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SPECIAL FEATURE: ORIGINAL ARTICLE

Sense of place in social-ecological systems: From theory to empirical exploration

Place-making to transform urban social–ecological systems: insights from the stewardship of urban lakes in Bangalore, India

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Abstract

With cities expanding globally and human populations becoming increasingly urban, sustaining ecosystems that support human well-being in cities is both increasingly challenging and urgent. City residents can take on important roles in the stewardship of public parks, trees, and waterbodies in their neighbourhoods, and sense of place is often brought forward as a motivation for engagement. In Bangalore, neighbourhood lake groups have partnered with public authorities to improve the restoration and upkeep of the city's disappearing and increasingly polluted lakes. In this study, we focus on five lake groups to investigate the influence of sense of place on stewardship, specifically place-making—a term used to describe intentional practices to design, improve, and manage 'good' public spaces. In each group, three-to-six members were interviewed and a survey tool was used to assess the place attachments and meanings associated with their specific lakes. Findings show that approaches to place-making were influenced by childhood experiences with nature, and an appreciation for what is becoming increasingly scarce in a fast-growing city; greenery, pleasant temperatures, free-flowing water, clean air, and access to nature. Over time, involvement in lake care has reinforced attachment for certain place meanings, but also broadened the range of meanings people are attached to, including seeing the lakes as places to express national and cultural pride. Findings also show that longer involvement in stewardship tends to give rise to a more complex understanding of the lakes' social and ecological functions, which in turn motivates the lake groups to advocate for a more socially just and nature-oriented approach to lake management. Based on our findings, we propose that stewardship groups can influence how a broader community interacts with and cares for urban green spaces, foster a more complex understanding of the varied benefits green spaces generate, and carve out alternative and more sustainable pathways for the governance of urban ecology.

Keywords Place-making · Sense of place · Urban social–ecological systems · Stewardship behaviour

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Introduction

Over the past 6 decades, the planet has gone through a process of rapid urbanization and since 2007 the global population has shifted from being majority rural to majority urban (United Nations 2009). This shift in demographics is causing the world's cities to swell, which puts severe stress on urban waterbodies (Elmqvist et al. 2013). Such challenges emphasise a need to promote cities as social–ecological systems (SES), i.e., places in which people rely upon functioning ecosystems, and in which ecosystems are influenced by human values, decisions, and behaviours (Chapin et al. 2009). Conceptualizing cities in this way invites investigation into how people think about their environments and how environments influence peoples' thinking (Jones et al. 2016).

In the river-less city of Bangalore in southern India, the thinking around how to address urban water scarcity has been to pump water from a river 100 km away. In combination with rapid urbanization, this has undermined the preservation of local water supply from a pre-existing hydrosocial system of man-made lakes and wells (Enqvist et al. 2016). This exemplifies what McLean (2017) describes as "big water culture" where large-scale engineering solutions dominate in supply side planning, to the exclusion of solutions that could arise from "everyday water cultures" and understanding local ecosystem functions. As illustrated by Enqvist et al. (2016), this approach has created trap-like dynamics in Bangalore, where a combination of large-scale technological investments, urban development, and centralised water management and distribution, has locked water supply into a trajectory where local resources are gradually destroyed.

Traps like these can prevent system change even when there is widespread recognition of the value of threatened resources (Scheffer and Westley 2007). This situation can stem from subjectively held perceptions about what the identity of a system is (e.g., what function do lakes have in the city), which reinforces rigid management approaches by causing social actors to systematically overlook alternatives (Stedman 2016). In addition, by neglecting to perceive diversity in system function, overly technocratic approaches to resource management can have detrimental effects on the close connections that exist between a place's natural assets and its historical, cultural, sacred, and communal significance (Friedmann 2010; van den Bosch Konijnendijk 2015). A way to remedy this can be to draw attention to other subjective perceptions of a system such as the place-based concerns, needs and prides held by community-based groups that use local places for mobilizing collective action (Martin 2003; Horlings 2016). Since neighbourhood and community-based organizations are becoming more and more responsible for securing local services in top–down governance schemes (Martin 2003; Svendsen and Campbell 2008; Connolly et al. 2013), this presents an opportunity to explore where and how different understandings of place matter for overcoming the constraints of unsustainable resource management (Moore et al. 2014; Masterson et al. 2017; Long and Lake 2018).

