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RESEARCH ARTICLE

# Understanding local knowledge and attitudes toward potential reintroduction of a former British wetland bird

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## Abstract

1. Stakeholder acceptance and support is essential for long-term success in species reintroductions, and assessing social feasibility of reintroductions within human-occupied landscapes is an integral component of effective decision-making.
2. The Dalmatian pelican *Pelecanus crispus* is an extirpated British bird, and possible pelican reintroduction to British wetlands is under discussion. Any reintroduction planning must first assess local community awareness, attitudes, and acceptance of potential pelican arrival and associated habitat management, as part of wider socio-ecological feasibility assessment. Pelicans are distinctive species with potential to increase support for wetland conservation, but might provoke conflict through real or perceived competition with landscape users such as fishers; such conflict is already seen within Britain between fishers and cormorants.
3. We conducted an online survey of 590 respondents in the Somerset Levels and East Anglian Fens, Britain's largest wetland landscapes, to understand local views on pelican reintroduction, other reintroductions and wetland restoration, and to investigate correlates of varying attitudes toward coexistence with pelicans and five other waterbirds (grey heron, Eurasian bittern, little egret, common crane, great cormorant).
4. Respondents had generally positive views about previous reintroductions of other species, and had overall positive attitudes toward all six waterbirds. Two-thirds of respondents supported or strongly supported pelican reintroduction, but both benefits and concerns were identified in relation to its possible reintroduction. Anglers and hunters were more likely to hold negative attitudes toward pelicans, other waterbirds and wetland restoration. However, although anglers raised more concerns, they were not more likely to be unsupportive toward reintroduction. More socio-demographic predictors were associated with negative attitudes toward restoration required to establish pelican habitat, suggesting that

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positive feelings toward biodiversity are outweighed by concerns around potential exclusion from local landscapes.

5. Our findings suggest pelican reintroduction might be supported by local stakeholders. Attitudes toward cormorants do not represent a blueprint for attitudes toward pelicans, and anglers may support reintroduction if concerns around impacts to fish stocks are addressed. Community engagement for species-specific and landscape-scale actions require separate approaches, with landscape management planning needing to target a wider range of stakeholder groups with separate concerns to those about coexistence with pelicans.

**KEYWORDS**
conservation awareness, Dalmatian pelican, public opinion, questionnaire survey, reintroduction, translocation, wetland restoration

## 1 | INTRODUCTION

Human activities have driven biodiversity loss and ecosystem change for millennia, and environmental restoration, species reintroductions and rewilding are now major components of conservation management worldwide (Corlett, 2016; du Toit & Pettorelli, 2019; Wynne-Jones et al., 2020). Evaluation of the suitability and feasibility of such biodiversity restoration projects is integral to effective conservation decision-making (Taylor et al., 2017; Torres et al., 2018), and insufficient assessments during project planning can lead to unexpected outcomes and potential failure. For example, the great bustard *Otis tarda* was reintroduced to Britain based on historical evidence for post-AD 1500 occurrence, but critical assessment of the zooarchaeological record suggests it was probably a historical-era introduction (Yalden & Albarella, 2009), and population viability analysis of the newly-established British population reveals limited likelihood of long-term reintroduction success (Ashbrook et al., 2016).

Conservation does not take place in purely ecological systems, but instead in social-ecological systems containing both human and non-human actors and processes (Berkes & Folke, 1998). Social as well as ecological dimensions of biodiversity restoration must therefore be evaluated before making management decisions about whether such actions are feasible or appropriate within particular landscapes. Local stakeholders can both impact and be impacted by conservation interventions, and key social baselines that must be understood include patterns of local awareness and enthusiasm for proposed activities, and potential areas of concern or conflict (Bennett et al., 2017; Consorte-McCrea et al., 2022; Dando et al., 2022). Local support is a key component of success in environmental restoration and rewilding, particularly for projects that involve species reintroductions (Berger-Tal et al., 2020; Hiroyasu et al., 2019), and early assessment of social feasibility is demonstrated to contribute toward successful project outcomes by enabling development of long-term relationships involving knowledge-sharing, trust and respect between stakeholders (Dando et al., 2022). For example, it is important to understand factors that influence social attitudes about potential conservation actions, guide appropriate educational or communication strategies, and assess project feasibility across existing stakeholders with differing characteristics, values and experiences (Lessard et al., 2021; Redpath et al., 2013). Such attitudes are correlated with socio-demographic and lifestyle factors (Martin et al., 2021; Martin & Czellar, 2017), and with species' ecological, taxonomic and visual traits, which influence people's emotional response and perception of instrumental value, utility, or 'cultural ecosystem services' (Echeverri et al., 2020; Gunnthorsdottir, 2001; Serpell, 2004). However, although attitudinal variation can affect stakeholder behaviour and influence project success (Milfont et al., 2010), local attitudes toward biodiversity and conservation, and their underlying drivers and relationships, are often not investigated or understood when assessing the potential feasibility of species reintroductions (Dando et al., 2022). Indeed, reintroductions of keystone taxa in many landscapes (e.g. beaver *Castor fiber* and wild boar *Sus scrofa* in Britain) have occurred without social feasibility studies, causing controversy and conflict with local stakeholders (Auster et al., 2021b; Coz & Young, 2020; Dutton et al., 2015).

Extirpated large bird species are an increasing focus of reintroduction planning (Dennis, 2021; Taylor, 2011) but the human dimensions of bird reintroductions and associated human-bird interactions are still poorly understood or explored (Martins et al., 2022). In particular, freshwater wetlands have experienced extensive habitat conversion and biodiversity loss at a global scale (Davidson, 2014), and regionally extirpated wetland birds are now being reintroduced to many landscapes through conservation efforts aiming to restore biodiversity and ecosystem services, with species' habitat requirements often used to guide wider landscape management and restoration (Li et al., 2021; Naito et al., 2014; Naito & Ikeda, 2007; Park et al., 2017; Seddon, 2011). In Britain, there has been recent discussion about the possibility of reintroducing the Dalmatian pelican *Pelecanus crispus* to wetland landscapes (Macdonald, 2019). This species is recorded in Britain's subfossil and zooarchaeological records during the Bronze Age, Iron Age, Roman Era and possibly Medieval Era, with former breeding populations documented from Britain's

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two largest freshwater wetland systems, the Somerset Levels and East Anglian Fens (Crees et al., 2023; Yalden & Albarella, 2009). It probably became extinct in Britain between one and two millennia ago, due to a combination of wetland drainage and hunting and disturbance from growing human populations (Crees et al., 2023; Yalden & Albarella, 2009) (Figure 1). Dalmatian pelicans are now restricted to southeast Europe and Asia, and are listed as Near Threatened by IUCN (Catsadorakis & Portolou, 2018).

