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1   Separating British Marsh Tits *Poecile palustris* and Willow Tits *P. montana* using a new

2   feature trialled in an online survey

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12   Running head: Online survey of Marsh and Willow Tits

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29   ABSTRACT

30   Confident separation of Marsh Tits and Willow Tits remains a challenge in Britain due to the

31   similar appearance of the local races of both species. Several criteria are available to assist

32   the identification of birds in the hand, but none is completely diagnostic and most are invalid

33   for young juvenile birds. Due to the continued decline in abundance of both species,

34   however, it is becoming increasingly difficult to trial new identification criteria in the field, as

35   very few ringers are catching sufficient numbers of either species. This paper describes the

36   results of an online survey that was used to test a proposed new identification feature for

37   separating the two species, based on differences in the pattern of colour contrast on the

38   greater covert feathers. The online survey was effective in recruiting a sufficient sample of

39   ringers of varying experience, who were asked to identify images of Marsh Tits or Willow Tits

40   based only on features of the greater coverts that were demonstrated using training images.

41   On average, each ringer correctly identified 82% of the 18 images, and each image was

42   correctly identified by an average 84% of the 140 ringers. The pattern of the greater coverts

43   is therefore recommended as an additional, complementary criterion for separating Marsh

44   Tits from Willow Tits. Online surveys are also recommended as an efficient platform for the

45   dissemination and trialling of identification features among the ringing community.

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47   Keywords: internet, ringing, taxonomy

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INTRODUCTION

In Britain the local races of the Marsh Tit *Poecile palustris dresseri* and Willow Tit *P. montana kleinschmidti* are widely considered to be one of the most challenging pairs of resident birds to identify, causing difficulty for observers and ringers alike (Broughton 2009). Various identification criteria for separating the two species in the hand have been proposed and reconsidered for over a century (e.g. Rothschild 1907, Perrins 1964, Scott 1999, Redfern & Clark 2001, Broughton 2009), and features continue to be tested (du Feu & Clark 2014, Broughton et al. 2016). One plumage feature that does not appear to have been considered previously is the colour pattern of the greater coverts. It was noted during fieldwork that the greater coverts of Willow Tits appear to be more patterned than those of Marsh Tits (pers. obs.), with a dark centre to the feather contrasting with a paler margin and tip. On Marsh Tits, however, the greater covert feathers generally appeared to be more uniform and with less obvious contrast.

The greater coverts are a feather tract that is routinely inspected by ringers that target passerines, primarily for determining the age of individuals in many species (Svensson 1992). As such, ringers are generally used to evaluating and distinguishing subtle differences in feather shape or colour, and so the feature was considered to have potential as a new identification tool for Marsh and Willow Tits.

Individual interpretations of pattern and colour tone are subjective, however, and it can be difficult to communicate the perceived differences to others. Due to the poor conservation status of Marsh and Willow Tits in Britain, with both undergoing substantial and accelerating declines in range and numbers since the 1960s (Robinson et al. 2015), there are further difficulties in finding an adequate number of ringers that are catching sufficient birds of either species on which to trial any proposed identification feature.

In light of these challenges, this paper describes the use of online tools to recruit a sufficient sample of ringers take part in a web-based trial of the identification criterion based on the greater coverts. In addition to testing the value of the greater covert pattern in separating Marsh and Willow Tits, an associated aim was to assess the use of the online media to

85 engage with a broad sample of ringers and adequately communicate subtle differences in

86 plumage features. The results were used as a case study in the use of online surveys as a

87 training tool for ringers, which, if successful, would have a much wider application among the

88 specialist ringing community.

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90 METHODS

91 During long-term research at Monks Wood, Cambridgeshire (52° 24'N 0° 14'W), Marsh Tits

92 of known age were routinely captured (by RKB) throughout the year and digital photographs

93 of the greater coverts were taken using a 12.1 megapixel compact digital camera (*Canon*

94 *Powershot SX40 HS*). Willow Tits were captured (by PJA) throughout the year in north-west

95 England, at various sites around Greater Manchester and adjoining areas of Lancashire and

96 Merseyside within 9 km of Wigan (53° 32'N 2° 37'W). As with Marsh Tits, digital photographs

97 were taken of the greater coverts, using a 10 megapixel compact digital camera (*Olympus*

98 *XZ-1*).