To investigate such processes, it is necessary to understand if and how sense of place acts as a catalyst for collective action and environmental stewardship (Manzo and Perkins 2006; Chapin and Knapp 2015). This understanding can be gleaned from using sense of place theories, which allow peoples' relationship to a place to be unpacked and understood (Relph 1976; Tuan 1977; Stedman 2003). A common conceptualization is to view *place meanings* as describing what a place is, while also forming the basis for *place attachment*—together creating what is referred to as *sense of place* (Stedman 2008; Brehm et al. 2013). This perspective can help to explain why certain people may be willing to invest time and energy in the stewardship of a particular place, if they believe that their efforts will be valuable in conserving, or realizing, the meanings that they are attached to. In this paper, we are particularly interested in the link between sense of place and stewardship behaviours. To explore this link, we highlight place-making as a component of place-based stewardship and use insights from urban planning and community development research, which defines place-making as putting intentional effort into the creation of good public spaces that promote people's well-being (Silberberg and Lorah 2013; Williams 2014). Although the place-making literature pays little attention to human–nature relationships (Wilkinson 2012), it does critique how top–down urban planning undermines people's sense of place, when it does not take place meanings into consideration (Fullilove 2004; Brugiatelli 2016; Horlings 2016). More importantly, it highlights strategies bottom–up initiatives can adopt to reshape their local places in community-centred ways. Three strongly emphasized strategies include: (1) "Championing mixed use over design"—understanding who uses a place, how, why, when, and with what consequences and benefits (Carmona 2014; Wyckoff 2014); (2) "Programming"—organising and planning events with the aim of encouraging community members to engage with a place (Silberberg and Lorah 2013); and (3) "Acceptance of controversy" (Flora and Flora 1996) as a natural part of managing public space, which requires negotiating between different views and perspectives as to what makes a place "good". These strategies emphasise the active creation of place meanings and the subjectivity inherent in transition management, social processes which need to be better understood and acknowledged within SES undergoing change (Manuel-Navarrete 2015; Stedman 2016).

This article applies these concepts to the study of citizen-led lake stewardship in Bangalore, which has emerged in reaction to the destruction of the city's lakes and canals—remnants of a centuries-old irrigation system (Enqvist et al. 2016; Nagendra 2016). Paying particular attention to how lake groups engage in place-making, as part of their stewardship efforts, we assess their influence on what type of places their restored lakes are becoming and how, in turn, this might matter for the evolution of stewardship behaviour. By selecting five lake groups, who co-manage their local lakes together with Bangalore's municipal authorities, we seek to answer the following research questions:

1. How have lake group members' perceptions of lake meanings and attachments changed over time? What place meanings do lake group members perceive as important now, compared to when they started?

2. What implications have these changes in sense of place had on the groups' approach to place-making and lake stewardship?
3. How have lake group initiatives influenced the formal management of lakes by Bangalore's municipal authorities?

Based on these questions, our study explores how creating opportunities for citizen involvement in governance can play a role in transforming the way green spaces are recognised, valued, and managed in rapidly urbanizing cities.

Study area: the transition of Bangalore's lakes from disappearing places to places of concern

In the last 15 years, the city of Bangalore has experienced a doubling in population and is now home to 10.1 million people (World Population Review 2017). This population increase is mirrored in the city's spatial expansion, which has grown more than tenfold since 1949 (Ramachandra and Kumar 2008). Such rapid growth has led to the creation of sprawl regions lacking in basic amenities and infrastructure, and a citywide decline in green cover and waterbodies of 78% and 79%, respectively, in just 40 years (Ramachandra et al. 2017).