Dalmatian pelican reintroduction planning in Britain is still at the discussion stage, with no official reintroduction application yet made. The reintroduction is primarily being considered with a goal to re-establish a viable pelican population and restore past wetland bird diversity, but it is likely that wider wetland restoration would also be necessary to provide suitable pelican nesting and feeding habitats, with pelican reintroduction thus having a wider role for restoring wetland ecosystem functions and processes (Macdonald, 2019; Yalden & Albarella, 2009). Any such reintroduction would require considerable research to understand the ecological conditions and human-environmental interactions associated with past pelican occurrence and disappearance, the suitability of existing British freshwater wetlands to support pelicans, and potential landscape restoration targets required to maintain viable populations (Crees et al., 2023). However, reintroduction within the densely populated British landscape must also assess social feasibility (IUCN/SSC, 2013), including assessing and accommodating community attitudes, awareness and acceptance toward proposed pelican arrival and associated habitat management, and the extent to which reintroduction might be appropriate or not in light of these factors (Dando et al., 2022). Pelicans are distinctive large-bodied birds with potential to act as flagship species for wetlands (Kalinkat et al., 2017), and thus might increase public support for wetland conservation and restoration and generate revenue through ecotourism (Thomas-Walters & Raihani, 2017; Walpole & Leader-Williams, 2002). However, direct impacts from people remain one of the greatest threats to Dalmatian pelican survival across their current range (Catsadorakis & Portolou, 2018). In particular, pelicans are piscivorous and thus might provoke conflict due to real or perceived competition with commercial fishers or recreational anglers (O'Gorman, 2016), and conflicts between fishers and Dalmatian pelicans associated with perceived fishery depletion are documented within parts of the species' remaining European range (Daoutopoulos & Pyrovetsi, 1990; Pyrovetsi & Daoutopoulos, 1989). Similar negative attitudes among freshwater resource users exist across Britain and continental Europe toward great cormorants *Phalacrocorax carbo*, another pelecaniform that has expanded its range into freshwater habitats in recent decades, and cormorants are persecuted in Britain and elsewhere (Marzano et al., 2013; Rauschmayer & Weiss, 2013; Wires, 2014).

Fishers' attitudes toward Dalmatian pelicans and other waterbirds have been investigated in northern Greece, within a landscape where the species has always occurred and where local economies are dependent upon artisanal fishing (Daoutopoulos & Pyrovetsi, 1990; Pyrovetsi & Daoutopoulos, 1989). However, there is currently no baseline on awareness and attitudes toward pelicans across a wider range of local stakeholders within different socioeconomic landscapes where the species is extirpated but might be reintroduced. To understand local views on potential pelican reintroduction and associated wetland restoration in British landscapes, and to investigate correlates of positive or negative attitudes toward coexistence with pelicans and other waterbirds, we therefore conducted an online survey in the Somerset Levels and East Anglian Fens. Our study aligns with the best-practice guidelines for social feasibility assessments for conservation translocations recently developed by Dando et al. (2022), and serves as a model for evaluating social baselines and incorporating them as a key component into decision-making around biodiversity restoration within social-ecological systems. Our findings further provide a new understanding of factors that might predispose people to like or dislike animal species that are present or likely to be reintroduced within their local landscapes.

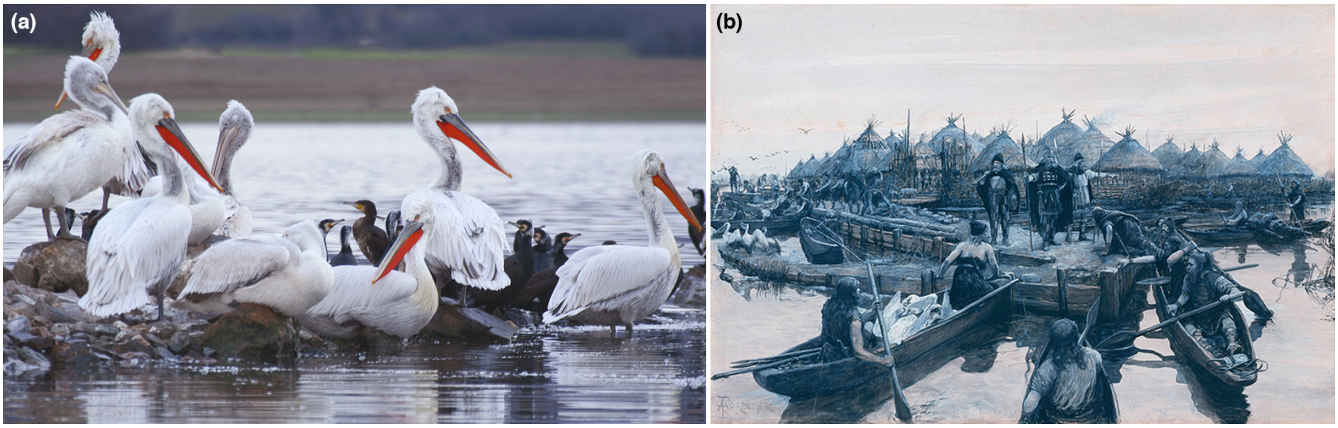



**FIGURE 1** (a) Dalmatian pelicans and great cormorants at Lake Kerkini, northern Greece. Photograph courtesy of Giorgos Catsadorakis (IUCNSSC Pelican Specialist Group (Old World) and Society for the Protection of Prespa). (b) Reconstruction of the Iron Age site of Glastonbury Lake Village in the Somerset Levels, depicting a group of Dalmatian pelicans (at left), and hunters returning from a waterbird hunt. Illustration by A. Forestier from *The Illustrated London News*, 11 December 1911.

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## 2 | METHODS

### 2.1 | Questionnaire survey

Because of restrictions on travel and social interaction during the Covid-19 pandemic, data were collected using a 15-min online questionnaire on the Qualtrics platform (www.qualtrics.com), which contained a mix of closed and open questions (Text S1). The questionnaire was distributed through a combination of purposive and snowball sampling approaches (Newing, 2011): it was shared to 142 local community groups on Facebook, emailed to parish clerks and district councillors in each study region, and advertised through the Zoological Society of London's Facebook page, with recipients asked to share the questionnaire with their social networks. Participation was restricted to residents of the Somerset Levels and East Anglian Fens by using an initial screening question that asked whether the respondent lived in either region, with those who chose 'No' unable to continue the survey. The questionnaire was piloted with 44 respondents from Somerset on 21–23 April 2021; as there were no major changes to survey design after piloting, these data were included in analysis. Other responses were collected between 10 May and 4 July 2021.

