

Protecting wildlife from predation by owned domestic cats: Application of a precautionary approach to the acceptability of proposed cat regulations

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Abstract While it is undeniable that owned domestic cats *Felis catus* (Mammalia: Felidae) kill large numbers of wildlife, it is contentious if this has significant impacts on wildlife populations. Under the precautionary principle such uncertainty does not preclude measures to reduce putative risk, but action should follow consultation with stakeholders. To initiate such consultation for the City of Armadale, Western Australia, we surveyed urban and rural residents to determine their opinions regarding putative impacts of owned cats on wildlife and the acceptability of proposed regulations. Key statements accepted by 70% or more of respondents, irrespective of their residence, gender or cat ownership status, included: (i) there is a need to regulate owned domestic cats; (ii) the presence of cats in nature reserves is harmful to wildlife; (iii) cats not owned by licensed breeders should be desexed; and (iv) local councils should be empowered to restrict the maximum number of cats per household. Seventy per cent or more of owners agreed to keep their cats on their property from sunset to sunrise and to register them if these measures became compulsory. All groups except urban men also indicated 70% or greater willingness to keep their cats on their property constantly if required. However, fewer than 40% of owners supported empowering local councils to enforce cat-free zones. In this community, cat regulation excluding cat-free zones should enjoy support. Similar approaches should be effective wherever the environmental impacts of owned domestic cats are debated, because compliance with such regulations should be high.

Key words: cat regulation, domestic cat, *Felis catus*, precautionary principle, wildlife protection.

INTRODUCTION

Many international studies confirm that owned domestic cats *Felis catus* (Mammalia: Felidae) do kill large numbers of wildlife and document mortality statistics (e.g. Churcher & Lawton 1987; Barratt 1998; Gillies & Clout 2003; Lepczyk *et al.* 2003; Woods *et al.* 2003). However, this evidence does not discount the possibility that cats simply take a 'doomed surplus' of prey (Bomford *et al.* 1995; Patronek 1998; Risbey *et al.* 1999) and few studies demonstrate a decline in prey populations unequivocally linked to predation by owned cats (Larkin 1989 and Dufty 1994 are important examples). Furthermore, Patronek (1998), Barratt (1998) and Chaseling (2001) stressed that high rates of predation might not be the only cause of declining prey populations in greatly disturbed or modified environments. Thus, two polarized views on the importance of regulating owned domestic cats to

achieve wildlife protection have arisen: on the one hand, that the impact of predation is exaggerated and deflects attention from more serious causes of wildlife decline (e.g. Fitzgerald 1990; Natrass 1992; Chaseling 2001), while on the other hand that the number of wildlife deaths must be having an impact and action is needed (e.g. Lepczyk *et al.* 2003; Paton 1991; Woods *et al.* 2003).

The precautionary principle provides a rationale for deciding on possible actions in cases such as this where both the risk to environmental values and the uncertainty about possible impacts are high. It states:

Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by: (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and (ii) an assessment of the risk-weighted consequences of various options. (The Intergovernmental Agree-

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ment on the Environment, May 1992, quoted in Deville & Harding 1997)

Where risks are well-known and grave, then the relevant action is prevention, not precaution. Small and well-known risks may require little action at all (Deville & Harding 1997).

Critics of the principle parody it as meaning 'do nothing until you know everything', referring to its use to prevent proposed resource extraction or development (e.g. Goklany 2001). However, precaution need not mean inaction and in some cases it advances specific actions over the *status quo* (Deville & Harding 1997; Calver *et al.* 1999; Calver 2003). Effective precaution has the further advantages of requiring widespread consultation before implementation and considerable freedom to tailor actions to specific local circumstances (Deville & Harding 1997; Kruger *et al.* 1997; Harding & Fisher 1999). These assets suit it to the debate over the putative impacts of owned domestic cats on wildlife.

Proposed protocols for applying the precautionary principle (Deville & Harding 1997) and reports of successful case studies (e.g. Kruger *et al.* 1997) recognize the difficulty in implementing regulations without compelling evidence. Instead, they suggest detailed consultation with stakeholders to determine their perceptions of risk and the actions they are prepared to take to reduce it. This consultation may suggest immediate precautionary actions acceptable to stakeholder groups while further research is undertaken to reduce uncertainty. This research may lead either to the implementation of preventive action if risk is confirmed to be high, or relaxation of precautionary measures if they are found to be unwarranted.

This paper reports the results of following this protocol to initiate a precautionary approach to managing the putative impact of owned domestic cats on wildlife in the City of Armadale, a local government municipality on the outer fringes of the metropolitan area in Perth, Western Australia. At the time of writing, Western Australia was one of the Australian states yet to introduce statewide regulations governing cat ownership, although several local government municipalities have taken action (Grayson & Calver 2004). At the instigation of one stakeholder, Armadale City Council (ACC, the Armadale local government authority), we surveyed the responses of men and women (both cat owners and non-owners) from urban and rural residences within the City of Armadale to suggested regulations for owned domestic cats. Our aim was to identify a range of measures supported by ACC and the different resident groups that would reduce risk to wildlife, and to suggest means of implementing them acceptable to all parties. The approach is applicable to other communities debating the putative impact of owned domestic cats on local wildlife.