99 For the identification trial a total of ten Marsh Tit images were selected (five adults, five

100 juveniles) and eight Willow Tits (three adults, five juveniles). The juvenile birds were less

101 than a year old and had retained up to five unmoulted greater coverts, having undergone

102 some or all of the post-juvenile moult in their first summer.

103 The Marsh Tit images were almost all taken under a heavy tree canopy, compared to the

104 open skies for the Willow Tits, giving a discernible greenish cast to many of the Marsh Tit

105 photos that may have given cues to their identity. Consequently, the colour cast of the

106 affected Marsh Tit images was adjusted in *Corel Paint Shop Pro Photo X2* graphics software

107 to eliminate this effect by-eye.

108 The survey was compiled using templates available from Bristol Online Surveys

109 (www.onlinesurveys.ac.uk), an online service that was used to build and host the survey.

110 The structure was intended to be self-explanatory and very easy to navigate, consisting of

111 an introductory page that asked initial multiple-choice questions on the level of ringing permit

112 (A: the highest level in the British and Irish scheme, C: intermediate, T: trainee) and the

113 number of Marsh and Willow Tits ringed in the previous three years: never, rarely (five or

114 fewer), occasionally (six to ten), or regularly (11 or more).

115 The second page described the aims of the survey and introduced the concept of the greater

116 covert feature being tested. This 'training page' featured two images of each species (one

117 adult, one juvenile) showing the greater coverts on the open wing in the hand. A description

118 was given alongside the images of the salient points to look for in identification, with a brief

119 summary at the end. The images and text delivered on this page are shown in Fig. 1.

120 After reading the training page, respondents were then invited to click a button and progress

121 to the next page to begin the survey. This section consisted of 18 individual pages, each

122 featuring one of the selected images of the greater coverts of a Marsh or Willow Tit, and a

123 multiple choice question asking 'Which species?'. Possible answers available to the

124 respondent were 'Marsh Tit' or 'Willow Tit', one of which must be selected (clicked) before

125 progressing to the next image on the following page. Images could only be viewed one at a

126 time, as this would generally be how users would experience birds in the field. The final page

127 announced the end of the survey and thanked respondents for taking part.

128 The survey was launched on February 15th 2016 and publicised via a message posted to the

129 *BTO Ringers' Forum* Yahoo Group (https://groups.yahoo.com/neo/groups/btoringers/info).

130 Password access was installed as a safeguard against malicious or spurious responses from

131 non-target users, with the password being included in the launch message on the forum.

132 Respondents were asked to complete the survey once, and only fully completed surveys

133 were recorded. Results of the survey were downloaded from the hosting site via a private

134 login.

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136 **Statistical analyses**

137 The survey results data contained an anonymous identifier for each respondent and answers

138 to each question regarding experience and image identification. Responses were grouped

139 by permit level and reported experience of each species and identification questions were

140 analysed as the proportion that were correctly identified by each respondent, and also the

141 proportion for each image (bird) that were identified correctly by all respondents. These

142 proportions of correct identifications were compared between groups of differing experience,

143 and also summarised for all ringers to give an overall indication of the success of the greater

144 covert feature in distinguishing between Marsh and Willow Tits.

145 Angular transformation was applied to proportional data before comparisons were made

146 between groups using Kruskall Wallis *H* tests. Non-parametric tests were used due to non-

147 normality of data, which was assessed using Anderson-Darling tests. All statistics were

148 performed in *Minitab 16*.

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150 RESULTS

151 A total of 140 ringers took part in the survey, most (66%) during the first full day after launch

152 and 86% within three days. No further responses were being added by the tenth day, when

153 the survey was closed. Most respondents (64%) held the highest level of permit (A), with

154 27% holding an intermediate C permit, and 9% were trainees (T permit).

155 Three-quarters (76%) of all ringers had handled either Marsh or Willow Tits in the previous

156 three years, but only 15% regularly handled either species (Fig. 2) and no ringers regularly

157 handled both. Trainees were the least likely to have handled either species, with 50% having

158 no experience of Marsh Tits in the last three years and 67% not ringing any Willow Tits.