Before answering any questions, respondents were informed that the purpose of the survey was to explore local experience, knowledge and attitudes about nature, and knowledge of landscape and biodiversity change over time (with specific mention of pelicans or other species avoided at this stage to avoid influencing participation or responses); that participation was voluntary; that they could withdraw at any time during or up to 14 days after the survey and their results would not be saved; and that they would not be identified individually and their data would be retained in an anonymised form. The opening set of questions then asked for written informed consent to participate in the survey, which all respondents had to complete before they could answer the remainder of the questionnaire. Ethical approval for study design was provided by the Imperial College Research and Integrity Team (reference: 21IC6769).

Information was first collected on respondents' socio-demographic characteristics (age, gender, education, occupation, urban–rural residence type, duration of residence in the study region, land ownership). Respondents were asked whether they were members of hunting, angling, or local or national nature conservation organisations, and whether they took part in nature-related activities (including birdwatching, hunting and angling). Nature-relatedness was measured using a five-point Likert scale with six items using the NR-6 scale (Nisbet et al., 2009; Nisbet & Zelenski, 2013). Respondents were then asked whether they had heard of rewilding; to free-list any species they knew had become locally extinct, that they would like or dislike to be reintroduced locally, and that they knew had already been reintroduced locally; and their attitudes about these past reintroductions, measured using a five-point Likert scale (extremely good to extremely bad, with neutral midpoint).

Respondents were then asked about their knowledge and attitudes concerning six large waterbird species present in the study areas now or in the past: grey heron *Ardea cinerea*, Eurasian bittern *Botaurus stellaris*, little egret *Egretta garzetta*, Dalmatian pelican, common crane *Grus grus* and great cormorant. These species have different local population histories and human-wildlife interactions (Yalden & Albarella, 2009): heron has always been regionally common; bittern was rare in past decades but has increased in response to wetland management; egret was probably not historically native but has recently colonised naturally; crane was formerly native and has recently re-established, naturally in the Fens (Buxton & Durdin, 2011), and through reintroduction in Somerset since 2010 through the Great Crane Project (Stanbury & Sills, 2012); and cormorant has increased and is perceived to compete with anglers for fish. Respondents were shown a picture of each species, and asked to name them, choose whether they occur locally or have ever/always occurred there in the past, and rate their attitude to each species using a five-point Likert scale (strongly like to strongly dislike, with neutral midpoint).

Finally, after being informed that Dalmatian pelicans had been locally resident during prehistory, respondents were asked to list any benefits or concerns they saw about potential pelican reintroduction, whether they would support it (measured using a five-point Likert scale from very supportive to very unsupportive, with neutral midpoint), and what they might want to know about pelicans that could influence their opinion about the species' reintroduction. They were then asked eight 5-point Likert scale questions (strongly agree to strongly disagree, with neutral midpoint) about their attitudes toward different aspects or implications of wetland restoration, and a further question about whether they agreed with the statement "It doesn't matter to me that much", to capture their wider opinion about wetland restoration in general.

### 2.2 | Survey data analysis

Statistical analyses were conducted in R version 4.0.3 (R Core Team, 2020), with model predictors given in Table 1. All geographic, socio-demographic and behavioural (nature-related activity and organisational membership) variables and nature-relatedness scores were used as predictors in all models unless otherwise specified. Only nine respondents reported either 'prefer not to say' or 'other' as their gender, so analyses were conducted without these respondents to reduce the number of two-way comparisons included in models. Occupation responses were grouped into outdoor and 'other' categories. Residence duration was calculated as proportion of respondent age, to reduce potential collinearity between these two variables. Composite knowledge scores were calculated by summing the combined number of correct responses to sets of questions, with no points deducted for wrong answers: (1) knowledge score: questions on local avifauna, local extinctions and past reintroductions, and whether respondents had heard of rewilding (excluding questions on pelicans); maximum score = 18; (2) knowledge about pelicans: accurate identification and knowledge of past and present status; maximum score = 3. Overall scores for Likert-scale questions on nature-relatedness (six questions) and attitudes toward wetland restoration (eight questions)

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**TABLE 1** Predictor variables included in different models investigating respondent awareness and attitudes toward reintroductions, waterbirds and wetland restoration. Asterisks indicate composite scores.

| | | Models in which variable is included as a predictor | | | | | |
|---|---|---|---|---|---|---|---|
| Variable | Data type | Attitude toward past reintroductions | Attitude toward waterbird species | Reintroduction benefits | Reintroduction concerns | Reintroduction support | Attitude toward wetland restoration* |
| Region | Binary | Y | Y | Y | Y | Y | Y |
| Age | Continuous | Y | Y | Y | Y | Y | Y |
| Gender | Categorical | Y | Y | Y | Y | Y | Y |
| Education | Continuous | Y | Y | Y | Y | Y | Y |
| Occupation | Categorical | Y | Y | Y | Y | Y | Y |
| Residence duration | Proportion | Y | Y | Y | Y | Y | Y |
| Residence type | Continuous | Y | Y | Y | Y | Y | Y |
| Local conservation organisation | Binary | Y | Y | Y | Y | Y | Y |
| National conservation organisation | Binary | Y | Y | Y | Y | Y | Y |
| Angling | Binary | Y | Y | Y | Y | Y | Y |
| Hunting | Binary | Y | Y | Y | Y | Y | Y |
| Birding | Binary | Y | Y | Y | Y | Y | Y |
| Landowner | Binary | Y | Y | Y | Y | Y | Y |
| Nature relatedness* | Continuous | Y | Y | Y | Y | Y | Y |
| Knowledge score* | Continuous | | | | Y | Y | Y |
| Pelican knowledge* | Continuous | | | | Y | Y | Y |
| Attitude toward pelicans | Continuous | | | | Y | Y | Y |

were also calculated using the mean of values across all responses for these sets of questions, and with internal consistency checked using Cronbach's alpha (values >0.7 considered acceptable; Tavakol & Dennick, 2011). Variables were transformed using Box–Cox transformation if necessary for linear models. Variance inflation factors were assessed to limit multicollinearity, with values <3 considered acceptable (Craney & Surles, 2002).

Chi-squared tests and *t*-tests were used to investigate differences between respondent samples from Somerset and the Fens (all socio-demographic and behavioural characteristics), and between samples from each region compared to available census data on age (five age-bins), gender and education for each wider sampled population (available for Somerset and Cambridgeshire; www.somersetintelligence.org.uk/census2011/, www.ukcensusdata.com/cambridgeshire-e10000003). For the subset of respondents who listed a reintroduction, factors predicting attitudes toward past reintroductions were investigated using Bayesian ordinal logistic models with a Cauchy prior distribution in the R package 'ARM' (Gelman & Su, 2020). Ordinal logistic regressions were run separately to investigate factors that predicted affinity for each waterbird species.