METHODS

Study area

The City of Armadale ($32^{\circ}15'S$, $116^{\circ}02'E$) is located approximately 29 km south-east of Perth, the capital of Western Australia (Fig. 1). The region has a Mediterranean climate and experiences 6 months of hot, dry weather, encouraging the outdoor husbandry of cats. There are over 19 000 dwellings within the City, some of which are zoned urban (primarily residential living with single dwellings on separate lots mostly less than 1000 m^2) and others rural (semi-intensive rural land use compatible with landscape conservation, lot size ranging upwards from 2000 m^2). The 545 km^2 of the City include the eastern portion of the Swan Coastal Plain, the Darling Scarp and the Darling Range. In the Darling Range and Scarp, substantial areas are reserved as water catchment (managed by the Water Corporation and Waters and Rivers Commission) and state forest (managed by the Department of Conservation and Land Management). Both of these land tenures also contribute to wildlife conservation. The City of Armadale manages 1000 ha of parks and reserves (<http://www.armadale.wa.gov.au>). Native mammals present in the region

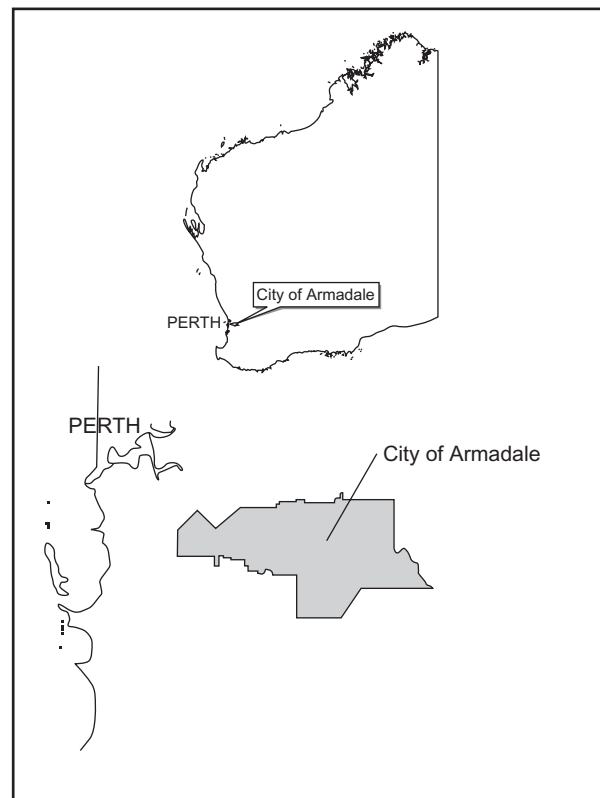


Fig. 1. Location of the City of Armadale, Western Australia.

and potentially preyed upon by cats include the Southern Brown Bandicoot *Isodon obesulus* and the Yellow-footed Antechinus (Mardo) *Antechinus flavipes*.

Design of survey

The survey protocol used in this study was developed by Grayson *et al.* (2002) to obtain public opinion on issues such as legislative control of cat ownership, impacts of cats on urban wildlife and aspects of cat husbandry such as confinement, sterilization and identification. The survey included 43 items relating to opinions and a further 32 items regarding characteristics of the respondents themselves and, in the case of cat owners, their cat husbandry practices. Some items were direct questions (e.g. How many cats do you have?) while others requested a response to a statement on a four-point Likert Scale (strongly agree, agree, disagree, strongly disagree). Responses to the opinions and practice items were used to construct three scales (Sterilization – 13 items covering attitudes and practices regarding sterilizing pets, Control – 19 items covering regulations desired and willingness to comply with proposed measures and wildlife – 11 items covering attitudes towards the interactions of owned domestic cats and wildlife). These reflected important areas of husbandry as well as attitudes towards wildlife. Participants' scores on these scales were used as dependent variables reflecting their attitudes. Gender (male/female), residential code (urban/rural) and cat-ownership status (owner/non-owner) of respondents were then used as independent variables in MANOVA (multivariate analysis of variance) to explore their influence on the dependent variables. Gender was chosen as a variable because it can be a significant factor in pet management practices (e.g. Blackshaw & Day 1994), while residence was chosen because the species richness and abundance of native fauna often vary in relation to the proximity of native vegetation (e.g. Barratt 1998; Catterall 2004; van der Ree 2004). Cat ownership was chosen so that differences between owners and non-owners could be assessed explicitly.

Fourteen key questions/statements were selected for individual analysis because they describe specific husbandry practices of owners, attitudes and beliefs of owners and non-owners, or regulatory options for the ACC. The first seven items in the list relate to cat owners only, while the others apply to all respondents:

- How many cats do you have?
- Has your cat(s) been desexed?
- Would you license your cat if it became compulsory?
- Is your cat currently confined to your house or to your property?
- I would be happy to keep my cat(s) on my property between sunset and sunrise.
- I would be happy to keep my cat(s) on my property at all times.
- I would be happy to keep my cat(s) in at night-time if it became compulsory.
- There is a need for cat legislation.
- Local governments should have the power to limit the number of cats per household.
- Domestic cats killing wildlife in the suburbs are a serious problem.
- To stop cats from attacking wildlife, cats should be kept on their owner's property at all times.
- Domestic cats in nature reserves are harmful to wildlife.
- Local governments should have the power to establish cat free zones in new sub-divisions.
- Excluding a cat(s) that is owned by a breeder, all cats should be desexed.

Administration of survey

One thousand names of rural residents and 1000 names of urban residents were selected randomly using case numbers from the City of Armadale residential database, representing 11.7% of all ratepayers. Surveys, together with a covering letter explaining the project and a stamped self-addressed envelope, were posted to the participants in June 2003. A reminder letter and a second survey were sent if no response was received within 3 weeks.

Data analysis

Representativeness of the survey

The representativeness of men and women in the survey was assessed by comparing the gender ratio of the respondents with that from the Armadale Electoral District. Although the Armadale Electoral District does not match exactly the City of Armadale boundaries, the electoral data are the best estimate of the true gender ratio of the population. Comparing the proportion of responses from owners to estimates of cat ownership across Australia published during the last decade assessed the likely representativeness of cat owners in the sample.

