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**Not in the countryside please! Investigating UK residents' perceptions of an introduced species, the ring-necked parakeet (*Psittacula krameri*)**

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27 **Abstract**

28 Wildlife management propositions can generate social conflict when stakeholder perceptions of the  
29 target species are not taken into account. Introduced Ring-necked Parakeets (RNP), which are  
30 established in the UK, have been added to the ‘general licence’ of birds that can be killed to  
31 prevent serious economic damage. We aim to better understand public perceptions of RNPs on a  
32 nationwide scale to mitigate potential future conflict over RNP management. We surveyed 3,947  
33 UK residents to understand public awareness of, knowledge of and attitudes towards the RNP  
34 across the UK.

35 We found that most respondents (90.2%) were aware of the RNP. The majority of  
36 respondents knew the species’ name (54.9%) but many underestimated current population numbers  
37 in the UK (82.6%) and few knew its full native range (10.0%). Almost half (45.9%) of responses  
38 indicated negative attitudes towards the RNP. We found aversion towards the RNP’s presence in  
39 rural areas and indifference in urban areas, highlighting that landscape and socio-cultural contexts  
40 are associated with attitudes. Respondent preference for the RNP in relation to other birds in their  
41 local neighbourhood was low (7.8%), contrasting with previous RNP perception studies.

42 Conversely, most respondents (83.0%) agreed that the RNP had pleasant aesthetics, suggesting  
43 nuanced views that separate appearance from impacts. We identified respondents’ preference for  
44 the RNP, ecological interest, age and education as significant factors associated with perceptions.

45 The RNP has a strong and complex public profile in the UK, and these perceptions and their  
46 drivers would be important factors in the popularity and success of any proposed management  
47 initiatives.

48  
49 **Keywords:** human-wildlife interaction; introduced species; public attitudes; public awareness;  
50 public knowledge; social impacts; urban ecology; wildlife management

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## 53 Introduction

54 The societal implications of non-native species (NNS) are less well-researched than their economic  
55 and ecological effects (Kapitza et al., 2019). Societal implications refer to the ways in which people  
56 recognise and perceive NNS in a variety of contexts, from the origins of the NNS in their  
57 introduced range to the species' impacts on people's lives (Kapitza et al., 2019). The omission and  
58 resulting knowledge gap of societal implications and perceptions in NNS research has been heavily  
59 criticised (Abrahams et al., 2019; Gobster, 2005; Gozlan et al., 2013; Kapitza et al., 2019) as it has  
60 become more widely acknowledged that their study and incorporation into a NNS management plan  
61 can greatly improve the acceptance, support for, implementation and success of that plan with a  
62 variety of stakeholders (Crowley et al., 2017; Jarić et al., 2020). Social and cultural research can  
63 explain why people view NNS the way they do, which is often diverse across different stakeholder  
64 groups (García-Llorente et al., 2008; Kapitza et al., 2019). Ignoring the societal implications of a  
65 NNS can result in conflict over suitable management, and can hinder efforts to successfully address  
66 problems caused by the target species (Crowley et al., 2017, 2019; Rotherham & Lambert, 2011;  
67 Shackleton et al., 2019).

68 The Ring-necked or Rose-ringed Parakeet (*Psittacula krameri*, from hereon RNP) is native  
69 to rural woodland, savannah and farmland habitats of sub-Saharan Africa and southern Asia, but  
70 has at least 90 established breeding populations across Europe (Pârâu et al., 2016). Outside its  
71 native range, the RNP predominantly occurs within urban environments, where warmer  
72 microclimates and abundant supplementary food have created suitable conditions for it to survive  
73 and thrive (Pârâu et al., 2016; Peck, 2014). The current UK population size was recently estimated  
74 at 12,000 breeding pairs (Woodward et al., 2020).

75 The RNP has been recorded as having ecological and socio-economic impacts across  
76 mainland Europe (White et al., 2019). Competition for nest sites has had negative, albeit highly  
77 localised, declines on cavity occupation by Greater Noctules (*Nyctalus lasiopterus*) in Seville  
78 (Spain) and competition for cavity nests (although not definitive impacts) with Nuthatches (*Sitta*

79 *europea*) in Belgium (Hernández-Brito et al., 2018; Strubbe & Matthysen, 2009). The RNP's  
 80 impacts on agriculture in mainland Europe include minor, local damage to both sunflower crops,  
 81 and to fruit trees in private gardens and orchards (White et al., 2019). Other documented effects of  
 82 the RNP on mainland Europe include noise disturbance from large roosts (Mori et al., 2020),  
 83 wellbeing benefits derived from observing the exotic species (Peck, 2014), and its potential as a  
 84 reservoir of avian pathogens and disease (Menchetti et al., 2016).

85 Previous studies have found no clear ecological impacts of the RNP on native bird  
 86 populations in the UK (Newson et al., 2011; Peck et al., 2014; Pringle & Siriwardena, 2022),  
 87 although Peck et al. (2014) found that some native birds increased their vigilance at the cost of their  
 88 feeding time in the presence of the RNP. Its socio-economic impacts in the UK are also little-  
 89 known and wholly anecdotal (White et al., 2019). While the RNP has been reported to damage UK  
 90 orchards and vineyards (Menchetti et al., 2016), White et al. (2019) argue that evidence for these  
 91 agricultural impacts is currently limited and localised. A clear picture of the RNP's impacts in the  
 92 UK is further complicated by the existence of numerous stories, grey literature, hearsay and beliefs  
 93 about its impacts (Heald et al., 2019; Hunt & Mitchell, 2019; Menchetti et al., 2016).

94 Despite this ambiguity surrounding the RNP's impact in the UK, it was added to two of the  
 95 three general licences in 2021 (DEFRA, 2020b), which allow people to kill certain species of wild  
 96 birds for defined purposes. The two defined purposes are "to conserve wild birds and fauna of  
 97 conservation concern" and "to prevent serious damage to crops, fruit and vegetables"; the species is  
 98 not under the third licence with the defined purpose "to preserve public health or public safety"  
 99 (DEFRA, 2020a). Prior to this, RNPs were not controlled in the UK, and DEFRA has, to date, not  
 100 provided any management strategy for the species.

101 Any assessment of management options for RNPs can benefit from an understanding of  
 102 public perceptions towards the species. Crowley et al. (2019) illustrate how a management plan for  
 103 the small population of Monk Parakeets (*Myiopsitta monachus*) in the UK stalled following fierce  
 104 opposition from both animal rights campaigners and local residents who had developed emotional

105 and cultural attachments to the birds. These different stakeholders had not been consulted prior to  
106 the announcement of the cull, and they disagreed with DEFRA's management justification, albeit  
107 for varied reasons (Crowley et al., 2019). To date, only one study by Baker (2010) has explored  
108 public perceptions of the RNP in the UK, and this survey was focussed solely on Greater London.  
109 While Greater London holds the majority of the UK's RNP population, they are also present in  
110 other areas and likely to spread (Holden & Cleeves, 2014). This leaves a research gap concerning  
111 perceptions of the RNP held by individuals across the UK. These wider perceptions should not be  
112 ignored as they can be utilised to identify, anticipate and mitigate the possible implications (e.g.  
113 conflict) if management is not conducted sensitively.

114 We aimed to obtain a better understanding of UK residents' perceptions of the RNP across  
115 the UK. We used an online questionnaire that specifically focused on assessing respondents'  
116 awareness, knowledge and attitudes towards this species. We also aimed to identify significant  
117 factors associated with awareness of and attitudes towards the RNP. Potential factors include  
118 respondents' socio-demographic background and their knowledge of the RNP, the former emulating  
119 previous RNP perception studies (see Supplementary Materials Section S1). We build on previous  
120 RNP perception studies by directly addressing awareness, knowledge and attitudes simultaneously  
121 to provide the most encompassing research into perceptions of the RNP to date. Through our  
122 findings, we hope to contribute important social and cultural perspectives that inform risk  
123 assessment and management of the RNP in the UK and in other areas of its introduced range.