Factors predicting whether a respondent reported benefits or concerns about pelican reintroduction were investigated using binomial logistic models; concerns listed in open-ended questions were divided into two categories (reintroduction feasibility, and impact of reintroduction), with a chi-squared test used to investigate whether being an angler was associated with listing a particular category. Factors predicting support for pelican reintroduction were investigated using a Bayesian ordinal logistic model, with predictors including knowledge score, pelican knowledge score, and attitude toward pelicans. Factors predicting attitudes toward habitat restoration were investigated using the same predictors as reintroduction support, using a linear model with Box–Cox transformation to account for a left skew in the data. Model selection was performed for all regression models using an automated backward stepwise approach based on AIC values, where variables with the lowest significance were sequentially removed when the removal did not impair model fit, and with the final selected model having the lowest AIC value (Chowdhury & Turin, 2020). Only the best-fit models are reported for each analysis. The *p*-values of best-fit models were adjusted for multiple comparison using Holm adjustment (Holm, 1979).

## 3 | RESULTS

### 3.1 | Respondent sample

In total, 590 respondents completed the questionnaire, including 271 from the Somerset Levels and 319 from the Fens. Most respondent characteristics were similar for the two regions, although respondents from Somerset were statistically more likely to belong to local

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and national conservation organisations (Table 2). Respondent samples showed some differences from the characteristics of the wider populations of both regions: significantly more respondents were middle-aged (45–65) (Somerset: $\chi^2 = 20.4$, df = 4, $p < 0.001$; Fens: $\chi^2 = 20.3$, df = 4, $p < 0.001$) and university-educated (Somerset: sample = 54.6%, wider population = 25.6%, $\chi^2 = 120.8$, df = 1, $p < 0.001$; Fens: sample = 46.8%, wider population = 33.0%, $\chi^2 = 27.1$, df = 1, $p < 0.001$), and significantly fewer were female (Somerset: sample = 41.7%, wider population = 51.2%, $\chi^2 = 9.41$, df = 1, $p = 0.002$; Fens: sample = 36.4%, wider population = 50.2%, $\chi^2 = 73.8$, df = 1, $p < 0.001$).

Overall, respondents had high nature-relatedness scores, with respondents from Somerset having higher scores (Somerset: mean = 4.35/5; Fens: mean = 4.26/5; $t = -2.03$, $p = 0.042$). Mean respondent knowledge score was 11.7/18 (SD = 4.52), with no regional difference in scores ($t = 1.64$, df = 181.57, $p = 0.102$). Most respondents (89.8%) were aware of the concept of rewilding, with no regional difference in awareness ($\chi^2 = 3.72$, df = 1, $p = 0.054$).

**TABLE 2** Socio-demographic and behavioural characteristics of our respondent sample, and differences between two survey regions (significant differences highlighted in bold).

| Variable | Somerset levels | East Anglian fens | Difference between regions |
|---|---|---|---|
| Age (years) | | | |
| Mean (SD) | 57.4 (12.4) | 55.8 (13.8) | $t = -1.46$, $p = 0.145$ |
| Gender | | | |
| Women | 41.7% | 36.4% | |
| Men | 57.2% | 61.8% | |
| Other/Prefer not to say | 1.1% | 1.8% | $\chi^2 = 1.95$, $p = 0.541$ |
| Education | | | |
| No formal education | 2.2% | 1.6% | |
| Secondary education | 14.8% | 23.3% | |
| Further education | 23.7% | 22.6% | |
| Undergraduate | 32.6% | 24.2% | |
| Postgraduate | 21.9% | 22.6% | |
| Other/Prefer not to say | 4.8% | 5.7% | $\chi^2 = 9.76$, $p = 0.135$ |
| Residence type | | | |
| Town | 8.2% | 11.6% | |
| Small town | 25.9% | 23.6% | |
| Village | 48.5% | 48.7% | |
| Isolated | 17.4% | 16.0% | $\chi^2 = 2.26$, $p = 0.520$ |
| Residence duration (years) | | | |
| Mean (SD) | 27.1 (19.2) | 27.5 (19.9) | $t = 0.62$, $p = 0.805$ |
| Nature-related organisations | | | |
| Local conservation organisation | 37.0% | 18.2% | $\chi^2 = 25.3$, **$p < 0.001$** |
| National conservation organisation | 40.7% | 29.9% | $\chi^2 = 7.12$, **$p = 0.008$** |
| Angling organisation | 4.1% | 7.6% | $\chi^2 = 2.56$, $p = 0.110$ |
| Hunting organisation | 4.4% | 3.1% | $\chi^2 = 0.37$, $p = 0.083$ |
| Nature-related activities | | | |
| Birdwatching | 65.2% | 60.4% | $\chi^2 = 1.24$, $p = 0.265$ |
| Angling | 10.4% | 12.6% | $\chi^2 = 0.50$, $p = 0.481$ |
| Hunting | 5.2% | 6.9% | $\chi^2 = 0.49$, $p = 0.483$ |
| Landowner | | | |
| Yes | 20.0% | 17.6% | $\chi^2 = 0.40$, $p = 0.526$ |
| Occupation | | | |
| Outdoor | 11% | 10% | |
| Other | 89% | 90% | $\chi^2 = 0.58$, $p = 0.745$ |

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### 3.2 | Knowledge and attitudes about extinctions and reintroductions

In total, 45.4% of respondents correctly listed at least one locally extinct species, with higher correct response levels in Somerset ($\chi^2 = 64.9$, df = 1, $p < 0.001$). Beaver was listed most frequently in both regions (Somerset: 47.6% of correct responses; Fens: 21.9% of correct responses). Overall, 56.3% of respondents listed a species they would like reintroduced ($n = 73$ species), with beaver the highest-named species by far (36.4% of positive responses referring to valid candidates for reintroduction). Only 17.3% listed a species they would not like reintroduced ($n = 24$ species), with wolf *Canis lupus* the highest-named species (36.4% of negative responses referring to valid candidates for reintroduction) (Figure 2). Before they were mentioned by name in the questionnaire, pelicans were given as a preferred species by 15 respondents (14 from Somerset, one from the Fens) and a non-preferred species by one respondent (from Somerset).

