Online relinquishments of dogs and cats in Australia

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Simple Summary: The aim of this study was to analyse dog and cat advertisements on a popular online trading website in Australia in February, 2016. A total of 2640 ads for dogs and 2093 ads for cats were classified as being relinquished on gumtree.com.au. There were 23% of dog ads and 62% of cat ads   for free animals. The median age was 1.42 years in dogs and 0.9 years in cats. Compared to the human population there were proportionately more ads in Queensland and fewer ads in Victoria. In comparison to pets from animal shelters advertised on petrescue.com.au there were more pure bred dogs on gumtree.com.au, although the common breeds were similar. Fifteen people who had relinquished a dog or cat on gumtree.com.au were interviewed. They used gumtree.com.au because they believed shelters were full, they wanted to see/interview the new owner, or because they originally got the animal on gumtree and it works. These results shed light on a hitherto under-studied population of relinquished dogs and cats.

Abstract: While traditionally people relinquish their pets to an animal shelter or pound, the internet provides a newer method to re-home. We analysed advertisements (ads) on the largest website in Australia for trading dogs and cats, gumtree.com.au. Data was collected in 2016. Dogs were sampled on February 7, 16 and 24, 2016 and cats on February 9, 19 and 26, 2016 with 2640 ads for relinquished dogs, and 2093 ads for relinquished cats. It was estimated >31,000 puppies/dogs and >24,000 kittens/cats are relinquished on gumtree.com.au per year. The median age of dogs was 1.42 and cats 0.9 years of age. There were 23% of dog ads and 62% of cat ads for free animals. Compared to the human population there were proportionately more ads in Queensland and fewer ads in Victoria. A total of 15 people were surveyed who had relinquished a dog or cat using gumtree.com.au. The dog owners used gumtree.com.au because they believed the shelters were full (n = 4), and; they wanted to see/interview the new owner (n = 2). For cat owners it was because they had originally got the cat on gumtree.com.au (n = 2); they use gumtree.com.au for other things, and it works (n = 2), and; they wanted to see/interview the new owner (n = 2). The data collected will be valuable for implementation of policy and interventions to protect the welfare of un-wanted dogs and cats.

Keywords: relinquishment, dog, cat, online, Australia

1. Introduction

Australia has an owned dog and cat population of approximately 4.8 million and 3.9 million, respectively [1]. However, it is likely that the total population of dogs and cats is higher, as un-owned animals - strays, and those in registered or independent shelters or pounds would also contribute to the total population. In addition, the ownership of an animal may be transferred through sale or other trade, and animals in a shelter or pound can be rehomed. This results in a complex network of animals transferred between the owned and un-owned populations, and between different owners. Animals leave the care of their owners through being lost, surrenders to a shelter or pound, being abandoned, being given away or being sold. Worldwide there have been attempts to measure the un-owned population of dogs and cats in shelters [2,3], but there is a lack

46   of research into the dogs and cats that are transferred between owners and between owned and un-
47   owned populations in other ways.

48   Much of what we know about the flow of animals from the owned and un-owned populations
49   comes from rescue shelters and pounds. Larger rescue organisations collect data on numbers of
50   surrendered dogs and cats each year. There were 55,570 cats admitted to RSPCA shelters around
51   Australia in 2015/16, with numbers rising in the last few years. In contrast there were 45,256 dogs
52   admitted to RSPCA shelters in the same year and numbers are declining [4]. However, the RSPCA
53   represents only a portion of the surrendered population. The total number of both stray and
54   surrendered dogs in Australia in 2012/13 from shelter and local municipal facilities, has been
55   estimated at 211,655 dogs   admitted, with 101,037 of these reclaimed [2]. There is no data available
56   estimating the total numbers of stray and surrendered cats in Australia, although it is likely to be
57   even higher. The incidence of unowned dogs and cats is a worldwide problem, with an estimated
58   129,743 dogs and 131,070 cats entering UK shelters in 2009 [3], and a study from South Korea
59   reporting over 10,000 abandoned dogs in Seoul [5]. In the US, it was estimated that 4.4% of dog-
60   and 3.8% of cat-owning households had relinquished a pet to a shelter in the previous year [6].

61   The relinquishment of pets represents a significant cost to society in a number of ways. In
62   Australia in 2004 there was an estimated $AUS180 million spent annually by animal welfare
63   agencies (ACAC 2006), while in the United Kingdom expenditure by animal welfare organisations
64   was approximately £340 million in 2010 [7]. Local governments in Australia in 2004 spent $AUS83
65   million on animal management (ACAC 2006); in the UK in 2011 the comparable figure was £57.5
66   million [8]. While local government costs include dog registrations and dealing with dog attacks, a
67   large portion of these figures would be expected to arise from stray and relinquished animals.

68   As well as the economic costs there are also emotional costs as people may be forced to
69   relinquish their pets due to external influences, such as a relationship breakdown or inability to find
70   rental accommodation that will allow a pet [9,10]. There are also emotional costs experienced by
71   staff involved in euthanizing large numbers of pets at shelters, with shelter workers struggling with
72   the moral dilemma of their job, often resulting in mental health problems and high staff turnover
73   [11-13]. Finally, un-owned dogs and cats are at an increased risk of impaired welfare using both
74   physical and psychological measures of welfare [14,15], as well as the emergence of diseases,
75   demonstrated by an outbreak of virulent systemic feline calicivirus in cats [16], and of *Streptococcus*
76   *equi* pneumonia in dogs [17].

77   If we are to design evidence-based strategies to reduce the numbers of dogs and cats
78   relinquished, as well as protect the welfare of pets in which relinquishment cannot be avoided, we
79   need to know more about the population of dogs and cats involved. Some shelters survey owners
80   who are relinquishing pets to determine their reasons for relinquishment [18,19], and also collect
81   demographic data on the age, sex and breed of the relinquished animal [4,18,19]. While this
82   information is not perfect (for example, owners may not be truthful about the behaviour of their pet
83   if they think it will negatively impact the likelihood of that pet finding a new home), it has been
84   helpful in designing interventions. For instance, knowing that sometimes pets are relinquished
85   because owners cannot find rental accommodation that allows pets has resulted in real changes,
86   with the Australian state of Victoria recently announcing modifications to rental agreements to
87   make it easier for people to rent with pets [20].

88   Pets are given away or sold through advertisements in newspapers, bulletin boards and using
89   the internet. In Australia, Gumtree (gumtree.com.au) has the highest volume of online ads for dogs
90   and cats, followed by Trading Post (tradingpost.com.au). Breeders of pure breed dogs also
91   advertise on DogzOnline (dogzonline.com.au), although this site represents a smaller number of
92   animals compared to Gumtree and Trading Post. Other forms of social media, such as Facebook®,

93 also advertise pets for sale or to find new homes. These online sites advertise both puppies and
94 kittens being sold by a breeder, and animals being relinquished.

95   There has been limited research into online trading of dogs and cats. In a US study, dog
96 breeders who advertised puppies on the internet were less knowledgeable about health issues
97 specific to their breed/s and less likely to screen their animals for heritable diseases compared to
98 dog breeders who did not advertise their puppies on a puppy internet site [21]. To our knowledge,
99 no published studies have focussed on pets being relinquished online. The aims of the present
100 study were to: 1) estimate the total numbers and prices of dogs and cats relinquished online on
101 gumtree.com.au; 2) analyse the breed and Australian State/Territory of origin of dogs and cats
102 relinquished on gumtree.com.au and compare with animals presented to petrescue.com.au (an
103 online charity advertising pets from a shelter or rescue organisation in Australia) and the RSPCA;
104 and 3) interview a sample of pet owners relinquishing their pets on gumtree.com.au to determine
105 their reasons for relinquishment and why they chose to advertise their pet online.

106 **2. Materials and Methods**

107 *2.1 Extraction of data*

108   Data from gumtree.com.au were collected over approximately three weeks for both dogs and
109 cats: February 8, 17 and 25, 2016 for dogs and February 9, 19 and 26, 2016 for cats. Data were
110 extracted using the BeautifulSoup module in python (version 3.2.1, released Feb 17 2012) to parse
111 the adverts, then cleaned and analysed using R (R Core Team 2017) and Pivot tables in Microsoft
112 Excel®. Cleaning was completed within Excel® by scrutinising individual ads to remove duplicates
113 or ads that were not for dogs or cats (e.g. equipment, pet sitting services). Data for the dog and cat
114 breed and cross/purebred status, owner status (owner/breeder), age, price and State/Territory were
115 collected. Where the town, but not the State or Postcode, were provided, an internet-based Postcode
116 finder (http://auspost.com.au/postcode) was used to determine the State/Territory. If there was
117 more than one place with the same name in more than one State/Territory then the ad was left as
118 State/Territory unknown. An estimate of the number of dogs and cats in each ad was made by
119 generating random numbers using R and then analysing the average number of dogs/cats per ad in
120 those random ads. There were 50 random ads used for both dogs (1.9% of total ads) and cats (2.4%
121 of total ads). Data on neuter, microchip and vaccination status were not collected as a minority of
122 ads reported on these factors.