The dramatic decrease in blue space reflects the loss of Bangalore's 'keres' or man-made waterbodies, the creation of which began centuries ago as a means of harvesting rainwater in a river-less landscape. Models of skilful engineering these keres were constructed to complement the area's undulating topography, so that during periods of heavy rainfall water would flow from higher elevation keres to lower ones through canals called rajakaluves (Gowda and Sridhara 2007). Year-round water supply was then ensured by the construction of open-wells around the keres, which filled through groundwater recharge and in-coming rain during monsoons (Nagendra 2016).

For centuries, each kere was managed as a commons by adjacent village communities, where maintenance responsibilities were assigned to particular village members in exchange for access rights to natural resources (Nagendra and Ostrom 2014). In this way, kere management was incentivised and specific to local conditions. However, towards the end of the nineteenth century, when the British transferred kere management to government-appointed officers, the specialized community knowledge of kere maintenance was separated from those empowered to manage them (Nagendra 2016). This community disempowerment culminated in 1964 when all keres were declared state property (D'Souza and Nagendra 2011). Five years later, the city

government decided to pipe river water into the city from 100 km away; water that would be distributed by a new body, the Bangalore Water Supply and Sewerage Board (BWSSB). This decision reduced incentive and administrative structures to invest in kere upkeep as water resources. Without adequate protection, the keres became increasingly threatened, and over the coming 5 decades, an estimated 800 were built on, encroached, or used as storage pits for debris and sewage (Nagendra and Ostrom 2014). In an attempt to halt this development, in 1985, the State Government deemed restoration to be the only viable option and entrusted the Forest Department, the Bruhat Bengaluru Mahanagara Palike (BBMP; Greater Bangalore Municipal Corporation) and the Bangalore Development Authority (BDA) with the responsibility of their preservation (Gowda and Sridhara 2007; Nagendra 2016)—notably all disassociated with the BWSSB's water supply mission. These agencies adopted an engineering-based approach to restoration that involved fencing the periphery to prevent 'encroachment', diverting sewage inflows, removing silt to maximise water holding capacity, and constructing a raised bund and walking track around the water (Fig. 1). By failing to recognise the keres' multiple uses, their ecological functions, and their hydrological connectivity, this approach has gradually converted Bangalore's keres into recreational spaces generally referred to as 'lakes' (D'Souza 2014).

Once restored, the management of lakes for recreation, water supply, fishing, and other uses was divided between nine different government agencies. This siloing of responsibilities, and lack of communication between departments, meant that the majority of restored lakes remained as susceptible to encroachment and pollution as before restoration (Nagendra and Ostrom 2014). In many cases, a cycle of top–down lake restoration, maintenance vacuum, gradual degradation, and subsequent need for re-restoration developed. This inefficient expenditure of funds, and emphasis on restoration rather than the maintenance and cultivation of meaningful public places, eventually provoked a reaction from local residents and started to mobilize stewardship behaviour (Nagendra 2010). Recognising the role engaged citizens could play in maintaining their local lakes, the BBMP decided to enter into public-civic collaborations in an effort to sustain their restoration efforts. In 2010, a handful of lakes started being co-managed by resident lake groups, formally recognised through memorandums of understanding (MoUs) with the BBMP (Luna 2014). This integration of local residents into the governance system has since given rise to a social movement of lake stewardship and the emergence of more than a dozen additional lake groups (Enqvist et al. 2016).

In combination with an increased sense of citizen agency, the speed of urban sprawl, and growing controversies about the city's reliance on a stressed external water

Fig. 1 Initial stages of lake restoration. **a** Fencing. **b** De-silting and bund formation. **c** Paving bund as walkway

source (see Safi and Doshi 2016) have turned Bangalore's lakes into places of concern. Hence, as part of the process of developing their own management approach, groups are reaching out to technical and ecological experts for advise on how to better adapt lake maintenance to local conditions and promote the city's lakes—not only as recreational parks, but also as places that support biodiversity, the livelihoods of less affluent communities, the preservation of cultural heritage, religious activities, flood mitigation, wastewater bioremediation, and local water supply through groundwater recharge (Nagendra 2016; Enqvist et al. 2016).