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130 **Methods**

131 *Survey design*

132 We used the conceptual frameworks presented in Shackleton et al. (2019) and Kapitza et al. (2019)  
133 as a structural basis for identifying factors associated with UK-wide perceptions of the RNP (see  
134 Supplementary Materials Section S2). We developed an online questionnaire, comprising both  
135 closed and open questions, using the Qualtrics platform ([www.qualtrics.com](http://www.qualtrics.com)). Respondents had to  
136 live within the UK and be aged 18 or over. The questionnaire was advertised as a UK bird  
137 perception study. This was to attract respondents who may not have responded to a questionnaire  
138 only about the RNP, and avoided responses being dominated by people with existing strong  
139 interests in, or opinions about, the RNP. The survey end-page explained the full intentions of the  
140 survey and respondents were clearly presented with the option to withdraw their responses if they  
141 so wished.

142 The questionnaire was piloted for clarity and validity with a sample of 35 individuals. A  
143 copy of the final version of the questionnaire and the associated coding/scoring structure is  
144 provided in Supplementary Materials Section S3. Approval for this study was granted by the  
145 Imperial College Research Ethics Committee (SETREC Reference: 19IC5114). The questionnaire  
146 contained four sections, focusing on: 1) socio-demographic information and individual respondent  
147 attributes, 2) awareness of the RNP, 3) knowledge about the RNP, and 4) attitudes towards the  
148 RNP.

149 The socio-demographic information collected comprised: gender, age, highest level of  
150 completed education, first half of postcode of residence, and whether they lived in the same  
151 residence as when aged 16. The postcode information allowed us to assign a Rural-Urban  
152 Classification (RUC) category to each respondent (Office for National Statistics, 2019) and to  
153 subsequently capture whether a respondent lived in a rural or urban area.

154 We determined the local RNP density for each respondent by using the British Trust for  
155 Ornithology's (BTO's) 2007-2011 Atlas dataset (Balmer et al., 2013) and matching it to

156 respondents' postcode prefixes. We also collected information on three nature-focussed variables  
157 for each respondent - nature relatedness; self-assessed bird identification expertise (on a scale of  
158 novice (1) to expert (5)); and whether they were a member of wildlife, nature or environmental  
159 organisation. These three separate variables can be interpreted as representing respondents'  
160 "ecological interest", as respondents who are closely connected to nature, members of wildlife  
161 groups, and have a greater self-assessed bird identification expertise can be argued as possessing  
162 greater interest in ecological systems and organisms. To measure respondents' nature relatedness,  
163 an attribute designed to capture how individuals view their relationship with the natural world  
164 (Nisbet & Zelenski, 2013), we used the 6-item Nature Relatedness scale (NR-6) (Nisbet & Zelenski,  
165 2013). Each respondent was asked to rate their level of agreement with each statement on a 5-point  
166 Likert scale, from 1-strongly disagree to 5-strongly agree. Based on satisfactory reliability for the  
167 scale (Cronbach's alpha = 0.72), we averaged the scores from the six items to derive a single NR-6  
168 measure per individual. To assess respondents' awareness of the RNP, they were presented with an  
169 unnamed image of the species and asked, "Do you know this bird?" (options: yes; no; unsure).  
170 Respondents were also separately asked "Have you encountered this bird before?" (options: yes  
171 [neighbourhood only, elsewhere only, both neighbourhood and elsewhere]; no).

172 To assess respondents' knowledge of the RNP, we asked them to name the species from the  
173 image provided. To score 'correct', the full common or scientific name had to be given (including  
174 the synonym Rose-Ringed Parakeet). If only the common genus or family name was correct then it  
175 scored 'partly correct' (e.g. parakeet / parrot), otherwise we classified the answer as 'incorrect'.  
176 Spelling did not affect classification as long as the name could be determined. Following these  
177 questions, respondents were again presented with an image of the RNP and told its full name. To  
178 further assess knowledge, respondents were presented with two multiple-choice questions. They  
179 were asked to select 1) the correct current estimated RNP population size and 2) the continent(s) to  
180 which the species is native. After submitting their own answers, respondents were shown the  
181 correct answers alongside some information on the RNP's ecology and behaviours in the UK.



182 Attitudes towards the RNP were measured by asking respondents whether they would like to  
183 see the RNP in each of urban and rural areas of the UK. For both questions, respondents were asked  
184 to rate their level of agreement on a 5-point Likert-type scale from 1-strongly disagree to 5-strongly  
185 agree. The mid-point score (3) on this scale was “indifferent” and a sixth “I don’t know” option was  
186 available. We chose to ask these questions given the potential influences of the RNP’s urban-centric  
187 UK distribution on attitudes and to capture socio-cultural and landscape contexts of respondents’  
188 perceptions of the RNP.

189 Respondents who had encountered the RNP before were given the opportunity to provide  
190 any stories or experiences that they may have had with the RNP in an open-text box following the  
191 answers they gave to “would you like to see the RNP in rural/urban areas?”.

192 We collected information on respondents’ preference for the RNP in their local  
193 neighbourhood by presenting them with ten images of UK common birds. We asked respondents to  
194 select the four species that they would most like to see in their neighbourhood (defined as the area  
195 an individual can cover in a twenty-minute walk around their home). The RNP and another city-  
196 dwelling bird, *Columba livia* (Feral Pigeon), were fixed choices for all respondents. The other eight  
197 bird options were randomised from a larger selection of 18 UK birds (see Supplementary Materials  
198 Section S4 for list of species and images).

199 Finally, we presented respondents who had encountered the RNP before with the following  
200 six attitudinal statements, adapted from Belaire et al. (2015): (1) “They are pleasing to the eye”, (2)  
201 “They make me feel better, physically or mentally”, (3) “They provide an opportunity for people to  
202 learn about nature”, (4) “They are too noisy”, (5) “They can be aggressive or intimidating”, and (6)  
203 “They make a mess and/or damage my property”. Respondents’ answers to these statements would  
204 help to indicate their attitude towards the RNP. The statements’ order was randomised for every  
205 respondent and responses were scored on a true-Likert scale from 1-strongly disagree to 5-strongly  
206 agree (except statements 4-6 which were reverse-scored). Based on satisfactory reliability for the  
207 sum of these six questions (Cronbach’s alpha = 0.81), we summed the scores from the six items to

208 derive a single “attitudinal” variable (minimum possible score of 6 and maximum possible score of  
209 30).

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### 211 *Survey dissemination*

212 We followed a non-probability sampling approach, incorporating both snowball and convenience  
213 sampling techniques (Bryman, 2016), to enable us to collect a large number of responses in a time-  
214 and cost-effective manner. The survey was open from 1 April 2019 to 30 June 2019.

215 We contacted >100 institutions and organisations – wildlife and non-wildlife related. We  
216 invited them to distribute the questionnaire to their members/followers, e.g. via email, newsletter  
217 and social media (institutions that helped are listed in Supplementary Materials Section S5). Project  
218 accounts were also created for distributing the questionnaire (Twitter, Instagram and Facebook).  
219 The survey was accessible to anyone with an internet connection and a computer, tablet or mobile  
220 phone. Generalisations made in this study apply only to the respondents and not to the whole UK  
221 population.

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### 223 *Data analyses*

224 All raw data from the questionnaire responses were checked for duplications and errors prior to  
225 analysis, and anomalies and incomplete answers were removed. We removed 42 of the 3,989  
226 complete responses because positive verification that the respondent lived in the UK could not be  
227 achieved. We reclassified respondent education, gender, age and RNP knowledge (Table 1) to  
228 ensure that: 1) either there were enough data points in each level of the aforementioned categorical  
229 predictor, or 2) that the re-categorised predictor better reflected actual known socio-demographic  
230 trends.

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233 **Table 1.** Study variables and associated descriptive information (percentage and number of  
234 respondents, unless indicated otherwise).