123 *2.2 Analysis of relinquishment ads*

124   Dogs and cats advertised on the internet represent a mixture of puppies/kittens being sold
125 alongside pets being relinquished or traded. Many ads request a sum of money for the pet, even
126 when it appears the pet is being relinquished. The definition of relinquishment used for this study
127 was the Oxford definition: 'Voluntarily cease to keep or claim; give up'
128 (https://en.oxforddictionaries.com/definition/relinquish). Dogs were defined as being relinquished
129 if: 1) there was a statement within the ad confirming that a new home was being sought (e.g.
130 seeking new home, very sad to part with…, need to find a new forever home); 2) they were being
131 offered for free at any age; or 3) if the dog was older than 16 weeks of age and there was no
132 indication it had been advertised as a puppy and was still looking for a home (''X' is a 6 year old
133 pure bred Sheffield Blue Heeler. He is very friendly and good with other dogs and children.
134 Microchipped and wormed. To good home only.'). On gumtree.com.au sellers are classified as
135 owner, breeder or shelter and the shelter animals were not included in the present study. It is
136 possible that some very small shelters were advertising as an owner rather than as a shelter, but
137 there was no way to differentiate these types of sellers. Both owner and breeder categories were
138 included as there were some breeders who were relinquishing pets using the above criteria (e.g.
139 *'Owner breeder out of work and no petmanent (sic) home, current home being sold by owner cannot find*

140 *another suitable home.' or 'Three female blue amstaffs mother and her two daughters ive raised my intentions*
141 *were to bread (sic) them but things have changed there pedigree papered registered ect (sic) spent alot $ for*
142 *these lines call for more info ect (sic)').* The same criteria were used to determine a cat being
143 relinquished. In some ads there was more than one animal advertised. In those cases, data was
144 collected only from the first animal mentioned in the ad (e.g. breed, age, price), and the other
145 animal/s were not included.

146   The relinquished ads on Gumtree per State/Territory were compared with data provided by
147 John Bishop, Co-Founder and Joint CEO of PetRescue (https://www.petrescue.com.au/), for the
148 same time period as the Gumtree data were collected and the published figures from the RSPCA
149 between July 1 2014 and June 30 2015.

150 *2.3 Surveys of owners who had relinquished dogs or cats*

151 An email was sent through gumtree.com.au informing people about the study that we were
152 conducting and asking if they would be willing to participate. Ads were chosen from those
153 available online using the criteria for identifying a relinquished dog, outlined above. These were
154 selected starting from the first ads shown on each day. Due to the high numbers not all ads for
155 relinquished dogs or cats were included on each day. A total of 324 emails were sent to dog owners
156 between May 11 and June 14, 2016 and 299 emails to cat owners between May 17 and June 14, 2016.
157 The owners responded to the email either by return email or by phone. Surveys were performed
158 either on the phone or in written form via email, depending on the preference of the respondent.
159 Questions included: the demographics of the animal (age, breed, sex, neuter status, microchip); two
160 Likert type scale questions on satisfaction with the health and behaviour of the animal (1 is very
161 dissatisfied and 5 is very satisfied); Where did you get pet's name from originally?; What was the
162 main reason you advertised pet's name?; Why did you decide to advertise on Gumtree instead of
163 going to a shelter; Did you advertise pet's name anywhere else?; Have you successfully found a
164 new owner for pet's name yet?; If yes, do you know anything about the new owner? Participants
165 were also given an open ended question at the end of the survey to add any other details they
166 wished to share. Approval for this study was provided by the University of Adelaide Human Ethics
167 Committee (H-2016-036).

168 *2.4 Statistical Tests*

169 Comparisons between groups where the data was not normally distributed were made using
170 Mann-Whitney tests. Categorical data was compared used Chi-square tests. Data are presented as
171 Mean ± SEM unless otherwise stated. A significance level of $p<0.05$ was used for statistical testing.

172 **3. Results**

173 *3.1. Dogs on Gumtree*

174   A total of 2640 individual ads were identified for dogs being relinquished on gumtree.com.au
175 between February 7 and 24, 2016. There were 1328 ads on February 7, 1411 ads on February 16 and
176 1450 ads on February 24. Of these, 650 were new ads on Feb 16, and 663 were new ads on Feb 24,
177 giving an estimate of 82 new ads/day, or by extrapolation (x 365) 29,930 ads per year. The average
178 number of dogs per ad in 50 random ads was 1.06 (all ads were for single dogs excepting 3 ads for
179 two dogs), giving an estimate of 31,726 dogs advertised on gumtree.com.au per year.

180   Most of the dogs on Gumtree were classified as pure bred (n=1361, 51.4%) with 1188 (44.6%)
181 cross bred dogs, and 103 (3.9%) ads in which it was not clear if dogs were pure or cross bred. The
182 most common dog breeds advertised on Gumtree and on PetRescue in the same time period are
183 shown in Table 1. The top two breeds in order for both Gumtree and PetRescue were the

184 Staffordshire Terrier and Kelpie, representing just over 20% of the total ads for both sources. The
185 third most common breed for Gumtree was the American Staffordshire Terrier (#4 for PetRescue),
186 with the Greyhound the third most common breed for PetRescue (#24 for Gumtree). Unlike
187 Gumtree, approximately three quarters (75.8%) of the ads on PetRescue were for cross breed dogs,
188 with only 23.8% representing pure breed.

189 **Table 1.** Dog breeds in which 20 or more individuals were relinquished on gumtree.com.au or
190 petrescue.com.au from February 8 to February 24, 2016 (In 103 dogs the pure breed status was
191 unknown)

	gumtree.com.au				petrescue.com.au		
	#[1]	Total	Pure	Cross	#[1]	Total	Pure	Cross
Staffordshire Terrier	1	325 (12.3)	163 (6.1)	162 (6.1)	1	234 (11.5)	48 (9.9)	186 (12.1)
Kelpie	2	219 (8.3)	119 (4.5)	100 (3.8)	2	181 (8.9)	40 (8.3)	141 (9.1)
American Staffordshire Terrier	3	182 (6.9)	132 (5.0)	50 (1.9)	3	91 (4.5)	14 (2.9)	77 (5.0)
Bull Arab	4	135 (5.1)	37 (1.4)	98 (3.7)	7	74 (3.7)	7 (1.4)	67 (4.3)
Border Collie	5	120 (4.5)	64 (2.4)	56 (2.1)	5	85 (4.2)	11 (2.3)	74 (4.8)
Mastiff	6	103 (3.9)	28 (1.1)	75 (2.8)	9	64 (3.2)	4 (0.8)	60 (3.9)
Rottweiler	7	101 (3.8)	73 (2.8)	28 (1.0)	15	37 (1.8)	7 (1.4)	30 (1.9)
German Shepherd	8	98 (3.7)	74 (2.8)	24 (0.9)	12	50 (2.5)	24 (5.0)	26 (1.7)
Siberian Husky	9	87 (3.3)	66 (2.5)	21 (0.8)	19	25 (1.2)	18 (3.7)	7 (0.5)
Great Dane	10	77 (2.9)	26 (1.0)	51 (1.9)	13	50 (2.5)	10 (2.1)	40 (2.6)
Labrador	11	75 (2.8)	34 (1.3)	41 (1.6)	10	64 (3.2)	17 (3.5)	47 (3.6)
Cattledog	12	71 (2.7)	45 (1.7)	26 (1.0)	6	84 4.1)	9 (1.9)	75 (4.9)
Bulldog	13	62 (2.3)	52 (2.0)	10 (0.4)	N	0	0	0
Chihuahua	14	55 (2.1)	39 (1.5)	16 (0.6)	16	30 (1.5)	8 (1.7)	22 (1.4)
Jack Russell Terrier	15	53 (2.0)	26 (1.0)	27 (1.0)	8	74 (3.7)	16 (3.3)	58 (3.8)
American Bulldog	16	42 (1.6)	27 (1.0)	15 (0.6)	21	20 (1.0)	1 (0.2)	19 (1.2)
Maltese	17	41 (1.6)	12 (0.5)	29 (1.1)	11	63 (3.1)	9 (1.9)	54 (3.5)
Bull Terrier	18	38 (1.4)	19 (0.7)	19 (0.7)	25	13 (0.6)	6 (1.2)	7 (0.5)
Shar Pei	19	35 (1.3)	18 (0.7)	17 (0.6)	22	20 (1.0)	3 (0.6)	17 (1.1)
Fox Terrier	20	35 (1.3)	21 (0.8)	14 (0.5)	18	28 (1.4)	5 (1.0)	23 (1.5)
Pomeranian	21	31 (1.2)	23 (0.9)	8 (0.3)	23	18 (0.9)	4 (0.8)	14 (0.9)
Malamute	22	27 (1.0)	21 (0.8)	6 (0.2)	26	13 (0.6)	6 (1.2)	7 (0.5)
Blue Heeler	23	25 (0.9)	12 (0.5)	13 (0.5)	27	5 (0.2)	1 (0.2)	4 (0.3)
Greyhound	24	25 (0.9)	23 (0.9)	2 (0.1)	3	109 (5.4)	98 (20.2)	11 (0.7)
Rhodesian Ridgeback	25	24 (0.9)	5 (0.2)	19 (0.7)	17	30 (1.5)	0	30 (1.9)
Maremma	26	20 (0.7)	17 (0.6)	3 (0.1)	28	4 (0.2)	1 (0.2)	3 (0.2)
Irish Wolfhound	27	20 (0.7)	2 (0.1)	18 (0.7)	24	14 (0.7)	1 (0.2)	13 (0.8)
Poodle	28	19 (0.7)	15 (0.6)	4 (0.2)	20	23 (1.1)	10 (2.1)	13 (0.8)
TOTAL		**2640 (100)***	**1357 (51.4)**	**1180 (44.7)**		**2027 (100)**	**484 (23.8)**	**1543 (75.8)**