Analysis of Sterilization, Control and Wildlife scales

The Sterilization, Control and Wildlife scales were constructed from the survey responses using the Rasch measurement model (Hashway 1978; Andrich 1988),

which examines the fit of a set of data to a linearized unidimensional model. If the fit is acceptable, the model places survey questions and respondents' attitudes on a single equal-interval continuum, resulting in locations (scores) for individual survey questions and individual respondents, which are directly comparable with each other. These linearized (logit) scores are more appropriate than raw scores for use in common statistical tests. In practice they usually range from -3 to 3 logits, measuring respondents' attitudes in relation to the items that comprise the scale. Furthermore, Rasch measurement is 'item free', meaning that, if the data fit the model, different subsets of items (questions) in the item bank administered to the same individual, yield scores that are not appreciably different. Rasch measurement is also 'person-free' in the sense that, if the data fit the model, the estimation of the scale locations of values or behaviours associated with survey items are not dependent on the population of subjects used to estimate them (Rasch 1980; Andrich 1988). Participants' linearized scores on the Sterilization, Control and Wildlife scales were then used as dependent variables reflecting their attitudes in MANOVA to assess the possible influence of gender (male/female), cat-ownership status (owner/non-owner) and residence (urban/rural). Where significant interactions or effects occurred, univariate tests were used to determine which of the dependent variables was responsible for the effect or interaction.

Before analysis, dependent variables were screened to ensure compliance with the assumptions of MANOVA and the requirements of Rasch analysis. The only issue found was the presence of extreme values of person fit statistics for some respondents. In survey data, these commonly indicate frivolous respondents deliberately either selecting the same response to all items or choosing randomly. Identification and elimination of these cases improves the final estimation of person and item locations because the estimates for these cases are unlikely to be valid measures. The 22 people who were outliers in terms of exhibiting extreme values for their person fit statistic (2.1% of the sample size) were removed from the dataset.

Analysis of specific items

Responses to specific questions or statements were summarized as multiway contingency tables using the categories of Gender, Residence and Cat Ownership (not applicable for questions addressed to owners only) and analysed using log-linear analysis. This uses a model-fitting approach to determine the most economical combination of interactions that best describes the data. The significance of effects of interest in the model is tested by removing them from the model and noting changes in the fit of the model to

the observed data. In our analyses, we were interested in any significant interactions between responses to the question/statement and the variables Gender, Residence and Cat Ownership (if applicable). Interactions involving only these variables were irrelevant, so the three-way interaction between them was included in the final model '... to avoid obtaining an overall lack of fit which may be entirely due to interactions between the design variables' (Statsoft 1999).

Software used

Multivariate analysis of variance and log-linear analyses used the relevant modules of the STATISTICA software (Statsoft 1999), while Rasch analysis used the RUMM 2020 package (Andrich *et al.* 2003).

RESULTS

Response rates and profile of respondents

Of the 1000 urban and 1000 rural residences sampled, 494 (49%) urban and 535 (54%) rural residences responded to the survey. Cat owners comprised 162 (33%) urban and 199 (37%) rural responses. Most surveys were completed by women (276 (56%) urban and 326 (61%) rural). Nineteen respondents omitted their gender and were excluded from analyses using gender as an independent variable. The effective overall response rate of 51% resulted in a sampling error of 3% at $\alpha = 0.05$.

Men and women were not represented in the sample in the same proportions as they were in the Armadale Electoral District (AED) rolls (sample: 40.4% men, 59.6% women, AED rolls: 48.4% men, 51.6% women, $\chi^2_1 = 38.07$, $P < 0.001$). Women were more likely to respond to the survey.

Analysis of Control, Wildlife and Sterilization scales

Means and standard deviations of subjects' scores on the three scales are shown in Table 1. Initial MANOVA of these data using the factors of Gender, Ownership Status and Residence found significant effects for gender and ownership and the ownership-residence interaction (Table 2). The results of univariate tests within these groupings indicated which of the dependent variables contributed most to significance (Table 3). In relation to gender, men were more in favour of cat control and more concerned about wildlife than women, but women were more in favour of sterilization. With regard to ownership status, non-owners were more in favour of cat control and were more

Table 1. Mean Rasch scores (in logits) of respondents on the Control, Wildlife and Sterilization scales, \pm standard errors

Gender	Cat ownership	Residence	Sample size	Control	Wildlife	Sterilization
Male	Non-owner	Urban	141	1.55 \pm 0.113	3.49 \pm 0.166	0.21 \pm 0.059
Male	Non-owner	Rural	138	1.87 \pm 0.118	4.12 \pm 0.169	0.33 \pm 0.065
Male	Owner	Urban	56	-0.08 \pm 0.201	2.22 \pm 0.350	0.21 \pm 0.076
Male	Owner	Rural	52	0.20 \pm 0.150	1.94 \pm 0.303	0.14 \pm 0.111
Female	Non-owner	Urban	169	1.35 \pm 0.103	2.95 \pm 0.168	0.34 \pm 0.052
Female	Non-owner	Rural	182	1.39 \pm 0.095	3.41 \pm 0.158	0.32 \pm 0.046
Female	Owner	Urban	105	-0.33 \pm 0.106	1.23 \pm 0.0219	0.39 \pm 0.055
Female	Owner	Rural	146	-0.19 \pm 0.086	1.31 \pm 0.179	0.28 \pm 0.050

Scores are grouped by gender of respondent, cat ownership and residence. This sample excluded 41 respondents who either did not disclose their gender (19) or whose person fit statistics (available from the Rasch analysis) suggested that they were unreliable respondents (22).