Variable ( <i>Shorthand name</i> )	Value range / Levels	% of respondents	N (total n = 3947)
<b>Response variables</b>			
Do you know this bird? ( <i>Awareness</i> ).	0 = no/unsure	9.8%	388
	1 = yes	90.2%	3559
Would you like to see RNP in urban areas? ( <i>Urban</i> )	1 = Definitely not	17.8%	704
	2 = Probably not	28.9%	1140
	3 = Indifferent	18.7%	740
	4 = Probably yes	21.6%	853
	5 = Definitely yes	9.9%	392
	“I don’t know” option	3.0%	118
Would you like to see RNP in rural areas? ( <i>Rural</i> )	1 = Definitely not	35.4%	1397
	2 = Probably not	29.3%	1157
	3 = Indifferent	12.1%	479
	4 = Probably yes	12.7%	502
	5 = Definitely yes	7.6%	300
	“I don’t know” option	2.8%	112
Attitudes toward RNP ( <i>Attitude</i> )	<i>Sum of respondents’ answers to six attitudinal statements (Belaire et al., 2015). Possible score range = 6 – 30. 1 = “strongly disagree” through to 5 = “strongly agree”.</i>	Mean = 20.0 (SD± = 4.0)	3217*
<b>Predictor variables</b>			
Member of a nature organisation ( <i>Membership</i> )	0 = No	39.2%	1548
	1 = Yes	60.8%	2399
Highest level of completed education ( <i>Education</i> )	No education completed (to GCSE level)	1.24%	49
	GCSEs or equivalent	12.0%	472
	A levels or equivalent	18.6%	736
	Undergrad degree or equivalent	32.1%	1266
	Postgrad degree/doctorate/professional qualification or equivalent)	36.1%	1424
<i>Gender</i>	Male	42.1%	1663
	Female	56.9%	2247
	I prefer not to say/Other (please specify)	0.94%	37
<i>Age</i>	18-29	8.08%	319
	30-39	9.48%	374
	40-49	13.9%	547
	50-59	21.6%	854
	60 or older	46.9%	1853
Live in the same city/region as aged 16 ( <i>Same residence aged 16</i> )	0 = No	53.7%	2118
	1 = Yes	46.3%	1829
Self-assessed bird identification expertise ( <i>Bird Expertise</i> )	1 = novice	5.85%	231
	2	14.1%	555
	3	43.9%	1734
	4	30.0%	1171
	5 = expert	6.49%	256

RNP Density in local area (RNP density)	Count data of RNP individuals sightings from BTO data	Mean = 26.3 (SD± = 216)	3947
Rural Urban Classification (RUC)	Urban	73.6%	2906
	Rural	26.4%	1041
RNP Knowledge (Knowledge: each knowledge level is the sum of respondents' answers to RNP identification, RNP population size and RNP native range)	0-1 = Low	25.8%	1020
	2-3 = Intermediate	58.1%	2295
	4-5 = High	16.0%	632
Nature Relatedness (NR-6)	Mean of six answers to NR-6 scale. Possible score range = 1 – 5. 1 = low nature relatedness; 5 = high nature relatedness	Mean = 4.44 (SD± = 0.54)	3947
Preference for RNP in local area (RNP preference)	0 = RNP not selected from provided images	92.2%	3639
	1 = RNP selected from provided images	7.80%	308
<b>Specific respondent knowledge and RNP encountership variables</b>			
Respondent knowledge of RNP name	0 = incorrect/no answer	2.46%	97
	1 = genus/family level	42.6%	1682
	2 = species level	54.9%	2168
Respondent knowledge of RNP population	0 = incorrect	82.6%	3261
	1 = correct	17.4%	686
Respondent knowledge of RNP native range	0 = incorrect	45.8%	1808
	1 = partially correct	44.2%	1746
	2 = fully correct	9.96%	393
Encountered RNP in the wild	0 = no	18.5%	730
	1 = yes	81.5%	3217

235 \*Only 3,217 respondents for this variable as it was only presented to respondents who had encountered the  
 236 RNP before in the wild.

237 To assess associations of respondents' answers to whether or not they would like to see the  
238 RNP in rural/urban areas, we built two separate Proportional Odds Logistic Regression (POLR)  
239 models using the MASS package in R (Venables & Ripley, 2002). We refer to these models as  
240 "urban" and "rural". "I don't know" answers were omitted for the "rural" (2.84%) and "urban"  
241 (2.99%) models. We also built two Generalised Linear Models (GLMs) to assess associations of  
242 respondents' awareness of the RNP and their attitudes through their responses to the amalgamated  
243 score from the six statements from Belaire et al. (2015) (i.e. an "attitudinal" model). The first GLM  
244 was fitted with a binomial distribution with respondent awareness as the respondent variable (i.e.  
245 "awareness" model). The second GLM was fitted with a Gaussian distribution and identity link with  
246 the composite attitudinal variable as the response variable (i.e. "attitudinal" model). We fitted all  
247 four models with the predictors listed in Table 1 but for two predictors. First, we did not include  
248 respondents' knowledge of the RNP as a predictor of respondent awareness because one needs to be  
249 aware of something to have knowledge about it in the first place. Second, we did not include  
250 whether respondents' had previously encountered the RNP before as a predictor in any of the  
251 models because it was a similar predictor to respondents' awareness of the bird.

252 We checked for collinearity between model predictors in our models using the *vif()* function  
253 from the *car* package in R (Fox & Weisberg, 2019). No predictors were removed from any of the  
254 four models as all  $GVIF^{(1/(2*df))}$  values were lower than 2.5 as per Santos et al. (2018).

255 We conducted a series of model validation steps testing the assumption of Proportional  
256 Odds (PO) for our POLR models, goodness of fit using POLR-specific indices alongside standard  
257 GLM diagnostic tests, and detecting trends in spatial autocorrelation (SAC) for all models. Both  
258 POLR models met the PO assumption after graphically inspecting for violation of the PO  
259 assumption (Fox & Weisberg, 2019). We used the Pulkstenis-Robinson, Lipsitz and Hosmer-  
260 Lemeshow goodness of fit tests (Fagerland & Hosmer, 2016) to conclude that our POLR models are  
261 a good fit (Supplementary Materials Section S6). We also ran goodness of fit tests on our GLM  
262 models (Supplementary Materials Section S6). We found no significant SAC in all models after

263 using correlograms (Rhodes et al., 2009). We applied the dredge() function to our models in R  
264 (Kamil Bartoń, 2020). We then sifted a 95% confidence set from each list of models produced by  
265 dredge() and averaged the list of models using the model.avg() function. We focused on the  
266 coefficients produced via the zero-averaging method (i.e. “full averages”) as this method is superior  
267 to the natural averaging method for identifying which predictors have the strongest effect on the  
268 response variable (Grueber et al., 2011).

269 Finally, a single coder (A.P-B) analysed free-text responses using NVivo (QSR International  
270 Pty Ltd., 2018). All responses were coded through an inductive, iterative process of close reading,  
271 labelling responses in relation to thematic categories, and then refining the groupings by sentiment  
272 (i.e. “negative”, “mixed”, “positive”, “unsure”, “neutral” and “[reviewer] could not tell”). This  
273 inductive approach was standardised by having the lead author randomly sample and code up to 200  
274 different text answers on three separate occasions before conducting the final labelling process (see  
275 Supplementary Materials Section S7) (Van Atteveldt et al., 2021). Word frequency analysis was  
276 also used to derive the descriptive words participants most associated with RNPs. Text was cleaned  
277 to remove stop words (e.g. ‘and’, ‘the’), punctuation and numbers, and inflected forms of each word  
278 were grouped so that they could be analysed as a single item (e.g. ‘big’, ‘bigger’, ‘biggest’).

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288 **Results**

289 A total of 3,947 respondents completed the questionnaire (Table 1), with skews towards: older  
 290 individuals, individuals with higher self-assessed bird expertise, individuals who perceive  
 291 themselves as more connected to nature and individuals who are well-educated. Just under half  
 292 (42.5%) of our respondents lived in postcodes located within the South-East of England, although  
 293 this region was not purposefully targeted (Figure 1). Our sample is an approximately geographically  
 294 representative sample of the UK population as 32.7% of the UK population live in South East  
 295 England (Office for National Statistics, 2019). Table 2 compares our sample’s demographics with  
 296 ONS census records from 2011.

297

298 **Table 2.** Our sample’s demographics compared to 2011 ONS census records for the UK.