192   [1] Ranking of breeds from most common to least common; N: not relevant

193   Most dogs on Gumtree were offered by the owner (n=2480, 93.5%) with 172 ads from breeders
194   (6.5%). The median age for the dogs was 1.42 years, with a range of 0.2 to 14.2 years (n=2640; Table
195   3). The most common age group was 1 to 2 years (32% of ads), with dogs that were 6 months to one
196   year of age and two to five years of age both representing 26% of the ads. Dog ages were not
197   normally distributed, with a right skew; with 10% of the ads for dogs over 5 years of age and 21 of
198   the ads for dogs of 10 years of age or more. Dogs that were cross bred were advertised at a
199   significantly lower age than pure bred dogs (2.0 ± 1.9 years, median 1.3 years) versus 2.3 ± 2.0,
200   median 1.6 years, respectively; p<0.0001 Mann-Whitney).

201   The median price for each dog was \$AUS200, with a range from 0 to \$AUS7000. Almost
202   one quarter (n=575, 23%) of dogs were advertised for free, with 43% of dogs advertised for
203   \$AUS100-499 (Table 2). There were 147 ads in which no price was given. Pure bred dogs were
204   advertised for a significantly higher price than cross bred dogs (\$AUS562 ± 727 vs \$AUS198 ±
205   266, respectively; p<0.0001 Mann-Whitney).

206   **Table 2.** Age and price categories of dogs relinquished on Gumtree from February 8 to 24, 2016

Age Range	N (%)	Price Range (AUS $)	N (%)
Up to 16 weeks	20 (0.8)	0	575 (23.1)
16 weeks to 6 months	131 (5.0)	1-499	1181 (47.4)
6 months to 1 year	680 (26.1)	500-999	480 (19.3)
1 to 2 years	832 (32.0)	1000-1999	187 (7.5)
2 to 5 years	679 (26.1)	2000-2999	44 (1.8)
>5 years	260 (10.0)	3000-7000	26 (1.0)
TOTAL	**2602 (100)**	**TOTAL**	**2493 (100)**

207   [1] Tables may have a footer.

208   The majority of Gumtree ads were from NSW (35.6%) and Queensland (34.8%), giving a total
209   of approximately 70% of all Gumtree ads in Australia coming from those two States (Figure 1). The
210   proportion of ads from Gumtree and PetRescue and the published figures on dogs surrendered to
211   RSPCA shelters were compared with the State/Territory human population sizes, using data from
212   the Australian Bureau of Statistics
213   (http://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/3ADCB8E8492A9156CA2580
214   8900122529?opendocument). There was a significant difference between the State/Territory human
215   populations and the proportions of dogs advertised on Gumtree ($\chi^2(7)$ = 566.6, p < 0.0001),
216   PetRescue ($\chi^2(7)$ = 507.4, p < 0.0001) and the RSPCA ($\chi^2(7)$ = 7001.2, p < 0.0001). Compared to the
217   proportion of the State/Territory human population, there were more ads for Gumtree in
218   Queensland and NSW and fewer ads for Gumtree in Victoria. Queensland had a higher proportion
219   of all three (Gumtree, PetRescue and RSPCA) versus the State human population (Figure 1). The
220   proportions of dogs advertised were significantly different between Gumtree and Petrescue ($\chi^2(7)$ =
221   158.9, p < 0.0001).

222   **Figure 1.** Proportions of total ads for relinquished dogs on gumtree.com.au and petrescue.com.au
223   from February 8 to February 24 2016, and RSPCA shelter admissions for each Australian
224   State/Territory. States/Territories are ordered in increasing proportion of total population. (Note: The
225   proportion of the Australian population in each State/Territory is: NSW 31.7%, Vic 24.9%, Qld 19.9%,
226   WA 10.8%, SA 7.0%, Tas 2.1%, ACT 1.6% and NT 1.0%)

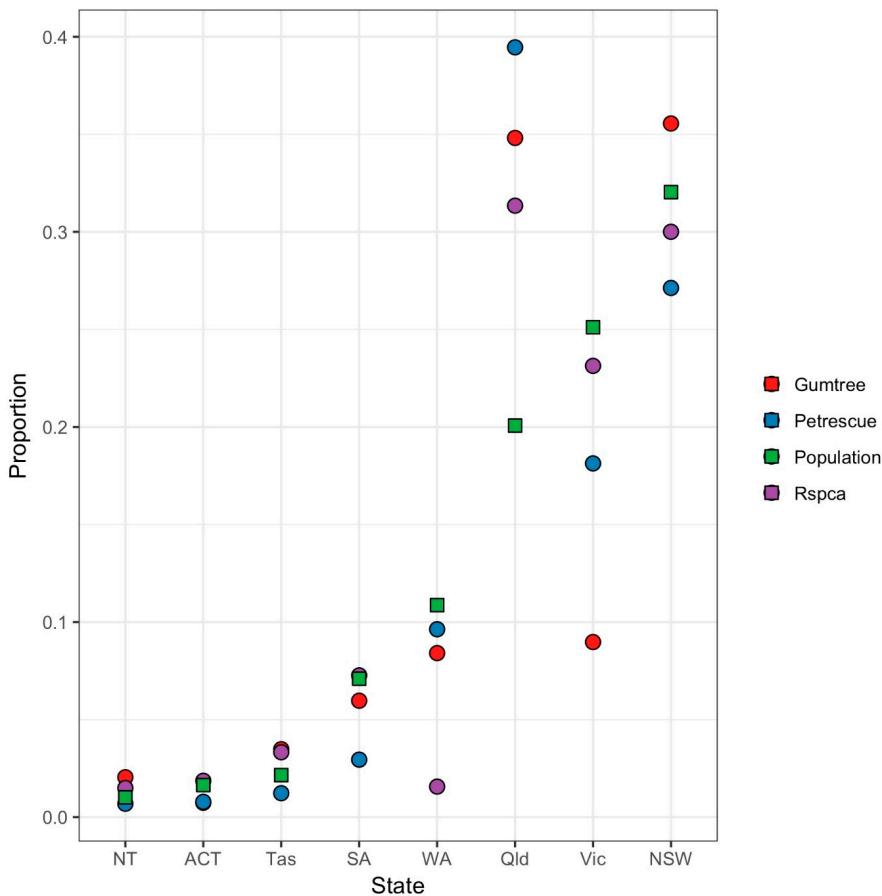
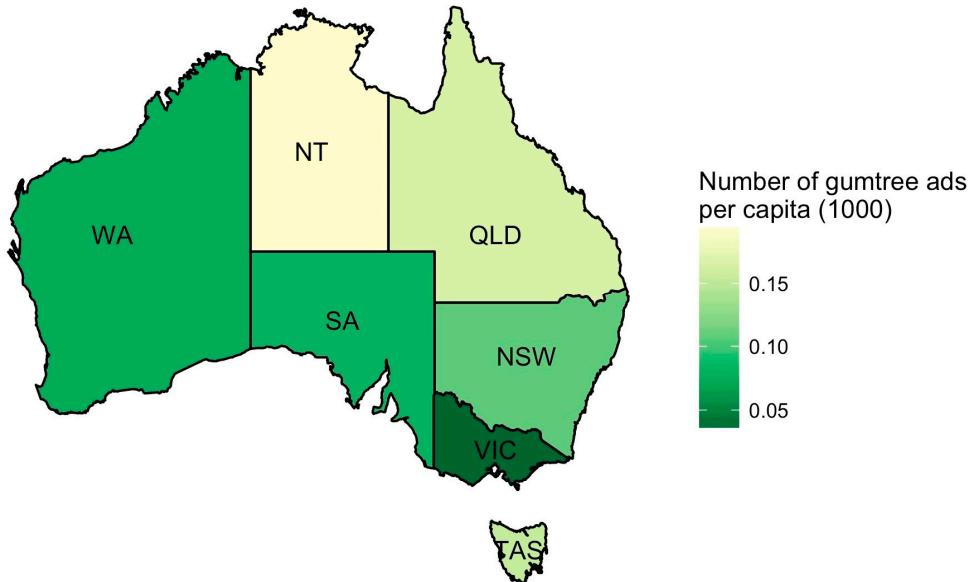
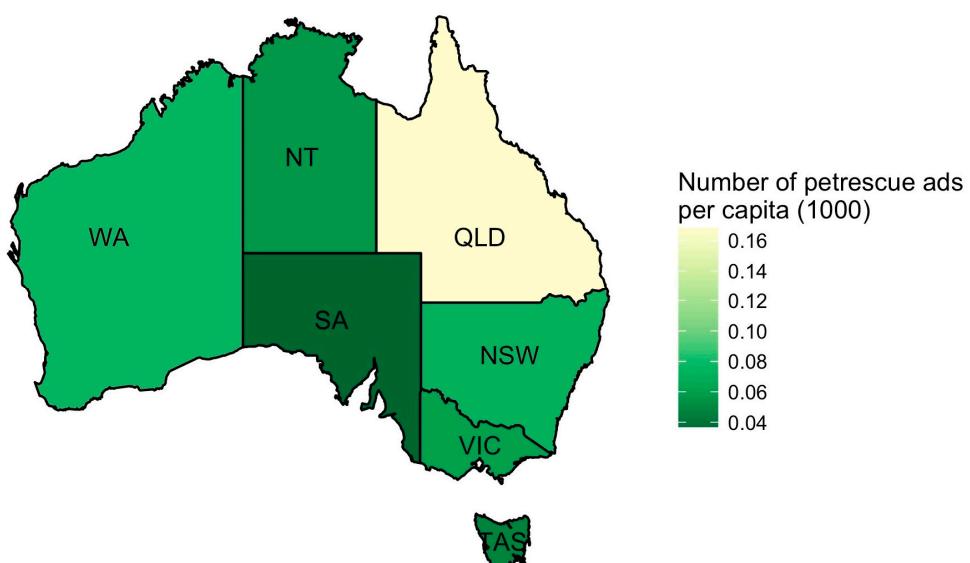
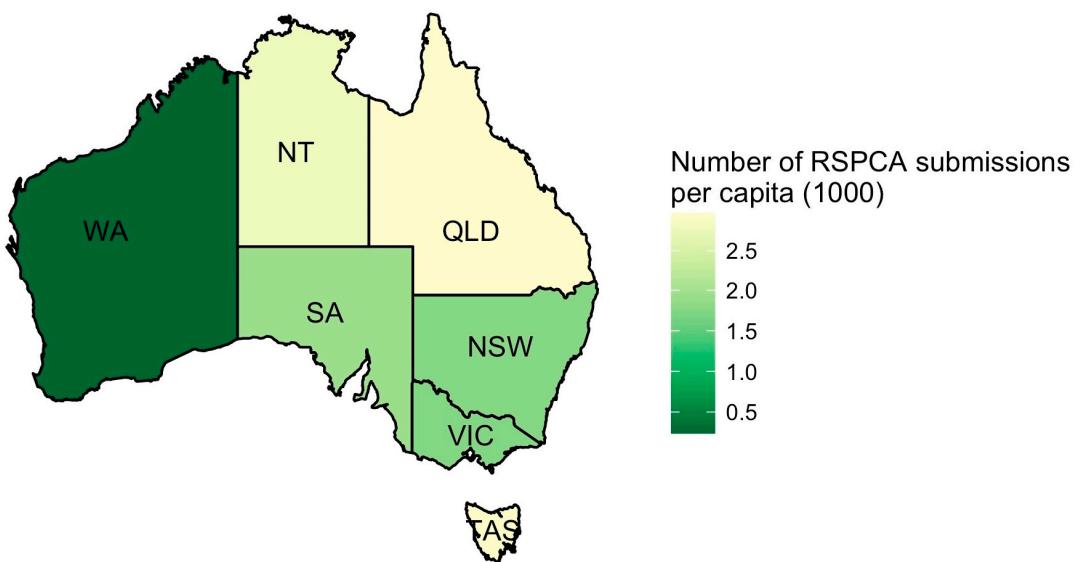
227

