Donnelly (1999) developed a cognitive hierarchy based on social-psychological theory, showing that attitudes, beliefs and norms mediate the relationship between values and behavior (Vaske & Donnelly, 2007). Attitudes directly affect behavior and value orientations reveal the impact of ideology and provide significance to those values relative to a specific topic (Teel & Manfredo, 2009; Vaske & Donnelly, 2007). For the purposes of this study, attitude is defined as the psychological tendency to appraise an entity with favor or disfavor (Eagly & Chaiken, 1993), while values are defined as guiding principles that inform attitudes (Fischer & van der Wal, 2007).

Understanding the attitudes and behavior of residents toward wildlife populations is vital to improving urban wildlife management. We examine these in relation to the wild koala populations of Southeast Queensland. The koala, *Phascolarctos cinereus*, is an Australian arboreal marsupial that is a highly specialized eucalypt folivore (Moore & Foley, 2005). The koala provides a good example of a human-wildlife conflict arising from urban encroachment into native ecosystems, where commercial and private development in koala habitat areas leads to habitat loss (Garden et al., 2006; McAlpine et al., 2006b). While koalas can live in peri-urban areas there is an associated increase in exposure to risks such as collisions with vehicles and attacks from domestic dogs as they move between small patches of remaining bushland (McAlpine et al., 2006a). Koalas are specialists that depend completely on the presence of a limited number of eucalypt species to survive (Hume, 1990; Rhodes et al., 2006). This puts koala populations particularly at risk when those trees are cleared for urban development, leading to genetic isolation (Lee et al., 2010) and elevated mortality as koalas attempt to disperse across a highly modified urban mosaic

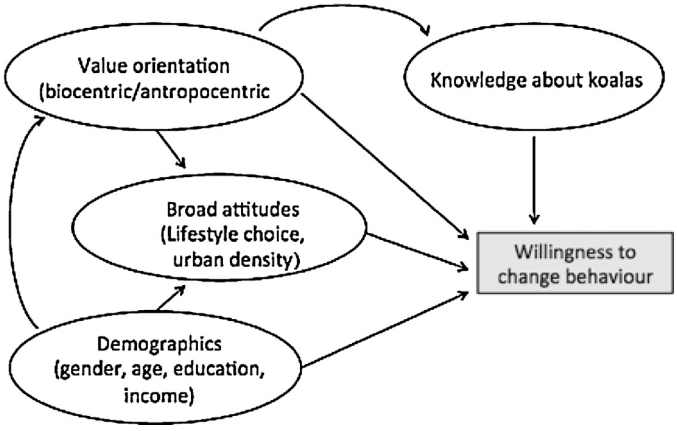

Fig. 1. Conceptual framework of influences of attitudes toward koala conservation.

(McAlpine et al., 2006b). Most koala deaths are attributed to habitat loss and fragmentation, car collisions and dog attacks, all factors which increase with human development (McAlpine et al., 2006a; Rhodes et al., 2006), and as a result, koala populations over most of their range have experienced local declines and extinctions (SECRC, 2011).

In 2012 the koala was listed as a vulnerable species under the Environment Protection and Biodiversity Conservation Act (1992) in areas where the species has dramatically declined in recent years (Queensland, New South Wales and the Australian Capital Territory) (Department of Environment, 2012). In South East Queensland, despite specific legislation protecting their habitat, koala populations in the Koala Coast area showed a 51% decline in koala population abundance between 2006 and 2008 and a 64% decline over the last ten years (Department of Environment, 2012).

In high-density urban areas where koalas no longer exist, it is less necessary to attempt to modify behavior since residents do not have enough regular exposure to wildlife. However, more research is needed to determine public interest and participation in conservation efforts in suburban and bushland areas where koalas continue to persist. Assessing residents' knowledge and attitudes toward koalas in general, as well as their values and attitudes toward local koalas, can provide important insight into how to minimize the impact of resident's activities on koala populations. The positive influence of increasing knowledge through wildlife education programs is demonstrated by the effectiveness of conservation education by Bat Conservation International in Austin, Texas (USA) where 100,000 people now congregate annually to see the evening emergence of 1.5 million Mexican free-tailed bats *Tadarida brasiliensis*, that were once unknown to most visitors (Dearborn & Kark, 2010).

This study aimed to answer the questions: (1) can attitude toward koalas be measured; (2) what factors influence community attitudes toward koalas; (3) how do different urban densities (suburban, peri-urban and an eco-village) affect conservation knowledge and behavior; and (4) what conservation actions would residents be willing to take to mitigate local threats? This information will serve as an exploratory study to establish a baseline of community knowledge and help determine residents' willingness to work toward sustainable conservation goals in suburban areas.

1.1. Conceptual framework

We examined the influence of values and demographic characteristics, on people's perceptions and attitudes toward koalas and koala conservation in the urban and peri-urban environment (Fig. 1). One area of focus was on the value orientation

of residents from biocentric (nature-centered) to anthropocentric (people-centered) (Dunlap & Van Liere, 1978; Vaske & Donnelly, 2007). These included views on the effectiveness of current legislation, the intrinsic rights of native wildlife, and interest in conservation actions.

We also predicted that place of residency (indicated by urban density) could perhaps reflect lifestyle choices and hence broad attitudes in regard to conservation (although we recognize that lifestyle will be influenced by other circumstances such as income and opportunity). The area of residence might also influence social norms and conservation behavior. Research by Teel and Manfredo (2009) shows a weak relationship between wildlife valuation and social demographics at an individual level. According to Teel and Manfredo (2009), value-orientation types (dominators, those who believe wildlife should be managed only as they pertain to humans versus mutualists, those who see intrinsic value in wildlife and believe in the social inclusion of human/wildlife relationships) on a broader scale were correlated to statewide demographics. For instance, more mutualists were found in areas with greater levels of urbanization, consistent with the idea that improved economic wellbeing and modernization are causing a shift away from a dominant orientation toward wildlife, and toward a more mutualist orientation (Teel & Manfredo, 2009). The affect of residential area (urban vs. rural) on attitudes toward wildlife has been demonstrated previously. Urban residents typically display more positive attitudes toward wildlife in general than rural residents (Ericsson & Haberlein, 2003; Reading & Kellert, 1993; Reading et al., 1999; Williams, Ericsson, & Heberlein, 2002). Studies on rural resident attitudes tend to focus on ranchers, farmers and live-stock owners, who are impacted more directly by possible damage to rangelands and grazing values (Reading, Miller, & Kellert, 1999) or the negative aspects of predator reintroductions (Ericsson & Haberlein, 2003; Williams et al., 2002). For example, in the case of wolf reintroduction, rural residents often viewed wolves as a symbol of urban dominance over rural values (Ericsson & Haberlein, 2003; Williams et al., 2002), while a study of black-footed ferret reintroductions (Reading and Kellert, 1993), found that the reintroduction of an endangered species elicited fear regarding increased government restrictions in ranching, and loss of autonomy and control over land. Additionally, ranchers had more dominant and utilitarian attitudes towards wildlife and were significantly more negative than their urban counterparts in regard to their attitude toward ferret reintroductions (Reading and Kellert, 1993). The attitude toward prairie dogs followed a general increasing pattern of positivity from ranchers to other rural residents, to urban residents, to conservation organization members (Reading and Kellert, 1993).