Variable	Level	Our sample	ONS 2011 Census (UK)
Respondent age <sup>a</sup>	18-29	8.08%	16.2% <sup>b</sup>
	30-59	45.0%	40.0% <sup>b</sup>
	60+	46.9%	22.5% <sup>b</sup>
Respondent gender	Male	42.1%	49.1%
	Female	56.9%	50.9%
	Other	0.94%	<i>Unable to find</i>
Highest level of education completed <sup>a</sup>	No schooling completed to GCSE level	1.24%	23.2%
	Up to 6th Form or equivalent	30.6%	44.7%
	Graduate and beyond (or equivalent)	68.2%	32.2%
Respondent RUC <sup>c</sup>	Urban	73.6%	80.5%
	Rural	26.4%	19.5%

299 <sup>a</sup>Concatenated since the ONS Census records age and education brackets differ slightly

300 <sup>b</sup>As a percentage of the total UK population (e.g. including individuals under 18 years old)

301 <sup>c</sup>Combined from ONS 2011 Census data for England & Wales (Office for National Statistics, 2011) and Northern  
 302 Ireland (Northern Ireland Statistics & Research agency, 2015), and 2011-12 Rural-Urban Classification (RUC) data for  
 303 Scotland (National Records Scotland, 2011).

304

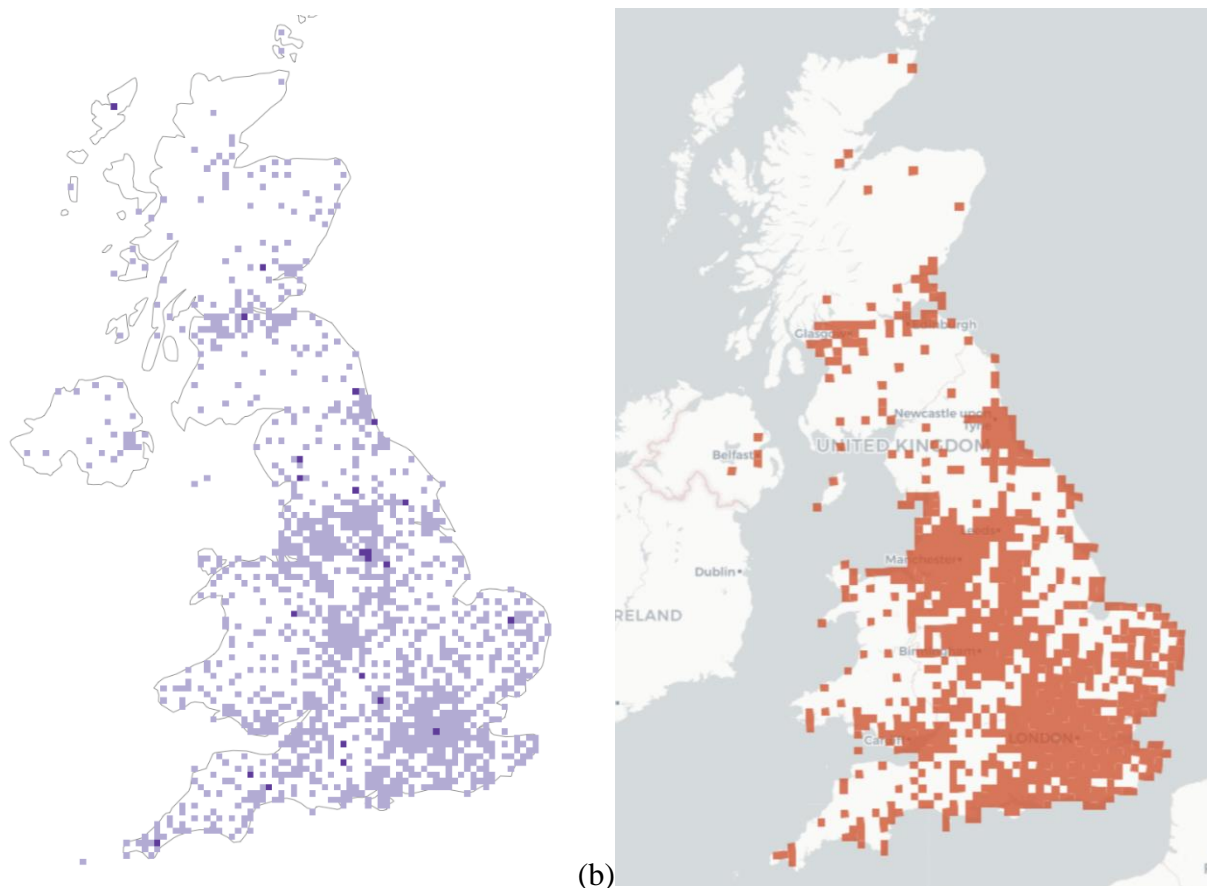
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310 (a) (b)

311 **Figure 1.** a) Map of respondents' geographical distribution at a 10 x 10 km square scale. Location  
 312 was derived by calculating coordinates from their postcode prefix by using a Google Maps API Key  
 313 retrieved in 2019 (Google, 2019), converting them to Easting and Northings and mapping them  
 314 onto a base BNG layer from the public repository on [www.naturalearthdata.com](http://www.naturalearthdata.com). Darker purple  
 315 squares indicate 10 x 10 km grid squares with >1 respondents. Note that the Channel Islands and  
 316 Shetland Islands (which contained two respondents each) are omitted due to space constraints. b)  
 317 RNP distribution in the UK at a 10 x 10 km square scale, from the NBN Atlas Partnership (2021).  
 318  
 319 Most respondents claimed they recognised the RNP from the picture provided (90.2%, Table 1).  
 320 Just over half of all respondents reported to have encountered the RNP outside of their  
 321 neighbourhood (56.4%), followed by 22.5% in their neighbourhood or elsewhere, and 2.2% in their  
 322 neighbourhood only. 18.6% of respondents had never seen a RNP before in the wild. We found a  
 323 significant association between this breakdown in encountering the RNP before and respondents'

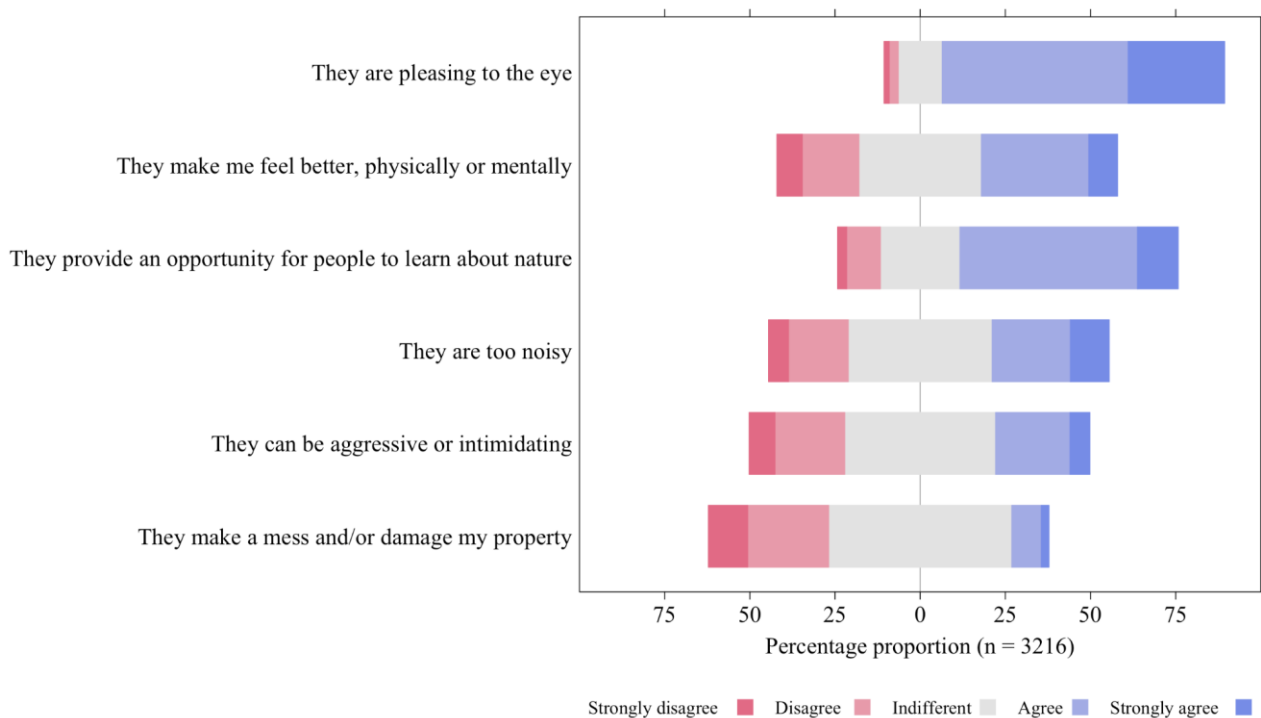


324 RUC category ( $X^2 = 13.1$ ,  $df = 1$ ,  $p < 0.001$ ), with a higher frequency of urban respondents having  
 325 seen a RNP in their neighbourhood and elsewhere compared to rural respondents.