The per capita values for each marketplace and State/Territory are shown in Figure 2. The per capita number of Gumtree ads are highest for the Northern Territory and lowest in Victoria, while PetRescue and RSPCA figures per capita are highest in Queensland. Per capita rates for the RSPCA are higher than for Gumtree and PetRescue. The ACT is not shown on the map as it is too small in area; the ACT per capita figures for Gumtree, PetRescue and the RSPCA are 0.04, 0.04 and 2.1 per 1000 residents, respectively.

Figure 2. Numbers per capita (1,000) of relinquished dogs on gumtree.com.au (A) and petrescue.com.au (B) from February 8 to February 24 2016, and RSPCA shelter admissions (C) for each Australian State/Territory. The ACT is not shown on the map as the area is too small for definition. Note: scales are different to enable differentiation of colour for each individual map.

263   The prices of advertised dogs in each State/Territory are shown in Table 3. There was a

264   significant difference in price category between states $\chi^2(12) = 89.7$, $p < 0.0001$ (data for the ACT was

265   not included as there were insufficient cases per category for analysis). The highest proportion of

266   free dog ads was in Qld (34.5%) followed by the NT (31.9%) with the lowest proportion of free ads

267   in WA (22.3%). The highest proportion of ads for dogs costing >$AUS500 was in Victoria (47.6%)

268   with the lowest proportion in Tasmania (16.3%).

269

270   **Table 3.** Price range (AUS$) of dogs advertised on Gumtree between February 7 and 26, 2016 and
271   their Australian State or Territory. Percentages represent the proportion of dogs within that
272   State/Territory in each price category.

	$0 N(%)	$1-499 N(%)	>$500 N(%)
NSW	189 (23.2)	420 (50.2)	217 (26.6)
Qld	276 (34.5)	331 (41.4)	192 (24.0)
Vic	51 (24.8)	57 (27.7)	98 (47.6)
WA	43 (22.3)	79 (40.9)	71 (36.8)
SA	39 (28.5)	64 (46.7)	34 (24.8)
Tas	24 (30.0)	43 (53.8)	13 (16.3)
NT	15 (31.9)	22 (46.8)	10 (21.3)
TOTAL	**637**	**1006**	**635**

273   *3.2. Cats on Gumtree*

274   A total of 2093 individual ads identified as cats being relinquished were posted between

275   February 9 and 26, 2016. This included 1353 ads on February 9, 1397 ads on February 19 and 1465

276   ads on February 26. There were 408 new ads on February 19 and 332 new ads on February 26,

277   giving an estimate of 44 new ads per day or 16,060 ads per year (44 x 365). The average number of

278   cats per ad in 50 random ads was 1.51 (37 ads for single cats/kittens, 8 ads for two cats/kittens, 3 ads

279   for five cats/kittens and one ad for six kittens; no number provided in one ad), giving an estimate of

280   24,250 cats advertised on gumtree.com.au per year.

281   A minority of 508 ads provided any information on whether a cat was a pure or cross breed,

282   with 61% of these pure breed (n=310) and 39% cross breed (n=198). The breeds for which there were

283   at least 15 ads on Gumtree are shown in Table 4 in comparison to cats advertised on PetRescue in

284   the same time period. The Ragdoll and Domestic Shorthair were the most common breeds

285   mentioned in the Gumtree ads, however, Domestic Shorthair and Domestic Medium Hair were by

286   far the most common breeds on PetRescue.

287   **Table 4.** Cat breeds relinquished on gumtree.com.au from February 9 to February 26, 2016 in
288   comparison to those advertised in the same period on petrescue.com.au

289

	gumtree.com.au				petrescue.com.au			
	#[1]	Total	Pure	Cross	#[1]	Total	Pure	Cross
Ragdoll	1	148	116	32	4	30	24	6

Breed								
DSH	2	81	0	81	1	1894	0	1894
Bengal	3	37	28	9	12	2	0	2
Persian	4	32	12	20	8	8	5	3
Siamese	5	29	19	10	5	16	15	1
Russian Blue	6	26	14	12	6	12	12	0
Burmese	7	24	19	5	8	8	8	0
British Shorthair	8	16	15	1	9	6	5	1
Manx	9	14	11	3	7	9	9	0
Birman	10	9	9	0	10	5	5	0
Himalayan	11	9	7	2	N	0	0	0
Devon Rex	12	9	7	2	N	0	0	0
Oriental	13	8	5	3	7	9	4	5
Tonkinese	14	8	6	2	11	3	2	1
Domestic Medium Hair	15	7	0	7	2	375	0	375
Maine Coon	16	5	5	0	12	2	2	0
Domestic Long Hair	17	4	0	4	3	38	0	38
Chinchilla	18	4	4	0	13	1	1	0
Sphynx	19	4	3	1	N	0	0	0
Snowshoe	20	0	0	0	11	3	2	1
Australian Mist	21	0	0	0	10	5	1	4
TOTAL		508	310	198		2426	95	2331

[1] Ranking of breeds from most common to least common

Most cats were offered by the owner (n=2003, 95.7%) with 90 ads from breeders (4.3%). The median age for the cats was 0.9 years, with a range of 0.0 to 18.2 years (n=2093). The most common age group was up to 16 weeks (23.6% of ads) with around half of the ads (53%) for cats that were one year of age or less (Table 5). Cat ages were not normally distributed, with a right skew; 10% of the ads were for cats over 5 years of age, and there were 9 ads for cats of over 15 years of age. Cats that were cross bred were advertised at a significantly lower age than pure bred cats (2.2 ± 2.7 years, median 1.3 years versus 2.5 ± 2.5, median 1.6 years, respectively; $p<0.01$ Mann-Whitney).