In this paper we compare suburban residents in different housing densities, hypothesizing that most peri-urban residents choose to live closer to nature at least in part, because they value the environment. The koala does not pose the same threats to livelihoods as large carnivores such as wolves, so there is no utilitarian reason for negative attitudes, although regulatory restrictions associated with koalas may have some influence. For this reason, we predicted that our results might differ from previous research.

A third group of variables looked at social demographics (income, education, age, and gender), which can play an important role in the valuation of wildlife and often act as behavioral predictors (Loyd & Miller, 2010; Mankin, Warner, & Anderson, 1999). According to Deruiter and Donnelly (2002), across varied circumstances, gender has been recognized as one of the most significant demographic variables affecting attitudes toward wildlife and management. Though the importance of gender was often not verbalized in surveys, it remains a key aspect of value orientations (Deruiter & Donnelly, 2002). Females are more likely to see the intrinsic value of ecosystems and wildlife (utilitarian-habitat value, esthetic value) (Hill, Carbery, & Deane, 2007) and were more likely to display interest in wildlife interaction, education regarding nature conservation and love of animals, but were also more likely to fear wildlife than were men (Miller & McGee, 2000). A study on the human dimensions of Possum conflict in Australia, found a significant difference in resident belief in the 'intrinsic value of possums' based on age (31–59 or >60) (Hill et al., 2007). Research also suggests that the perceived degree of endangerment, likeability, attractiveness, charismatic nature and human-like characteristics of a species are all important aspects of the public's affection toward a species and their willingness to support their conservation (Tisdell & Nantha, 2007). The extent of an individual's knowledge in relation to a species has a direct effect on the demand to conserve and sustain that species (Tisdell & Wilson, 2006). Knowledge of threats does not necessarily lead to greater conservation (McKenzie-Mohr, Lee, Schultz, & Kotler, 2012), but it does help determine a baseline of educational awareness that can be built upon and expanded. Evidence also suggests that promoting positive behaviors is more likely to provoke change (Schultz, 2011).

2. Materials and methods

2.1. Study area

The study was carried out in Southeast Queensland, Australia in the communities of Elanora and Currumbin Waters within the Gold Coast Local Government Area (Fig. 2). The study area is located 38 km south of Brisbane and the region is experiencing rapid urban development. Projections indicate that the Gold Coast will continue to grow at an average rate of 3.6% per year, increasing from the current population of 536,000 to over 730,000 residents by 2026. The study area has an average density of 1300 residents/km^2 (Australian Bureau of Statistics, 2011) with a population of 11,645 in Elanora and 8883 in Currumbin Waters (Australian Bureau of Statistics, 2011b).

Elanora and Currumbin Waters are some of the few areas remaining in southeast Queensland that still have a relatively large population of urban koalas (GCCC, 2011). The vegetation consists predominantly of eucalypt woodland and open-forest, but has been heavily modified and is therefore classified as 'Of Concern' (Department of Environment, 2010). It is also part of a larger bioregional corridor, connecting relatively intact remnant vegetation in the west to coastal vegetation in the east (Chenoweth, 2010).

The Elanora and Currumbin Waters' area is the focus of the Gold Coast City Council's conservation efforts as part of a new Koala Conservation Plan for the area. There is a mix of dense urban settlements and larger, more vegetated peri-urban properties at the outskirts. A wildlife 'friendly' eco-village in the Currumbin Valley was incorporated into the study although it supports a minimal number of koalas. The goal was to compare conservation views between residents of different locations within the same community and their accessibility to and knowledge of local koala populations.

2.2. Survey design and questionnaire

During 2012, door-to-door surveying was carried out in suburban areas of Elanora and peri-urban areas of Currumbin Waters and Currumbin Valley. Based on the population numbers given above and an average household size of 2.65, there were approximately 7500 houses in the study area (Australian Bureau of Statistics, 2011b). We visited approximately 334 homes (4.5% of the estimated number of households), with 102 completed interviews. We chose to use face-to-face surveys with a mix of open and closed questions to allow participants to expand upon their responses, generating a more in-depth understanding of their attitudes (Doyle,