159 Amongst C-permit holders, the vast majority had rarely or never ringed a Marsh Tit (84%) or

160 Willow Tit (97%) and none had handled more than ten of the latter over the last three years.

161 Even among the most experienced ringers (A permit), only a third had handled more than

162 five Marsh Tits in that time period, and just 9% had handled more than five Willow Tits.

163 Despite these variations in experience, each ringer answering the survey had correctly

164 identified 82% (1.7 s.e.) of birds on average, based only on the images of the greater

165 coverts, with little variation between holders of different permits (Fig. 3a). Twelve ringers

166 (9%) identified all birds correctly, with a third (34%) making only one mistake or none, and

167 only eight (6%) misidentifying more than half of the images. There was a slight tendency for

168 ringers with greater experience of either species to correctly identify more birds than those

169 with less experience (Fig. 3b), but differences were not statistically significant (Kruskall

170 Wallis test: H = 4.92, df = 3, P = 0.178). Taken together, these results indicated that ringing

171 experience was not very important in discerning the identification feature being tested, and

172 all ringers could perform similarly well with the basic instruction provided (see Fig. 1).

173 Each image/bird featured in the survey was correctly identified by an average 84% of

174 respondents. The proportion of success varied between 60-94%, meaning that all birds were

175 identified correctly on a collective basis, but some were more difficult than others. The

176 accuracy of identifying both species was similar, with an average 85% (76-94%) of ringers

177 correctly identifying the ten Marsh Tits and 83% (60-92%) the eight Willow Tits, suggesting

178 that neither species was more difficult than the other. Juvenile Marsh Tits appeared the most

179 difficult species/age group to identify (Fig. 4), with an average of 81% (76-89%) of ringers

180 being correct compared to an average 84-88% (60-94%) for other groups, but differences

181 were not statistically significant (H = 3.06, df = 3, P = 0.382). The images for each species

182 that received the highest, lowest, and closest to average proportions of correct identifications

183 are shown in Fig. 5 to illustrate the variety of difficulty experienced by respondents to the

184 survey.

185 Feedback from respondents, received via private email or through the Yahoo Group forum

186 used to advertise the survey, was generally positive about the concept of trialling

187 identification features in this way, and also contained constructive comments on

188 improvements. These comments centred on the survey not providing immediate feedback at

189 the end of the 'quiz' to indicate how many images the respondent had identified correctly,

190 which was not considered during survey design.

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192 DISCUSSION

193 The survey was successful in attracting a significant sample of ringers with a broad range of

194 experience, and most with some previous knowledge of Marsh Tits and/or Willow Tits.

195 Nevertheless, the total of 140 respondents represented only 5% of the ringers registered in

196 the British and Irish scheme in 2014 (Walker et al. 2015). The survey was only operational

197 for ten days, however, and advertised on only one online platform (which had 995 registered

198 users but probably a much smaller number of active users). As such, and considering the

199 relatively low numbers of full-grown Marsh Tits (981) and Willow Tits (286) ringed in Britain

200 during 2015 (Robinson et al. 2016), the survey is likely to have reached many of the primary

201 target audience, i.e. those ringers likely to be catching either of these species.

202 On average, more than eight out of ten respondents (84%) correctly identified each image of

203 a Marsh or Willow Tit from only the greater covert pattern. On average each individual ringer

204 correctly identified 82% of the images, and experience of either species, or ringing in

205 general, made little difference. This suggests that simple guidance and illustration of the

206 distinction between the greater coverts of each species, as given in the introductory pages of

207 the survey, was adequate for ringers of all ability to apply the method with similar success.

208 Using the greater covert pattern, the level of correct identification of Marsh Tits (averaging

209 85%) and Willow Tits (83%) was relatively high, rivalling other identification features such as

210 cheek pattern (87-94% accuracy, Broughton 2009), tail feather measurements (89%,

211 Broughton et al. 2016) or presence/absence of pale marks on the bill (96-99%, Broughton et

212 al. 2008). Unlike cheek pattern, however, which is only valid for birds after their post-juvenile

213 moult, and also the bill and tail features that are invalid for young juveniles in the first few

214 weeks after fledging, the greater covert pattern appears a valid feature for identifying birds of

215 any age. Using combinations of these features, it should be possible to identify with

216 confidence essentially all Marsh or Willow Tits.