In this study, we selected five lake groups (Fig. 2), to investigate what meanings and attachments which group members associate with their rescued lakes, and what influence this has on their approach to stewardship and place-making.
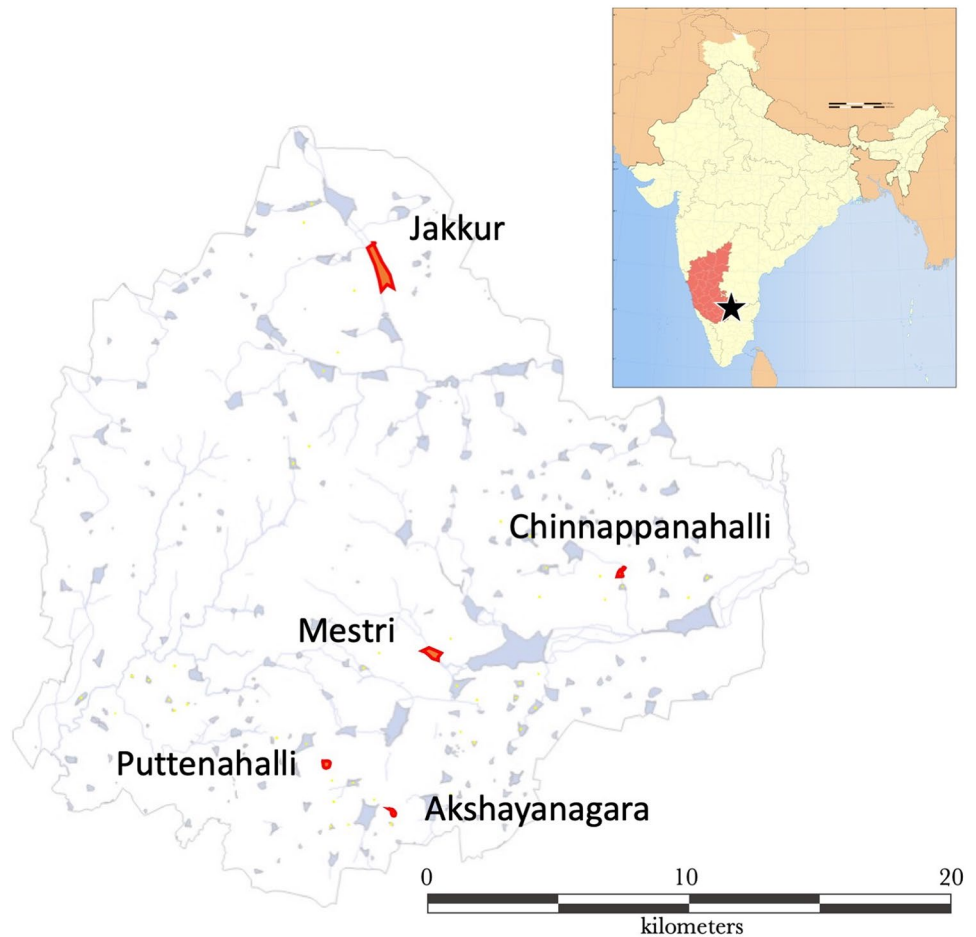
Materials and methods

This study was based on a mixed-method approach, combining semi-structured interviews and participant observation with quantitative surveys (Creswell 2014). The design of the interview and survey protocol was adapted from a previous study investigating the link between sense of place and the protective and restorative stewardship of urban waterways in New York City (Enqvist et al. this issue).

Case study and interviewee selection

Based on a list of twenty-four known lake groups (Enqvist et al. 2016), we selected five groups that were still active, had more than three members, and were progressing from a restoration phase to a maintenance phase at their lakes (Table 1). All interviews were carried out by the lead author from October to December 2016. Contributors to the study included lake group members ($n = 22$), individuals working with lake issues at a city scale, such as NGO workers, consultants, and local researchers ($n = 9$), public officers at BBMP's Lake Division and BWSSB's New Water Department ($n = 3$), and lower income residents from remnant lake villages and spontaneous settlements that abutted the selected lakes ($n = 7$). The principal source of data came from the individual semi-structured interviews conducted with lake group members. This group consisted of middle-to-upper class individuals who predominantly lived in new lake-side apartment blocks. Interviews ranged from 42 min to 1 h 48 min in length. As recommended by Trell and Hoven (2010), these interviews were conducted on location while either sitting or walking