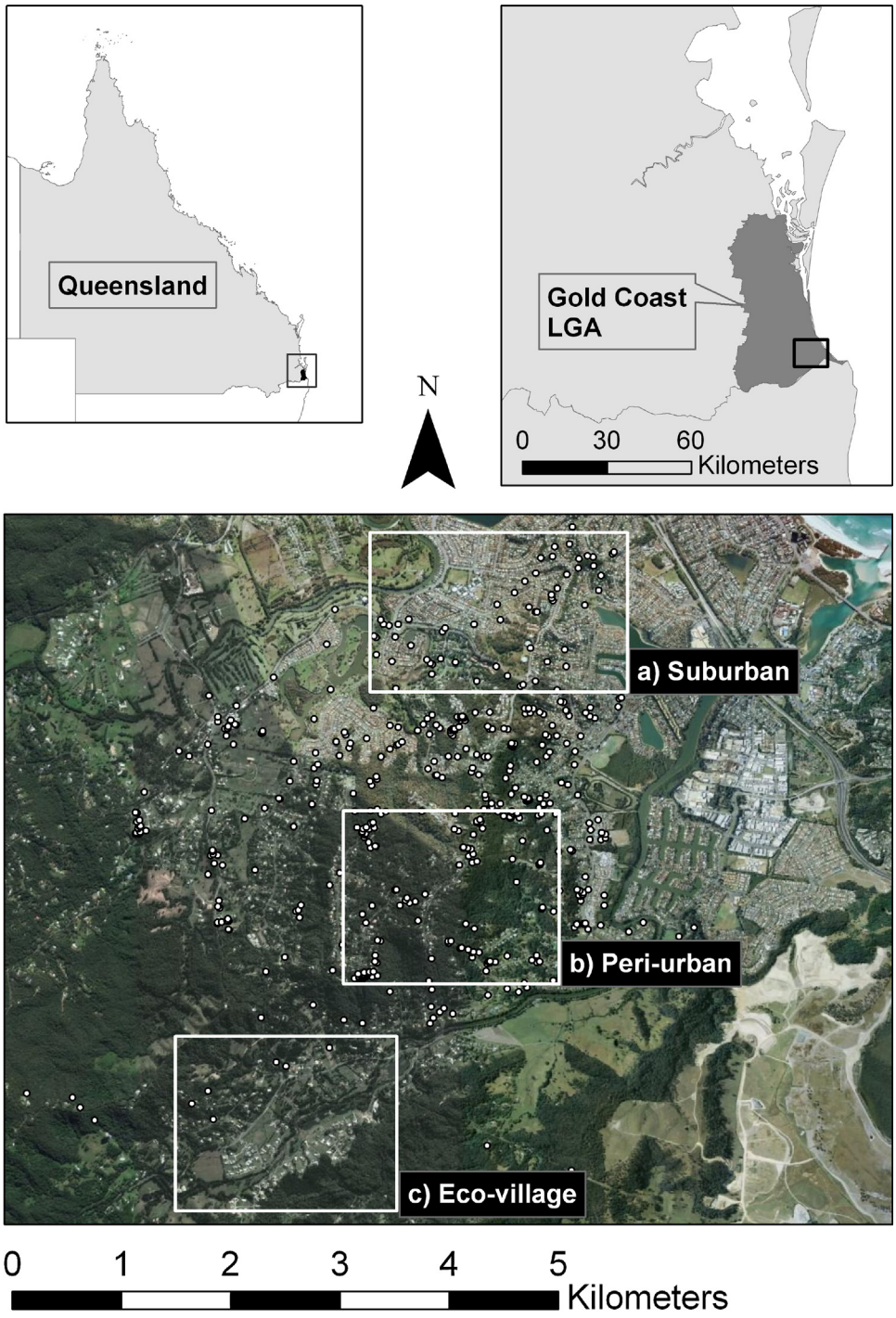

Fig. 2. Map of the study site showing the Gold Coast Local Government Area in south-east Queensland and residential areas where surveys were carried out: (a) suburban, (b) peri-urban, and (c) eco-village (base image from Google Earth). Koala sightings are shown as white dots (source: Gold Coast City Council and Wildcare, Queensland Government).

2005). Although the use of face-to-face surveys took more time than mail or telephone surveys, the additional information provided valuable data but resulted in a lower than ideal sample size. Given the primary purpose of the survey was to examine community attitudes and knowledge of koalas, we chose to target residents in areas where koalas were reported most frequently, based on Council records of local koala sightings (Fig. 2). Streets were selected at random close to koala sightings and we visited each accessible free standing-house on that street. Respondents were then asked to fill out a questionnaire (see Appendix 1).

The questionnaire consisted of both multiple-choice and short answer questions and was designed to take less than ten minutes to complete. Our aim was to assess whether attitudes toward koalas and willingness to adapt behavior varied according to place of residence or demographic variables. Data was collected on the following topics:

A. Demographics: Information on respondents' gender, age and level of education were collected as well as information on property size and length of residency. Differences in demographics have proved influential in previous human dimension of wildlife studies

(Deruiter & Donnelly, 2002; Hill et al., 2007; Loyd & Miller, 2010; Mankin et al., 1999).

B. Residents' attitudes toward and knowledge about koalas, including knowledge of threats: Residents were asked if they had seen or reported koala sightings on or near their residence, and to share any details of these sightings. The questionnaire also requested details of residents' attitude in respect to koalas and koala conservation policy. Respondents were presented with 13 statements regarding koalas and asked the degree to which they agreed or disagreed on a five-point Likert scale, 1–4 being a scale of strongly agree to strongly disagree and 5 being neutral (See Appendix 1). The statements covered aspects of living with koalas, koala conservation policy and the rights of native wildlife. Respondents were also presented with a list of threats to koalas (e.g., disease, vehicle collisions, dog attacks) and asked to assess the level of threat on a continuum of not true to very true (See Appendix 1). This was done so that the respondents' perception of the importance of each threat could be identified relative to another for each respondent. A self-assessment of residents' knowledge toward koalas in their neighborhood, city and throughout the state was also included in the questionnaire.

C. Possible actions to mitigate threats: Respondents were asked via multiple choice questions, about the reasons they valued the presence of koalas in their community, dog ownership and where dogs were kept between dusk and dawn, when koala activity is at its highest. Residents were also asked how likely they were to participate or support a range of koalas conservation action (e.g., community conservation group, native vegetation restoration, road control measures in koala habitat areas), on a four-point scale from highly unlikely to highly likely.

2.3. Statistical analysis

Questionnaire responses were collated using a Microsoft Excel database (Excel for Mac, version 14.0.2). Principal Component Analysis (PCA) was performed using 'R' Statistical Computing (R Development Core Team, 2012) on thirteen Likert scale statements (see Q9 in Appendix 1) that examined attitudes toward koala conservation and eight action statements (see Q15 in Appendix 1) that examined the likelihood of participating in conservation behavior to identify any major components that may account for variation in responses. Principal Component Analysis was used to analyze the Likert scale data as it explains the maximum possible variance with the fewest possible components. The reliability of each component was analyzed with Cronbach's alpha and Guttman's Lambda 6. Any components with an Eigenvalue greater than one were analyzed further using Analysis of Variance (ANOVA) to determine if the data groups varied significantly. Each significant component was also analyzed against resident demographics (e.g., age, gender, education), koala activity and knowledge of koala conservation. Model fit was verified using standard diagnostic plots supplied by 'R' ("residuals versus fitted values" and "qqnorm"). Effect size, a measure of the practical importance of a significant relationship, was measured using eta (r^2) as $r^2/(1-r^2)$, in order to determine whether effect size was minimal (.100), typical (.243) or substantial (.371) (Vaske, Gliner, & Morgan, 2002). When significant differences were identified, post hoc *T*-tests revealed the source of the significance. A Bonferroni correction was applied to the three pair wise *T*-tests from each Anova table (EV-PU, PU-SU, SU-EV), the result of which was that only *p*-values below .017 were deemed significant.