Table 5. Price and age ranges of kittens and cats sold on Gumtree from February 9 to February 26, 2016. There were 11 ads in which no age was provided and 90 ads in which no price was provided.

Age Range	N (%)	Price Range (AUS $)	N (%)
Up to 16 weeks	492 (23.6)	0	1298 (62.0)
16 weeks to 6 months	414 (19.9)	1-499	617 (29.5)
6 months to 1 year	201 (9.7)	500-999	73 (3.5)
1 to 2 years	373 (17.9)	1000-1999	13 (0.6)
2 to 5 years	391 (18.8)	2000-2999	2 (0.1)
>5 years	211 (10.1)		
TOTAL	**2082 (100)**	**TOTAL**	**2003 (100)**

301

302   The median price for each cat was $AUS0, with a range from 0 to $AUS2500. Almost two thirds

303   (n=1298, 62%) of cats were advertised for free, with 30% of cats advertised for $AUS1-499 (Table 6).

304   Pure bred cats were advertised for a significantly higher price than the cross bred cats ($AUS351 ±

305   331 vs $AUS66 ± 99, respectively, n=508; p<0.0001 Mann-Whitney).

306   The same proportion of cat ads on Gumtree were from NSW and Queensland (32.7% each;

307   Figure 3). The proportion of cat ads from Gumtree and PetRescue were compared with the

308   State/Territory human population sizes

309   (http://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/3ADCB8E8492A9156CA2580

310   8900122529?opendocument). There was a significant difference between the State/Territory human

311   populations and the proportions of cats advertised on Gumtree ($\chi^2(7) = 566.6$, $p < 0.0001$), PetRescue

312   ($\chi^2(7) = 507.4$, $p < 0.0001$) and the RSPCA ($\chi^2(7) = 9969.9$, $p < 0.0001$). In Queensland the proportion

313   of cats from all three sources was higher than the Queensland human population, while in Victoria

314   PetRescue and Gumtree represented a lower proportion than the State human population. In WA

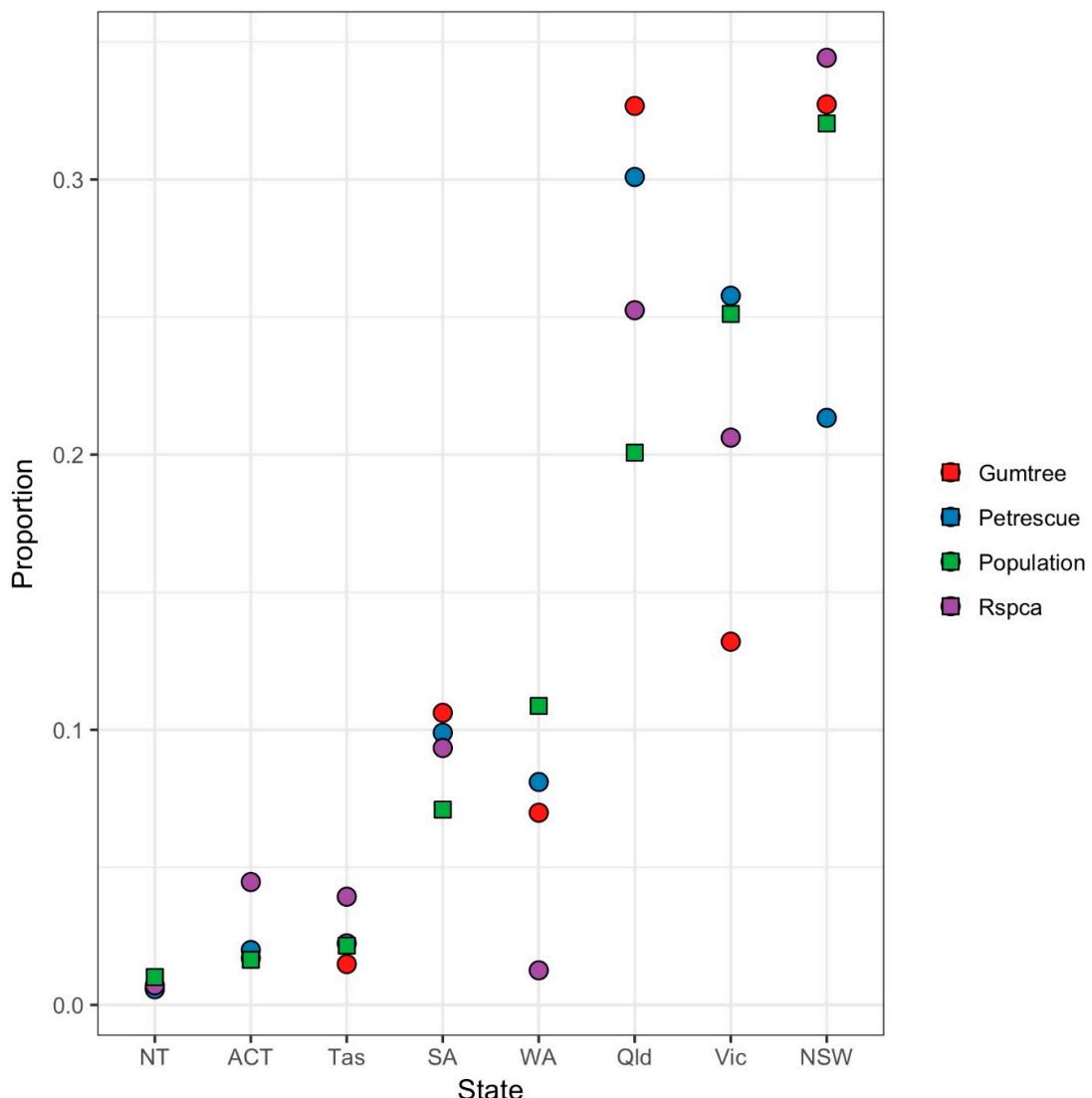
315   Gumtree, PetRescue and the RSPCA were a lower proportion than the human population, while in

316   NSW only the proportion of PetRescue ads was substantially lower than the State human

317   population. The proportions of cats advertised was significantly different between Gumtree and

318   Petrescue ($\chi^2(7) = 158.9$, $p < 0.0001$). Compared to PetRescue, there were more Gumtree ads in NSW,

319   SA, Tasmania and the Northern Territory than expected, and fewer ads in Victoria than expected.

320   **Figure 3.** Proportions of total ads for relinquished cats on gumtree.com.au and petrescue.com.au from
321   February 9 to February 26 2016, and RSPCA shelter admissions for each Australian State/Territory.
322   States/Territories are ordered in increasing proportion of total population. (Note: The proportion of
323   the Australian population in each State/Territory is: NSW 31.7%, Vic 24.9%, Qld 19.9%, WA 10.8%,
324   SA 7.0%, Tas 2.1%, ACT 1.6% and NT 1.0%)

325

326   The per capita values for each marketplace and State/Territory are shown in Figure 4. The per

327   capita number of Gumtree ads are highest for the Northern Territory and lowest in Victoria, while

328   PetRescue and RSPCA figures per capita are highest in Queensland. Per capita rates for the RSPCA

329   are higher than for Gumtree and PetRescue. The ACT is not shown on the map as it is too small in

330   area; the ACT per capita figures for Gumtree, PetRescue and the RSPCA are 0.08, 0.12 and 6.3 per

331   1000 residents, respectively. The per capita rate of cat admissions to RSPCA shelters is higher in the

332   ACT than any other State/Territory.

333

334   Figure 4 Numbers per capita (1,000) of total ads for relinquished cats on gumtree.com.au (A) and
335   petrescue.com.au (B) from February 9 to February 26 2016, and RSPCA shelter admissions (C) for each
336   Australian State/Territory. Note: scales are different to enable differentiation of colour for each
337   individual map.