Table 2. Initial MANOVA analysis of the data in Table 1

Effect	Rao's <i>R</i> (d.f.1, d.f.2)	<i>P</i> -value
Gender	11.44 (3, 979)	0.00
Ownership	115.37 (3, 979)	0.00
Residence	1.80 (3, 979)	0.14
Gender-ownership	0.68 (3, 979)	0.56
Gender-residence	1.36 (3, 979)	0.25
Ownership-residence	3.59 (3, 979)	0.01
Gender-ownership-residence	0.33 (3, 979)	0.80

Significant values are in bold. MANOVA, multivariate analysis of variance.

concerned about wildlife issues compared with owners. However, both owners and non-owners favoured sterilization equally.

The interaction of Ownership Status and Residence was significant for the Wildlife scale. Non-owners in rural areas were more concerned about wildlife than non-owners in urban areas and, overall, non-owners were more concerned about wildlife than owners. There was little difference in the level of agreement from owners in both residential codes.

Questions in the survey

Attitudes and practices of cat owners

Log-linear analysis showed no significant interactions involving combinations of the variables gender, residence and number of cats owned, although each was present as a main effect in the fitted model ($\chi^2_{10} = 8.36$, $P = 0.59$). Most owners had only one cat (59%), a further 27% had two cats and only 8% kept four or more cats, with no significant differences between urban and rural residences (Table 4). Log-linear analysis of the incidence of sterilization (91.6% overall)

also showed no significant interactions involving combinations of the variables Gender, Residence and incidence of Sterilization, although each was present as a main effect in the fitted model ($\chi^2_4 = 7.47$, $P = 0.11$) (Table 5). The incidence of confinement practices was significantly related to residence ($\chi^2_8 = 98.56$, $P < 0.001$). Approximately one-third (38.4%) of urban owners always kept their cats inside at night, compared with 26.6% of rural residents. However, rural residents were more likely to allow the cat to move inside and outside but within the property (21.6%) compared with urban residents (13.8%). Comments on the survey indicated that some rural owners who kept their cats inside/outside and within their property had a cat enclosure or a cat run (Table 6).

Tables 7 and 8 summarize responses to some key statements by cat owners that were analysed by log-linear analysis. The models fitted and the significance of their components are shown in Table 9.

- Statement 61 – I would be happy to keep my cat(s) on my property between sunset and sunrise.

There was a significant three-way interaction involving gender, residence and agreement with the statement. In urban areas, women were more compliant than men (90.1% and 72.2%, respectively). In rural areas, both women and men were equally supportive of the statement (87.3% and 88.2%, respectively).

- Statement 62 – I would be happy to keep my cat(s) on my property at all times.

All three factors were interdependent. In urban areas, women were more compliant than men (71.7% and 56.6%, respectively). In rural areas compliance was higher overall and men were more willing to comply with the statement compared with women (81.6% and 72.6%, respectively).

- Statement 63 – Would you keep your cats in at night-time if it became compulsory?

There was an interaction between gender and agreement with the statement. Women (94.8% urban and

Table 3. Univariate tests where the multivariate effect or interaction from Table 2 is significant

Effect	Control	Wildlife	Sterilization
Gender	$F_{1,981} = 13.8, P < 0.001$	$F_{1,981} = 22.3, P < 0.001$	$F_{1,981} = 5.7, P = 0.017$
Cat ownership	$F_{1,981} = 336.7, P < 0.001$	$F_{1,981} = 144.1, P < 0.001$	$F_{1,981} = 0.8, P = 0.367$
Ownership–residence	$F_{1,981} = 0.02, P = 0.894$	$F_{1,981} = 4.6, P = 0.03$	$F_{1,981} = 2.1, P = 0.15$

Significant values are in bold.

Table 4. Number of cats kept by owners in Armadale

No. cats	Urban		Rural		Total
	Male	Female	Male	Female	
1	34	56	34	86	210
2	15	28	13	40	96
3	4	8	1	12	25
>4	4	10	5	8	27
Total	57	102	53	146	358

The table excludes replies where gender was omitted.

Table 5. Frequency of sterilization of owned cats in Armadale

No. cats	Urban		Rural		Total
	Male	Female	Male	Female	
Sterilized	51	98	47	132	328
Not sterilized	5	3	5	11	24
No answer	1	1	2	2	6
Total	57	102	54	145	358

The table excludes replies where gender was omitted.

Table 6. Current confinement practices of cat owners from urban and rural zones in Armadale

Current confinement	Urban		Rural		Total
	Male	Female	Male	Female	
Solely inside	6	16	6	14	42
Solely outside	4	3	5	8	20
Solely inside at night	19	42	9	44	114
Inside/outside within property	8	14	11	32	65
Inside/outside free roaming	18	17	18	39	92
Multiple answers	1	8	3	6	18
Blank	1	2	2	2	7
Total	57	102	54	145	358

The table excludes replies where gender was omitted. Respondents giving multiple answers or leaving the item blank were excluded from analysis.

Table 7. Frequency of responses to three key statements/questions by Armadale cat owners classified according to the categories residence and gender

Residence	Gender	Statement 61			Statement 62			Statement 63		
		Agree	Disagree	Total	Agree	Disagree	Total	Agree	Disagree	Total
Urban	Male	39	15	54	30	23	53	44	8	52
	Female	91	10	101	71	28	99	92	5	97
Rural	Male	45	6	51	40	9	49	42	7	49
	Female	124	18	142	98	37	135	129	8	137

Statement 61: I would be happy to keep my cat(s) on my property between sunset and sunrise; Statement 62: I would be happy to keep my cat(s) on my property at all times; Statement 63: Would you keep your cats in at night-time if it became compulsory?