Fig. 2 Location of selected lakes within BBMP municipal boundary (Adapted form Enqvist et al. 2016)

at the interviewee's local lake. This allowed participants to see, hear, smell, and feel the place which they were communicating about. As an additional aid for describing place-based experiences, a print out of the lake from Google maps was presented to each interviewee, which they could refer to if needed. This is known to be an effective way of generating place-based data and prompting respondents to more comfortably articulate local knowledge (Gould et al. 2015).

Sense of place surveys

To allow the patterns of attachment to be compared between lake groups and triangulate the information gathered during interviews, lake group members were asked to complete a survey (see Supplementary Material). The first part of the survey consisted of standard place attachment statements and Likert scales (Stedman 2003). The second part of the survey, which focused on lake meanings, asked participants to select and then rank the ecological and social characteristics of the lake that were most relevant for initiating and sustaining their engagement in lake care (adapted from Enqvist et al. this issue). During this exercise, participants

were presented with a table of pre-selected place meanings and twenty counters, which they could distribute as they wished. Afterwards, interview questions such as, "What about this category made you rank it the highest?" were used to guide a discussion on how the participant had filled out the table.

Participants were asked to complete both survey sections twice: once, thinking back to when they started working with the lake (which ranged from 1 to 10 years ago), and a second time based on their present-day perceptions and feelings. This attempt to give the quantitative data which a temporal dimension was based on the concept of "retrospective pre and post" evaluation, a survey method used to identify self-reported behavioural or attitudinal changes after having gone through a particular experience (Rockwell and Kohn 1989). Rather than being a way to measure quantifiable change in place attachment and meanings over time, this method was used to explore the participants' self-perceived changes in their sense of place. This experimental approach was built on insights from a previous study, where interviewees often expressed a need to distinguish between their present motivations and their original reasons for engaging in stewardship (Enqvist et al. this issue). This approach also addresses

Table 1 Selected case studies

Lake	Jakkur	Chinnappanahalli	Mestri kere	Puttenahalli	Akshayanagara Kere
Area (acres)	157[a]	11[a]	10[a]	13[a]	6[a]
Degree of urbanization	Peri-urban but urbanizing	Urbanized ~15 years ago	Urbanized > 20 years ago	Urbanized ~ 15 years ago	Peri-urban but urbanizing
Initial restoration (agency and year)	BDA (2009)	BBMP (2010)	BDA (2013–2016)	BBMP (2009)	Forest Department 2000
Current custodian	BBMP (since 2015)	BBMP	BBMP (since Dec. 2016)	BBMP	BBMP (since Dec. 2016) (after several years with BDA)
Non-temporary settlement abutting the lake	No	No	Yes (attached to original village)	Yes (~ 30 years old) (includes original lake villagers as well as rural migrants)	No
Original lake villagers still engaged in lake use	Yes	No	Yes	No	Yes
Lake group	Jala Poshan (nurturing the water)	Chinnappanahalli Lake Development Trust (CLDT)	Mestri Lake Coordination Committee	Puttenahalli Neighbourhood Lake Improvement Trust (PNLIT)	Akshaya Nagara Kere Sutta Mutta (Akshayanagara lake and its surroundings)
Start of group activities	2010	2010	2000	2009	2004
MoU with the BBMP	Since 2015	Since 2013	No MoU	Since 2010	No MoU
Approximate number of members	4 Trustees, core team of 30, 100 volunteers on WhatsApp	4 Trustees plus a handful of local donors and volunteers	Ca. 20, with 5 consistent members since 2000	5 trustees, 10 + regular volunteers	Core group of 10, 50 volunteers on WhatsApp
Employees	Woman's self-help group (10 village woman who garden daily)	2 Families of gardeners who work and live at the lake	Lake still being restored	1 Sweeper, 2 gardeners, 2 lake cleaners, and a staff manager	1 Security guard who lives with his family at the lake
Celebrated for	About to implement a "*social–ecological*" design at the lake. Infrastructural work will be done by the BBMP	Created the city's first Senior Citizen Park with a medicinal garden	Advocating since 2000 for the lake's restoration. Due to receive water in the next year, after being dry since the 1970s	First group to sign an MoU with the BBMP	Hands on group maintaining the lake without hired gardeners or corporate funding