3. Results

Of the approximately 334 households, 102 surveys were completed (33% response rate). Suburban (SU) respondents accounted for $n = 34$ responses, peri-urban (PU) $n = 38$ and eco-village (EV) $n = 30$.

Table 1
Dog ownership percentages and location at night.

Variable	Q13. Dog ownership	
	Suburban	Peri-urban
Dog	46%	63%
Variable	**Q14. Dog location (night) %**	
	Suburban	Peri-urban
Inside	38%	67%
Restricted area outside	24%	12%
Roam freely outside	38%	21%

3.1. Demographics

Females accounted for more than half of questionnaire responses ($n = 56$). The age of respondents ranged from 18 to over 70, with 82% ($n = 84$) between the ages of 31–70. Most (64%) residents indicated they had seen koala(s) on or near their property (SU, $n = 16$; PU, $n = 35$; EV, $n = 14$). Length of residency within the Elanora, Currumbin Waters area varied considerably, with 20% of respondents living in the area for less than one year, 44% for 1–10 years, 31% for 11–30 years and 4% for over 30 years.

3.2. Pet ownership

Of the 72 suburban and peri-urban respondents, 68% reported pet ownership (Table 1). Residents of the eco-village are not allowed pets and were excluded from analysis in this section. Of the 65 residents who have seen koalas on or near their property, 48% owned dogs.

3.3. Knowledge of koalas

Respondents were asked to rate their level of knowledge about koalas in their own suburb, on the Gold Coast and across Queensland, as well as their knowledge of the threats facing koala populations. The majority stated they had an 'average' knowledge of koalas in their locality but knew 'very little' about koalas elsewhere in the state (Fig. 3a). All residential areas considered habitat clearing and housing development to be the two most urgent threats to koala survival, while disease was scored as the least serious threat. Both suburban and peri-urban residents believed cars to be more threatening to koala populations than dogs, though eco-village residents found dogs more of a threat (Fig. 3b).

3.4. Attitudes toward koalas and koala conservation

The scree plot and eigenvalue scores (equal to or greater than 1) from PCA were used extract four factors which accounted for most of the variation within the responses to the Likert scale attitude statements (see Q9 in Appendix 1) from the questionnaire (Table 2). Two factors, accounting for 47% of variance were analyzed further using analysis of variance and linear regression modeling.

Prior to PCA analysis, the order of the Likert scale in the questionnaire was reversed to range from 1 (strongly agree) to 4 (strongly disagree). Therefore, for accurate interpretation, scores that are positive reflect disagreement with the statement, while scores that are negative reflect agreement with the statement. Component 1 accounted for 27% of variation within the attitude statements (Table 2). The statements correlated with this component described an individual's positive attitude toward koala conservation. This

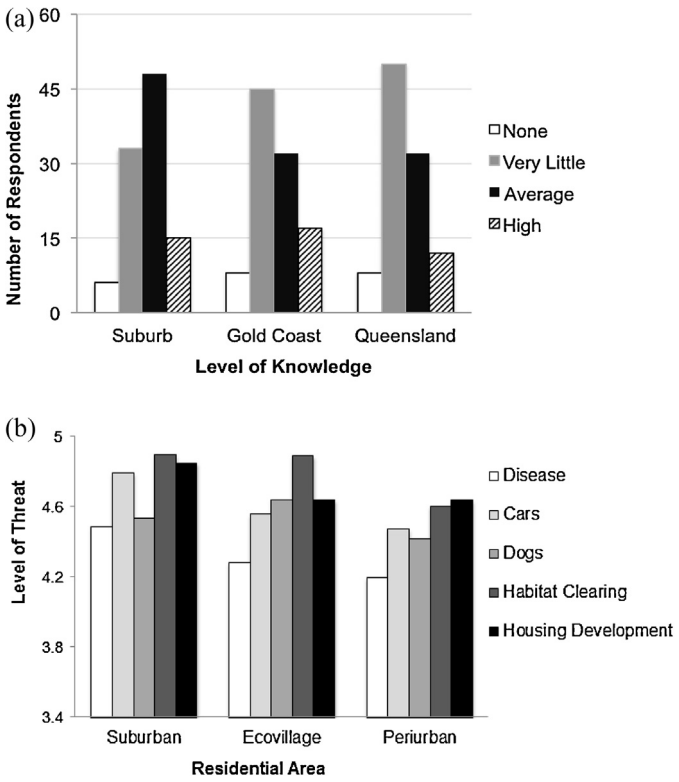

Fig. 3. Respondent knowledge of (a) koala populations in their suburb, Gold Coast and Queensland, and (b) perceived level of threat by residential area.

component described residents who did not think it would be better for them or for koalas if suburban koalas were moved to bushland areas, and who agreed that koalas are an important part of suburban areas.

Component 2 accounted for 19% of the variation within the attitude statements and reflected an individuals' preference to keep koala conservation law as it is currently (Table 2). High negative loading was seen on the statement, 'vegetation protection laws are unnecessary,' indicating unfavorable attitudes toward changing or improving koala conservation law. Components 3 and 4 together accounted for 21% of total variation within Q9. Component 3, labeled 'concern for koala conservation' shows the extent to which residents believe that current conservation laws are ineffective and that koalas would be better off if moved to bushland. However, Component 3 did not vary significantly by area of residence (analysis not shown). Component 4 or 'lack of awareness,' reflected views that koalas are an important part of suburban areas, but that current laws are effective in koala conservation.