338   A.

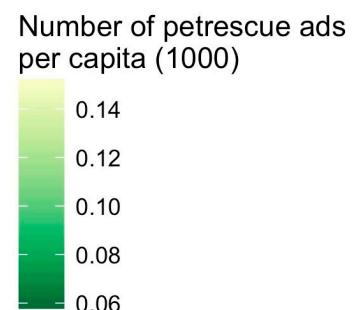
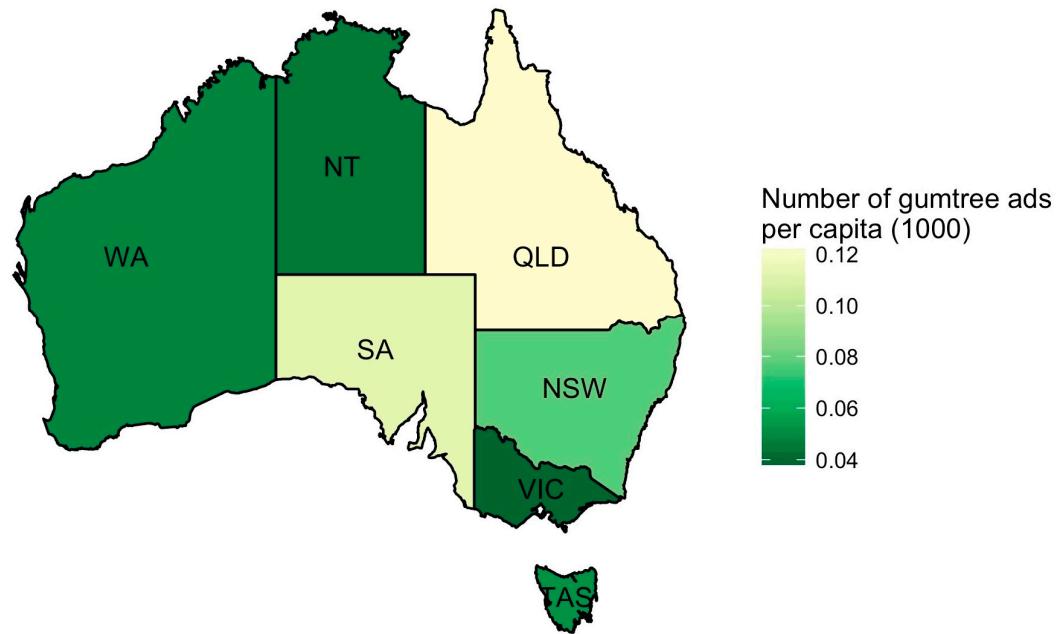
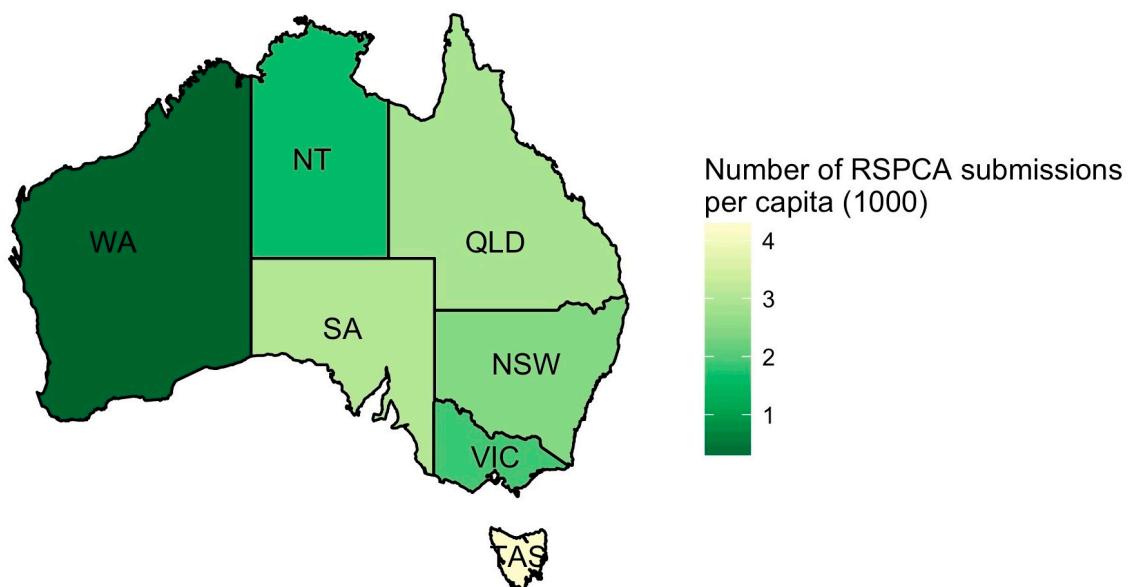
347   B.

359   C.

The prices of advertised cats on Gumtree in each State/Territory were compared using three categories: $AUS0, $AUS1-499 and >$AUS500. The data for the ACT, NT and Tasmania were not included as there were insufficient cases per category. There was a significant difference in price category between states $\chi^2(8) = 38.6$, $p < 0.0001$. The highest proportion of free cat ads came from Victoria (77%) and SA (67%) with the lowest proportion of free ads in WA (54%; Table 6). Victoria had a lower proportion of Gumtree ads for cats $AUS1-499 (16% vs >30% for other States), and the highest proportion of ads for cats costing >$AUS500 (7%). The proportions of Gumtree ads for cats >$AUS500 was low overall (3-7%).

Table 6. Price range of cats advertised on Gumtree between February 7 and 26, 2016 and their Australian State or Territory. Percentages represent the proportion of cats within that State/Territory in each price category.

	$0 N(%)	$1-499 N(%)	>$500 N(%)
New South Wales	356 (62.2)	190 (33.2)	26 (4.5)
Queensland	366 (64.3)	183 (32.2)	20 (3.5)
Victoria	178 (77.1)	36 (15.6)	17 (7.4)
Western Australia	65 (53.7)	50 (41.3)	6 (5.0)
South Australia	125 (67.2)	56 (30.1)	5 (2.7)
TOTAL	**1090 (64.9)**	**515 (30.7)**	**74 (4.4)**

3.3. Interviews

Most interviews took place on the phone (n=11), with four people emailing back a survey. There were 15 responses in total, a response rate of 2.5% (8/324) for dogs and 2.3% (7/299) for cats. In addition, 16 people responded to the email to notify that they would not be involved, giving reasons such as not having time, or that the situation was too distressing.

390   There was a mix of dog and cat breeds being relinquished by the respondents (Table 7). Five of
391   the dog owners had desexed dogs, with two dogs entire, and one in which the response was
392   unclear. All dogs were microchipped, excepting one in which the response to this question was also
393   unclear. Six dog owners scored a 4/5 (satisfied or highly satisfied) with their dog's health. Five dog
394   owners also responded on their dog's behaviour, with three of the five highly satisfied and two
395   giving a 3 or 3.5, i.e. neither satisfied nor dissatisfied. Four of the dogs were originally obtained
396   online – three from Gumtree and one from tradingpost.com.au. Only one cat was entire, with the
397   owner not clearly stating neuter status in one other cat. All cat owners were highly satisfied with
398   their cat's health, but one owner scored their cat's behaviour a 2/5 and another owner 3/5 (Table 7).

399   **Table 7.** Demographic factors for the dogs and cats being relinquished by the 16 people
400   participating in surveys of why they relinquished their pets on Gumtree (X represents a cross
401   breed). Responses to the pet's Health and Behaviour were scored on a 1-5 Likert-type scale where 1
402   was very dissatisfied and 5 was very satisfied. (NS = not stated)

Age (yrs)	Sex	Breed	Neut [1]	MC [2]	Health	Behav [3]	Original source
Dogs							
1	M	Pug x Jack Russell Terrier	NS	NS	NS	NS	Gumtree (rescue)
4	F	Greyhound	No	Yes	NS	NS	NS
1	F	Bull Mastiff X	No	Yes	5	NS	Gumtree
7	F	Siberian Husky	Yes	Yes	4	3-3.5	Friend as puppy
6	M/F	Maltese/Maltese X Pomeranian	Yes	Yes	4 & 5	5 & 5	TradingPost
NS	M/F	Beagle	Yes	NS	5 & 5	5 & 5	Gumtree (rescue)
4.5	M	Jack Russell	Yes	Yes	5	3	Registered breeder
1.5	M	American Staffordshire Terrier	Yes	Yes	5	5	Unregistered breeder
Cats							
1	M	Ragdoll X	Yes	Yes	5	5	Gumtree
0.33	F	NS	No	Yes	NS		Gumtree
4.5	M	DSH	Yes	Yes	5	2	Family litter
3	M	British Shorthair	Yes	Yes	5	5	NS
2	M	DSH	Yes	No	5	NS	Family with 2 Ragdolls
0.92	M	Ragdoll	Yes	Yes	5	3	Family
NS	NS	DSH	NS	NS	NS	NS	Strays

403   [1] Neutered; [2] Microchipped; [3] Behaviour

404   There were a variety of reasons given for relinquishment of the dogs and cats (Table 8). For the
405   eight dogs, the most common reasons were that they had rescued the dog and needed to find a new
406   home for it (n=2), and the behaviour of the dog (escaping in one dog and too interested in nearby
407   livestock in another). For two dog owners, two reasons were provided for the relinquishment, in

408   the other six cases, a single reason was provided. For the seven cats, the most common reasons for
409   relinquishment were that the pets in the house were not getting on (cats in two cases and a dog in
410   one case), and moving (n=2). For three of the cat owners, two reasons were provided for the
411   relinquishment, in the other four cases, a single reason was provided.