94.2% rural) were more compliant than men (84.6% urban and 85.7% rural).

- Statement 64 – Would you license your cat if it became compulsory?

No significant interactions occurred. However, the level of support from cat owners was high (82.7% urban men, 83.7% urban women, 85.7% rural men and 88.4% rural women), indicating an overall willingness to license cats if it was compulsory.

Table 8. Frequency of responses to a key statement/question by Armadale cat owners classified according to the categories residence and gender

Residence	Gender	Statement 64		Total
		Agree	Disagree	
Urban	Male	43	9	52
	Female	82	16	98
Rural	Male	42	7	49
	Female	122	16	138

Statement 64: Would you license your cat if it became compulsory?

Attitudes of all respondents to wildlife issues and proposed regulations

Log-linear analysis was used to test whether responses to a question or a statement were significantly associated with respondents' gender, cat-ownership status or residence. Tables 10–12 summarize responses to some key items, while the models fitted and the significance of their components are shown in Table 13.

- Statement 1 – There is a need for cat legislation.

There was a significant relationship between cat ownership and agreement with the statement and between residence and agreement with the statement. Although non-owners strongly favoured cat legislation (93.5% in urban areas and 96.9% from rural areas), the support from cat owners was also high (73.5% in urban areas, 79.9% in rural areas). People in rural areas were more in favour of the statement than those in the urban category.

- Statement 15 – Local governments should have the power to limit the number of cats per household.

There was an interaction between cat-ownership status and agreement with the statement. Although

Table 9. The log-linear models fitted to the responses to each statement/question (position in the survey shown in parentheses) in Tables 7 and 8

Statement	Model fitted	Significance of model components
I would be happy to keep my cat(s) on my property between sunset and sunrise. (61)	Residence–gender–agreement	–
I would be happy to keep my cat(s) on my property at all times. (62)	Residence–gender–agreement	–
Would you keep your cats in at night-time if it became compulsory? (63)	Residence–gender Gender–agreement $\chi^2_2 = 0.052, P = 0.97$	$\chi^2_2 = 274.744, P < 0.001$
Would you license your cat if it became compulsory? (64)	No significant interaction	

The interaction of gender–residence was included in each model so the interaction between these variables did not contribute to the overall lack of fit. The table shows the chi-squared tests for fit of the models unless there was no interaction or a three-way interaction (always non-significant) and the significant components of the models.

Table 10. Frequency of responses to three key statements/questions by Armadale residents classified according to the categories residence, cat ownership and agreement with the statement

Residence	Cat owner	Statement 1			Statement 15			Statement 21		
		Agree	Disagree	Total	Agree	Disagree	Total	Agree	Disagree	Total
Urban	Yes	114	41	155	125	36	161	94	54	148
	No	301	21	322	302	17	319	283	21	304
Rural	Yes	151	38	189	156	39	195	119	66	185
	No	311	10	321	319	11	330	304	15	319

Gender is not indicated as it was not involved in any significant interactions.

Statement 1: There is a need for cat legislation; Statement 15: Local governments should have the power to limit the number of cats per household; Statement 21: Domestic cats killing wildlife in the suburbs are a serious problem.

Table 11. Frequency of responses to three key statements/questions by Armadale residents classified according to the categories residence, cat ownership and gender

Residence	Cat owner	Question 6			Question 17		
		Agree	Disagree	Total	Agree	Disagree	Total
Urban	Yes	92	70	162	44	111	155
	No	290	31	321	179	118	297
Rural	Yes	125	66	191	71	121	192
	No	307	17	324	223	95	318

Statement 6: To stop cats from attacking wildlife, cats should be kept on their owner’s property at all times; Statement 17: Local governments should have the power to establish cat free zones in new sub-divisions.

Table 12. Frequency of responses to statement 23 and 31 by Armadale residents classified according to the categories residence, cat ownership and gender

Residence	Gender	Cat owner	Question 23			Question 31		
			Agree	Disagree	Total	Agree	Disagree	Total
Urban	Male	Yes	49	6	55	45	10	55
		No	135	8	143	113	28	141
	Female	Yes	83	15	98	97	9	106
		No	154	11	165	151	17	168
Rural	Male	Yes	46	5	51	45	7	52
		No	140	1	141	126	11	137
	Female	Yes	115	20	135	122	22	144
		No	178	4	182	161	18	179

Statement 23: Domestic cats in nature reserves are harmful to wildlife; Statement 31: Excluding a cat(s) that is owned by a breeder, all cats should be desexed.

non-owners were more in favour (94.7% in urban, 96.7% in rural areas), the level of support from owners was also high (77.6% urban, 80% rural), indicating an overall support for the need to limit the number of cats per household.

- Statement 21 – Domestic cats killing wildlife in the suburbs are a serious problem.

There was a significant relationship between cat-ownership status and agreement with the statement. Non-owners (93.1% urban, 95.3% rural) agreed, but cat owners (63.5% urban, 64.3% rural) were less supportive.

- Statement 6 – To stop cats from attacking wildlife, cats should be kept on their owner’s property at all times.

The responses showed a significant interaction between cat-ownership status and the statement, as well as between residence and the statement. Non-owners (90.3% from urban, 94.7% rural) were more supportive of the statement compared with owners (56.8% urban, 65.4% rural). Rural residents were more supportive of keeping cats on their owners’ properties.

- Statement 17 – Local governments should have the power to establish cat free zones in new sub-divisions.