217 If the sample captured by the survey was representative of ringing activity throughout Britain,

218 then the low proportion of ringers that regularly catch Marsh or Willow Tits is serious cause

219 for concern. For Willow Tits in particular, the great majority of intermediate (C permit) and

220 trainee (T) ringers did not ring any birds at all during the previous three years. This

221 underlines the genuine scarcity of this rapidly vanishing species, whose abundance in Britain

222 declined by 90% from 1988-2013 (Robinson et al. 2015). For Marsh Tits too, whose

223 abundance fell by 40% between 1988-2013 (Robinson et al. 2015), only one in five ringers

224 responding to the survey had handled more than five birds in the last three years.

225 From these figures it can be assumed that only a small minority of current and future ringers

226 in Britain will have much experience of identifying these species in the hand. As such,

227 additional training methods of the type being trialled in this study could help fill the gap of

228 direct field experience and help to ensure that those birds which are caught will not be

229 misidentified. Correct identification of these species will be essential for accurate monitoring

230 of the remaining populations.

231 The results and feedback from respondents to the survey suggest that online methods can

232 be a highly successful platform for trialling identification criteria among the ringing

233 community. Improvements to future surveys of this kind could include the standardisation of

234 images by using the same equipment and conditions, perhaps with the aid of a lightbox or

235 lamp to reduce the variation in colour cast experienced with Marsh and Willow Tit images

236 due to differing conditions.

237 Some of the feedback suggested other improvements for user satisfaction in future surveys,

238 such as immediate reporting of the user's performance in any trials. This could be

239 accommodated, although care would be needed not to bias testing of other users that may

240 be present at the same time, or tempt users to retake the test and revisit the more

241 challenging questions. Our survey could not exclude users from taking the test more than

242 once, although they were explicitly requested not to do so. Individual passwords could

243 enable such restrictions to be placed on users, but this would increase the complexity of

244 accessing the survey and may deter some people.

245 In summary, the online survey was successful in trialling a new identification feature for

246 separating Marsh and Willow Tits, i.e. the pattern of the greater coverts. With only four

247 images and brief comments as tuition, a pooled sample of ringers was able to identify all

248 birds with a moderately high degree of success. This identification method is recommended

249 to ringers as a new tool to be used alongside other established criteria, such as tail

250 measurement, bill and plumage features, when handling British Marsh Tits or Willow Tits.

251 The feature may also be valid for birds from other populations, such as the similar

252 subspecies in adjacent Continental Europe (e.g. France, Netherlands, Belgium, Germany),

253 and testing would be useful.

254 The general use of online surveys is recommended for trialling new identification features

255 among the ringing community, and could also be used for assessing features for ageing and

256 sexing of birds. With a testable idea, high quality images, suitable guidance and a user-

257 friendly online platform and interface, a large amount of trial data can be collected from a

258 broad sample of users in a very short period. The results can provide solid evidence of the

259 validity (or otherwise) of identification criteria, and also the ability of the target audience to

260 apply them. The reporting of any results is essential, however, to promote engagement and

261 the uptake of successful methods.