Overall, 28.6% of respondents correctly listed a locally reintroduced species, with different highest-named species in each region (Somerset: common crane, 94.4% of correct responses; Fens: otter *Lutra lutra*, 60.4% of correct responses). Respondents from Somerset were more likely to list a species (Somerset: 46.5%; Fens: 13.5%; $\chi^2 = 76.5$, df = 1, $p < 0.001$). Most respondents (87.6%) had a positive view of past reintroductions. In the best-fit model for attitudes toward past reintroductions (AIC = 472.22), respondents who correctly listed reintroduced species were more likely to have negative attitudes if they hunted (est = −1.41, SE = 0.40, *t*-value = −3.50, $p < 0.001$). Living in Somerset and being a member of a local conservation organisation were also near-significant predictors of positive attitudes (Somerset: est = 0.60, SE = 0.28, *t*-value = 2.10, $p = 0.054$; local conservation organisation: est = 0.70, SE = 0.31, *t*-value = 2.26, $p = 0.054$), and angling was a near-significant predictor of negative attitudes (est = −0.89, SE = 0.38, *t*-value = −2.37, $p = 0.054$).

### 3.3 | Knowledge and attitudes about waterbirds

Respondent knowledge varied considerably across the six birds in terms of accurate identification (43.9%–89.6% of respondents answering correctly), current residence status (35.3%–96.6%), and past residence status (5.6%–40.5%), with highest correct responses for identification and current status of heron and past status of cormorant (Table 3). In total, 80.3% of respondents correctly identified pelicans (accepting either 'Dalmatian pelican' or 'pelican' as a correct answer), and 79.8% knew they were currently absent from Britain, but only 5.6% knew pelicans were former natives, with no regional difference in identification ($\chi^2 = 0.99$, df = 1, $p = 0.320$), knowledge of current status ($\chi^2 = 0.14$, df = 1, $p = 0.705$), or knowledge of past status ($\chi^2 = 0.91$, df = 1, $p = 0.339$). Respondents had overall positive

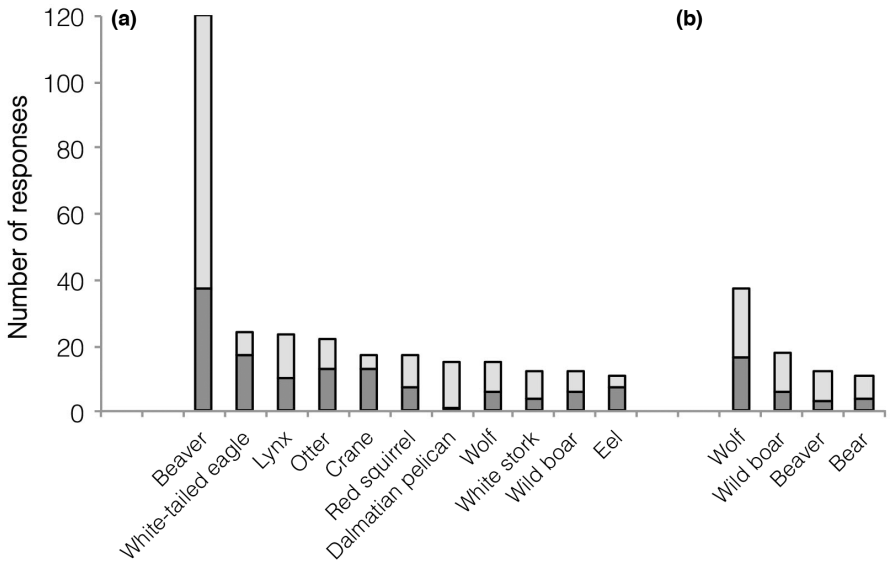



FIGURE 2 Species named by ≥10 respondents in open-ended questions about possible candidates for local reintroduction. (a) species that respondents would like to be reintroduced locally; (b) species that respondents would not like to be reintroduced locally. Key: Fens, dark grey; Somerset, pale grey. 'White-tailed eagle' also includes birds just described as 'eagle', and 'Dalmatian pelican' also includes birds just described as 'pelican'. Generic groupings of species mentioned by some respondents (e.g. 'birds of prey', 'top predators', 'butterflies') are not included.

| Species | Correctly identified | Correct current residence | Correct past residence | Attitude (± SE) |
|---|---|---|---|---|
| Grey heron | 89.6% | 96.6% | 35.8% | 4.50 ± 0.03 |
| Eurasian bittern | 60.0% | 56.3% | 27.6% | 4.22 ± 0.05 |
| Little egret | 68.0% | 66.8% | 13.9% | 4.33 ± 0.03 |
| Dalmatian pelican | 80.3% | 79.8% | 5.6% | 3.91 ± 0.04 |
| Common crane | 43.9% | 35.3% | 26.4% | 4.01 ± 0.04 |
| Great cormorant | 67.6% | 66.9% | 40.5% | 3.85 ± 0.04 |

TABLE 3 Summary of respondent knowledge and attitudes about six waterbird species, showing percentages of our respondent sample who could correctly identify each species and who knew their current and former residence status in Britain, and attitude scores for each species based on a five-point Likert scale.

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attitudes (>3/5) toward all species (Table 3), with heron most liked (mean score = 4.50) and cormorant least liked (mean score = 3.85). Pelican was the second least-liked species (mean score = 3.91).

Predictors of positive or negative attitudes varied across species in the best-fit models for attitudes toward different waterbird species (Table 4). Higher nature-relatedness predicted more positive attitudes toward all species; birders had more positive attitudes toward heron, egret, crane and cormorant (also near-significant for pelican); members of local conservation organisations had more positive attitudes toward bittern, egret and crane; and members of national conservation organisations had more positive attitudes toward bittern. Conversely, hunters had less positive attitudes toward heron, crane and cormorant (also near-significant for pelican); anglers had less positive attitudes toward cormorant (also near-significant for pelican); respondents living in more isolated rural areas had less positive attitudes toward heron; female respondents had less positive attitudes toward crane; and landowners had near-significant less positive attitudes toward pelican.

## 3.4 | Attitudes toward pelican reintroduction and wetland restoration

Overall, 185 respondents listed benefits of pelican reintroduction (including ecotourism opportunities, excitement at seeing pelicans, and improved ecosystem functioning). Conversely, 264 respondents

**TABLE 4** Significant positive or negative predictors of attitudes toward six waterbird species in best-fit models, based on ordinal logistic regressions and automated backward stepwise model selection using AIC values. The *p*-values that are nearly significant following Holm adjustment are included in italics.