The effect of area of residence on component 1 (attitude) was statistically significant ($F_{(2, 99)} = 2.82$, $p < .05$). Post hoc comparisons using the Bonferroni correction revealed SU to be significantly below PU ($T = -2.447$, $p = .008$), but not significantly below EV ($T = -2.101$, $p = 0.0382$) (Fig. 4). No other significant differences were seen when comparing demographic variables such as age and gender within this component. The effect size of area of residence on attitude was small at .057.

Area of residence was also significant ($F_{(2, 99)} = 3.59$, $p < .05$) related to Component 2 ('maintain current conservation law') (Fig. 4). Post hoc testing of this component using the Bonferroni correction showed SU to be significantly different from the EV ($T = 2.478$, $p = 0.0149$), though PU was not significantly different from the EV ($T = 2.203$, $p = .0299$). The effect size of area of residence on 'maintain current conservation law' was small at .072.

Table 2
Eigenvalues of attitude statements and conservation participation with components identified by PCA. Variables with the highest loading values for each component are highlighted in bold.

Q9	Attitude statements	Component			
		1	2	3	4
A.	Koalas should be allowed to live in suburban areas	−0.286	−0.041	−0.098	−0.106
B.	I like/would like to see koalas in my neighborhood	−0.174	−0.026	−0.128	−0.099
C.	Koalas are a bother to have near my home	0.143	−0.164	0.082	−0.08
D.	Suburban koalas would be better off if moved to bushland	**0.467**	−0.071	**−0.403**	−0.34
E.	Vegetation protection laws are unnecessary	0.064	**−0.863**	−0.184	0.359
F.	I consider koalas when designing or changing my backyard	−0.288	−0.182	−0.381	−0.009
G.	Koalas have a right to exist in their natural environment	−0.177	−0.025	−0.214	−0.13
H.	Increased protections measures for koalas are necessary	−0.188	0.024	−0.273	−0.338
I.	It would be better for residents if koalas in suburban areas were moved to bushland	**0.496**	0.001	−0.281	−0.284
J.	Koalas are an important part of suburban areas	**−0.41**	−0.207	0.111	**−0.593**
K.	I consider the bushland near my home to be an important area for koala conservation	−0.208	−0.016	−0.179	−0.292
L.	Current Legislation is effective in conserving local koala populations	0.108	−0.374	**0.602**	**−0.554**
M.	I would like more information on what personal actions I can take to conserve koalas in my area	−0.154	0.033	−0.132	−0.173
	Explained variance (%)	26.99	18.81	11.39	9.95
	Reliability Coefficients-Cronbach's Alpha	0.75	0.75	0.77	0.76
	Reliability Coefficients-Guttman's Lambda 6	0.8	0.8	0.83	0.81

Q15	Likeliness to participate in conservation actions	Component 1
A.	Community Conservation Group	0.2
B.	Restoration of native bush on property	−0.254
C.	Modification of yard to allow for koala movement	−0.265
D.	Backyard Stewardship Program	−0.258
E.	Driving slowly between Dusk and Dawn	−0.016
F.	Keeping dog inside at night	**0.836**
G	Reporting koala sightings	−0.095
H.	Council-led initiatives for conservation on your property	−0.221
	Explained variance (%)	48.74
	Reliability Coefficients-Cronbach's Alpha	0.78
	Reliability Coefficients-Guttman's Lambda 6	0.81

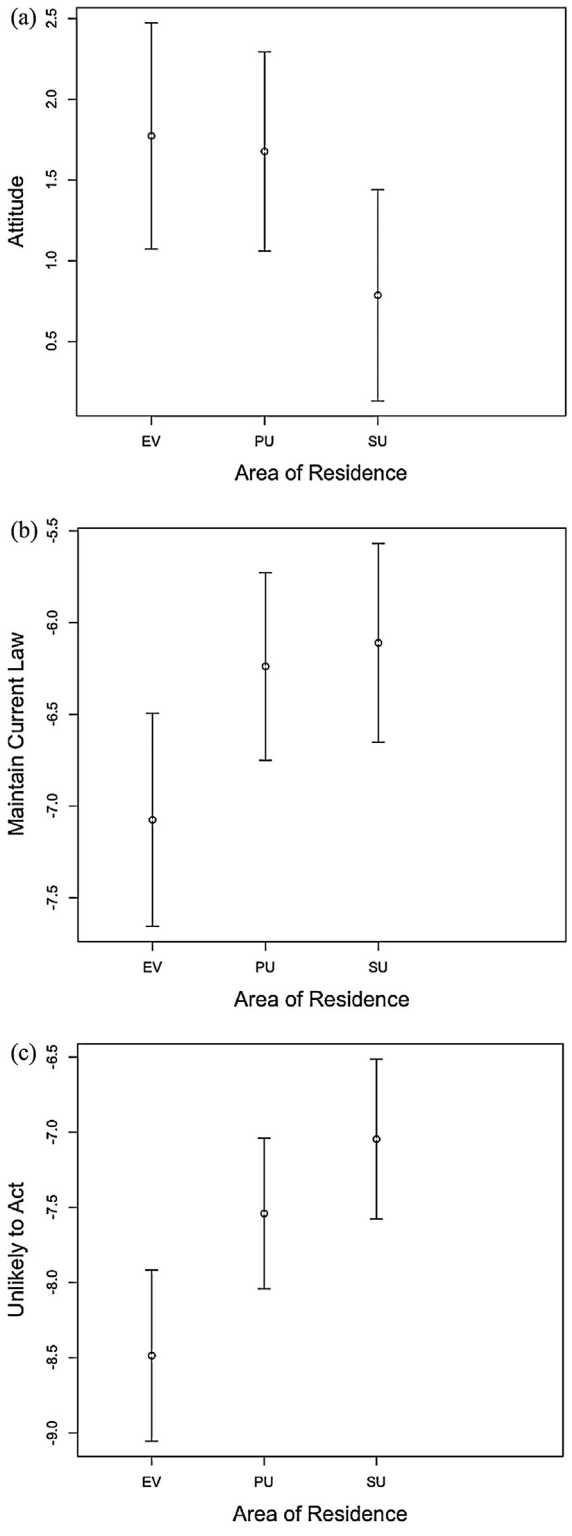

Fig. 4. Bar plots of influence of residential area on (a) attitude toward koala conservation, (b) maintaining current koala conservation law, (c) unlikeliness to participate in koala conservation action (numerical values represent PCA scores).