326 The proportions of respondents who correctly estimated numbers of RNPs in the UK (“more  
 327 than >21,000”) and knew their native range at the continental level (both “Africa” and “Asia”) were  
 328 17.4% and 10.0%, respectively. The majority of respondents (54.9%) were able to provide the full  
 329 species name of the RNP as opposed to the 42.6% of respondents who could name the RNP to the  
 330 family level and the 0.02% who were unable to correctly name the RNP.

331 Overall, respondents tended to be more averse to seeing the RNPs in rural than urban areas  
 332 (Table 1,  $X^2 = 4431$ ,  $df = 16$ ,  $p < 0.001$ ). The majority of respondents selected (strongly) agree for  
 333 the three positively framed attitudinal statements about the RNP. However, negatively framed  
 334 statements were dominated by neutral responses (Figure 2).

335



336

337 **Figure 2.** Respondents’ answers as a percentage proportion to the six attitudinal statements from  
 338 Belaire et al (2015). The statements are recontextualised for the RNP and utilised to inform the  
 339 composite *Attitude* response variable.

340

341 Nearly all respondents (94.3%) who had encountered a RNP before provided free-text  
342 opinions concerning the species. The sentiment breakdown of responses were 45.9% negative,  
343 27.1% mixed, 16.1% positive, 7.3% unsure, 2.6% neutral and 0.9% we could not discern the  
344 sentiment. Table 3 shows the different topics mentioned by respondents with example quotes (see  
345 Supplementary Materials Section S5 and S8 for more detail).

346 The top ten adjectives in all the text responses were “native”, “invasive”, “noisy”, “rural”,  
347 “urban”, “introduced”, “nesting”, “indigenous”, “local” and “protected” (max n = 2214). “Native”,  
348 “invasive”, “noisy”, “introduced” and “indigenous” were all used to describe the RNP negatively.  
349 “Native” was used to refer to either the RNP’s introduced status, its effect on native species or  
350 sometimes both in the same response. “Indigenous” was used to refer to the RNP’s introduced  
351 status in 42.7% (n = 199) of the responses, and 57.3% (n=199) of the time it was used to refer to the  
352 species’ impacts on native wildlife. Respondents expressed concerns about the impacts of the RNP  
353 on “nesting” and “local” UK species, as well as stating a preference for the latter. Respondents  
354 expressed an aversion to the effects the RNP might have in “rural” areas and conversely did not  
355 mind the RNP much – or thought it added value – to “urban” areas. “Protected” was used to  
356 describe the protection status of the RNP in the UK.

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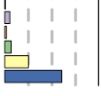




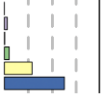

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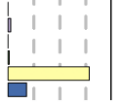
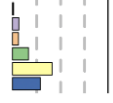
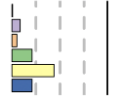

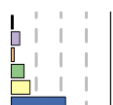
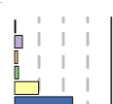
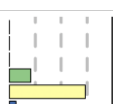
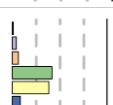
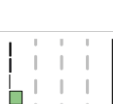
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362 **Table 3.** Topics that respondents mentioned in their open-text answer. The following are provided: a topic description, sample size (n), a graph  
 363 illustrating the different sentiments towards the RNP of respondents within that topic and an example quote. The graph illustrates the % proportion of  
 364 different sentiments across the specific topic responses that were negative (blue), positive (green), mixed (yellow), neutral (orange), unsure (purple),  
 365 and can't tell (black). Topics are ordered by sample size and only topics with n > 50 are shown. All topics (n>0) can be viewed in SM Section S8.  
 366 More detail on each topic and their sub-topics can be found in SM Section S5.

Topic	Example Quotes
Non-native status of the RNP (n = 2006) 	‘as this bird is not native to this country I’m not sure what effect it would have on our resident bird populations. I know they are becoming more common in the southeast and visiting bird tables.’
RNP as a bird that add pressure on UK wildlife (n = 1282) 	‘Very colourful and interesting to see - seen in Thames Ditton & near Hampton Court. However, may cause problems with local bird population. Are rural birds more vulnerable?’
Respondents mentions RNP noise (n = 453) 	‘A pain in the backside - so intrusively noisy and not a native bird’
Respondent experience with RNP (negative, positive or otherwise) (n = 403) 	‘I love seeing them in St James' Park when I go to London. I love hearing them in the trees .I am sure I have heard one mimicking a 'Hello' ..maybe wishful thinking !!’
RNP impact on UK ecosystems and local species is unknown (n = 319) 	‘an introduced bird with as yet unknown affects on native populations’
Damage that RNPs cause (n = 301) 	‘15 years ago, I lived in an area where Rose-ringed parakeets were endemic. They are pretty and spectacular birds, but very noisy. They travel around in large flocks, swooping down into gardens and monopolising bird feeders - I think the largest number we had in our garden at one time was 25. <i>They also ruined the crop on my apple tree by picking young, unripe apples in their claws, removing a strip of peel using their beak, tasting the exposed flesh with their tongues and then dropping the apples on the ground. They didn't seem to learn to try elsewhere when they found that the apples were still unripe: they just kept on picking, tasting and dropping.</i> ’
Spread of the RNP in the UK (n = 282) 	‘Depends on their impact to other species and habitat but if adverse I would rather they stay contained to areas they have established in only’

<p>RNP will affect rural areas (n = 270)</p> 	<p>‘A very colourful bird I love to see when in London for work but am concerned by the impact it would have on other wildlife in rural areas’</p>
<p>How RNP should be controlled in the UK (n = 261)</p> 	<p>‘I still think of this as an alien introduced bird not native. <i>However I wouldn’t actively support eradication</i>’</p>
<p>The legal context and protection that surround the RNP in the UK (n = 258)</p> 	<p>‘Evidence I have seen regarding ecological impact of this bird seems inconclusive. <i>For the moment it should be given the same level of protection as other species</i>’</p>
<p>How many RNPs there are in the UK (n = 174)</p> 	<p>‘All wild birds in UK are protected by law. <i>Having seen them in Europe in urban areas they appear to breed in large numbers adding to noise and pollution and , like feral pigeons, should be managed to maintain smaller populations.</i>’</p>
<p>Release of the RNP in the UK (n = 153)</p> 	<p>‘I am unsure if these are all due to escaped pets so they're not native to the UK?’</p>
<p>RNP as a competitor at birdfeeders in the UK (n = 101)</p> 	<p>‘A lovely bird to see flying around <i>but totally dominates garden bird feeder and wrecks any soft fruit bushes/trees for fruit in the Autumn.</i> A rather unwanted pest sps. Also good at continually harrying any sparrowhawks so tend not to see them much now.’</p>
<p>RNP brightens urban areas (n = 97)</p> 	<p>‘A bird that would lend beautiful colour to sometimes drab urban sprawl.’</p>
<p>All biological life is precious and should’t be mercilessly killed (n = 94)</p> 	<p>‘<i>All bird life should be protected including introduced species.</i> Although not common in Gloucestershire, occasionally escapees are seen.’</p>
<p>RNP is a part of urban areas in the UK (n = 93)</p> 	<p>‘I associate this bird with London, and as I am not a fan of cities, I think this means I have a slightly negative perception of this species, plus it’s introduced, of course.’</p>

