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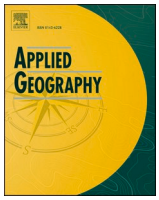

Species as placemakers: the role of species in place attachment

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ABSTRACT

Our connections to places are formed on the basis of bonding routes defined by the meanings and values that shape our own identity. In the context of global environmental change, the meanings and role of specific features of a place - such as the species living there - are shifting and redefining people-place relationships. Here we conduct a systematic review to explore the current literature on the interplay between people, species, and place attachment. Our review identified 30 peer-reviewed studies which suggests this is an emergent area of research. Drawing from our findings, we illustrate the relationship explored between species and place attachment and highlight its connection to the multidimensional construct of place attachment. Based on the person-process-place framework, we describe six roles that species played in place attachment evident in the literature: 1) identification, 2) association, 3) interaction, 4) knowledge, 5) kinship, and 6) actors. With foreseeable impacts of environmental change, we call for place attachment scholars to consider the changing role of species in people-place relationships. By using species as a focal point in conservation strategies, the six roles described builds on existing frameworks and highlights important processes in shaping intentional behaviours in management practices.

1. Introduction

People-place relationships are diverse in form because of the intricate interplay of human interactions with the environment. Our relationships to places are experiential in nature, and the ways in which we form attachments are mediated by our actions within the landscape, as well as our motivations for our interactions (Arias-Arévalo et al., 2017; Harris et al., 2023; Kaltenborn, 1997; Salcido et al., 2023). Humans associate meanings and values with place to differentiate it from space and define their own identity (Lewicka, 2011; Manzo & Devine-Wright, 2020). This implies that people's livelihoods, and wellbeing are influenced by their attachment to the environment (Adger et al., 2013; Brown et al., 2015). With current and foreseeable environmental challenges such as climate change, how we connect to and observe nature is shifting. As people's place meanings change and force new place-related behaviour to take shape, so too will our emotional bond to a place (Masterson et al., 2019).

1.1. Understanding place attachment

A commonly used theoretical approach to help understand people-place relationships is place attachment (Agnew, 1987; Cresswell, 2004; Inalhan et al., 2021; Malpas, 2018; Massey, 1994; Tuan, 1977). Meanings of place have been examined from a psychological and geographical perspective and have evolved as a complex and multidimensional concept (Lewicka, 2011; Manzo & Devine-Wright, 2020; Sebastien, 2020). Place attachment has been described as the general emotional connection one has to a place and is commonly conceptualised as being composed of two constructs: *place dependence* (the functional component that provides the physical amenities to support a desired goal or activity), and *place identity* (a component of personal identity developed by the interactions with a specific place) (Williams & Vaske, 2003). While other place-based constructs have been proposed (e.g. sense of place, place meaning), there has been no clear consensus on the theoretical structure of place attachment (Manzo & Devine-Wright, 2020; Sebastien, 2020). Within a social psychological framework, sense of place is conceptualised as an umbrella concept encompassing symbolic meanings, attachment, and place satisfaction

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(Stedman, 2002). Sense of place focuses on the interplay between the cognitive, affective, and behavioural aspects of place attachment, thereby offering a multi-dimensional approach than previously proposed constructs that have been inconsistently observed in studies due to socio-demographic characteristics (e.g. residential location and stakeholder group (Gurney et al., 2017)), features of places (e.g. building size (Lewicka, 2010)), and the way in which cognitive and affective dimensions influence the bonds to places (Jorgensen & Stedman, 2001; Lewicka, 2011).

1.2. Towards a unified framework: person-process-place

To understand the variety of factors that can influence place attachment, the combinations of place-based constructs has been conceptualised as a tripartite framework, or the person-process-place (PPP) framework (Scannell & Gifford, 2010). This framework was founded on the basis that place attachment is a multidimensional concept, with dimensions and levels that may overlap but also remain distinct within disciplines and landscapes. Unlike previous frameworks that apply a narrow focus on a specific phenomenon such as the psychological processes (Fried, 2000; Manzo, 2005; Nasar & Julian, 1995), or the social aspect (Hidalgo & Hernández, 2001; Milligan, 1998) of place attachment, the PPP framework synthesizes a variety of theoretical perspectives into an integrated, yet simplified approach. Below we describe the dimensions involved in detail.

The first dimension is the *person* (the who), which describes the personal connection to a place from an individual and/or collective level. This includes places that create meaning to a person, formed by significant experiences that can shape individual growth (Manzo, 2005), as well as places that share meaning among members of the community, including religious practices or cultural history (Mazumdar & Mazumdar, 2004). Instead of attachment formed through external factors, such as the meanings and associations that individuals or groups attribute to that place, the second dimension, the psychological *process* (the how) focuses on the internal or inward relationships with that place. Following the models of attitude structure (Jorgensen & Stedman, 2001), this includes the three psychological aspects of place attachment: affect (the emotional connection), cognition (memories, beliefs, knowledge), or behaviour (how attachment is expressed through actions). The third dimension, *place* (the what), highlights the social (e.g. sense of community, having good neighbours), and physical attributes of a place. By integrating the social, psychological, and physical aspects of place, the PPP framework highlights the diverse bonds, and pathways through which placemaking occurs, providing a unique basis for exploring multifaced relationships among people, species, and place.

1.3. Our connection to species and place

To understand the features of places, and what builds an individual's bond to a place in natural environments, researchers have operationalised the mapping of landscape values and special places as a method to identify key features associated with place attachment (Brown et al., 2015; Brown & Raymond, 2007; Cerveny et al., 2017; Fagerholm et al., 2019; H. Zhang et al., 2019). The mapping of landscape values is often dichotomous, distinguished between features that provide tangible benefits (e.g. economic or recreation values), or values that are more abstract and non-material such as wilderness or spiritual values (Brown et al., 2020). This includes value markers in areas that have an abundance of wilderness or natural landscape features, as well as areas with recreation and therapeutic experiences (Brown & Raymond, 2007). Indeed, studies of the physical features and values of a place have also been linked to the role of memories associated with that place. In one study, favourite places were predominantly described as natural, encompassing elements like forests, lakes, parks, and gardens, as well as half-built and half-natural features such as old buildings (Ratcliffe & Korpela, 2016). However, with parks and gardens artificially designed and maintained, true wilderness areas introduce a layer of complexity to place attachment processes that remains largely understudied. While landscape values and favourite places provide valuable insight into the diverse elements of people-place relationships, there is still a need to examine the processes underpinning the relationship, and in particular the specific (and often wild) features of a place that encompass the environment. In this light, one key feature of natural places is the species themselves, which not only inhabit landscapes but also embody mapped values of both instrumental services and cultural meaning.

Viewed through the lens of landscape values mapping, species become the vessels of the very attributes that underlie people's bonds to place. Early remarks alluded to the nature of color and morphology of animals, describing its ability to blend seamlessly with their surroundings (Riegner, 1993). Coupled with increasing documentation on the ecological relationships between specific species and the environment (Puniwai, 2020), the association of species as a cultural-ecosystem service (Schirpke et al., 2018), and their role in improving human well-being (Amberson et al., 2016; Brock et al., 2021), there is support in the notion that the presence of species plays a role in shaping the perception of place. Moreover, there is evidence that biophysical landscape features are integral in shaping the cognitive map individuals create of their place (Bieling et al., 2014). These cognitive maps consider the emotional and cultural connections that individuals develop with landscapes, where the presence of specific species not only enhances the aesthetic value but also plays a formative role in shaping the overall experience of a place (Wartmann & Purves, 2018). This is particularly demonstrated for species characterised as "charismatic megafauna" or "iconic", as they hold symbolic power that often evokes heightened feelings of responsibility and concern for the environment (Ducarme et al., 2013; Horsley et al., 2020). Thus, a reasonable hypothesis is that where species are an essential part of a place, the relational qualities of place extend to the species that occupy them. This draws on the belief that our connection to nature extends beyond instrumental or intrinsic values, aligning with the growing body of literature on relational values (i.e. values associated with a good life) (Chan et al., 2016; Klain et al., 2017; Pascual et al., 2023; Pratson et al., 2023). When presented in this context, species reflect cognitive, affective and behavioural dimensions of people-place interactions and can be viewed as an essential, active part in the pathways through which individuals strengthen their bonds (i.e. bonding routes) with both place and nature.