There was also a statistical significance for level of education and Component 2, but no significant difference between genders or age groups for this component. Those with bachelor degrees or higher scored significantly higher than those with lower levels of education, ($F_{(5, 96)} = 2.49$, $p < .05$). However, there was no correlation between Component 2 and residents' 'positive attitude' toward koalas.

3.5. Specific statements within attitude (Q9)

Correlations between some individual attitude statements varied significantly across certain demographics. 'Current legislation is effective in conserving local koala populations' showed a significant difference in both the 31–50 and 51–70 age range ($F_{(3, 98)} = 3.84$, $p < .05$), when compared to 18–30 year olds. Respondents in the 18–30 age range marked significantly lower on this statement, signifying that older respondents were more likely to believe that current koala legislation was ineffective. Men were significantly less likely than females to consider koalas when designing or changing landscape in their backyard (Q9F), ($F_{(1, 100)} = 15.48$, $p < .001$). The level of spending (more than $500) to make yards more koala 'friendly' was significant when compared to Q9J, 'koalas are an important part of suburban areas' ($F_{(5, 96)} = 3.37$, $p < 05$). Pet ownership was also highly significant $F_{(6, 95)} = 4.39$ for dogs ($p < 001$), dogs and cats ($p < 01$) and no pets ($p < .001$) when compared to the importance of koalas to suburban areas (Q9J).

The most strongly positive responses were to the statements 'koalas have a right to exist in their natural environment' (98%), and 'I like/would like to see koalas in my neighbourhood' (97%). A slightly lower number of respondents agreed with the statement 'koalas should be allowed to live in suburban areas' (88%) and 'I consider the bushland near our home to be an important area for koala conservation' (93%). However, 19% of respondents disagreed with the statement 'koalas are an important part of suburban areas' and only 20% agreed or strongly agreed in the statement, 'suburban koalas would be better off if moved to bush-land.'

3.6. Participation in conservation actions

The scree plot and eigenvalue scores from the PCA of Q15 from the questionnaire (see Appendix 1), which assessed respondent's willingness to participate in activities to improve koala conservation, identified one factor that accounted for 49% of the variance of the question (Table 2). The statements correlated with this component described an individual's 'unlikeliness to act' toward koala conservation, where a positive score represented someone likely to act and a negative score was reflective of unlikeliness to act. Respondents were most likely to keep their dogs inside at night, to drive slowly between dusk and dawn and to report koala sighting. Residents were highly likely to support koala area signage along roads but less likely to support speed bumps (Table 3).

Area of residence was significantly different when analyzed against 'Unlikely to act': relative to EV, PU is significantly higher (by 0.9448) $p < .05$ and SU was significantly higher than EV (by 1.4397), $p < .001$ (Fig. 4c). Post hoc comparisons revealed PU to be significantly above EV ($T = 2.539$, $p = 0.012$), and SU to be significantly higher than EV ($T = 3.772$, $p = 0.0003$). The effect size of area of residence on 'unlikely to act' was substantial at .605. Length of time in residence was also a significant influence on the reported likeliness to act. Respondents who have lived in the area 11–30 years or more than 30 years were significantly more likely to act than those who have lived in the area a shorter period of time. The likelihood of 'keeping dog inside at night' (Q15F) was excluded from analysis as it was left blank by 61% of respondents (those that did not own dogs, as marked in Q13). Some gender differences were also seen in which actions residents were willing to take (Q15 & Q16). Women were significantly more likely than men to drive slowly between dusk and dawn ($F_{(1, 100)} = 6.16$, $p < .05$) and significantly more likely to support decreased speed limits in koala habitat areas ($F_{(1, 100)} = 4.58$, $p < .05$).

When comparing between components, 'positive attitude' and 'unlikeliness to act' showed a significant negative correlation overall, so that as positive attitude toward koala conservation increased so did a respondent's likeliness to act (Fig. 5). Desire to

Table 3
The likelihood of resident participation in conservation actions (Q15) and road control measures (percentage).

		Scoring			
		Highly likely	Likely	Unlikely	Highly unlikely
Q15	Participation in Conservation Action				
A.	Community Conservation Group	13%	49%	33%	5%
B.	Restoration of native bush on your property	33%	44%	16%	7%
C.	Modification of your yard to allow koala movement	28%	41%	24%	7%
D.	Backyard Stewardship Program	18%	37%	37%	8%
E.	Driving slowly between dusk and dawn	51%	44%	5%	0%
F.	Keeping dog inside at night	62%	24%	12%	2%
G.	Reporting koala sightings	43%	43%	13%	1%
H.	Council-led initiatives for conservation on your property	32%	39%	22%	7%
Q16	Participation in Road Control Measures				
A.	Rumble Strips	46%	34%	15%	5%
B.	Painted Section of Road	56%	37%	7%	0%
C.	Koala Area Signage	68%	30%	1%	1%
D.	Speed Bumps	40%	33%	20%	7%
E.	Decreased Speed Limits	46%	45%	9%	0%

'maintain current conservation law' was not related to having a 'positive attitude' toward koalas, nor to a resident's 'likeliness to act.'

4. Discussion

This study aimed to answer the questions: (1) can attitude toward koalas be measured; (2) what factors influence community attitudes toward koalas; (3) how do different urban densities (suburban, peri-urban and an eco-village) affect conservation knowledge and behavior; and (4) what conservation actions would residents be willing to take to mitigate local threats? Koalas are an iconic and well-loved species and despite this, populations are in decline in southeast Queensland as a result of increased urbanization.