412   **Table 8.** Reasons for relinquishment given by dog and cat owners advertising their pet on
413   gumtree.com.au

Dogs	N	Cats	N
Rescue	2	Dog/cat not getting on	3
Behaviour	2	Moving	2
Dog injury (working dog)	1	Rescue	1
Own health	1	Allergy	1
Money	1	Expecting a baby	1
Relationship breakdown	1	Too many pets	1
Moving	1	Time	1
Time	1		

414   When asked the reason for using Gumtree rather than other places, the most common reason
415   for the dog owners was that they believed the shelters were full (n=4) and that they wanted to
416   see/interview the new owner of their dog (n=2; Table 9). The cat owners chose Gumtree as they
417   originally got the cat on Gumtree (n=2), because they use Gumtree for other things and it works
418   (n=2) and to see/interview the new owners of their cat (n=2). There were three dog owners and four
419   cat owners who gave two different reasons to choose Gumtree.

420   **Table 9.** Reasons people gave for choosing to advertise their relinquished pet on gumtree.com.au

Dogs	N	Cats	N
Shelters full	4	Got the animal on gumtree	2
To see/ interview the new owner	2	Use gumtree for other things	2
Lack of knowledge of shelters	1	To see and interview the new owner	2
It worked before	1	It worked before	1
Shelter is last resort	1	Shelter is last resort	1
Immediate posting and quick response	1	Would be put down at a shelter	1
Would be put down at a shelter	1	Shelter too hard on pet	1
		Don't drive so can't get to shelter	1

421
422   Relinquishing owners were also asked about the success of rehoming their pet on
423   gumtree.com.au. Of the eight dog owners, three had successfully rehomed their dog at the time of
424   completing the survey, and another owner had a prospective re-home organised. In one of the
425   successful re-homings, the owner had carried out two failed trials with the dog, with a third trial
426   being successful. For one dog owner there had been two responses with neither suitable, and in
427   another there had been so many responses that they had had to take the ad down, although none
428   had been successful at the time of the interview. In another two dog owners there had not yet been
429   any responses. For the seven cat owners, one person had had 50 offers for the cat within ten
430   minutes, and another had two potential homes within one day. Both of the cats in these examples

431   were pure breeds. In another two cat owners there had been a single response, the three remaining
432   owners had not yet received responses.

433

434   **4. Discussion**

435   The current study provides evidence about the numbers and types of dogs and cats
436   relinquished on one popular website (gumtree.com.au) in Australia, filling an important gap in
437   knowledge. It indicates that thousands of dogs and cats are being relinquished on gumtree.com.au
438   per year. Information collected on their breed and age profiles allows comparison with other
439   relinquished populations on petrescue.com.au and published RSPCA data. Although there are
440   similarities between the populations, such as the most common dog breeds on gumtree.com.au,
441   petrescue.com.au and in published RSPCA figures, there also appear to be differences suggesting
442   pets relinquished on gumtree.com.au represent a sub-population of relinquished animals.

443   By extrapolation, the total number of dogs and cats relinquished via Gumtree ads was
444   approximately 30,000 and 16,000, respectively. Recent estimates have indicated that 211,655 dogs
445   were admitted to shelters and municipal facilities in Australia in 2012-13 [2]. Some of the dogs
446   being offered on Gumtree may eventually be relinquished to a shelter or end up at a municipal
447   pound if a new owner is not found. The estimated Gumtree ads represent a significant proportion
448   (~14%) of the total number of dogs admitted to shelters and municipal facilities per year. This
449   proportion would be even higher if one considered other online websites (e.g. DogzOnline,
450   TradingPost), as well as Facebook®, and other private or closed websites advertising pets. The
451   diverse and diffuse nature of online ads, as well as the fact some are closed websites, makes it
452   impossible to estimate the total numbers of pets advertised online. If it is also considered that less
453   than half of shelter relinquishments are owner surrenders (19% in dogs to Queensland RSPCA
454   shelters in 2014 and 32% of cats between 2006 and 2009 in Queensland RSPCA shelters; [18,22]) then
455   the online ads would represent an even higher proportion of owner surrenders.

456   There is a complex flow of dogs and cats between the owned and un-owned populations. The
457   data presented from the gumtree.com.au ads, from petrescue.com.au (representing larger and
458   smaller shelters and pounds) and from published data from the RSPCA, illustrate the complexity of
459   movements of surrendered dogs and cats within and between Australian States/Territories. The
460   human population for each State/Territory was used for comparison; if one assumes that a similar
461   percentage of people in each State/Territory own a dog or cat, the human population is a proxy for
462   the dog and cat population. If one then assumes that a similar proportion of dog and cat owners in
463   each State/Territory relinquish their dogs or cats each year, the proportions should be similar. In
464   fact they were not, and this may be because these two assumptions are not true, and that people in
465   different States/Territories are more or less likely to own a dog/cat and to then relinquish it. In
466   general, Queensland had an overrepresentation of the surrendered population of dogs and cats on
467   Gumtree, PetRescue and the RSPCA compared to their human population, while Victoria tended to
468   have an underrepresentation of relinquished dogs and cats compared to their population. An
469   additional confounder is that RSPCA data is dependent on the numbers and sizes of shelters in each
470   State/Territory, and the petrescue.com.au data depends on the market penetration of
471   shelters/pounds using their website from each region. Internet access and hence access to Gumtree
472   may be more uniform between States. To fully understand the flow of owned and un-owned dogs
473   and cats within and between regions of Australia will require further research.

474   Although there were similar total numbers of ads for dogs and cats on Gumtree, there were
475   fewer new ads posted in the follow-up data sets for cats versus dogs. This suggests the turnover of
476   cat ads on gumtree.com.au is longer than for dogs. Of the dog and cat owners that were
477   interviewed, a higher proportion of dog owners had already successfully rehomed their pets versus
478   the cat owners, at the time of interview. Of the two cat owners who had multiple responses for

479 relinquishment, and had been able to successfully rehome their pets, both were pure bred cats.
480 However, the very small number of responses from owners relinquishing their pets on
481 gumtree.com.au means that this data is not likely to be representative of the entire population of
482 relinquishing owners.

483   There are many risks involved with online trade in pets for both prospective owners and
484 animals, but as yet online sales of dogs and cats remain unregulated around the world. In some
485 countries voluntary standards for online sales of pets have been developed, with the Pet
486 Advertising Advisory Group (http://paag.org.uk/) in the UK, the Irish Pet Advertising Advisory
487 Group (http://ipaag.ie/) and the BelgPAAG (Belgian Pet Advertising Advisory Group) was recently
488 launched in Belgium [23]. The EU Dog & Cat Alliance released a report into the cost of online sales
489 in the EU recently [24].   The main findings were that online ads are now the most common way for
490 people to purchase a pet, that there are no regulations around Europe that cover this trade, and the
491 many risks involved. These include sale of unweaned animals and animals in poor health. There are
492 up to 269,620 dogs and 67,847 cats estimated as being advertised online in the European Union on
493 any given day [24]. A report issued by BBB® International Investigations Initiative presents
494 evidence on how online pet sellers scam pet buyers in the US [25]. The BBB ScamTracker contained
495 907 reports on pet scams at the time the report was published, which was 12.5% of all online
496 purchase fraud complaints. Many of the scams do not involve a real animal, for example an ad for a
497 free dog or cat that urgently needs a new home may be posted. Once a person responds to the
498 advertisement, costs relating to transportation and care of the animal are requested. The report
499 includes information from other countries, with 337 pet complaints to the Australian Competition
500 and Consumer Commission in the first six months of 2017, and 377 complaints involving animals to
501 the Canadian Antifraud Centre in 2016, with estimated losses of $222,000 [25].

502   In addition to the risks relating to online sales of dogs and cats outlined above, there are other
503 risks relating specifically to dog and cat relinquishment. If an aggressive dog is relinquished to a
504 reputable shelter, the dog's behaviour will be assessed and the risk to new owners evaluated.
505 Although behavioural assessments performed in shelters are unreliable [26], prospective owners
506 can be educated on the behaviour of the dog and triggers of aggression prior to adoption. In
507 addition, good shelters have access to trainers and behaviourists who can implement programs to
508 improve the behaviour of an animal. In some of the ads it was possible to read between the lines
509 and see that aggression was likely to have been a problem (e.g. *'Urgent rehoming needed for Jack*
510 *Russell cross, male, 10 years. Beautiful dog, very friendly but best suited to a kid free home.'*) but there is
511 nothing to prevent owners advertising and selling pets with a behavioural problem without
512 providing any warning or information to the new owner.