Indeed, the importance of people-species relations have long been documented under the field of animal geography, tourism, and environmental conservation (Echeverri et al., 2018; Markwell, 2015; Urbanik, 2012). In animal geography, there has been a growing interest in understanding the conception of place in relation to animals, emphasizing "animal" as a socially constructed category whose meaning is shaped by human perceptions, cultural contexts, and interactions (i.e. domesticated, urban, wild) (Wilbert & Philo, 2000). Similarly, "place" in this sense is set by imaginative boundaries defined by its physical, symbolic, and affective traits from people-species encounters (Wilbert & Philo, 2000). For example, in urban environments, animals such as pigeons, or rats are often perceived as 'non-humans', creating a clear human-animal divide despite their presence in our daily lives (Wolch, 2002). Such a statement asserts the importance of understanding how animals are actively contributing to how spaces are experienced, valued, and narrated within society (Johnston, 2008). Building on this perspective, studies in tourism and environmental conservation highlight how animals such as dolphins, or lions in natural environments to evoke a state of euphoria (Cousins et al., 2009), heighten awareness (Schänzel & McIntosh, 2000), foster awe-inspiring moments (Pearce et al., 2017), increase satisfaction (Cong et al., 2014), and develop deep personal connections (Campbell & Smith, 2006). While these findings demonstrate that species can actively evoke a strong emotional response, trigger feelings of nostalgia and build fond memories that can have lasting reflective and behavioural impacts on individuals (Ballantyne et al., 2011), the current literature has yet to fully consider

how these encounters reciprocally contribute to the changing nature of place.

In the context of the PPP framework, the various pathways through which species shape people-place relationships augment both the defining features of a place, and the processes that foster place attachment (van Putten et al., 2018). There exists an innate love and drive for a connection to nature and other organisms that motivates people to actively pursue experiences in natural settings or with living organisms (Vining, 2003). Species embody the character of a place, thereby reinforcing the relational values between people and the ecosystems species rely on (Arias-Arévalo et al., 2017; Salcido et al., 2023). In this context, species can be viewed as 'objects of care' (Pecl et al., 2023; Wang et al., 2018), or valued objects, acting as connectors between individuals and environmental challenges, such as climate change. For example, ocean warming has facilitated the spread of long-spined sea urchins (*Centrostephanus rodgersii*) in Tasmania, eliciting feelings of sadness and grief over the loss of the environment. However, when urchins are reframed as an 'object of care', they have the capacity to foster community engagement and support to mitigate their ecological impact on place (Pecl et al., 2023). Thus, reframing species as connectors to the place experience becomes a valuable source for effective management and conservation dynamics between key roles, processes, and places in play (Pecl et al., 2023). In other words, species act as placemakers, a specific facet of a place that contribute to shaping the character, meaning, and experience of a place. Here, placemaking refers to the process by which elements of the landscape, such as species, shape and add cultural, emotional, and ecological value to the environment. Considering the significant influence species have in our natural environment, coupled with our innate desire to connect with natural spaces, species play a central role in shaping our connection to places.

According to the PPP framework, convergence and isolation can occur among the dimensions of place attachment (Scannell & Gifford, 2010), yet little is still known how, where, and what types of species-specific interactions shape these dynamics. For instance, an individual's attachment to their childhood home reflects the convergence of their personal history (person dimension), the memories it holds (process dimension), and its physical environment (place dimension) (Scannell & Gifford, 2010). Within this framework, species may also play a role, as evidence already suggests that their presence or loss can have profound impacts to an individual's personal narrative of a place (Raymond et al., 2010; Wynveen et al., 2012). While studies highlight the cognitive, affective, and behavioural bonds in people-species relationships (Bieling et al., 2014; Horsley et al., 2020; Klain et al., 2017; Wartmann & Purves, 2018), research on place attachment has yet to fully integrate the ways in which species contribute to these emotional and spatial connections from a person-species-place framework. To address this gap, we explored the role of species as placemakers and contribute a new perspective to a growing body of literature about place attachment. To do so, the following objectives are proposed:

1. To close gaps in the literature on place attachment from the lens of people-species-place relationships by conducting a systematic quantitative literature review (Baum, 2021) to identify when, where, and how species are studied in relation to place attachment,
2. To build on the PPP framework by qualitatively evaluating existing conceptual approaches that explore the role of species in place attachment.

On this basis, the paper is structured as follows. Section 2 outlines the methodological approach, detailing the quantitative literature review, and the subsequent qualitative analysis used to extend the PPP framework by examining the multidimensional relationships explored between people, species, and place attachment. Section 3 evaluates and discusses the current representation of species in place attachment, providing an overview of the existing literature and highlights key insights. It also describes the limitations of this study and details recommendations for future research, thereby leading the way for the conclusions presented in Section 4.

2. Methods

2.1. Screening process

We conducted a systematic quantitative literature review to assess the existing body of literature on the role of species in place attachment. The review protocol followed the SQLR guidelines detailed by Pickering et al. (2021) (Fig. 1). Data were collected from peer-reviewed journal articles using the Scopus and Web of Science database during June 2023, returning 172 and 138 papers respectively. While there is considerable overlap between the two databases, both were selected to maximize the broader range covered by Scopus, and the stronger focus on social sciences from Web of Science. As an emergent topic, relevant titles not initially captured in the search query but seeded from a queried article were additionally examined. Given we were specifically interested in a more subjective and personal aspect of how species relate to people's physical, emotional and psychological attachment to a specific place, our review focused on the literature on place attachment rather than on the broader literature on people-species relationships (e.g. that on ecosystem services which focuses on transactional and measurable benefits). The following search query, to include article title, abstract, and keywords was used for all years: *("Species" AND (("Place Attach*") OR ("Place Identit*") OR ("Place Depend*") OR ("Place Meaning*") OR ("Sense* of Place")))*. Articles retrieved from the database were first screened by title and abstract. Inclusion of initial papers included:

- Focus on a species or group of species
- Mentions place attachment or some derivative, either explicitly or implicitly
- Written in English
- A primary source of academic literature, excluding conference proceedings, literature reviews, or grey literature

After the screening process, papers were assessed for eligibility based on whether the relationship between species and place attachment was explicitly discussed and explored quantitatively or qualitatively. Information relating to the inclusion criteria for eligibility included:

- The species were identified at the species level or within a broader taxonomic category excluding those mentioned solely in relation to species richness or diversity
- A clear connection between species and the study site were described
- The influence of the connection between species and study site were explored, with studies demonstrating the connection species may shape in place attachment

2.2. Data analysis

The full text of all identified articles was then entered into a database where we sought to identify what species was studied in place literature, the current breadth of the literature, and the role of species in place attachment (Table 1, Table 2).

Species identified in the studies were coded based on its represented taxonomic group, prevalence, nativeness, study location, and ecosystem type. Only species that were part of the main study analysis or examined in placemaking concepts were taken into consideration. If multiple species were addressed, a note was indicated for the study and species mentioned would be written in the database. In cases where multiple species were referred to in the studies but primarily investigated by a broader taxonomic level (i.e., Asian Carp, plants), the species reported in the analysis would correspond to the higher taxonomic level. Type of species was also recorded based on its assumed native status in the region. Flora species, including ornamental plants were considered