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Figure 1. Four images used to 'train' users of an online survey to trial the identification of proposed differences in the greater covert pattern of a) first-year and b) adult Willow Tits compared to c) first-year and d) adult Marsh Tits. Information given in the survey advised users to note on Willow Tits the very dark central shaft and greyish centre of the greater covert feathers that contrasts with a brownish fringe. Pale tips may be present on the outer web only, as in the Willow Tit in b). On Marsh Tits the central shaft is a less obvious brownish colour, rather than the blackish on Willow Tits, and the outer webs of the greater covert feathers are a more uniform brown with a slightly olive fringe. Marsh Tits greater coverts were suggested to often have a slightly paler tip running across the inner and outer webs in adults, as in d), or a strongly pale tip on the outer web of unmoulted greater coverts in first-years, as in c).
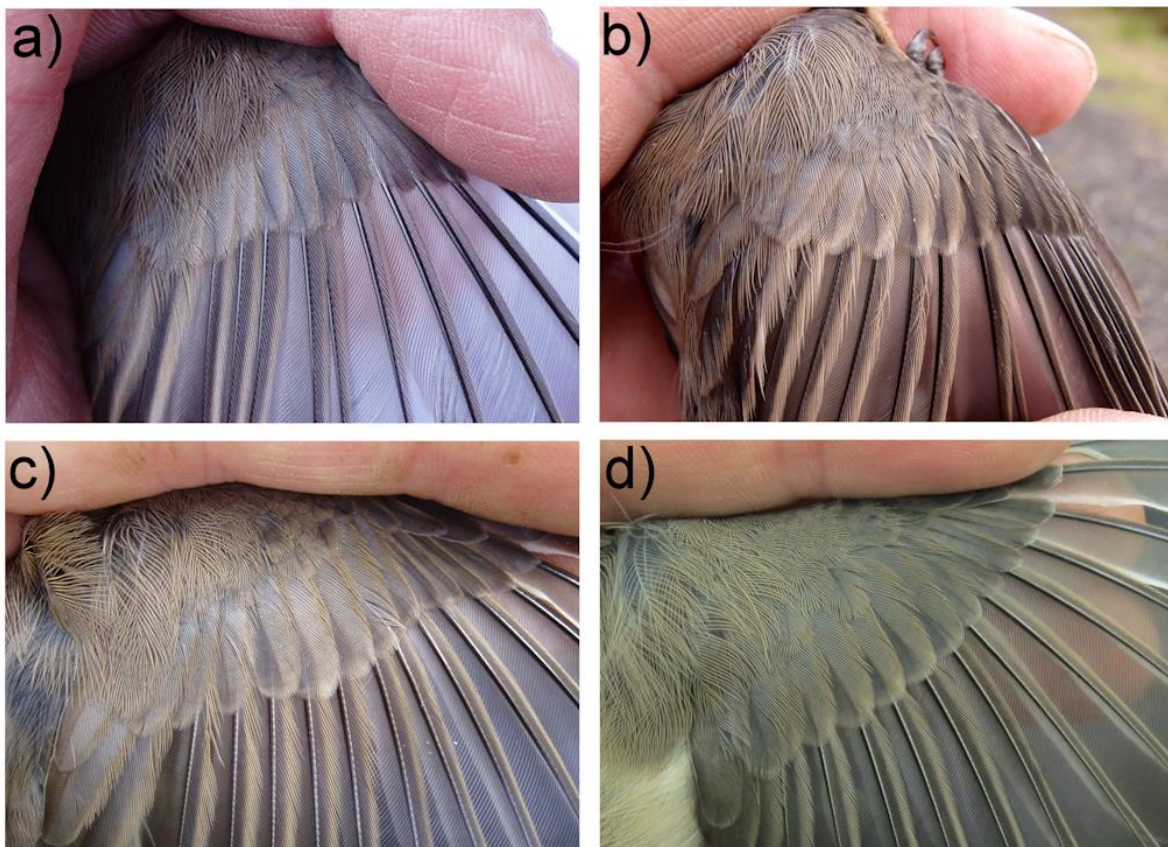
322   Figure 2. Breakdown of 140 respondents to an online survey by ringing permit level (A:

323   greatest experience, C: intermediate, T: trainee) and number of Marsh Tits or Willow Tits

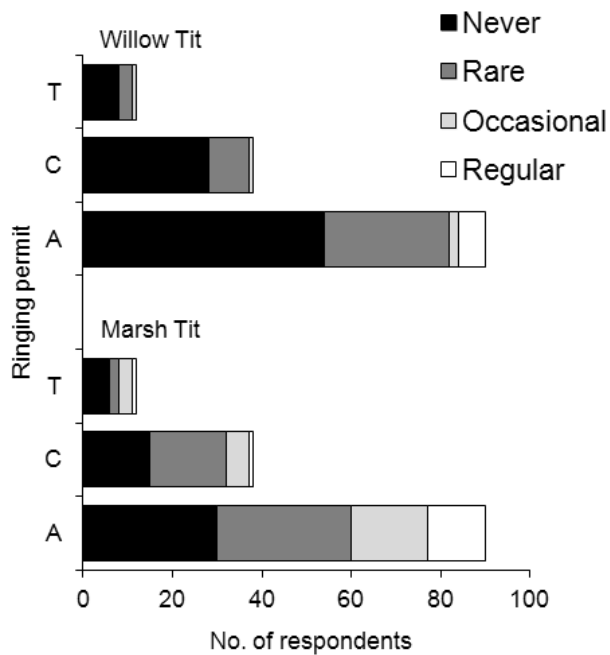324   ringed over the previous three years (Never = none, Rare = 1-5, Occasional = 6-10, Regular