Comparing the RNP to other non-native species in the UK (n = 87)		‘It’s a non-native species and as such could endanger native species. They don’t occur where I live but I guess it’s just a question of time! <b><i>I predict that like Canada Geese and Grey Squirrels, they will become a serious nuisance species.</i></b> ’
RNP has no impact on UK ecosystems and local species (n = 78)		‘It’s a naturalised species in the UK, <b><i>but as far as I’m aware it isn’t considered invasive and is not putting other species under stress due to competition.</i></b> This being the case, I don’t have any particular preconceptions about what its range ‘should’ be.’
RNP adds diversity to current UK wildlife (n = 74)		‘ <b><i>Add[s] colour, bird song (?) and interest to urban areas. Probably more adapted to urban areas, especially gardens and parks where food and shelter can be found.</i></b> Not sure about rural colonisation, could they adapt when many of our native birds are struggling and from a purist point of view prefer to see native species in the wild. ‘
Acceptance of RNP is in the UK despite not being a native species (n = 67)		‘As time passes, ring necked parakeet will be another part of our diverse ecology <b><i>we should just enjoy their noisy boisterous presence.</i></b> ’
RNP as a pest (n = 54)		‘The bird is a total pest. It does not belong in the UK and creates problems wherever it turns up. It also displaces resident species from their rightful nest sites’
Respondents prefer local (native) species compared to the RNP (n = 51)		‘ <b><i>Because I prefer to see indigenous species.</i></b> I am concerned about the effect that non native species have on the native flora and fauna. Unnatural competition for food and nesting sites.’
RNP can be used to raise awareness of nature in the UK (n = 50)		‘Non native spp, now naturalised. They possibly displace other hole nesting spp such as starling. They are noisy. <b><i>They are good for introducing non birders to start noticing nature</i></b> ’

367 <sup>a</sup>The entire quote is supplied and unhighlighted if the whole quote is pertinent to the topic, otherwise the sections of the quote pertinent to the topic are highlighted in ***bold italic***

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370 **Table 4.** Model-averaged estimates derived from the 95% confidence model set for our four models. These models are of awareness of and attitudes  
 371 toward RNPs, and whether or not respondents would like to see the RNP in rural/urban areas. Significant levels within predictors are highlighted in  
 372 bold and italics. See SM Section S9 for details on the models’ 95% confidence model sets and more detailed tables for each model.

Variable	Level*	Awareness	Attitudinal	Rural	Urban
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		<i>Estimate (SE)</i>	<i>Importance</i>	<i>Estimate (SE)</i>	<i>Importance</i>	<i>Estimate (SE)</i>	<i>Importance</i>	<i>Estimate (SE)</i>	<i>Importance</i>
Intercept (GLM)	(Intercept)	<b>-1.30 (0.52)</b>	<i>na</i>	<b>15.35 (0.90)</b>	<i>na</i>	<i>na</i>	<i>na</i>	<i>na</i>	<i>na</i>
Intercept (POLR)	Definitely not Probably not	<i>na</i>		<i>na</i>		<b>-1.89 (0.36)</b>	<i>na</i>	<b>-1.33 (0.34)</b>	<i>na</i>
	Probably not Indifferent	<i>na</i>		<i>na</i>		-0.5 (0.36)		0.16 (0.34)	
	Indifferent Probably yes	<i>na</i>		<i>na</i>		0.25 (0.36)		<b>1.06 (0.34)</b>	
	Probably yes Definitely yes	<i>na</i>		<i>na</i>		<b>1.60 (0.36)</b>		<b>2.75 (0.34)</b>	
Age	30-39	0.15 (0.21)	1.00	-0.2 (0.32)	1.00	0.06 (0.13)	0.82	-0.10 (0.14)	0.99
	40-49	<b>0.56 (0.21)</b>		<b>-0.58 (0.29)</b>		0.29 (0.18)		0.09 (0.13)	
	50-59	<b>0.65 (0.2)</b>		<b>-0.99 (0.28)</b>		0.20 (0.15)		0.02 (0.12)	
	60 or older	<b>0.62 (0.18)</b>		<b>-2.02 (0.26)</b>		0.11 (0.12)		-0.02 (0.11)	
Self-assessed bird expertise	Expertise Level 2	<b>0.58 (0.18)</b>	1.00	0.00 (0.05)	0.02	<b>-0.43 (0.16)</b>	0.99	-0.02 (0.07)	0.09
	Expertise Level 3	<b>1.29 (0.18)</b>		0.01 (0.06)		<b>-0.52 (0.15)</b>		-0.01 (0.05)	
	Expertise Level 4	<b>2.05 (0.23)</b>		0.01 (0.06)		<b>-0.51 (0.16)</b>		-0.01 (0.06)	
	Expertise Level 5	<b>3.19 (0.61)</b>		0.01 (0.08)		<b>-0.61 (0.2)</b>		-0.03 (0.10)	
Gender	Male	0.07 (0.11)	0.69	-0.21 (0.15)	0.90	-0.01 (0.04)	0.39	-0.10 (0.06)	0.99
	Other	1.22 (1.18)		-1.48 (0.81)		-0.22 (0.35)		<b>-0.95 (0.33)</b>	
Knowledge of RNP	Mid Knowledge Level	<i>na</i>		0.01 (0.08)	0.20	<b>-0.30 (0.08)</b>	1.00	-0.15 (0.09)	0.88
	High Knowledge Level	<i>na</i>		0.05 (0.14)		<b>-0.27 (0.10)</b>		-0.25 (0.13)	
Membership	Yes	<b>0.74 (0.12)</b>	1.00	0.02 (0.09)	0.28	<b>-0.24 (0.07)</b>	1.00	<b>-0.23 (0.07)</b>	1.00
Education	GCSEs or eq.	-0.04 (0.22)	0.07	<b>1.34 (0.67)</b>	1.00	0.10 (0.28)	1.00	-0.01 (0.14)	0.26
	A Levels or eq.	-0.04 (0.22)		<b>1.41 (0.66)</b>		-0.14 (0.28)		-0.03 (0.15)	
	Graduate or eq.	-0.03 (0.19)		<b>1.81 (0.65)</b>		-0.47 (0.28)		-0.08 (0.18)	
	Post-graduate	-0.03 (0.19)		<b>2.06 (0.65)</b>		-0.50 (0.28)		-0.05 (0.16)	
Awareness of RNP	Aware of RNP	<i>na</i>		-0.08 (0.2)	0.34	<b>-0.62 (0.11)</b>	1.00	-0.17 (0.13)	0.75
RNP Density	RNP Density in Respondent's Area	0.00 (0.00)	0.59	-0.00 (0.00)	0.76	-0.00 (0.00)	0.46	0.05 (0.00)	0.36
NR-6 Mean	Respondent NR-6 Score	<b>0.25 (0.11)</b>	0.94	<b>0.90 (0.13)</b>	1.00	0.01 (0.04)	0.30	<b>0.17 (0.06)</b>	0.97
Preference for RNP	Preference for RNP	0.36 (0.24)	0.82	<b>4.15 (0.25)</b>	1.00	<b>2.39 (0.12)</b>	1.00	<b>2.59 (0.12)</b>	1.00
RUC	Urban	<b>0.47 (0.13)</b>	1.00	-0.02 (0.09)	0.28	<b>0.21 (0.07)</b>	0.99	0.00 (0.04)	0.26
Same residence aged 16	Yes	-0.06 (0.1)	0.43	0.00 (0.07)	0.26	0.02 (0.04)	0.33	-0.01 (0.04)	0.31