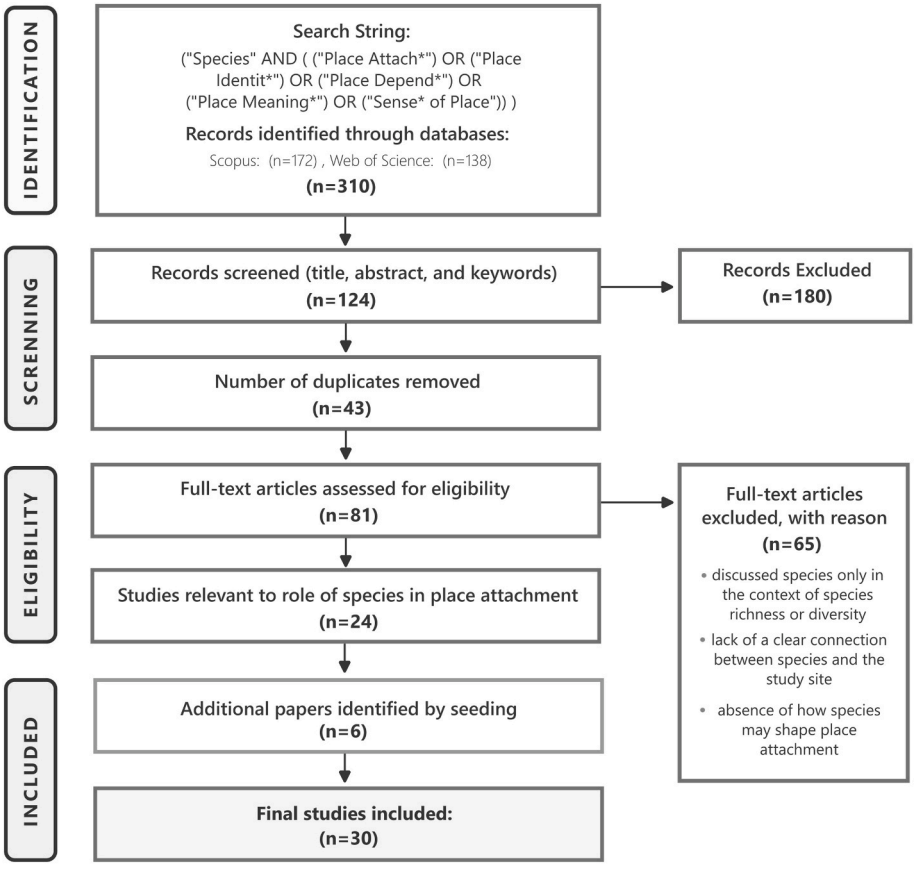

Fig. 1. PRISMA flow diagram outlining studies selected for analysis.

Table 1
Identified studies were assessed based on the summary of categories developed below to explore the (1) species identified, and (2) current breadth of the literature (n = 30).

Objective	Category	Definition	Categories derived from identified articles
(1) Species identified	Species group	The broader taxonomic groups of the species identified in the study linked to place attachment	Flora, mammals, birds, fish, insects, shellfish, reptiles
	Prevalence	The number of species mentioned in relation to place attachment	Single, multiple
	Nativeness	The species native status in the study area	Native, non-native
	Country	The countries where the research was conducted	A specific country, multiple
	Country profile	Whether the country is a member of the Organisation for Economic Co-operation and Development (OECD)	OECD, non-OECD country
	Ecosystem	Following the Millennium Ecosystem Assessment, the ecosystem type of the species identified in the study area	Mountain and polar, forest and woodlands, inland waters, drylands, cultivated, urban, coastal, island, marine
(2) Current breadth of the literature	Year	When the study was published	–
	Study design	How data was collected, anaylsed and interpreted	Quantitative, Qualitative (phenomenology, ethnography, historical, case studies, narrative inquiry), Mixed-methods
	Study method	Tools used to conduct the research	Surveys and questionnaires, interviews, focus groups, observations (including archaeology and palaeontology), documents
	Actors	The participants relationship to the species and study area	Indigenous people, local community, others (visitors, conservation agencies), mixed, absent
	Study motives	A rationale for understanding species-place relationships: why this research was conducted	Restoration, conservation/tourism, invasive species management, livelihood/wellbeing, archaeological discovery

'native' unless otherwise stated. The same was applied for domesticated species such as dogs, cats, or cattle. We note the potential inaccuracies in this classification, due to factors such as globalisation, trade, and human cultivation which can blur what is truly native and what is introduced. For a methodological example, Lavy & Zavar (2023) explored the role of various flora species, including the native live oak (*Quercus virginiana*), and nonnative palm species. In this scenario, flora represented the taxonomic group of interest, with a prevalence of more than one species. Based on the authors' definitions, trees were identified as components of the urban forest and coded as both native and non-native species.

Study location was analysed by OECD (Organisation for Economic Co-operation and Development) countries to identify where species were represented in the existing literature. Ecosystem type was inferred based on the habitat of the species identified within the study area. The habitat detected was then matched to the ecosystems represented in the Millennium Ecosystem Assessment (Millennium ecosystem assessment, 2005) to assess which environments species are most represented in.

To understand the current breadth of the literature, year of publication, study design, actors involved, and motives behind the study was gathered (Table 1). We recorded the publication year to analyse whether

Table 2
Summary of criteria guided by the PPP framework to assess identified studies on species-place relationships.

Dimension	Criteria	Definition	Subcriteria	Definition	Example
Person	Kinship	A description that expresses the participants deep connection to the species in the study area	Familial	A statement about strong familial or spiritual connections with species in place	"Through such discourses, we encounter a 'place-based Nyishi sense' of the limits of human economic engagement with the forest. Nyishi uplanders recognise that forest animals like the pangolin possess value not only within a human economy, but also in a parallel **spirit** economy upon which they rely." (Aisher, 2016)
	Actors	An explanation of how a participant's attachment to species and the study area is shaped by their relationship to the place	Position in place	A statement about the person's specific position in place and how that influences an individual's relationship to species	"Additionally, our findings suggest that **visitors and residents** experience the Rockport-Fulton area differently. Both groups communicated emotional responses to tree loss. However, residents focused on the loss of native live oaks during interviews while visitors commented more frequently on the non-native palm trees." (Lavy & Zavar, 2023)
Process	Association	A description of how participants refer to the species in the study area	Memories	A statement about the influence of shared memories and experience with species from past generations and present engagement within the study area	"In this way, the urban forest becomes an overarching symbol of what the place is and of the experiencehad while visiting or living in the Rockport-Fulton area, and through this, visitors and community members attached **memories** to the trees." (Lavy & Zavar, 2023)
			Personal values	A statement about the values that influence how species are perceived in place	"Thus, cockles support a strong place-specific identity which, like in other areas, is built up around the **history, heritage and culture** associated with the region (Ma & Lew, 2012)." (Jackson-Bué et al., 2022)
			Linkage	A statement about the influence of connectivity with other species or traditions in the study area	"This quote exhibits an acute awareness of how *Scalesia* harbors habitat for other species, how residents derive happiness from seeing characteristic flora and fauna, and how a healthy *Scalesia* habitat is seen as **linked to quality of life**. Thus, beyond other extrinsic material values, restoration of *Scalesia cordata* would appear to support other intrinsic values by constituting "home" and serving as a source of psychological well-being—both core elements of sense of place." (Hunt et al., 2023)
	Interaction	A description of how people perceive the species present in the study area	See	A statement about how species were seen within the study area	"We found that visitors cited the importance of protecting open spaces more frequently after the bison reintroduction, suggesting that the **presence** of bison, as a highly recognizable flagship species, forged a stronger sense of connection between visitors and landscape conservation." (Wilkins et al., 2019)
			Hear	A statement about the influence of the acoustic environment shared between people and species within the study area	"This results in a situation in which owls were acoustically omnipresent, while direct interactions with humans must have been comparatively limited. As a result, the **sound** of owls likely formed a distinct marker of early Gravettian environments in the Pavlovian Hill region – environments with a 'lived' quality (sensu Bollnow 1997,1822) of being 'stained in owls'." (Hussain, 2019)
			Feel	A statement about the emotional response felt with species within the study area	"These interactions and comments all capture solastalgia (Albrecht et al., 2007) where Hurricane Harvey altered the physical landscape causing **emotional distress** for those with strong attachments to the area." (Lavy & Zavar, 2023)
	Knowledge	A description of how informed the participants are about the species in the study area	Species knowledge	A statement about the general knowledge about the species in place	"The yearning for place-based attachments of home motivates an **ongoing process of learning** to identify and familiarise herself with bird species. The process of learning to identify bird species becomes part of the emotional work of home-making." (Wilkinson et al., 2014)
			Species value	A statement about the services species provide to the ecosystem and culture in place	This sense of connection is also a sense of place. Through the experience of being the objects of constant study, Uaxactuneros come to know their place as one defined by its standing forests and the "**clean air**" they produce (a local interpretation of global climate discourse)..." (Rahder, 2014)
Place	Identification	A description of how participants labelled the species in the study area	Nativeness	A statement about the influence of the species' original occurrence within the study area	"However, it is argued in this paper that **native** species can make an even larger contribution to a destination's sense of place when they become part of the built environment." (Forristal et al., 2014)
			Classification	A statement that categorises species based on ecological, social or symbolic significance (e.g. endangered, charismatic, flagship) that influences people's place identity	"...this paper identifies and discusses three different categories of tree **symbolism** in the South Pare Mountains, relating to sacred groves, exotic timber trees, and fruit and fertiliser trees respectively. It suggests that each of these categories, rooted in different elements of Pare social and ecological history, presents a distinct register by which people relate to place, each associated with particular types of conservation and land use practices." (von Hellermann, 2016)

there was an ongoing pattern in publication trends.