Both cat-ownership status and residence interacted with the statement. Support from owners for this statement was low, although those in rural areas (37%) were more in favour compared with urban owners (28.4%). There was a higher level of agreement from non-owners, which was strongest in rural areas (60.3% urban, 70.1% rural).

- Statement 23 – Domestic cats in nature reserves are harmful to wildlife.

There were significant two-way interactions between residence and agreement with the statement and between ownership and agreement with the statement. Cat owners from both urban and rural areas (86.3% and 86.6%, respectively) were equally supportive of the statement. However, within the non-owner category, rural residents have a stronger view (98.5%) compared with urban residents (93.8%). While the interaction between gender and agreement with the statement was included in the model, this interaction was marginally non-significant. There may be a slight

Table 13. The log-linear models fitted to the responses to each statement/question (position in the survey shown in parentheses)

Statement	Model fitted	Significance of model components
There is a need for cat legislation. (1)	Ownership–residence–gender agreement–ownership agreement–residence $\chi^2_5 = 3.786, P = 0.58$	$\chi^2_1 = 74.50, P < 0.01$ $\chi^2_1 = 5.182, P < 0.05$
The council should have the power to limit the number of cats per household. (15)	Ownership–residence–gender agreement–ownership $\chi^2_6 = 2.990, P = 0.81$	$\chi^2_2 = 775.96, P < 0.01$
Domestic cats killing wildlife in the suburbs is a problem. (21)	Ownership–residence–gender agreement–ownership $\chi^2_6 = 6.647, P = 0.355$	$\chi^2_2 = 597.81, P < 0.01$
To stop cats from attacking wildlife, cats should be kept on their owner's property at all times. (6)	Ownership–residence–gender agreement–ownership agreement–residence $\chi^2_5 = 7.499, P = 0.186$	$\chi^2_1 = 139.31, P < 0.01$ $\chi^2_1 = 6.26, P < 0.05$
Domestic cats in nature reserves are harmful to wildlife. (23)	Ownership–residence–agreement Owner–agreement Gender–agreement Residence–agreement $\chi^2_4 = 7.964, P = 0.093$	$\chi^2_1 = 32.782, P < 0.01$ $\chi^2_1 = 2.206, P = 0.07$ $\chi^2_1 = 4.07, P < 0.05$
Local governments should have the power to establish cat free zones in new sub-divisions. (17)	Ownership–residence–agreement agreement–gender agreement–ownership agreement–residence $\chi^2_4 = 0.362, P = 0.985$	$\chi^2_1 = 7.45, P < 0.01$ $\chi^2_1 = 90.56, P < 0.01$ $\chi^2_1 = 10.76, P < 0.01$
Excluding cats that are used for breeding, all cats should be desexed. (31)	Gender–ownership–residence agreement–residence–gender $\chi^2_4 = 3.554, P = 0.4696$	$\chi^2_4 = 629.05, P < 0.01$

The interaction of ownership–residence–gender was included in each model so the interaction between these variables did not contribute to the overall lack of fit. The table shows the chi-squared tests for fit of the models (always non-significant) and the significant components of the models.

trend for women to agree less with the statement than men.

- Statement 31 – Excluding a cat(s) that is owned by a breeder, all cats should be desexed.

There was a significant three-way interaction involving residence, gender and agreement with the statement. Women non-owners in both rural and urban areas were equally supportive of desexing (89.9%). Urban women owners (91.5%) were more in agreement with desexing their pet cats compared with rural women owners (84.7%). However, urban male owners (81.8%) agreed less than rural male owners (86.5%).

DISCUSSION

Validity of the survey

The response rate of 51% for a mailed survey was moderate compared with the average of 61% for this form of survey (de Vaus 2002). Nevertheless, there are strong indicators that the data are representative.

First, although men appeared underrepresented in the sample compared with the target population, they still comprised nearly 40% of the 1029 respondents, so gender-related responses were likely to be detected. Second, approximately 35% of the respondents owned cats, corresponding closely to the estimated third of Australian households with a cat (see review of relevant surveys and assessments of trends over time in Baldock *et al.* 2003). Therefore, there is no indication that owners' views are underrepresented. Finally, sampling error was only 3%. Thus, the large sample size overall offset the moderate response rate.

Cat owners' practices

Owners in Armadale had very similar husbandry practices and attitudes to those reported from elsewhere in Australia. Approximately 86% of owners had only one or two cats. Armadale owners also reported sterilization rates of their pets of over 90%, comparing closely to figures of 88–93% (REARK 1994a; Perry 1999), 90% or 93% of all cats (McHarg *et al.* 1995 and

Murray *et al.* 1999, respectively) and 94% of all cats older than 1 year (REARK 1994a) from elsewhere in Australia. In Armadale, 32% of owners practised nocturnal confinement, compared with the range of 17% (REARK 1994b) to 61% (McHarg *et al.* 1995) reported in other Australian surveys.

Applying a precautionary approach

Are precautionary measures needed?/How much precaution is required?

The MANOVA indicated that owners and non-owners differed significantly in their scores on the Wildlife scale, with owners being less concerned about wildlife. Analysis of specific questions revealed that both urban and rural non-owners believed strongly that 'domestic cats killing wildlife in the suburbs are a serious problem' and that 'domestic cats in nature reserves are harmful to wildlife' (93% agreement or greater from both groups to the two questions). Urban and rural owners responded very differently to these questions, registering approx. 63% agreement to cat predation being a serious problem in the suburbs but approx. 86% agreement to it being a problem in nature reserves. Leaving aside the question of whether or not these opinions are justified, a large majority of respondents, irrespective of their cat ownership status, do accept that cats attacking wildlife are a problem and that this issue is greater in nature reserves than in the suburbs in general. Such widespread suspicion of risk across main stakeholder groups, coupled with the significance of urban bushland remnants and nature reserves such as those within the City of Armadale for fauna conservation (How & Dell 2000 and included references), indicates that precautionary measures are justified and should be greatest near reserves.