One of our key finding was that there was a significant difference between attitudes toward koala conservation in respondents living in different urban densities (EV, PU, SU). Though the effect size of area of residence on attitude was small, a general effect size statistic is not always sufficient to explain distinct group differences, and in some cases a small effect size can have more practical significance than a larger effect size (Vaske et al., 2002). The results of our study suggest suburban residents are significantly less likely to have a positive attitude toward koala conservation and are therefore significantly less likely to take action to improve the conservation status of koalas in their neighborhoods. This finding concurs with behavioral theory, whereby a less positive attitude is reflected by less interest in changing behavior (Ajzen, 1991; Eagly & Chaiken, 1993; Vaske & Donnelly, 2007). Understanding the attitudes of local communities to wildlife in urban areas is important for biodiversity conservation around the world. Biodiversity hotspots globally tend to have larger than average human population densities, most of which are rapidly urbanizing (Miller & Hobbs, 2002). Urbanization is particularly detrimental because its effects are far longer lasting and pervasive than other forms of habitat loss (McKinney, 2002), including the division and fragmentation of natural areas (Baker & Harris, 2007). There is an urgent need to verbalize the diverse values that society receives from wildlife and these values should be applied in situations involving a trade-off between socio-economic development and the protection of species (Kellert, 1985). The more removed urban residents become from nature and wildlife, the less these benefits affect the population and the more important it becomes to communicate nature conservation in cities to strengthen these connections.

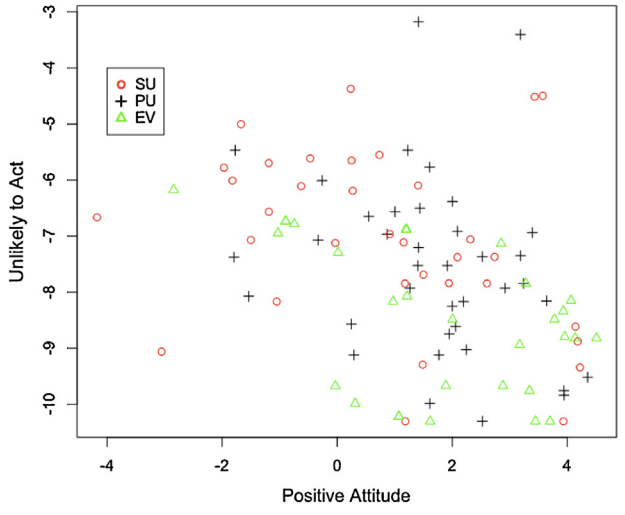

Fig. 5. Scatter plot of PCA showing negative correlation between positive attitude toward koala conservation and unlikeliness to participate in conservation actions (numerical values represent PCA scores).

A wide array of behaviors and experiences affect how individuals assess and value wildlife. The properties that make up a person's predisposition toward wildlife are as varied and complex as behavior itself. Intent to conserve is far different from actual conservation, and theories describing environmental predilections are not always sufficient in understanding how to change or improve environmentally significant behaviors (Stern, 2002). This study found that area of residence, whether respondents lived in the suburban, peri-urban or eco-village areas, was more influential in determining the likelihood of a respondent's participation in conservation actions than any other variable or demographic (Fig. 4c). This suggests that participants in this study, living on larger, peri-urban properties with more exposure to native wildlife were more likely to take positive action toward koala conservation. These results parallel work done by Miller and Hobbs (2002), which explored the importance of stressing conservation measures in the everyday lives of individuals, especially where they live and work. The failure to communicate the importance of biodiversity may stem from the idea that conservation happens most often in parks and wilderness areas rather than in suburban areas, where conservation initiatives should be concentrated for greatest effectiveness (Miller & Hobbs, 2002). Without further study however, it is difficult to determine whether living in suburban areas with little access to bushland and native wildlife is the cause of a lower regard for koala conservation, or if individuals with less conservation education are simply more likely to live in denser, more urbanized housing areas.

Social demographics can also play an important role in the valuation of wildlife and often acts as behavioral predictors (Loyd & Miller, 2010; Mankin et al., 1999). For example, gender has been recognized as one of the most significant demographic variables affecting attitudes toward wildlife and management (Deruiter & Donnelly, 2002). In this study, men and women had similar highly positive views of the intrinsic value of koalas and liked seeing koalas in their neighborhoods. However, there were gender differences in the actions that respondents would undertake in this study. Men were considerably less likely than women to drive slowly at night or support decreased speed limits in koala habitat areas.

Family pets such as dogs and cats are known to prey upon native species in Australia (Dique, Thompson, Preece, de Villiers, & Carrick, 2003; May & Norton, 1996; McAlpine et al., 2006a,b), and their abundance, behavior and management are important for the preservation of native wildlife in urbanized areas (FitzGibbon & Jones, 2006). A human wildlife conflict arises from dog ownership, though ownership of dogs seemed to have little statistical significance on koala sightings in this study. Within suburban areas however, where dogs were allowed to roam more frequently at night, the percentage of residents who had observed koalas on or near their property were much lower than other residential areas. One respondent with a large dog had never seen koalas near her home, though the neighbor immediately adjacent did not own a dog and reported seeing a koala in their yard on a weekly basis.

Perceptions of wildlife conflict held by residents are often inconsistent with the extent of actual conflict. For example, Williams, Weston, Henry, & Maguire (2009) examined pet owner's views on leashing in beach areas and the effects of dogs on coastal birds, and noted that owners recognized that dogs in general were a problem for wildlife but were unable to recognize the personal impact of their own dogs. Williams et al. (2009) findings correspond with the results seen in this study, which is important, as conflict with humans is one of the most urgent problems in current koala conservation (Lunney, Gresser, O'Neill, Matthews, & Rhodes, 2007). This study found that 62% of suburban respondents, and 33% of peri-urban respondents who owned a dog left their dogs free to roam within a fenced yard at night. Veterinary hospital records indicate that at least 1400 koalas were attacked in Queensland between 1997 and 2008, the majority being fatal, with most attacks on koalas taking place in the dog's own yard (Department of Environment, 2009). Greater public education with regards to the effects of dogs on koalas would increase awareness about domestic pet impacts and help minimize conflict in areas where humans and koalas coexist. However, increasing knowledge alone will not necessarily lead to behavioral change and education programs must be well planned, with the nature of the problem and clear solutions for behavioral change to be achieved (Collier & Smith, 2009).