Study design was coded by quantitative, qualitative, or mixed methods approach. Quantitative methods included data derived from surveys and questionnaires to measure species-place relationships, whereas qualitative studies used interviews, focus groups, observation, and external documents. Given the scope of the literature, we also included archaeological, palaeontological and ethnographic studies as qualitative measures.

The actors involved in the research was grouped by local community, indigenous people, others, mixed, or absent based on their relationship to the species and study area. If different social groups (e.g. environmentalists, tourists) participated for the purpose to gain insight from an outsider perspective, they were recorded as 'others' rather than being considered as part of the local community. Author motives in understanding the influence of species in place attachment was collected from explicit objectives, references or keywords extracted from the study.

Following the quantitative systematic analysis, we then drew on the PPP framework to qualitatively identify the role of species within the dimensions of person, process and place (Table 2). To do so, we followed a qualitative two-stage coding process, First, a deductive coding process aligned the reviewed literature with the core PPP dimensions. Second, using an inductive process, we identified emergent themes, resulting in codes relating to person, process and place criteria. The first author undertook the coding with assistance from the other authors, specifically through a consensus coding approach on a subset of text during the stages of defining and refining codes (Appendix A).

3. Results and Discussion

Our final data set includes 30 papers that examined the role of species in place attachment (Fig. 1, Appendix B). We first conducted a comprehensive analysis of the literature to outline the species represented (3.1) and the portrait of the literature between people, species, and place (3.2). With this knowledge, we utilised the PPP framework to further identify six characteristics that describes the role of species in place attachment (3.3). By adding to the PPP framework, we discuss the interconnected nature of species as placemakers (3.4) and conclude with limitations of this study (3.5) and potential future directions in the fluid nature of people-species relationships (3.6).

3.1. Species representation

The species represented in the literature were primarily flora and mammal species with 10 and 9 instances each, respectively (Fig. 2). Birds (n = 8), and other species such as fish (n = 4), insects (n = 3), shellfish (n = 2), and reptiles (n = 1) were also examined among the studies. Several studies investigated multiple species (n = 16) as opposed to a focus on a single species (n = 14). The ecological status of the species described in the studies were primarily native (n = 18), non-native (n = 4) or a mix of both (n = 8). Geographically, flora, mammal and bird species were represented among a variety of continents, including North America, Europe, and Oceania. The species examined in studies were often emblematic to a particular place, indicating the potential presence of geographic biases in this research space. Specifically, the majority of taxonomic classes were examined in OECD (Organisation for Economic Co-operation and Development) countries (n = 22) including United States, Canada, Australia, Europe and United Kingdom (Fig. 2). The remaining studies (n = 7) were conducted in non-OECD countries, including Belize, Ecuador, Ghana, Guatemala, Honduras, India, and Tanzania. Three studies involved research in multiple (i.e., two) countries, with one involving both an OECD and a non-OECD country.

The low number of non-OECD countries identified in the review raises a potential bias in understanding how socio-economic conditions, personal values, and historical narratives influence place attachment. This observation highlights the need to support more research efforts in underrepresented areas, since species may carry a stronger utilitarian or spiritual significance, particularly in light of their vulnerability to environmental change. For example, in economically constrained regions, placemaking may centre more on ecosystem services or local governance rather than charismatic attributes which will shape who interacts with which species and how. Addressing this geographic bias will require a comparative case study across contrasting cultural, economic, and political contexts, as well as the support of local researchers and use of diverse knowledge forms to implement coproduction frameworks that are founded on principles of inclusivity (i.e. Indigenous knowledge) and a responsive approach to co-management strategies. (Ens et al., 2015; Gould et al., 2023; Hoelting et al., 2024; Robinson et al., 2022).

The species examined in this review inhabited forests and woodlands (n = 17), followed by urban (especially gardens) environments (n = 11), inland waters (n = 8), marine (n = 4), drylands (n = 4), coastal (n = 1), mountain and polar (n = 1), cultivated (n = 1), and islands (n = 2) (Fig. 2). Multiple ecosystems were addressed in seven studies. Only three ecosystems, including forest and woodland, inland waters, and urban environments revealed diverse taxonomic classes (Fig. 2). Particular attention appears to be directed towards studying flora species in forest and woodland and urban environments, implying a potential bias in the selection of species in ecosystems based on accessibility and cost-effectiveness in facilitating data-collection. While this could indicate fewer people living in those environments, it is more likely that the absence in these ecosystems is due to the inherent challenges of conducting research in remote or less accessible areas, compounded by potential language barriers. Considering the potential vulnerability of these habitats to climate change, communities living in remote environments are also frequently intertwined with a dependency on various species for their livelihood and overall wellbeing (Bunce et al., 2010; Huynh et al., 2021; Shahzad et al., 2019). Future studies should seek to explore such relationships to unpack how species in more remote environments influence people-place relationships.

3.2. Portrait of the literature

3.2.1. Study design

Research on the role of species in place attachment emerged in the last two decades. Published studies have shown a relatively consistent pattern, with one or two publications per year, apart from three separate years (Fig. 3). Methods employed by studies to address the role of species in place attachment varied between qualitative (n = 20) studies, quantitative (n = 4), and mixed methods (n = 6). Studies that employed qualitative methods primarily used interviews which included focus group discussions, and non-participant observations. In one study, mixed qualitative methodologies including participant observation and "go-along" interviews, during which the researcher directed participants to make a sketch, and photograph birds (Wilkinson et al., 2014). This helped facilitate the expression of participants' affective ties to birds, which might otherwise have been difficult to convey in words. Another study employed follow-ups with local experts and drew from secondary and historical data sources (Forristal et al., 2014). Quantitative studies utilised surveys, self-administered surveys or a combination of surveys and interviews. See Appendix B for a more comprehensive breakdown of reviewed papers.

While the methods employed to examine the relationship between species and place were diverse, studies favoured in-depth qualitative approaches as opposed to applied quantitative methodologies. This approach was likely driven by the intrinsic complexity of people-species relationships and focus on the concept of place rather than related concepts such as nature connectedness or ecosystem services that are more quantifiable. For species, applying on-site research methods such as locational storytelling can help to capture lived experiences and emotional responses of wildlife in their natural habitats, unfolding in real time (Rishbeth, 2014). Although qualitative approaches offer depth