325   = 11+).

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Figure 3. a) Mean (and s.e.) proportion of images of 10 Marsh Tits and 8 Willow Tits that were correctly identified by each of 140 ringers. Identification was based solely on the greater covert pattern; b) mean (and s.e.) proportion of ringers that correctly identified each image, based solely on the pattern of the greater covert feathers.
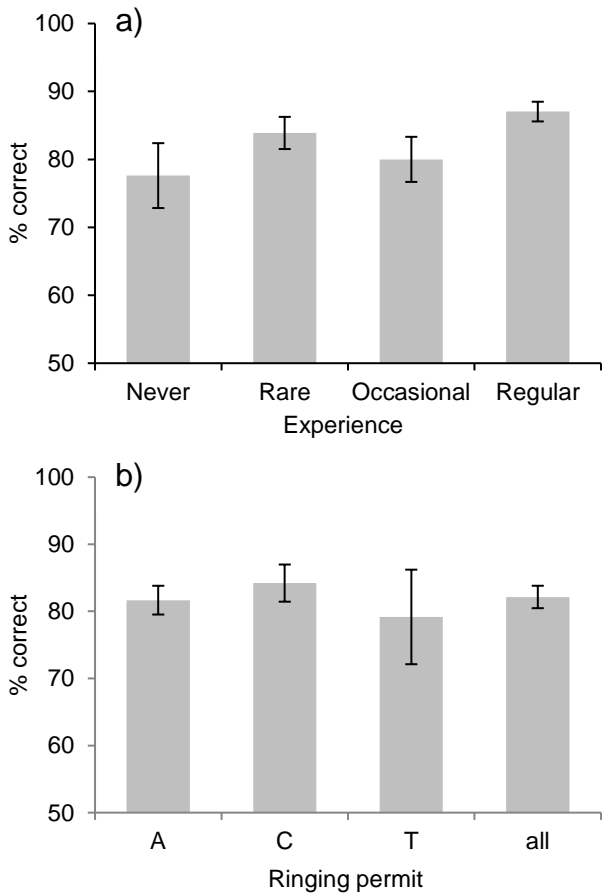
355   Figure 4. Mean (and s.e.) proportion of images of the greater coverts of 10 Marsh Tits (5

356   juvenile/first-year, 5 adult) and 8 Willow Tits (3 juvenile/first-year, 5 adult) that were correctly

357   identified by 140 ringers based on the greater covert pattern.