| Predictor | Estimate | Standard error | *t*-value | *p*-value |
|---|---|---|---|---|
| 1. Grey heron (best-fit model: AIC = 1031.31) | | | | |
| Residence type | −0.29 | 0.11 | −2.70 | 0.018 |
| Hunting | −0.95 | 0.32 | −2.94 | 0.018 |
| Birding | 0.53 | 0.18 | 2.86 | 0.018 |
| Nature relatedness | 0.75 | 0.17 | 4.56 | <0.001 |
| 2. Eurasian bittern (best-fit model: AIC = 1055.76) | | | | |
| Local conservation organisation | 1.26 | 0.24 | 5.22 | <0.001 |
| National conservation organisation | 0.71 | 0.21 | 3.43 | 0.011 |
| Nature relatedness | 1.17 | 0.17 | 7.05 | <0.001 |
| 3. Little egret (best-fit model: AIC = 1070.38) | | | | |
| Birding | 0.56 | 0.18 | 3.11 | 0.006 |
| Local conservation organisation | 0.76 | 0.22 | 3.42 | 0.004 |
| Nature relatedness | 1.22 | 0.16 | 7.48 | <0.001 |
| 4. Dalmatian pelican (best-fit model: AIC = 1364.45) | | | | |
| Hunting | −0.96 | 0.37 | −2.56 | *0.055* |
| Angling | −0.59 | 0.27 | −2.20 | *0.063* |
| Birding | 0.41 | 0.17 | 2.44 | *0.060* |
| Landowner | −0.47 | 0.21 | −2.30 | *0.063* |
| Nature relatedness | 0.73 | 0.15 | 4.94 | <0.001 |
| 5. Common crane (best-fit model: AIC = 1085.56) | | | | |
| Gender: female | −0.54 | 0.18 | −2.92 | 0.015 |
| Hunting | −0.88 | 0.35 | −2.50 | 0.048 |
| Birding | 0.71 | 0.19 | 3.80 | <0.001 |
| Local conservation organisation | 0.72 | 0.22 | 3.35 | 0.006 |
| Nature relatedness | 1.02 | 0.17 | 5.94 | <0.001 |
| 6. Great cormorant (best-fit model: AIC = 1479.34) | | | | |
| Hunting | −1.50 | 0.35 | −4.33 | <0.001 |
| Angling | −1.15 | 0.28 | −4.03 | <0.001 |
| Birding | 0.48 | 0.17 | 2.88 | 0.016 |
| Nature relatedness | 0.78 | 0.15 | 5.35 | <0.001 |

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listed concerns (reintroduction feasibility, 36.8% of responses; reintroduction impacts, 63.1% of responses: including pelicans' effect on ecosystems, especially on fisheries, and social acceptance by anglers) (Figure 3). Two respondents were concerned as they thought pelicans were not native species. In the best-fit model for reintroduction benefits (AIC = 676.41), respondents were more likely to list benefits if they had higher nature-relatedness (est = 0.65, SE = 0.19, *z*-value = 3.32, $p = 0.005$), and less likely if they were older (est = −0.03, SE = 0.01, *z*-value = −4.39, $p < 0.001$) or female (est = −0.72, SE = 0.20, *z*-value = −3.51, $p = 0.003$). In the best-fit model for reintroduction concerns (AIC = 771.68), respondents were more likely to list concerns if they were anglers (est = 0.96, SE = 0.29, *z*-value = 3.36, $p = 0.005$), and anglers were significantly more likely to list a concern about impacts than about feasibility compared to the overall sample ($\chi^2 = 6.21$, df = 1, $p = 0.013$).

When asked whether they would support pelican reintroduction, 4.9% of respondents were strongly against, 7.6% were against, 14.9% were neutral, 35.9% supported, 29.0% strongly supported, and 7.6% were unsure. In the best-fit model for reintroduction support (AIC = 1716.09), respondents were more likely to support reintroduction if they had more positive attitudes toward pelicans (est = 0.52, SE = 0.09, *t*-value = 5.85, $p < 0.001$), and less likely if they hunted (est = −1.57, SE = 0.36, *t*-value = −4.32, $p < 0.001$). Higher nature-relatedness was also a near-significant predictor of greater likelihood of support (est = 0.36, SE = 0.14, *t*-value = 2.58, $p = 0.060$).

Mean attitude toward wetland restoration scored 3.72/5 (SD = 0.61). In the best-fit model for attitude toward wetland restoration (AIC = 2298.67), more positive attitudes were associated with higher nature-relatedness (est = 0.76, SE = 0.14, *t*-value = 5.35, $p < 0.001$), positive attitudes toward pelicans (est = 0.36, SE = 0.07, *t*-value = 5.21, $p < 0.001$), birding (est = 0.45, SE = 0.17, *t*-value = 2.70, $p = 0.030$) and membership of local conservation organisations (est = 0.49, SE = 0.18, *t*-value = 2.75, $p = 0.030$), and less positive attitudes were associated with older age (est = −0.03, SE = 0.01, *t*-value = −5.84, $p < 0.001$) and being a hunter (est = −2.34, SE = 0.33, *t*-value = −7.02, $p < 0.001$), landowner (est = −0.64, SE = 0.20, *t*-value = −3.27, $p = 0.007$) or angler (est = −0.65, SE = 0.25, *t*-value = −2.64, $p = 0.030$). Over half of respondents (53.7%) strongly disagreed with the statement "It doesn't matter to me that much", 15.4% somewhat disagreed, and only 5.2% agreed or strongly agreed.

## 4 | DISCUSSION

Our study provides the first baseline on stakeholder awareness and attitudes toward a suite of wetland bird species, including the regionally extinct Dalmatian pelican, and associated biodiversity restoration topics across two British social-ecological landscapes. Overall, few respondents were aware of the Dalmatian pelican's status as a former native British species; this is unsurprising, given that pelicans probably became extinct in Britain over a thousand years ago (Crees et al., 2023), and is possibly the reason they were slightly less liked than most locally occurring waterbirds. However, pelicans were generally well-recognised and liked by respondents in our study, who were also generally supportive of the possibility of pelican reintroduction and associated habitat restoration. We thus