What precautionary measures could/should be used?

Proponents of regulating cat ownership to protect wildlife suggest a range of measures including: confinement (keeping cats indoors at night or confining them to their owners' property at all times) to reduce encounters with potential prey, sterilization to prevent dumping of unwanted kittens, registration/identification of pets so nuisance animals can be identified, imposing a maximum number of cats/property to control densities, banning cat ownership in environmentally sensitive areas and impounding or destroying cats caught roaming in nature reserves (Grayson & Calver 2004 and included references). Not surprisingly, our analyses revealed some strong differences between owners and non-owners in their attitudes to the con-

cept of regulating ownership of owned domestic cats. However, they also revealed areas of broad agreement, which could prove the basis of generally acceptable action, as well as highlighting motivations of the two groups that could be exploited in gaining acceptance of proposals.

Multivariate analysis of variance confirmed that sterilization of pet cats was a strong point of agreement for both owners and non-owners, with ownership not significant either as a main effect or an interaction. The survey items which were analysed in detail reveal further agreements if the items are divided into two groups: in the first, all categories of respondents including cat owners registered 70% or greater agreement, while in the second some categories of respondents registered less than 70% agreement. Thus, the first category indicates widespread agreement in the Armadale community that: there is a need for cat regulation, local councils should be empowered to regulate the maximum number of cats kept at a given property, cats roaming in wildlife reserves are a threat to wildlife and cats not owned by licensed breeders should be desexed. Although owners were less inclined to accept these measures than non-owners, the overall strong agreement suggests that cat regulations requiring sterilization, restrictions on the number of cats per household, identification of pet cats and prohibitions on cats entering nature reserves should enjoy widespread support across the interest groups studied. Furthermore, all categories of owners indicated >80% compliance with licensing their cat if it became compulsory, so this measure also enjoys a high level of acceptance. By contrast, fewer owners confine their cats to their properties at all times although more owners indicated they would comply if this became compulsory. Owners also disapproved of empowering local councils to enforce cat exclusion zones and this measure attracted >70% support only from rural non-owners. Therefore, confinement and exclusion zones are far more likely to be contentious. However, both non-owners and owners from rural areas showed higher support for these measures than owners and non-owners from urban areas, suggesting that confinement or exclusion might be more acceptable near nature reserves or remnant natural vegetation.

What motivates the agreement of 70% or better for some proposed measures? A desire to protect wildlife may be important in the attitudes of non-owners, who scored more highly than owners on the Wildlife scale and also indicated over 93% agreement to the statements 'Domestic cats killing wildlife in the suburbs are a serious problem' and 'Domestic cats in nature reserves are harmful to wildlife'. They may also be motivated by the nuisance caused by roaming cats (e.g. Perry 1999), although this was not addressed in our study. Interestingly, non-owners show much weaker support for empowering local governments to

enforce cat exclusion zones, perhaps feeling that such a step contravenes basic civil liberties.

In contrast, owners scored less on the Wildlife scale and registered only approximately 65% agreement to the statement 'Domestic cats killing wildlife in the suburbs are a serious problem' and approximately 86% support for the statement 'Domestic cats in nature reserves are harmful to wildlife'. They also indicated a low inclination to keep their cats on their property to protect wildlife (56.8% urban owners, 65.4% rural owners). Therefore, they are less likely to respond to an appeal to protect wildlife when deciding on the husbandry of their pets, especially in urban zones. Their motivation to accept some controls may come from a desire to improve their pets' welfare and to reduce the nuisance caused by strays or other owners' roaming cats.

All the proposed measures accepted by owners at 70% agreement or greater have potential cat welfare benefits: sterilization reduces the possibility of nuisance strays or roaming males, restricting the number of cats per household limits cat densities and hence the likelihood of fights, while identification and licensing facilitate the return of lost or injured pets as well as the identification of nuisance or problem animals. Significantly, these measures may also reduce both nuisance and predation on wildlife, so cat welfare, nuisance reduction and wildlife protection can be addressed simultaneously with appeal to major stakeholders.

Overall, this study indicated that the Armadale community is likely to accept cat regulations enforcing registration/identification, sterilization and limits on the number of cats per household, with cautious optimism that moderate confinement regulations such as a dusk to dawn curfew might also be acceptable. Promoting the benefits of these actions for cat welfare is most likely to encourage compliance from owners. However, one of the key points of the precautionary principle is that stakeholders may develop individual solutions for particular communities or circumstances. It is therefore valuable to compare the Armadale perspective with that of other areas within Australia and to consider the possibility of extrapolating precautionary approaches internationally.

Experience with regulation elsewhere in Australia

In Australia, local councils pioneered regulations on cat ownership (e.g. Anderson 1994; Pergl 1994) and several state legislatures followed their lead (Penson 1995; Kelly 1999). All state Acts include provision for identification of cats, action against nuisance animals and, with the exception of the South Australian legislation and Australian Capital Territory legislation, compulsory registration of cats with discounts for neu-

tered animals. Thus, the existing regulations enforce broadly the points shown to be largely acceptable to the Armadale community, with the exception that they do not restrict the number of cats kept on individual properties. Other local councils report success with stronger measures including complete confinement of cats to owners' premises (Baker 2001), prohibiting cat ownership in new sub-divisions before residents move in (Buttriss 2001), night-time curfews (Pergl 1994) and declaring nature conservation areas where free-roaming cats will be impounded (Moore 2001). The few reports on the implementation of regulations are positive both for cat welfare and for wildlife (e.g. Pergl 1994; Kelly 1999; Murray *et al.* 1999), although there are some concerns about compliance (Pert 2001; Scheele 2001) and enforcement (Pert 2001). Pergl (1994) argued that a key element of success was an emphasis on the welfare of both wildlife and pet cats.