373 \*Reference levels for the categorical variables was as follows: Age = 18-29, Self-assessed bird expertise=Expertise Level 1, Gender = Female, RNP Knowledge = Low Knowledge  
374 Level, Membership = No, Education = No schooling completed, Awareness of RNP = Not Aware of RNP, Preference for RNP = No Preference for RNP, RUC = Rural, Same  
375 residence aged 16 = No.  
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394 The average-weighted “awareness” model (Table 4) showed that respondent awareness was  
395 positively associated with membership of a wildlife group, greater self-assessed bird expertise,  
396 living in urban areas and nature-relatedness. Respondents aged 40 and above were more likely to be  
397 aware of the RNP than respondents aged 18-29. The average-weighted “attitudinal” model (Table  
398 4) showed that positive attitudes were associated with nature relatedness, higher levels of education  
399 and a preference for the RNP in the local neighbourhood. The attitudes of respondents aged 40 or  
400 older were more negative than respondents aged 18-29. The average-weighted “rural” model (Table  
401 4) found that support for the RNP in rural areas was positively associated with a preference for the  
402 RNP in the local neighbourhood and living in an urban area. Support for the RNP in rural areas was  
403 negatively associated with respondent awareness, self-assessed bird expertise Level 2, RNP  
404 knowledge, and membership of wildlife groups. The average-weighted “urban” model (Table 4)  
405 showed support for the RNP in urban areas was positively associated with nature-relatedness and a  
406 preference for the RNP in the local neighbourhood. Support for the RNP in urban areas was  
407 negatively associated with membership of a wildlife group. Respondents choosing “Other” for  
408 Gender were more likely to be against the RNP in urban areas compared to “Female” respondents.

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## 424 Discussion

425 We found that respondent awareness was high, and that many respondents knew the RNP's name  
426 but were relatively poor at identifying its native range and UK population size. A large proportion  
427 of respondents (45.9%) indicated that they held a negative opinion of the RNP, building an  
428 impression of a notable but not decisive aversion towards this species. Furthermore, we found that  
429 respondents were strongly not in favour of the RNP in rural areas of the UK, but conversely were  
430 tolerable or indifferent to its presence in urban areas. Respondents also provided more positive  
431 responses to the attitudinal statements about the RNP's aesthetic characteristics and educational  
432 value, which contrasted with predominantly indifferent responses towards the attitudinal statements  
433 about noise, aggression and damaging behaviours. Finally, we found that respondents had a very  
434 low preference for the RNP in relation to other birds in their neighbourhood (7.80%), and that RNP  
435 local population densities did not influence respondent perceptions.

436

### 437 *Why is there such a high awareness of the RNP?*

438 Our sample's awareness of the RNP (90.2%) is greater than awareness levels found in previous  
439 RNP perception studies in Greater London (Baker (2010): 71.0%) and Seville (Luna et al. (2019):  
440 80.1%). The increase in respondent awareness in our study compared to Baker's (2010) could be  
441 due to the 10 year gap between studies, providing the public with more opportunities to encounter  
442 and familiarise themselves with the species. It is unsurprising that ecological interest and an urban  
443 provenance drive greater awareness of the RNP: respondents with a greater ecological interest are  
444 more likely to have encountered or be aware of UK fauna which includes the RNP, whilst  
445 respondents from urban areas are simply more likely to have encountered the urban-centric species.

446 Our findings further suggest that levels of public awareness of the RNP are notably high  
447 when compared with birds and IAS more generally. Cox and Gaston (2015), for example, found  
448 that people living in urban areas are largely unaware of the avifauna that is around them, while  
449 Rodríguez-Rey et al. (2022) found the UK public's awareness of IAS to be low. Such a high

450 awareness of the RNP likely means that there are many individuals who know what the RNP is and  
451 hold an opinion of the species. Should these opinions be varied, as we found, difficulties for  
452 consensus on management could ensue and would require careful consideration to avoid escalation  
453 of conflict.

454

455 *Why is knowledge of the RNP mainly concentrated around knowing what it is?*

456 We found that numerous respondents knew the RNP's name and this could be due to the high  
457 awareness of and respondent encountership with the species. Many respondents did not know the  
458 RNP's population size in the UK, but this is likely to represent the fact that absolute population  
459 sizes are an abstract concept without reference points, rather than a genuine lack of knowledge *per*  
460 *se*. We recommend investigating if knowledge about the RNP's numbers in relative terms e.g. 'a  
461 few', 'many' could reveal a clearer pattern of individuals' perceived RNP abundance; this is known  
462 to influence perceptions (Van Der Wal et al., 2015) and could be utilised to inform perceptions of  
463 the RNP in the UK and any required engagement for potential management programmes.

464

465 *Why are respondents indifferent or tolerant to the RNP's presence in urban areas?*

466 The fact that the tolerance for the RNP in urban areas seems to be higher in younger generations  
467 indicates that RNPs are increasingly accepted as part of these urban ecosystems, suggesting  
468 potential evidence of shifting baseline syndrome (Soga & Gaston, 2018) (even though people might  
469 not 'like' them particularly as implied by the large number of "negative" opinions we identified).  
470 Respondents' tolerance could also be because the RNPs are colourful birds with an attractive  
471 aesthetic that beautify areas perceived as otherwise drab and wildlife-depleted, as some respondents  
472 suggested. This is further supported by the large number of respondents who agreed to the  
473 attitudinal statements that the RNP "*provides an opportunity to learn about nature*" and is  
474 "*pleasing to the eye*". Indeed, Berthier et al. (2017) found that the RNP has the "attraction of the

475 aesthetic of the diverse” in Paris (France), and it could be that a similar factor is influencing  
476 respondents’ acceptance of the RNP in urban areas of the UK.

477

478 *Why do respondents view rural areas as a sanctuary for wildlife unwelcome to the RNP?*

479 Rural areas might not be considered as ecological ‘sacrifice zones’ in the same way cities often are  
480 (correctly or not) (De Souza, 2021; Sanz & Rodríguez-Labajos, 2023) . Consequently, respondents  
481 view rural areas as worthy of protection from parakeet expansion. Indeed, respondents viewed the  
482 RNP’s noise and ‘damaging behaviours’ as unfit for UK rural areas, possibly partly driven by how  
483 respondents could view the UK countryside as a highly regarded socio-cultural ideal (Bunce, 2005)  
484 that should be protected from potentially disruptive non-native species.

485         The aversion to the RNP in rural areas could also be partly because respondents presumed  
486 the RNP to already be having negative ecological implications in the UK countryside, even though  
487 current research shows the RNP to have negligible ecological effects in the UK (Newson et al.,  
488 2011; Peck, 2014; Pringle & Siriwardena, 2022). It is not unprecedented that numerous respondents  
489 held factually incorrect perceptions of the RNP’s ecological implications in the UK, and that these  
490 supposed impacts influenced these respondents’ attitudes towards the RNP. Berthier et al. (2017)  
491 also found that some Parisian respondents viewed the RNP negatively due to their perception that  
492 the RNP had serious ecological and social (noise and damage) impacts, despite there being no  
493 current evidence of negative ecological implications driven by the species in Paris (France) (White  
494 et al., 2019). Berthier et al. (2017) found that this perception of the RNP was caused by these  
495 respondents living in areas with, or experiencing, the RNP in high numbers, and we therefore  
496 recommend that managers do not ignore how RNP population density or experience of the RNP can  
497 shape perceptions and in turn the social and ecological feasibility of management.

498

499 *Is “dissonance” a factor in differing perceptions of the RNP along rural and urban areas?*

500 Our observed difference in perceptions at a landscape context could be due to prevailing positive  
 501 and negative manifestations of dissonance by respondents who have experienced the species in  
 502 urban and rural landscapes respectively. Crowley et al. (2019) described “dissonance” as the  
 503 surprise of encountering an organism out of a (expected) place, and it can play a key role in  
 504 perceptions towards and the perceived charisma of parakeets. Dissonance might manifest itself  
 505 negatively, as shown by our respondents who have experienced the RNP and found it to be a  
 506 “noisy, non-native bird [that] shouldn't be here”, or positively, as shown by our respondents who  
 507 have experienced the RNP and happily expressed how encountering RNPs in urban areas “adds to  
 508 the magic [of London’s Parks]”. Manifestations of dissonance among the public may either lead to  
 509 support for or unpleasant clashes in reaction to potential RNP control programmes, and we suggest  
 510 that managers anticipate this accordingly. One possible avenue to mitigate this is to further engage  
 511 with members of the public to understand their reactions to RNP management in different and  
 512 possibly more-defined ecosystems and areas.