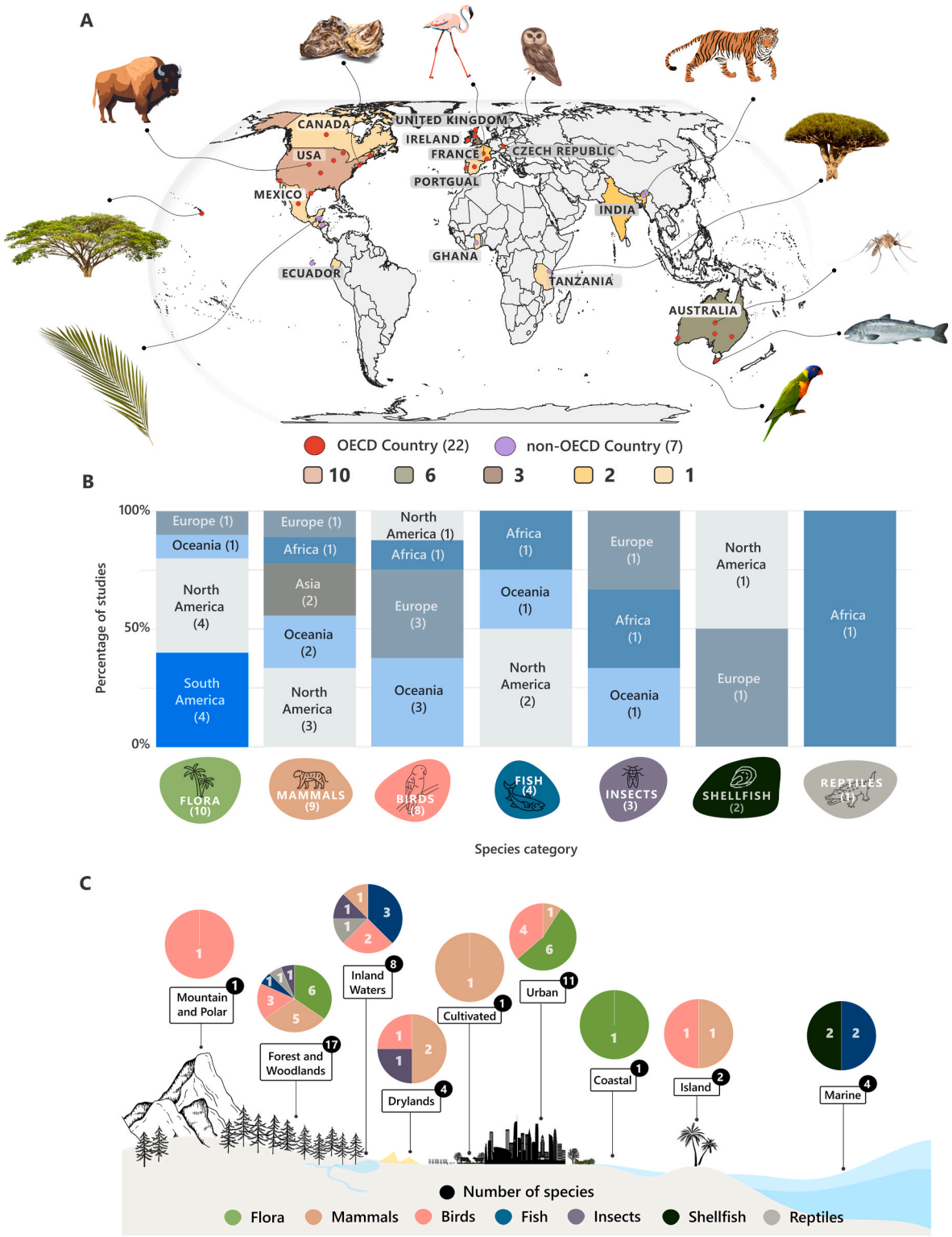

Fig. 2. Global geographic representation of studies featuring species reviewed in the literature. **A,** A sample of the diversity of species, color-coded according to OECD classification and the number of studies for each country. **B,** Species identified color-coded by 7 main taxonomic groups by continents: flora, mammals, birds, fish, insects, shellfish, and reptiles. **C,** Ecosystems represented and color-coded by taxonomic groups according to the Millennium Ecosystem Assessment identified. Numbers indicates the number of species. Note that some studies examined more than one species and ecosystem. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

and flexibility, they often lack generalizability and are more vulnerable to researcher bias (Creswell & Creswell, 2023). Conversely, quantitative methods can detect patterns across larger populations and test for specific hypotheses but may overlook the symbolic or emotional bonds of species-place relationship (Creswell & Creswell, 2023). Therefore, we advocate the use of a mixed-methods approach that can triangulate statistical patterns with narrative detail. For example, more participatory methods such as participatory mapping can illustrate the spatial associations in the environment (Brown & Raymond, 2007), and be supported by rich narrative data to trace both spatial and emotional

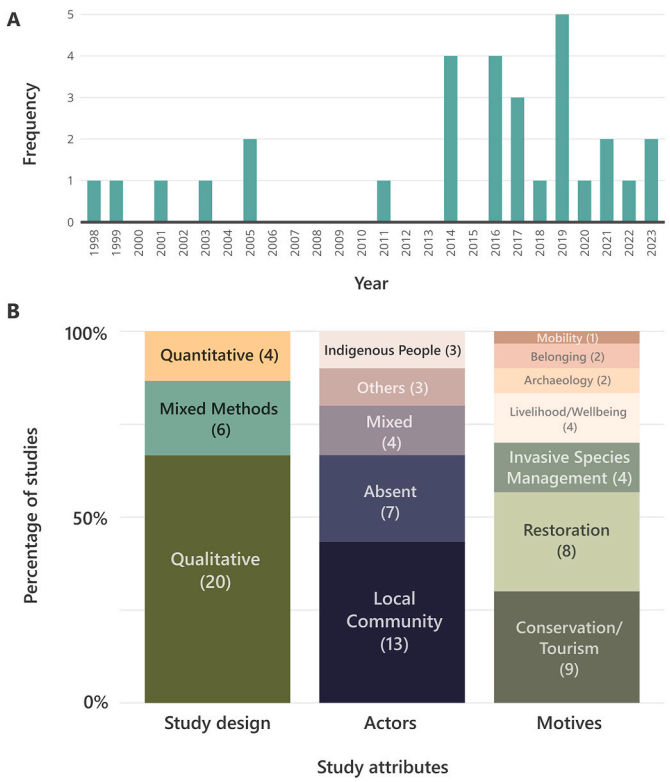

Fig. 3. A, Number of articles published by year. **B,** Portrait of the literature by study design, actors, and motives. Number of studies are represented by the number in parentheses.

bonds of species-place attachment. When considering the influence of environmental change on species, places and people, this practical application can be utilised to identify hotspots associated with species as a way to prioritize goals in conservation planning (Ernoul et al., 2018). This becomes particularly important in understanding people-species relationships in place attachment given that the first initial response from species to climate change is often a shift in location that shares similar environmental conditions (Pecl et al., 2017).

3.2.2. Actors involved

The key actors in the reviewed literature were largely part of the local community (n = 13) (Fig. 3). Four studies had a mix of actors (i.e. local community, indigenous people, others) participating in their studies. Notably, studies incorporating other groups as part of their study such as tourists, hunters, authorities, and managers, provided a more unique insight into the distinct emotional responses different actors may exhibit toward a place.

It appears that the literature tended to focus on a single actor group, neglecting comparisons between different actors in species-place relationships. While some studies identified the position in place (i.e. conservation agencies, visitors), no consideration (apart from four studies) of differences across groups in place attachment was analysed. Indeed, extensive literature on people-species relationships reveals that conflicts and the management of co-existence strategies largely stem due to different values and knowledge between the local community and conservation agencies (Nayak & Swain, 2022; Scuderi et al., 2023), as well as the formation of attitudes towards specific species between opposing social groups such as hunters and environmentalist (Lin et al., 2021). Although placemaking elements are implied to be a function of these conflicts, a more thorough consideration of the dimensions of place attachment is required. We explore these relationships in greater detail below in the context of the PPP framework.

3.2.3. Motives

Based on the study's objective, the clearest theme that emerged for motivation behind exploring species-place relationships was conservation/tourism (n = 9) and restoration of the environment (n = 8) (Fig. 3). For example, Lavy & Zavar (2003) demonstrated how trees are an important symbol within the coastal community after a natural disaster because it unites and encourages people to rebuild, restore, and recover. Such studies were concerned about the changing nature of the environment and aimed to identify the drivers in species-place relationships that may foster engagement in conservation practices and stewardship behaviours, as well as practices to build resilience to environmental change. Invasive species management (n = 4), impact on livelihood and wellbeing (n = 4), understanding of the past from archaeology (n = 2), the nature of belonging (n = 2), and the age of mobility (n = 1) were also identified motives behind understanding species-place relationships.

These motives may be driven by the current trend in incorporating more tourism practices in restoration and conservation efforts (Blanco-Pimentel et al., 2022; Clark & Nyaupane, 2022; Z. Zhang et al., 2023). Tourism is not only economically beneficial for the region, but it also provides direct benefits to people's livelihoods (Hunt et al., 2023), and establishes an all-inclusive opportunity for people to be actively engaged in sustainable practices (Blanco-Pimentel et al., 2022). Though the negative association of tourism on the local community is not to be neglected (Guttentag, 2009), we highlight how species can act as a pathway to promote more meaningful dialogue about a changing place. With increased efforts to scale tourism practices in a more positive light, the connection between species and their role in fostering place attachment for the success of restoration and conservation practices will likely become more pronounced in future research.

3.3. The role of species in place attachment

Considering the gaps in the literature on species-specific relationships in placemaking concepts, we then sought to qualitatively identify how the PPP framework can be extended to describe the role species play in shaping connections to places. Based on the reviewed literature, six characteristics which species-place relationships can take include: **identification, association, interaction, knowledge, kinship, and actors** (Fig. 4)**.** We map each of these to the relevant component of the PPP framework and discuss the proximity of these characteristics and relationships in detail below.