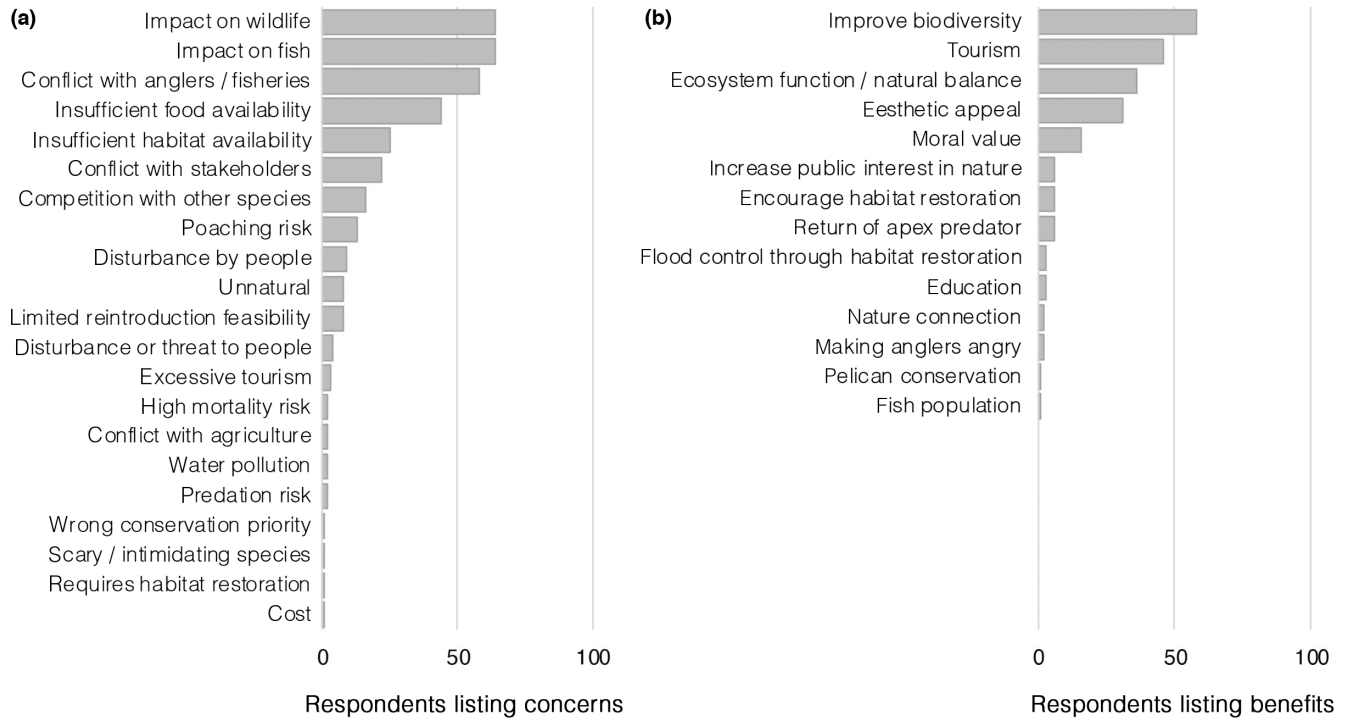



**FIGURE 3** Numbers of respondents who listed different perceived (a) concerns and (b) benefits associated with potential pelican reintroduction.

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support the findings of previous studies that stakeholder attitudes toward reintroduction of species such as large waterbirds are not necessarily affected by knowledge of species' past status (Sakurai et al., 2022). These findings also suggest that communities in both the Somerset Levels and the Fens could engage well with any future plans to restore Dalmatian pelicans to Britain, and that the species has potential to become a flagship for wider wetland restoration.

Through this study, residents of British wetland landscapes who were interested and/or potentially affected by a pelican reintroduction were provided with a platform and voice to directly engage with, and therefore inform, decision-making around any future reintroduction proposals. However, we recognise that despite our efforts to conduct representative sampling, the limitations imposed by remote data collection during the Covid-19 pandemic meant that our respondent samples show some differences from the socio-demographic characteristics of the wider populations of both regions, containing a greater proportion of highly educated middle-aged males. Furthermore, over 60% of respondents in both landscapes reported that they went birdwatching, and c. 20%–40% were members of national or local conservation organisations. In contrast, available national estimates suggest that only between three and six million people regularly go birdwatching (www.rspb.org.uk/birds-and-wildlife/wildlife-guides/birdwatching/the-birdwatchers-code/, www.birdspot.co.uk/bird-watching) and only 4.5 million people are members or supporters of UK environmental or conservation groups (Cracknell et al., 2013), representing less than 10% of the UK's population. Local residents who were more engaged with nature-related activities may thus have been more likely to complete our survey, following a common pattern in interview surveys where people show greater participation in research that feels relevant to them (Coon et al., 2020). Therefore, while respondents in both landscapes tended to be knowledgeable about local nature and rewilding, have high nature-relatedness and positive attitudes toward all target birds and species reintroductions, and report that conservation issues mattered to them, we cannot assume these patterns are necessarily shared by unsampled inhabitants of the Somerset Levels or the Fens or that our findings reflect the views of the wider public.

However, relative patterns demonstrated by our data provide important insights for informing and evaluating regional conservation actions. For example, respondents from both regions were more likely to list a preferred than a non-preferred species for reintroduction, indicating generally positive attitudes toward reintroductions; and mammals rather than birds were most frequently named as non-preferred reintroduction candidates, providing further indirect evidence that pelican (or other avian) reintroduction might be locally supported. Our results also show a relationship between strong local awareness of crane reintroduction and increased wider positive attitudes toward reintroductions in Somerset, providing potential evidence for societal support of the Great Crane Project and effectiveness of its community outreach in changing local perceptions (Taylor, 2011). Furthermore, while our dataset cannot provide insights into absolute baseline patterns of people's awareness and attitudes about pelicans and wetland conservation issues across the two study regions, we did not intend to achieve this goal; instead, our aim was to capture sufficient variation around different knowledge and environmental values and different socio-demographic and behavioural characteristics of interest within our respondent sample, to understand how these variables influenced responses in our questionnaire survey. Our dataset thus enables us to identify key factors associated with differing patterns of awareness and attitudes toward pelicans and other biodiversity within our study regions. These findings have important implications for understanding how different local stakeholders might respond to future coexistence with pelicans and associated landscape management, and provide important new baselines for informing targeted community engagement and other conservation planning.

Our models reveal that several predictors showed significant relationships with positive or negative attitudes toward different waterbirds, species reintroductions and wetland restoration. However, most significant relationships involved a reduced set of specific variables. Overall, generally similar patterns were seen between predictors of specific attitudes toward pelicans, wetland restoration required to support pelican reintroduction, and other waterbirds and wider reintroductions, indicating that societal views on potential pelican reintroduction reflect wider regional attitudes toward local biodiversity and its applied management. Some patterns are unsurprising, in particular the more positive attitudes toward all waterbirds and toward pelican and other reintroductions and wetland restoration by respondents with higher nature-relatedness, and the more positive attitudes toward most waterbirds, wetland restoration and/or reintroductions by respondents who identified as birders or were members of conservation organisations. These attributes are all known to be strongly correlated with pro-environmental attitudes and behaviour (Nisbet et al., 2009). Interestingly, local conservation organisation membership explained considerably more variation in positive attitudes toward both locally occurring waterbirds and conservation management actions than national conservation organisation membership did, suggesting that this predictor might represent a better indicator of personal investment in local biodiversity. Conservation organisation membership was also specifically correlated with more positive attitudes toward all three waterbirds that occurred locally today but had formerly been rare or absent in the study regions within living memory (bittern, little egret, crane), suggesting that this attribute is associated with greater understanding of local environmental change.