Understanding of threats (Fig. 3b) showed that respondents had a good level of knowledge of the threats facing koalas, though eco-village residents' knowledge of threats was more accurate than peri-urban or suburban residents. With regard to general awareness of key threats to koalas, their value in the community, and respondents' knowledge about koalas in their immediate neighborhood and at a wider region or state level, most respondents felt they had an average level of knowledge about koalas in their neighborhood and very little knowledge of koalas elsewhere in the state (Fig. 3a), despite the information being readily accessible through a variety of sources. This lack of conservation knowledge mirrors many similar studies (Casey, Krausman, Shaw, & Shaw, 2005; Dowl & Deane, 2009; FitzGibbon & Jones, 2006; Hill et al., 2007; Lunney, O'Neill, Matthews, & Coburn, 2000) and confirms the need for increased public education to combat conflict issues and other conservation misconceptions. In this study, respondent's 'positive attitudes' toward koalas were not significant when compared to maintaining current conservation laws. Thus, laws themselves did not seem to be associated with koala conservation. If respondents had been consistent in answering this question, a strong relationship between 'positive attitude' and 'maintain current conservation law' would have been seen. The fact that no relationship existed shows the lack of connectedness of the two subjects in respondents' minds. However, nearly 25% of respondents were neutral to the statement 'current legislation is effective in conserving local koala populations.' This received more neutral responses than any other statement, with respondents often commenting that they were 'unaware of koala legislation'. This is important for local koala conservation as meaningful conservation often begins with regulation, and studies have shown that the more extensive an individual's knowledge of a species, the greater the demand to conserve and sustain that species (Tisdell & Wilson, 2006).

A significant negative correlation was found when comparing a respondent's positive attitude with their unlikeliness to act: the more negative a respondent's attitude toward koala conservation, the less likely they were to participate in conservation actions. These findings can be used in developing local government conservation strategies, as conservation often seeks to modify human behavior, but influencing it successfully depends on correctly predicting behavior, which is complex and based on personal attitudes and perceived social pressures (subjective norms) (St. John, Edwards-Jones, & Jones, 2010). By quantifying what influences attitude toward native wildlife, we can more accurately determine causes of species decline and formulate ways in which to minimize human impacts. St. John et al. (2010) focuses on the factors that motivate human behavior toward conservation, finding that biodiversity loss is the direct result of human behavior, which needs to be more specifically defined in order to better understand the predictors of specific behaviors. One classic example of this is the reintroduction of wolves to one state in the United States, all of which were subsequently killed within eight months of release because the human dimensions of wolf restoration had not been adequately assessed prior to wolf release (Hook & Robinson, 1982).

4.1. Research limitations

The response rate and sample size of this study ($n = 102$) limits our ability to generalize the results to the total population of this region without confirmation from further surveys.

According to Bartlett, Kotrlik, and Higgings (2001), an adequate number to represent a population of this size would be 120 households for continuous data ($p < 05$), and 260 for categorical data. However, Dillman, Smyth, and Christian (2009) reports that 377 individuals would be a more adequate sample size ($p < 05$) for this population. Though the effect size of urban density on 'attitude' and 'maintain current law' was small, a larger sample size increases the power of the statistical analysis and could change the size of the effect (Vaske et al., 2002). There is also the possibility of response bias in the survey. While every effort was made to randomize sampling and minimize sampling error, it is possible that residents not interested in survey participation or koala conservation were more likely to decline to participate, thus creating a skewed sample for analysis. Incorporating a non-response check would strengthen the results of any future study.

4.2. Management implications

The field of conservation generally struggles to comprehend the decision-making of individuals that ultimately leads to biodiversity loss (St. John et al., 2010) and the gap between conservation intent and conservation action is an important aspect of environmental behavior (Tudor, Barr, & Gilg, 2006). By understanding what motivates individuals to modify their behavior and minimize threats to the environment, the gap between intent and action can be

bridged (Barr & Gilg, 2007). Human dimensions research does not necessarily provide managers with a definite solution to complex wildlife problems, however when used additively with ecology, it can often provide a better platform for more informed management decision making (Miller, 2009). Understanding peri-urban and suburban residents' knowledge and attitudes toward koalas can therefore help alleviate declining populations and provide more informed and effective management decisions. This study gives local managers a better idea of the attitudes and level of knowledge of residents and where to focus education to encourage increased effort in koala conservation. For example, targeting suburban populations to raise awareness of local koala populations may increase conservation interest, whereas in peri-urban areas, conservation actions are more likely to be implemented successfully. Further work to validate this survey, would serve to inform decision-makers of which conservation initiatives residents are most likely to participate in and could guide campaigns to increase awareness about the necessity of certain actions that the public is hesitant to support.

While this research shows that these residents do value the presence of koalas near their homes, koalas can also elicit more neutral feelings from suburban residents, who are less prepared to share their homes with native wildlife. These findings are important to the management of wildlife in urban areas, and planners should be tasked with developing ways to preserve biodiversity as urban sprawl continues to change natural environments (McKinney, 2002). It is increasingly important for urban residents to value wildlife and become actively engaged in wildlife conservation. This could occur through increased education programs or economic valuation of the benefits of nature (Miller & Hobbs, 2002; Raik, Lauber, Deckers, & Brown, 2005). Though urban habitats seldom harbor the most endangered of wildlife, preservation and restoration in highly urbanized areas is essential for the conservation of biodiversity (Miller & Hobbs, 2002).

5. Conclusions

This study indicates that the majority of respondents interviewed valued having koalas in their neighborhood. However, the results give an indication of community attitudes and perceptions in this region only, and need further validation to test their applicability to a larger population. Though a standard endangered species program emphasizes ecology rather than social science, understanding the value that people place on the preservation of species is essential in prioritizing and implementing successful management plans. Though koala conservation efforts should focus on the preservation of habitat, the impacts of human conflict with koala populations cannot be ignored. A better understanding is needed of why koala declines are continuing to occur, despite all the evidence that Australians appreciate and value koalas. Research such as this can help minimize conflict, and promote collaborative solutions, and government incentives such as grant programs or cost sharing, that will be important to the future of urban conservation. However, governments alone cannot be responsible for the vast undertaking of wildlife conservation, and landowners need to recognize that they have an important and active role to play. Understanding societal values toward wildlife is crucial for effective conservation management and the social science behind the determination of these values can act as a framework for the preservation of species on a global scale. If indeed area of residence is as important in creating positive attitudes and actions as this study suggests, giving residents of urban areas greater access to bushland habitat will only enhance koala conservation, and incorporating these human dimension issues into management will aid in minimizing wildlife declines in expanding urban regions.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.landurbplan.2014.03.004.

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