3.3.1. The person dimension - kinship and actors

The 'person' dimension (i.e. the 'who') of the PPP framework describes how personal and collective bonds to species shared among members of the community are actively involved in building connection to places. In the case of species-specific relationships, symbolic meanings of a place can be reflected through objects like ornaments, or establishments, reflecting cultural and historic connections with species. This can be understood as familial bonds, or **kinship** (n = 7) where the expression of the species are woven into the social fabric of a place (Forristal et al., 2014; Hussain, 2019). For example, cicadas are featured in decorative household items, such as tablecloths and cups, as well as in traditional clothing for special occasions, thereby amplifying a shared physical appreciation of these species. Beyond physical representations, species such as baboons, pangolins, or tigers have been preserved across generations through traditional stories that portray them as spirits, known respectively as *Tano Akora*, *Sechik*, and *Aamra* (Adom, 2019; Aisher, 2016; Aiyadurai, 2016). These stories emphasized the sacred nature of these species, and were highly tabooed, believed to bring misfortune if mistreated. Consequently, communities took great care to protect these species and were often cautious with their interaction, recognising them as kinsmen. This creates a structured social network that in turn can mobilize collection action and shape how people treat the species in their environments. In each case, the ways in which people collectively name, honour, and safeguard species serve as connectors

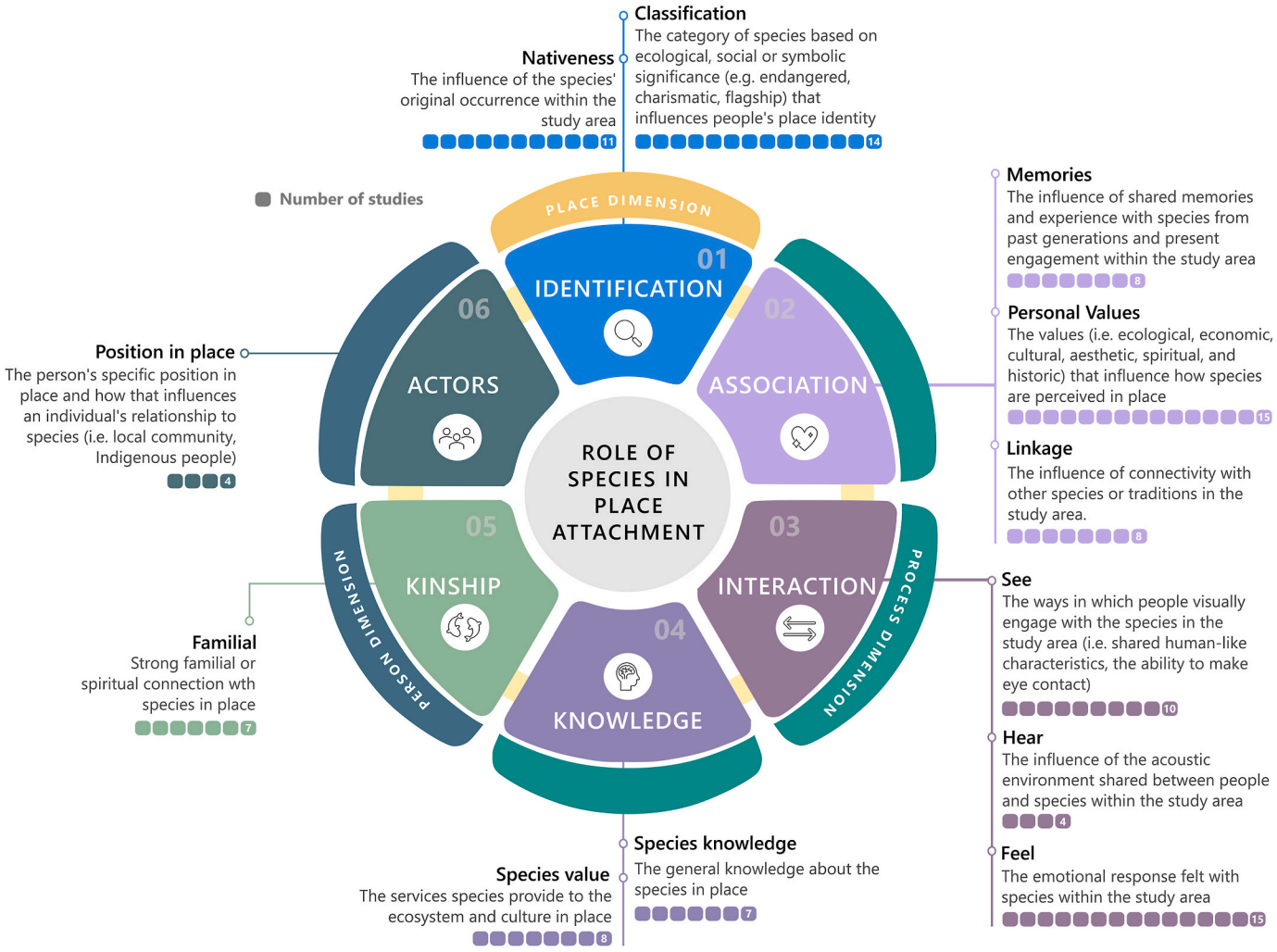

Fig. 4. Based on the PPP (Person-Process-Place) framework, the literature reviewed was coded deductively to reveal six main characteristics that provide insight into the role of species in place attachment: 1) identification, 2) association, 3) interaction, 4) knowledge, 5) kinship, and 6) actors. Characteristics were further categorised into related elements using an inductive approach. Squares represent the number of identified studies.

that reinforce shared narratives of identity and origin, embodying the "person" dimension of place attachment.

Actors describe how an individual's position in place influences the role of species in place attachment. Only four papers demonstrated contrasting views between actors in place attachment (Aiyadurai, 2016; Ernoul et al., 2021; Forristal et al., 2014; Lavy & Zavar, 2023). For example, there were a clear distinction in values between the local community and 'others', including scientists and managers (Ernoul et al., 2021), the way people interact with the cicada as a resident or tourist (Forristal et al., 2014), as well as contrasting sentiments between visitors and residents regarding which species they felt a greater sense of loss for after a natural disaster (Lavy & Zavar, 2023). Similarly, Aiyadurai (2016) revealed how traditional community members and official authorities regarding the practice of hunting fail to recognise their shared goal in protecting the tigers, and their environment, leading to misunderstandings and ineffective conservation practices. These cases demonstrate that individuals' identities and social positions shape their beliefs and values, leading to distinct, and often conflicting bonding routes to species and place. This underscores how, through the person dimension, individual identities, as well as shared social bonds can influence attachments between people, species, and place.

3.3.2. *The process dimension- association, interaction, knowledge*

In line with the PPP framework, the 'process' dimension (i.e. the 'how') reflects the psychological aspects of place attachment. Specifically, the emotional connection and cognitive elements of process-oriented bonds were identified to align with three central characteristics in the role of species in place attachment.

The first and highest reported characteristic was the **association** of species to place by an experience, shared memory, personal values, or linkages (n = 31). Studies highly regarded memories about specific species from experiences or shared stories from family members to be an important factor in fostering a strong sense of nostalgia and creating an emotional connection to place (n = 8). Other personal values related to a species history or spiritual connection to place, economic gains and losses, and cultural significance were frequently reported (n = 15). Several studies (n = 8) also highlighted how the association of species with other species fosters strong belief systems through the concept of duality between species (Hussain, 2019), where it is believed that the obtrusive behaviour of ravens encouraged a positive people-owl relationship, enabling a stronger sense of cohabitation. Similarly, associations drawn from prior encounters with species exhibiting similar behaviours (Pizarro & Larson, 2017), preserved traditional and religious practices (Bonta et al., 2019), and the species' presence as a reminder of a healthy, biodiverse environment (Ernoul et al., 2021; Hunt et al., 2023; Schebella et al., 2017), all emphasize the importance individuals place on species in place. These examples show that *association*-whether through memories, moral or practical significance, or connectivity to

other species - acts as a means to bind species to place. In doing so, these bonding routes reflect how emotional and cognitive elements intertwine, as defined by the "process" dimension of the PPP framework.