Implications for communities outside Australia

Cat ownership in Australia is declining, possibly because of a dislike of cats and concern over perceived impacts of cat predation on wildlife (Baldock *et al.* 2003). This contrasts to the increased popularity of cats as pets in the USA and the UK (American Bird Conservancy 1997; Chaseling 2001; Baldock *et al.* 2003). The decade between 1988 and 1999 was especially telling, with the owned cat population in Australia falling 20% while that of the USA rose 14% (Baldock *et al.* 2003). Therefore, communities in the USA and the UK may have attitudes very different from their Australian counterparts, necessitating specific precautionary measures tailored to local views.

In the UK, Woods *et al.* (2003) concluded that the British population of approximately 9 million cats accounted for 85–100 million prey items over a 5-month survey period and, based on these figures, surmised that cats were the major predators of wildlife in Britain. Furthermore, Ruxton *et al.* (2002) highlighted the importance of domestic gardens as bird habitat in the UK. They argued that this, coupled with the high incidence of cat ownership and predation by owned cats, justified a precautionary approach to reduce predation although detrimental impacts on prey populations were still uncertain. Ironically, significant wildlife advocates in the UK hold the opposite view that lack of proof prevents action, which is directly contrary to the precautionary principle. For example:

Some people have called for legislation introduced to curb the freedom with which cats are allowed to roam. While we understand why people feel this way, we are not able to urge the government to introduce such legislation, as we have no scientific

evidence of the impact of cat predation on bird populations that is strong enough to support such a call. (Royal Society for the Protection of Birds 2002)

If advocacy groups are unlikely to lobby for cat regulation to protect wildlife, then alternative grounds such as cat welfare and reduction of nuisance might be used. Cats Protection (2002) overviewed the current position of cats and the law in the UK, where there is emphasis on prevention of cruelty, public health and reduction of public nuisance. Thus, determining the understanding and attitudes of citizens towards cat welfare and public nuisance, as well as wildlife, might be useful as part of a precautionary approach to negotiate regulations at a community level that have broad acceptance.

In the USA, both wildlife biologists (Lepczyk *et al.* 2003 and included references) and wildlife agencies (American Bird Conservancy 1997) are concerned about predation by owned domestic cats. There must be a significant level of owner concern too, given the marketing of products to deter predation by free-ranging cats (e.g. 'CatBib', <http://www.catgoods.com/>). Ash and Adams (2003) also reported concern about cat predation on wildlife in their assessment of citizen's attitudes towards the management of free-ranging cats. However, while respondents in their study acknowledged that cats killed wildlife they did not accept that this or the fact that cats were introduced animals justified control. Thus, the reasonable supposition of risk that should trigger a precautionary approach is present in the USA, although there are indications that people's attitudes to the putative impacts of cats on wildlife may well be different to those held in Australia.

Local government municipalities enforce some regulations including registration/identification, impounding of nuisance animals, rabies vaccinations and, less commonly, restrictions on free-roaming cats (e.g. Municipal Research Services Center of Washington 2002) but the primary motivation for many of these measures is public health or nuisance. For example, Ordinance 359 of the Town of Coulee Dam, Washington introduced amendments to the Municipal Code including:

Section 6.02.040 – No dog or cat shall be permitted to commit any of the following acts on any premises or property, private or public: bite or charge any person, destroy private property, scatter refuse (sic), chase vehicles, deposit fecal matter on any property not that of its owner, or commit any other nuisance defined by this chapter or any other Town ordinance. (Council of the Town of Coolee Dam 1988)

Section 6.02.060 – It is hereby declared a public nuisance and it is unlawful for any person to own

or keep any dog within the Town which barks or howls or any dog or cat which whines or otherwise behaves in such a manner as to disturb the peace and quiet and safety of persons in the neighbourhood. (Council of the Town of Coolee Dam 1988)

However, lobby groups such as the Cat Fanciers' Association, which even has a legislative committee (<http://cfainc.org/org/legal.html>), offer stringent resistance to many measures. Against this background, serious attempts to determine the precise wishes of individual communities may offer the greatest opportunity for implementing precautionary measures until the uncertainty over predation impacts is reduced.

Concluding remarks

The precautionary principle assists in determining actions to reduce plausible risk to the environment where uncertainty over the true magnitude of the risk is high. Thus, the attitudes of Armadale residents identified in this survey do not necessarily reflect the real impact of owned domestic cats on wildlife in their community, nor do we imply that management action should only be taken if there is strong public support. However, the level of concern coupled with scientific uncertainty over the issue warrants action. Some important precautionary measures improve the welfare of both cats and wildlife and enjoy substantial community support, so they should be implemented while awaiting the results of research to reduce the level of uncertainty (see the review by Grayson & Calver 2004 for suggestions for research directions). There may also be some basis for varying precautionary measures according to the location of residential sub-divisions. While the specific results cannot be extrapolated to other communities, the procedure of confirming a need for precaution and then identifying a range of precautionary actions acceptable to a wide range of stakeholders is broadly applicable. In the USA and the UK, where the popularity of cats as pets is increasing, wildlife protection may be a less powerful motivator for precautionary action than cat welfare or reduction of public nuisance.

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