513   As well as the risk to new owners, there are also risks to the animals themselves. While not
514 perfect, shelters do question prospective new owners on their ability to look after a pet and may not
515 allow somebody to adopt a pet if they believe it will not be well cared for. Again, there is no
516 obligation when dogs and cats are traded online for this to occur. As people may have ready access
517 to the internet at any time of the day, and with the posting of cute photos, impulse buying may also
518 be a significant problem. The wording of some of the ads indicated an impulse purchase, for
519 example *'6 month old Shar Pei puppy we brought him off gumtree two weeks ago and he's the best puppy*
520 *ever but unfortunately I have no time for him as I have three babies. He has had all he's (sic) needle are up to*
521 *date. Looking for a good home with someone who has plenty of time for him.'* An additional risk associated
522 with the Gumtree ads was that a large proportion were free, or a minimal cost. It has been
523 suggested that animals obtained at no or a low cost are at an increased risk of future relinquishment
524 [27], perpetuating the problem. However, a later study suggested that the attachment of people to
525 cats did not differ between free- and fee-based cat adoptions [28]. Further research will be needed
526 to assess whether free animals adopted online are more or less at risk of being re-relinquished.

There is also an additional risk associated with offering dogs and cats free, or very low cost. One of the interview respondents discussed how they had been taking home dogs advertised on Gumtree free in order to find them a new home. This respondent felt that otherwise people involved in dog fighting would take them (they had rehomed approximately 80 animals in the past year). To our knowledge, there is no evidence of trade and use of dogs in dog fighting, although it should be considered as a possibility. There were a number of ads describing dogs suitable for pig hunting, which is illegal in some States of Australia [29]. In fact the Bull Arab, which is not a recognised breed by the Australian National Kennel Council [30], is a breed often associated with pig hunting, and a large number of Gumtree ads for Bull Arabs from Queensland (in which pig hunting is legal) were observed. The final risk for dogs and cats advertised free or for low cost online is from animal hoarders. Arluke et al (2017) describe three types of animal hoarders: the overwhelmed caregiver, rescue and exploiter. The rescue hoarder has a missionary zeal to save all animals and actively seeks to acquire animals [31]. Being exposed to advertisements of animals that need rescuing on Gumtree is likely to trigger a rescue hoarder, who can acquire multiple animals free or at minimal cost.

It is difficult to determine if the population of dogs and cats surrendered on Gumtree overlaps with the animals that are surrendered to the RSPCA or other shelters. Four of the people interviewed who had relinquished dogs on Gumtree stated that they used Gumtree as the local shelters were full, and while this was not given as a reason by any cat owners there was one person who said they used Gumtree because the cat would be 'put down' at a shelter. The animals advertised on Gumtree would represent the 'owner surrender' dog admissions to a shelter. Only 19% of the 11,967 dogs entering the RSPCA in Queensland in 2014 were owner surrender, with 24% classified as strays admitted by the public, and 34% from municipal councils [22]. However, some of the strays admitted by the public may represent owned animals, with owners avoiding paying shelter surrender fees, or not wanting people to know they are relinquishing their own pet. The top four breeds processed by RSPCA shelters in Queensland in 2014 were the Staffordshire Bull Terrier (20%), Australian Cattle Dog (8%), Kelpie (7%) and Bull Arab (7%). The top four breeds advertised on Gumtree in the current study were the Staffordshire Bull Terrier (12%), Bull Arab (8%), Kelpie (6%) and Australian Cattle Dog (5%). Thus the most popular breeds for the RSPCA and Gumtree are similar, and also to the dogs offered on petrescue.com.au which represent both larger and smaller shelters. Despite similarities in the breeds, the proportions of pure and cross breed dogs differ widely, with 92% of the dogs admitted to the RSPCA in Queensland in 2014 being cross bred, while only 46% of dogs from Queensland advertised on Gumtree cross bred. The median price of pure bred dogs was significantly higher in the Gumtree ads than for cross bred dogs.

There is an important difference in relinquishing online versus giving up a dog or cat at a shelter. At a shelter, owners may have to pay a fee to relinquish their pets, whereas on an online site, they can request a sum of money. However, based upon the definition of relinquishment being used in this study ('Voluntarily cease to keep or claim; give up') the owners are voluntarily giving up their dog or cat. Indeed, if a dog or cat has been purchased originally for a large sum of money, offering the pet online may allow the owners to make up for some of this loss. The general use of the term relinquishment describes an animal taken to a shelter. When devising the criteria to determine if a dog or cat was being relinquished, we originally planned to have a cap on price for the animals we included in our study. However, when reading the descriptions of the ads, there were ads in which the dog or cat was being traded for over $AUS1000, and yet the wording suggested that the decision of the owner to relinquish their pet had been difficult. Thus, it was not possible to use a cut-off price and say that all pets below that price were relinquished and above that price were not.

One reason provided by respondents for the use of Gumtree for relinquishing their pets was that they could speak to the new owners and see where their pet would live before agreeing to give their pet a new home. One of the owners had even run trials of their dog with the prospective new

577   owners, and had two failed trials before having success with the third. Follow-up and control on
578   the re-homing of their pet is something that cannot be provided in a traditional shelter, where the
579   animal is left and no further information on where, and even if it has been rehomed, is provided. A
580   novel dog adoption program has been suggested in the US which involves placing dogs into foster
581   homes, with the foster carer tasked with finding the dog a new home [32]. There are obvious issues
582   with protection of privacy and the possibility of the new owners being harassed by the previous
583   owner (or *vice versa*), but this feedback is important for shelters to consider. To accommodate
584   owners who want to know where their pet goes and that it is being well looked after, innovative
585   programs should be considered.

586   An important limitation of the current study was the limited number of relinquished owners
587   who responded. Of those who did respond, all would be classified as responsible pet owners who
588   were in positions in which they had no real choice but to relinquish their pet, and who were doing
589   their best to find a good home. One of the respondents had rescued the animal previously from an
590   ad on gumtree.com.au and believed that the owner was going to kill the animal if a new owner was
591   not found quickly (an unavoidable change in this persons living arrangements outside of their
592   control meant that they needed to relinquish the pet). It is likely the population of people
593   relinquishing their pets on gumtree.com.au are mixed, with some doing everything they can to find
594   a good home, and others not caring where their pet goes as long as they can dispose of it. Further
595   research with responses from a larger range of respondents would be difficult, as people who do
596   not care for their pet are also unlikely to respond to requests to participate in research. For the
597   owners who were relinquishing their pets, several were obviously upset about the difficult decision
598   they had been forced to make. It was also interesting that some owners felt it necessary to respond
599   to the email to notify us that they were not willing to participate as they found the situation too
600   distressing. This aligns with previous research that concluded that rather than giving their pet up at
601   a shelter thoughtlessly many people struggled with an unavoidable situation and really had no
602   choice [19].

603   Research based on the use of big data from web scraping (automated collection of data from
604   web pages) provides both important research data but also ethical questions. Guidelines for internet
605   research have been published [33], and we believe the current study presents no significant ethical
606   problem using these guidelines. The respondents in the present study who were interviewed
607   provided their informed consent to participate, and no personal details are included that could be
608   used to identify them. However, owners whose data were used to estimate numbers and
609   demographics of the relinquished pets did not consent to this use. Although the data were
610   publically available on gumtree.com.au, it can be argued that people did not consent to other uses
611   of their information. However, risks to these people are minimal in the present study as aggregate
612   data were used that do not permit identification of individuals, and the direct quotes used in the
613   paper are unlikely to be able to be used to identify individuals as the ads are now more than a year
614   old and are taken down from gumtree.com.au once new owners are found or owners decide not to
615   continue advertising. The benefits of the research in understanding a population of relinquished
616   pets that have hitherto not been studies are also likely to outweigh the minimal risks to the
617   individuals whose data was used.

618   Another important limitation of the study is that not all information posted by the dog and cat
619   owners is accurate, for example some owners may not know the true age of their pet or may
620   provide false information on factors such as dog breed. Owners may also provide false reasons for
621   the relinquishment due to social pressure to have others think well of us [34]. Finally, the
622   extrapolation from the ads posted in February to the total number per year is likely to be inaccurate
623   as numbers of ads will vary from month to month. This is particularly relevant for cats, as they are
624   seasonal breeders.

625

626   **5. Conclusions**

627   The present study provides evidence that many thousands of dogs and cats are relinquished
628   online in Australia each year. This population of pets has previously not been considered in policy
629   or strategies to reduce the risk of relinquishment and protect the welfare of un-owned dogs and
630   cats. Knowledge of online relinquishments adds detail to what we currently know about the
631   complex flow of dogs and cats between owned and un-owned populations, and between different
632   owners.

633

634   **Acknowledgments:** The authors would like to acknowledge The Australian Pet Welfare Foundation for a
635   research grant enabling this work to be performed, to John Bishop for allowing us access to the petrescue.com.au
636   dog and cat data from the same time period, and to Dr Veronika Czerwinski for helping with the initial stages
637   of data cleaning.

638   **Author Contributions:** S.H. and J.T. conceived and designed the experiments; S.H., J.T. and C.J. performed the
639   experiments; S.H., J.T. and C.J. analyzed the data; S.H. wrote the paper and S.H., J.T. and C.J. edited the final
640   version.

641   **Conflicts of Interest:** The authors declare no conflict of interest.

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