Negative perceptions about local biodiversity and conservation were similarly associated with relatively few socio-demographic predictors across our models, with hunters and anglers constituting the two main stakeholder groups who exhibited more negative attitudes toward pelicans, other waterbirds and/or wetland restoration. These groups also exhibit more negative attitudes toward pelicans and other waterbirds in areas of southeastern Europe where Dalmatian pelicans still occur (Daoutopoulos & Pyrovetsi, 1990; Pyrovetsi & Daoutopoulos, 1989), and will be essential to engage with closely if pelican reintroduction planning goes ahead, to move beyond information-provisioning and seek to build trust and confidence.

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Previous studies have found varying evidence over whether hunters engage in pro-environmental behaviour in other systems (Raynal et al., 2020), with increased understanding of sustainable resource use potentially offset by domination value orientation (Cooper et al., 2015; Ghasemi & Kyle, 2021), and with regional differences in traditional or utilitarian wildlife value orientations between hunting communities (Daigle et al., 2002; Gamborg & Jensen, 2016). However, hunters have also been demonstrated to hold generally negative perceptions about other species reintroductions (Grima et al., 2021).

Concerns about potential conflict with anglers are of particular importance for pelican reintroduction planning, as specific conflicts already exist between cormorants and anglers in many British freshwater systems (Harris et al., 2008; Marzano et al., 2013; Parrott et al., 2003). Anglers in our study only held significant or near-significant negative perceptions about cormorants and pelicans, supporting the possibility of similar conflicts over fish resources with reintroduced pelicans, and many of the potential concerns raised about pelican reintroduction in our overall respondent sample related to the possibility that anglers in particular would oppose it. However, hunters also held negative attitudes toward cormorants in our study, with this stakeholder group additionally negative about other species (heron, crane), suggesting a more general dislike of large waterbirds. Furthermore, anglers and hunters showed differing patterns of support for possible restoration of pelicans to their local landscape: whereas hunters were specifically less likely to support pelican reintroduction and were also more negative about reintroductions in general, anglers raised significantly more concerns about pelican reintroduction, in large part related to lack of information on potential impacts, but were not statistically more likely to be unsupportive of the species' possible reintroduction. Our respondents also had overall more positive attitudes toward pelicans than cormorants, and fishers have significantly more negative attitudes toward great cormorants than Dalmatian pelicans in landscapes where these birds co-occur in southeastern Europe, despite known conflicts with both species (Daoutopoulos & Pyrovetsi, 1990; Pyrovetsi & Daoutopoulos, 1989). These findings thus suggest that potential pelican introduction could be supported by anglers if targeted stakeholder engagement is carefully managed from an early stage to limit the potential for perceived conflict, in particular by providing ongoing opportunities to voice existing or emerging concerns, and with a focus on potential impacts to fish stocks and resource competition. Anglers also exhibit nuanced, complex perspectives on other species reintroductions into freshwater systems in Britain and elsewhere, potentially perceiving both positive and negative outcomes (Auster et al., 2021a). Our findings thus demonstrate more widely that critical evaluation of social baseline data is essential to avoid making simplistic or erroneous assumptions about the attitudes of key stakeholder groups toward potential future reintroductions.

Interestingly, whereas only hunters were less supportive of pelican reintroduction in our models, a greater number of stakeholder groups, including not only hunters and anglers but also landowners and older respondents, were associated with negative attitudes toward habitat restoration measures that would be required to provide suitable conditions for pelicans. Habitat restoration would likely reduce the land available for human use and recreation within both study landscapes, and could thus raise concerns around potential exclusion from outdoor spaces by outside agents, or among older stakeholders who may be more conservative about management actions promoting environmental change and its impacts (e.g. increased ecotourism). Such attitudinal patterns are also seen in response to conservation programmes in other human-use landscapes (Ancrenaz et al., 2007; Moore-Colyer & Scott, 2005; Törn et al., 2008), although patterns of restoration support shown by key groups such as anglers also differ in other systems (Scholte et al., 2016), highlighting the importance of evaluating socio-ecological feasibility at local scales rather than making assumptions about commonalities across different systems. These findings thus suggest that generating support for species-specific and landscape-scale aspects of pelican reintroduction would likely require separate tailored and nuanced approaches; stakeholder engagement around landscape-scale management would need to engage with a wider range of stakeholder groups who may have separate concerns to those specifically about coexistence with pelicans. Public attitudes toward wetland restoration can be associated with diverse and potentially conflicting values and motivations, and differing ways of perceiving and interacting with the landscape (Scholte et al., 2016), and our findings provide further important evidence that a range of stakeholder perspectives need to be accommodated and addressed when making decisions about the feasibility of restoring such systems.

Overall, our results suggest that communities living in former pelican landscapes in Britain might be supportive of potential pelican reintroduction in the future. It is important to acknowledge that negative attitudes from stakeholders likely to be impacted by reintroductions are not uncommon, particularly when only limited information is locally available about candidate species (Hiroyasu et al., 2019; Titus & Jachowski, 2021; Watkins et al., 2021). Further research and engagement is needed to gain a deeper understanding of local viewpoints, establish mechanisms for effective communication of diverse voices, and build trust between the different actors and stakeholders involved or impacted by any proposed restoration activities. We recommend that future work should assess our results against a more representative (e.g. truly random) respondent sample in each study region when in-person interviews are more feasible, and that comprehensive follow-up engagement and consultation is conducted with stakeholder groups identified as holding more negative attitudes toward pelican reintroduction and associated landscape modification (anglers, hunters, landowners). Our findings also demonstrate the potential complexity of social attitudes toward biodiversity restoration, with diverse perspectives possible even within the same stakeholder groups, and the associated need for nuanced and rigorous evaluation within locally-specific contexts. Species reintroductions within human-occupied landscapes are an increasing component of the global toolkit for conserving biodiversity, and are becoming integrated within a wide range of varying social-ecological systems and contexts (Naito et al., 2014; Park et al., 2017; Sakurai

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et al., 2022; Seddon, 2011). Our study highlights the core role of socio-ecological feasibility evaluation within this process, to ensure that societal perceptions of both potential conflicts and potential management solutions are embedded within interdisciplinary project planning to maximise the likelihood of conservation success and human well-being.

## AUTHOR CONTRIBUTIONS

Samuel T. Turvey, Jennifer J. Crees, Živa Alif, Rachel L. White and M. Megan Quinlan designed research with input from all authors; Živa Alif coordinated data collection; Živa Alif interpreted and analysed data; Živa Alif, Samuel T. Turvey and Jennifer J. Crees wrote the paper with input from all authors.

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## CONFLICT OF INTEREST STATEMENT

The authors report no conflict of interest.

## DATA AVAILABILITY STATEMENT

The data used in this study are available online at University College London's Research Data Repository: https://doi.org/10.5522/04/23217572.v1.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

**Text S1:** Survey questionnaire.

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