A closely related characteristic to the association of species to place is the **interaction** between species and people in place attachment (n = 29). This interaction includes sensory elements, including how we see, hear, and feel, when engaging with species. The presence of particular species in a local environment, including those that share human-like characteristics (Hussain, 2019), can remind people about their landscape values (Wilkins et al., 2019), and lead people to believe there is high biological diversity (Ernoul et al., 2021). This includes portrayal through species-shaped object, species-decorated object, or species-named object (Forristal et al., 2014). Interactions between species and people can also be driven by the acoustic environment (n = 4), such as the salient voices of owls (Hussain, 2019), or calling songs of cicadas (Forristal et al., 2014), where its sound becomes a prominent marker for the environment. Feelings (n = 15) of familiarity can be fostered by memories and stories exchanged since childhood (Jackson-Bué et al., 2022; Krasny et al., 2014), a former pet (Trigger & Mulcock, 2005), or simply accrued over time (Bonta et al., 2019). Strong emotional attachments can make species act as 'points of references' for people to recalibrate their sense of place in new environments to feel a sense of belonging (Pizarro & Larson, 2017). However, familiarity can also pose as a challenge to the management of species as revealed by residents' attachment to an invasive species (Lavy & Zavar, 2023; Nieiec et al., 2017). By engaging our senses and feelings, these interactions can trigger place-specific memories and reinforce the emotional bonds that shape the identity of a place. Over time, repeated encounters with particular species strengthens the psychological process by which individuals form to a place.

Knowledge of the species or understanding of the role species play in the environment (n = 15) was also demonstrated to be a characteristic in the role of species in place attachment. For instance, learning about the historical significance of the bison in the Great Plains increased people's willingness to protect that space (Wilkins et al., 2019). This finding highlights those individuals with greater species knowledge (n = 7), tend to pay closer attention to the environment. Similarly, recognising species value (n = 8), such as the value of oysters in filtering pollutants from the water further reinforces this relationship between species and place (Krasny et al., 2014). A sense of being known as an expert for a species, as described by Radher (2004), shapes how individuals see themselves in the environment, and how they care for the landscape and nurture people-species relationships. However a strong place attachment is not always reflective of an individual's knowledge of the species that inhabit the area (Lockwood, 1999), nor does it appear to be correlated with knowledge of the negative impacts of invasive species (Niemiec et al., 2017). In these studies, learning about the significance or value of species helped individuals develop a sense of deeper responsibility and emotional investment in their connection to place. This heightened form of engagement reflects the cognitive element of the process dimension of the PPP framework.

3.3.3. The place dimension- identification

The 'place' dimension (the 'what') in the PPP framework centres on the outermost and immediate attributes of a place. One aspect of nature frequently associated with the environment is the species present within the biophysical setting (Schebella et al., 2017) where the initial response is the **identification** of species (n = 25). When identifying a species, its' nativeness (n = 11) to the place or classification (i.e. flagship, charismatic, megafauna) appeared to contribute to an individual's connection to place. In fact, participants explicitly expressed their enjoyment in observing the growth of Australian native plants and the presence of native birds, koalas, and kangaroos. As a result, "nativeness" emerged as one of the top 20 "loved" aspects of their favourite places (Schebella et al., 2017). Aspects of favourite places, however, is dependent on people's sense of belonging and identity with those places where a mixture of native and non-native species was generally found to be the most widely accepted approach for satisfying sentinel attachments to particular landscapes among the people (Trigger & Mulcock, 2005). In Perth, Australia, participants expressed that blending native and introduced plants helped define what belongs in nature and society, though these views varied by personal ancestry. Those who did not grow up locally were more likely to plant non-native species since it reinforced their sense of belonging (Trigger & Mulcock, 2005). A similar observation emerged when comparing the contribution of native live oaks (*Quercus virginiana)* and nonnative palm species to placemaking between residents and tourists, with aesthetic values playing a more prominent role (Lavy & Zavar, 2023).

Classification of species based on ecological, social, or symbolic significance was also referenced in 14 studies to influence how people valued specific species in place attachment. Studies identifying species by "iconic", "socioecological symbols", "flagship", "keystone", "charismatic", "endangered" (Aisher, 2016; Bonta et al., 2019; Forristal et al., 2014; Hunt et al., 2023; Krasny et al., 2014; Lavy & Zavar, 2023; Lockwood, 1999; Trigger & Mulcock, 2005; Wilkins et al., 2019) were found to increase recognition and engagement within the community. In one case, baboons were regarded as "taboos" within the community, a symbol that supports the strong place identity among the people (Adom, 2019). Indeed, not all species classifications conveyed benefits when planted exotics for example, symbolised socio-economic status, exclusion and inequality (von Hellermann, 2016). In this case, the planting of exotic fast-growing trees such as eucalyptus became a tool to assert land ownership, wealth, and power, thereby excluding poorer families and isolating them from resources - a complex socio-economic disparity that warrants further exploration beyond the scope of this paper. With nativeness and classification defined among various papers, we can see how specific attributes such as whether a plant is native or symbolic, become distinct markers of place. In identifying which species are present, and how they are classified, these attributes (i.e. the 'what') provide visible cues that people use to recognise and interpret meaning to their surroundings, thereby expressing the physical attributes or 'place' dimension of the environment.

3.4. The interconnectedness of species as placemakers

The PPP framework emphasizes the interconnectedness of person-process-place dimensions, where there can be both overlap and independence between each dimension. Similarly, when analysing species-specific relationships in placemaking, varying combinations of these dimensions emerge and are influenced by context. For example, when exploring people's motivation for environmental stewardship, placemaking with species appear to correlate strongly between place and process dimensions. Species identified as native or symbolic were observed to reinforce personal values, prompting individuals to seek further interactions that foster a more intimate connection to place (Krasny et al., 2014). The resulting interplay between how species are identified, valued, and engaged supports the build of a reinforced feedback loop where species remind people about their particular attachment to place (Hunt et al., 2023).

From a landscape management perspective, species-specific relationships in placemaking can be explained by person and process dimensions. In this lens, variations in personal values - whether perceived as insiders or outsiders, directly influenced their individual connection to place (Ernoul et al., 2021). Compared to tourism, or destination marketing, person, process, and place dimensions appear to collectively contribute to species-specific relationships. Here, placemaking results from a strong identification of species, which often translates into their prominent representation within the area (Forristal et al., 2014). However, this dynamic also tends to contribute to a divide between individuals in different positional roles in place, such as those between tourists and residents (Forristal et al., 2014). Like the PPP framework, species-specific relationships are context-dependent, highlighting

diverse overlapping characteristics that support the multidimensionality of place attachment.

With various combinations of interconnectedness, complex dynamics may also lead to unintended consequences, as not all overlapping characteristics in people-species relationships foster positive outcomes. In the case of *identification* and *knowledge*, species identified by their nativeness appear to have the potential to either encourage or suppress knowledge. In one study, the knowledge of the environmental impacts caused by an invasive species (i.e. the albizia tree- *Falcataria moluccana*) did not necessarily translate into taking effective actions to mitigate its environmental impacts (Niemiec et al., 2017). This was due to residents forming an attachment to the invasive species as an integral part of the landscape. Thus, *identification* and *knowledge* of species in relation to our connection to place can potentially evoke conflicting emotions (Niemiec et al., 2017).

3.5. A synthesis: extending the PPP framework

The proposed extension of the person-process-place framework of place attachment builds upon empirical evidence that positions species as effective placemakers. In other words, species should be recognised as a specific facet of a place that helps shape both individual and collective identities. Specifically, this framework demonstrates that species serve as a pathway to placemaking predominantly through process-oriented bonds, as evidenced by the large number of studies identified (Fig. 4). However, this does not discount the pathways associated with person or place dimensions. These bonds capture the fixed social and physical characteristics of species in placemaking (e.g. a species' native status), in contrast to the dynamic processes that emerge through interactions, behaviours, and experiences. It thus serves as a novel contribution to place attachment research at a time marked by rapid ecological and social change where traditional concepts of place are continually being redefined (Di Masso et al., 2019). For instance, environmental changes such as rising sea levels and warmer sea temperatures may impact food sources, life cycles and habitat conditions of marine benthic species by pushing species to move to cooler water temperatures. Similarly, terrestrial species may face nest inundations or habitat changes, and move to cooler and higher grounds (Pecl et al., 2017). By integrating species as placemakers, this framework can be used to manage species-on-the-move to understand how this might influence people within their environment. In particular, it can encourage the use of species as a way to frame how communities are likely to respond to a changing place, thereby stimulating new research by synthesizing complex dynamics in a more accessible manner.