513

514 *What are the implications of respondents agreeing more with the positive attitudinal statements and*  
 515 *less with the negative attitudinal statements?*

516 Our results for the attitudinal statements were similar to the findings of Belaire et al. (2015), which  
 517 more broadly studied urban residents' perceptions of multiple bird species in the United States.  
 518 Their respondents valued birds’ aesthetics and cultural ecosystem services highly, whilst they  
 519 tended to ignore or only classify species’ annoyances and associated disservices as minor (apart  
 520 from certain exception species). UK residents might similarly value the RNP’s aesthetics and  
 521 cultural services highly, as long as the species is experienced in ‘the right place’ i.e. urban areas (as  
 522 discussed earlier), and in the ‘right quantity’ as Crowley et al. (2019) suggested that parakeet  
 523 aesthetic charisma depended on their proximity and numbers. However, Kueffer and Kull (2017)  
 524 suggest that reducing a NNS/IAS’s aesthetics to a ‘service’ can be limiting and we recommend

525 exploring the deeper psychological and social processes that influence the RNP's perceived  
526 aesthetics to better understand its implications for management.

527

528 *Why do respondents not have a preference for the RNP?*

529 The actual selection rate for the RNP by respondents was much lower than the expected random  
530 selection rate of the RNP being selected 40% of the time on average. This is similar to Luna et al.  
531 (2019), who found that the majority of their sample did not choose the parakeet (34.8%) and that  
532 their respondents' selection rate for the RNP was also below the expected random selection rate  
533 (50%). Similar results were obtained in Paris (France), where the RNP was only placed in 8% of the  
534 gardens people designed using a computer program, ranking 29th out of 32 species proposed  
535 (Shwartz et al., 2013).

536 The species low popularity in our sample could be due to respondents unwilling to disregard  
537 the "non-native" attribute of the RNP due to a higher level of ecological and associated knowledge  
538 about the RNP's potential impacts. Ribeiro et al. (2021) did find that preferences for the RNP were  
539 high and that respondents disregarded the "non-native" tag attributed to the RNP possibly due to a  
540 lack of ecological knowledge about the RNP's impacts. Differences between our sample's and  
541 Ribeiro et al.'s (2021) RNP preference could be due to density-dependent effects, since the RNP  
542 population in Ribeiro et al.'s (2021) study site is drastically smaller (Porto, 16 individuals).  
543 Alternatively, our sample's low RNP preference could be a manifestation of respondents actually  
544 'liking' the RNP but not in 'the right place' i.e. the UK, and again highlights that geographical  
545 contexts play a role in perceptions of the RNP.

546

547 *Why do we not see attitudes being directly related to local RNP density?*

548 Studies by Berthier et al. (2017), Luna et al. (2019), Ribeiro et al. (2021) and Mori et al. (2020) all  
549 found that attitudes towards the RNP became more negative when respondents lived in areas with,  
550 or experienced, the RNP in high numbers. However, we did not find a significant relationship

551 between RNP local density and respondents' attitudes or answers to the "Rural/Urban" questions.  
552 Our finding could differ from previous studies due to potential limitations of the RNP density  
553 dataset, which relied on maximum number of sightings and was based on the geographical level of  
554 a postcode prefix. The utilisation of a different RNP population metric on a more granular spatial  
555 level could have yielded a result similar to previous studies. For example, Mori et al. (2020) used  
556 RNP noise levels as a proxy for RNP density as well as utilising the date of first local introduction  
557 of the RNP as a potential driver of respondent attitudes.

558 Another reason could also be that our respondents were surveyed at a different geographical  
559 scale (national) compared to these previous studies, which sampled specific city populations. It  
560 should also be noted that the UK RNP population dwarfs the RNP populations in cities studied by  
561 Berthier et al. (2017), Luna et al. (2019), Ribeiro et al. (2021) and Mori et al. (2020), as well as the  
562 populations of RNP in those cities' countries (Pârâu et al., 2016) (see SM Section S1). We do not  
563 know the implications of these differences on our findings. Nevertheless, we still recommend  
564 exploring the relationship between RNP densities and perceptions to highlight implications for  
565 management. For example, Monk Parakeet numbers can influence their own aesthetic charisma  
566 (Crowley et al., 2019), which in turn plays an important role in influencing perceptions of NNS/IAS  
567 (Jarić et al., 2020; Shackleton et al., 2019).

568

#### 569 *Sample biases and skews*

570 It should be noted that the prevalence of negative opinions held towards the RNP in our sample  
571 could be a result of our demographic skew towards older, more nature-oriented individuals with  
572 greater ecological knowledge. These individuals may be more ecologically aware as they are more  
573 likely to be members of wildlife groups (Oxley et al., 2016; Waliczek et al., 2017) and therefore are  
574 more likely to know about the impacts of non-native species. Such individuals may be more likely  
575 to be predisposed towards possessing a greater awareness and/or holding negative views of non-  
576 native species based on the precautionary principle and/or a general aversion to non-native species.

577 Indeed, Bremner and Park (2007) and Oxley et al. (2016) found that older individuals and those  
578 who were part of wildlife organisations were more likely to support control measures towards NNS.  
579 Additionally, 42.5% of our respondents came from the SE of England which is where the majority  
580 of the RNP population is concentrated in the UK. Whilst we did not find a relationship between  
581 RNP population density and perceptions in our study, it should not be discounted as a potential  
582 underlying factor as to the prevalence of negative sentiment in our sample. Furthermore, our  
583 respondent sample was mostly composed of more educated individuals compared to the UK  
584 population average, which might increase the likelihood of our respondents being informed on UK  
585 nature, the RNP and its potentially deleterious effects. Finally, we acknowledge that our survey was  
586 advertised as a survey on perceptions of UK garden birds and that this could have attracted  
587 respondents who are already interested in nature and ornithology, and consequently are possibly  
588 more likely to be aware and know about the RNP already. All together, these sample skews need to  
589 be considered when examining the high number of concerns about the RNP's ecology in the UK  
590 and negative attitudes towards the RNP.

591

## 592 **Conclusion**

593 We found that there is a high awareness of the Ring-necked Parakeet in the UK, including  
594 awareness of its non-native status. However, perceptions were split between positive and negative,  
595 indicating a high potential for conflict should any management be proposed. We found that  
596 tolerance for parakeets was higher in urban areas than rural, indicating that rural management  
597 (especially where focused on impact reduction) would have higher societal acceptability. Similarly,  
598 there may be greater acceptability for RNP management in areas with high RNP population  
599 densities and measurable impacts. The inclusion of RNPs on the general licence does allow for this  
600 localised control, though interestingly is not permitted for socio-economic nuisance. We also found  
601 that younger respondents were more tolerant of RNP presence than older respondents, potentially  
602 indicating that RNP tolerance is increasing over time, which could lead to lower support for

603 management in future. This may be counteracted, however, by the extent of spread and perceived  
604 impacts, which could equally rise with time if the population continues to expand.

605

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612

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794  
795 **Figure legends**

796

797 **Figure 1.** a) Map of respondents' geographical distribution at a 10 x 10 km square scale. Location  
798 was derived by calculating coordinates from their postcode prefix by using a Google Maps API Key  
799 retrieved in 2019 (Google, 2019), converting them to Easting and Northings and mapping them  
800 onto a base BNG layer from the public repository on [www.natureearthdata.com](http://www.natureearthdata.com). Darker purple  
801 squares indicate 10 x 10 km grid squares with >1 respondents. Note that the Channel Islands and  
802 Shetland Islands (which contained two respondents each) are omitted due to space constraints. b)  
803 RNP distribution in the UK at a 10 x 10 km square scale, from the NBN Atlas Partnership (2021).  
804

805 **Figure 2.** Respondents' answers as a percentage proportion to the six attitudinal statements from  
806 Belaire et al (2015). The statements are recontextualised for the RNP and utilised to inform the  
807 composite Attitude response variable.

808  
809  
810 **Supplementary Material**

811  
812 See other files