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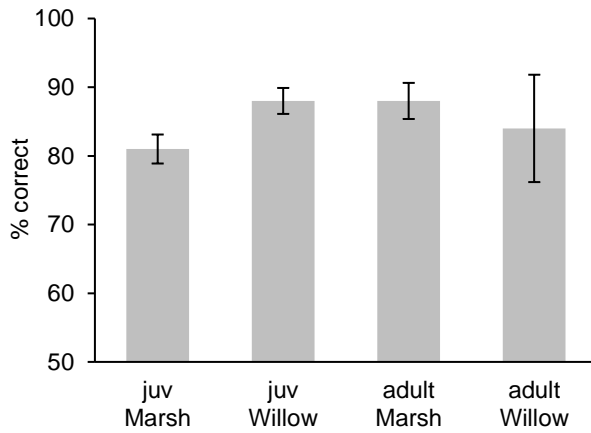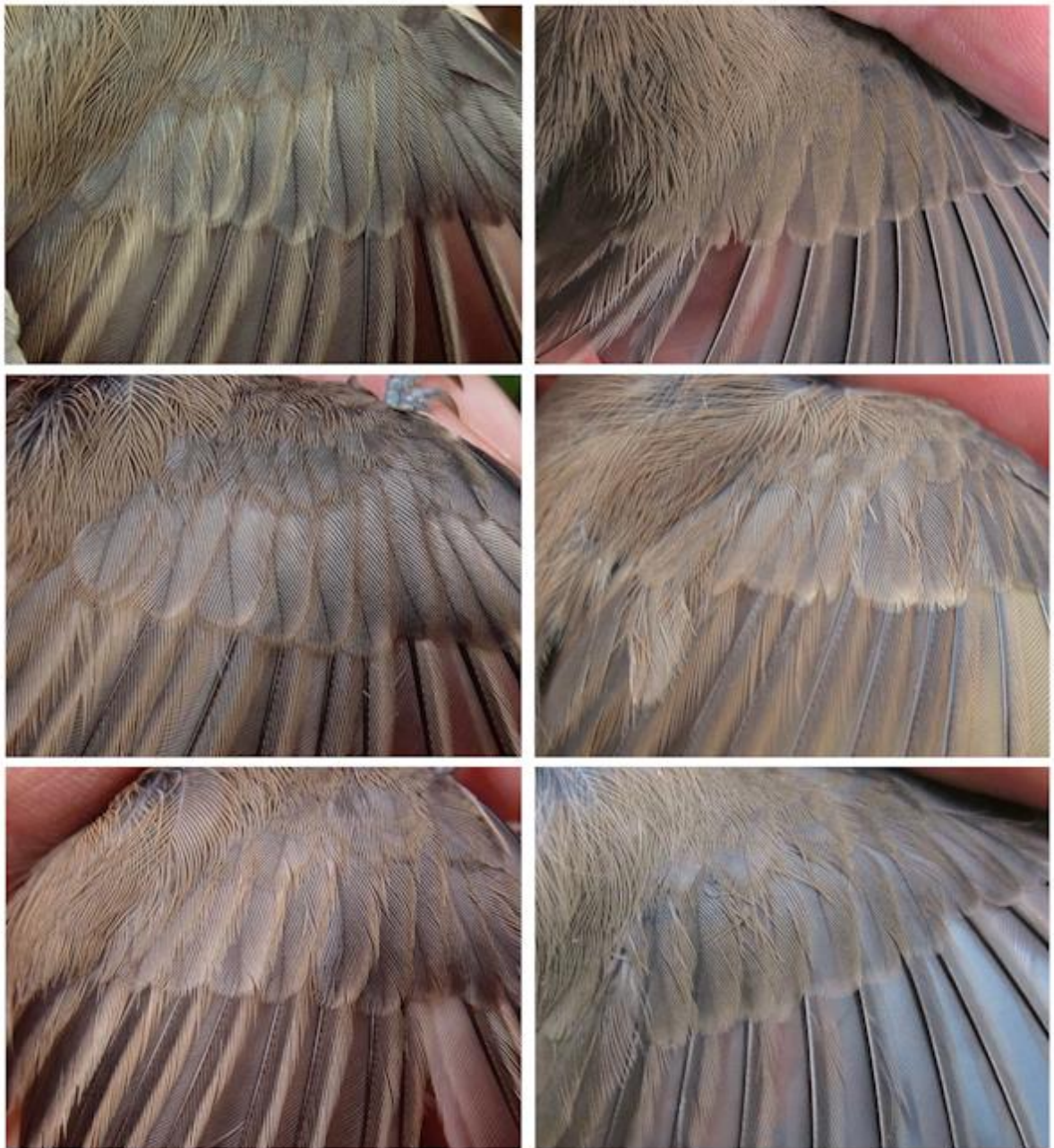366

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375   Figure 5. Images of the greater coverts of three British Willow Tits (left) and three British

376   Marsh Tits (right) used in the survey to trial the proposed differences in feather pattern.

377   These images received the highest proportion of correct identifications by survey

378   respondents (top), the proportion closest to the average (middle) or the lowest proportion of

379   correct answers (bottom), demonstrating the variation in perceived difficulty in judging the

380   greater covert pattern.

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