3.6. Limitations

This review was designed to identify the role of species in place attachment by only targeting literature that explicitly uses the term "species" in place-based literature. While relying solely on this term may have excluded studies using alternative naming conventions such as "animals" or species-specific names, the focus on "species", allows the approach to focus on a subset of research where the term is more commonly used in a natural context. A targeted, post-hoc screen using "animals" retrieved predominantly unrelated immunology, toxicology, and genetics studies, reflecting its poor relevance to place attachment literature. However, it is important to recognise that our review does not encompass the entire body of research related to the people-species-place relationship, but rather a snapshot of the literature.

Engagement with grey literature and publications not written in English could have offered a more comprehensive view of species relationships within various cultural, ecological, and geographic contexts. This is particularly evident in studies of Indigenous literature or in non-OECD countries, where traditional knowledge and species may be viewed as placemakers from a different lens. As an applied geography study, we also acknowledge that our framework remains tied to specific places described by the literature. In other words, although the PPP framework and our species-focused extension are inherently place-specific, it cannot at present capture how spatial variability such as differences in species distribution influences place attachment. Finally, despite our attempt to conduct a methodical systematic literature search, we acknowledge that an element of subjectivity remains when interpreting whether the studies revealed the characteristics defined within the PPP framework.

3.7. Future directions: the fluid nature of people-species-place relationships

Humans are actively shaping and being shaped by changes in their environment, suggesting that there are strong dynamic processes to consider that were not adequately reflected in the existing literature. While studies emphasized the positive outcomes of a species in the context of place attachment, the role of species in nurturing these place relationships appears to be dependent on nativism and socio-cultural dimension. In other words, some species might strengthen ties to the natural world, while others could potentially introduce conflicting emotions and be ill-represented within the community (Brook, 2003). Further research on the negative connotations of specific species in place attachment will shed light on how we frame species representation and narratives in policy, planning, and management decisions.

There is also an indication that our connection to species is maladaptive. Concern about maladaptation was originally discussed about how species evolve to fit in changing environments, but has more recently gained attention in the human dimension, particularly in the context of climate change (Magnan et al., 2016). While this has not been explored within place attachment, radical changes to species in the environment can change the meaning of places to people (Gmelch & Gmelch, 2019, pp. 36–41; Wilbert & Philo, 2000). This has the potential to evoke a strong emotional reaction, consequently shaping ecological decisions towards more effective conservation methods. In the place of pet keeping, individuals who experience the loss of a pet are documented to experience a greater distress and report more difficulties in adapting to changes (Gerwolls & Labott, 1994). With this consideration, there is considerable scope for maladaptive behaviour to extend to people-species relationships in the dynamics of place attachment in the future.

Although the studies we reviewed did not explicitly focus on climate change, there is observable evidence of individuals redefining their connection to place in response to changes to their environment. When considering the impact of natural disasters on the environment, the loss of trees for example is an abrupt change to the physical landscape (Lavy & Zavar, 2023). Such vivid transformations to the landscape can entirely redefine how people connect to a place (Butler et al., 2018; Knez et al., 2018, 2021). This can occur in the form of direct impacts to their livelihoods and/or wellbeing (Masterson et al., 2019; Yerbury & Boyd, 2018). As climate change persists, natural disasters are anticipated to increase in frequency and severity, thereby influencing where people may constitute as home (Zander et al., 2020). Climate-driven redistribution also concerns species who are volatile to major floods and wildfires (Pecl et al., 2023). Future studies will need to go beyond typical localist and static framings of place attachment to explore the changing nature of people-species relationships in place attachment.

Lastly, given the diverse nature of place-based relationships, there is a notable gap in studies examining how certain types of species evoke distinct responses among different groups of people. Our quantitative and qualitative extension of the PPP framework indicate that species play unique roles in shaping local identities and cultural practices, with their significance varying widely depending on ecological, historical, and socio-cultural contexts. Consequently, understanding how people respond to species in people-place bonding can better equip researchers to consider the differences in values. For example, examining how an iconic species influences a resident in the area compared to a visitor can

help reframe management strategies to effectively align with the values and needs of specific target groups. To bring these directions together, an integrated approach is required, as we elaborate and summarise next.

This systematic review was designed to identify the role of species in place attachment, and how species may function as placemakers. In doing so, we note the implications of our findings in light of the rapidly changing environment as species are on the move. While the study of species as placemakers is an emerging topic, there remains many gaps in the taxa and geographic contexts studied. With the limited representation of species across all ecosystems, we suggest that future research is needed to specifically address the role different types of species play in our connection to place. This includes further engagement in various cultural, ecological, and geographic contexts that makes species fundamental to the place experience. To fill these gaps, the role of species in place attachment provides an enriched way of understanding the diverse ways in which species may support place attachment in a changing environment.

Considering the literature examined in this study, researchers could develop measurement items that capture the role of species as placemakers within the PPP framework, thereby quantifying each of the six placemaking roles among a wide range of species - including those with negative connotations (e.g. invasive species). For example, future research of species-place relationships could engage with the framework to quantify underlying processes at play and compare relationships across taxa. However, overcoming the literature's bias toward charismatic taxa and OECD contexts will require researchers to be more deliberate on exploring underrepresented species and geographies. This framework also provides opportunities to adopt non-static framings of place attachment that can be designed as a longitudinal study to track how species-place bonds evolve over time and space: How does environmental change such as the introduction or loss of a species impact people-place relationships? What spatial and temporal dynamics underlie these shifts, and to what extent does this differ among diverse groups of people? Addressing these questions will require the merging of quantitative and qualitative narratives under clear data triangulation protocols. One promising avenue would be integrating our framework with spatial data to determine where and how species relocate, and how species heterogeneity at multiple scales (local, regional) affects people's attachment. For instance, mapping whether proximity to native versus non-native species alters emotional and cognitive bonds can reveal variations in stewardship intentions or willingness to mitigate non-native species impacts across different areas. Coupled with a neurocognitive measure to assess the personal impacts on individuals, this approach provides a practical avenue that addresses both theoretical and applied aspects for future research.

4. Conclusion

In this review, we explore the role of species in shaping our connection to place and in particular, how the literature has studied these relationships to date. Given this is an emerging space of research, the topics studied were far from comprehensive. Interestingly, flora species was most represented in the literature. OECD countries were the centre of focus in the literature as well as forest and woodland ecosystems. Studies primarily employed a qualitative approach in the form of interviews with residents to identify people-species relationships in place attachment.

To build on the relationships drawn from place-based literature, we build on the PPP framework and move beyond static framings of people-place relationships to outline how species actively act as placemakers through six main characteristics: *1) identification, 2) association, 3) interaction, 4) knowledge, 5) kinship,* and *6) actors*. By integrating species into the PPP framework, this study reorients human-environment geography and bridges the human-animal divide, providing a unique multispecies perspective. Analogous to the PPP framework, we suggest that these characteristics are interconnected and subjected to dynamic processes overtime. For instance, one interpretation is that the way species are *identified* helps to develop an *association* to the species, which in turn can encourage *interactions* and the acquisition of *knowledge*. As people learn more about the species, a sense of *kinship* can develop and lead to the formation of societal groups with a vested interest (i.e. *actors*).

With current and foreseeable environmental challenges, we call for research efforts to focus on the multifaceted nature of relationships between people, species, and place attachment. Using species as a focal point in understanding place-based relationships can help inform effective management decisions and guide the development of targeted engagement programs, educational curricula and well-informed policies. Managers can prioritize flagship or keystone species not only for their ecological role but also for their capacity to foster local stewardship, strengthen collective identity, and enrich lived experiences. Framing species in six key placemaking roles offers a practical guidance for spatial analysis in human-environment geography to move beyond human-centric approaches and widen participatory methods to identify species-driven attachment "hotspots". In an era of rapid environmental change, this framework can help to anticipate how species-on-the-move will redefine people-place relationships. Bridging the gap between scientific knowledge and public understanding from an emotional, cultural, and societal standpoint, can encourage more meaningful conversations and foster a sense of urgency for action in a changing world.

CRediT authorship contribution statement

Edith Shum: Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Vanessa M. Adams:** Writing – review & editing, Validation, Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **Georgina G. Gurney:** Writing – review & editing, Validation, Supervision, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Edith Shum reports financial support was provided by Tasmanian Land Conservancy. Edith Shum reports financial support was provided by Holsworth Wildlife Research Endowment & The Ecological Society of Australia. Vanessa M. Adams reports financial support was provided by Australian Research Council- Future Fellowship. Georgina G. Gurney reports financial support was provided by Australian Research Council-Discovery Early Career Award. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.apgeog.2025.103697.

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