[a] According to surveys conducted by Bangalore Development Authority (2013) and the Karnataka Lake Conservation and Development Authority (2016)

a broader need to develop research methods that can elicit more of the complexity inherent in people–place relationships and better represent sense of place as dynamic and pluralistic (Raymond et al. 2017).

Data analysis

Prior to analysis, all interviews conducted with lake group members and lower income lake residents were transcribed verbatim. For expert interviews, transcription was limited to key sections that related to their interactions with community lake groups. Transcriptions were coded both deductively and inductively (Maxwell 2005) using the qualitative analysis software QDA Miner Lite (version 3.0.). Deductive coding (based on the place attachment statements and lake meanings from the survey) allowed for comparison between the quantitative and qualitative data (see Supplementary Material). Place-making and stewardship strategies used to secure, facilitate, or inhibit place meanings were also coded for, as well as strategies that diverged from, or directly challenged, conventional governmental lake restoration approaches. Inductive coding was used to explore the other salient themes within the transcripts that did not fall under the predetermined codes. Survey responses were collated using Microsoft Excel (version 15.12).

Results

Analysis of the five cases revealed a common stewardship journey of discovering a threatened lake, learning about its complexity, developing place attachment, and proceeding to exert influence on other people's interactions with the lake through the use of place-making techniques. This section describes this progression and addresses the research questions by drawing on both the qualitative and quantitative findings.

Discovery of new lake meanings and the evolution of stewardship

Before the studied lake groups emerged, the five lakes now being cared for were in a state of disrepair and generally perceived as polluted, inaccessible, and unsafe. In all cases, the founders of the five groups were motivated to engage in lake rejuvenation as a reaction to witnessing the lakes become "dumps", "sewage pits", and spaces that "property sharks" were attempting to fill in and build on. The initial engagement in stewardship, therefore, involved a willingness to engage in the grimy realities of cleaning up a polluted ecosystem:

When we started… you wouldn't believe, we used to find the weirdest garbage. Once, we found 25 jumbo garbage bags of sanitary pads and diapers… Another time we had a truckload of dead chickens … Every Sunday we'd clean and it was like saying, "Please come and dump more!"
ID 71—Jakkur (Lake group founder referring to the status of the lake in 2010)

As their engagement with the lakes continued, the lake group members became more aware of the history behind the lakes' decline and increased their understanding of how the lakes were originally designed, maintained, and used as connected chains of lakes and channels for irrigation. They were conscious, for example, that the movement of middle-class communities into the peri-urban areas surrounding lakes was due to the conversion of farmland into layouts for apartment complexes and housing, a process which involved government agencies buying out local farmers in the area. At the more centrally located Puttenahalli and Mestri Kere, this process had happened 15–30 years ago, while, at Jakkur, Chinnappanahalli, and Akshayanagara, the transition from rural to urban was still underway with the construction of new apartment blocks visible next to the lakes' boundaries. All lake group members, therefore, discovered their local lakes at a time when their original function as irrigation tanks had been lost, and remnant farming and village populations had become disconnected from their upkeep. For domestic lake users, still reliant on animal herding and outdoor laundry as a means of living, lake restoration techniques employed by government agencies had made the lake shorelines too steep for cattle and clothes washing. Fencing to protect the lakes from 'encroachment' created further access issues, both practically and psychologically. Hence, by choosing to engage in lake maintenance, the studied lake groups not only took on the task of improving the lakes' environmental condition, but also the challenge of trying to generate enthusiasm for the lakes' revival amongst their original custodians, i.e., the local villagers, as well as others living long term in the vicinity. This is an ongoing process, which involves the group members informing themselves about what the lake meant to this community before its decline:

We were a little careful when we started this lake group, because what happens very often is that we come with an urban mind-set, which is very disruptive. I mean people have been living around here for ages… so we didn't want to pave this place, and have shops and vendors come in here. A picnic spot! You can't do anything worthwhile, sustainable by alienating the local guys.
ID 21—Jakkur (Lake group trustee for 1 year)

At the same time, lake groups also want the lakes to cater to the needs and interests of the neighbourhood's growing middle and upper class communities, of which they themselves are a part. To gain the interest and support of this community, they invest time and thought into programming different activities at the lake, such as storytelling sessions, bird watching tours, yoga classes, national day celebrations, and open-air concerts. As described by one lake group member, organising such activities is seen as an important way of generating awareness and appreciation for the new type of places which these lakes are becoming:

> We had this debate in the beginning saying, "Should we hide away this lake and not make it too popular? Or should we involve more people in activities at the lake, and at the same time sell them the concept of a natural lake?" So we chose to go with the latter… You need to get as many people involved and educated at the same time so that this lake stays maintained."
> ID 21—Jakkur (Lake group trustee for 1 year)

Programming events is also seen as a way of informing the community about the lake group itself, and recruiting new members interested in taking on responsibility for their local lake's upkeep. In this way, groups generally gained momentum as the local population around their lake grew. For newer group members, who joined once the lake's condition had somewhat improved, many admitted that their now committed involvement had actually started "accidently" or "by chance". They were invited to attend an event by a friend, or they noticed in passing that there were activities taking place at the lake. For other newcomers, their initial engagement with the lake started because of an interest in running, walking, or bird watching. However, as they continued to participate in lake maintenance, engaging in personal interests became less important:

> Initially I came to see what birds where around, just to see the birds. Then I realised there's a lot more going on at the lake… so the birds, the plants, the soil and how there is this intricate network between all of them and how they work. And the great thing is, the lake has changed so much [and] I have been very overwhelmed with its dynamics.
> ID 46—Puttenahalli (Regular volunteer for 5 years)

The quote above also captures how witnessing environmental change, becoming more familiar with the lake, and building more local knowledge have caused lake group members to adapt the way which they interact with the lakes as their perception of its meanings evolve. This evolution in lake perception is visible in the results from the place meaning exercise, where the interviewed group members were individually asked to select and rank nine listed lake meanings using twenty tokens. Figure 3a illustrates how the

relative importance of different lake meanings has changed over time, and how multiple lake meanings are starting to become more equal in importance as the groups progress from restoring the lakes to maintaining them. This is a process that happens gradually as the condition of the lakes improves and the many benefits of a functioning lake start to be tangibly experienced:

> See, as I get more and more involved I try to look at the benefits we derive from this lake. Groundwater is getting recharged, so I have to save the lake! Earlier it was my selfish attitude that I love nature, I want to be here. Now, I take a broader look… how is it useful to the society? In the beginning I never thought of water supply, public utility, and all those things.
> ID 8—Akshayanagara (Lake group founder for 15 years)

In addition, the number of lake meanings that respondents assigned tokens to was greater when they completed the place meaning exercise for 'today' compared to 'when starting' (Fig. 3b), implying that they are now motivated to care for the lakes by a broader set of place meanings than when they first began. This mirrors their current interest in managing the lakes as places that serve a mix of ecological and social functions. It also suggests that, within each group, the collective perception of what makes the lakes important is becoming more cohesive with time.

In spite of these changes, participants still rated "environmental condition" and "type of nature found here" as the most important lake meanings for motivating and sustaining their work. When starting out these were characteristics the groups wanted to "improve" or "re-create". Now, they are qualities which they want to "enhance", "protect", and enjoy the benefit of. The importance of these ecologically informed meanings is also evident in how they express a new sense of attachment to the lakes, a factor that is becoming a deeper driver behind their current stewardship and place-making behaviours.

Developing lake attachment and implications for place-making

As described previously when the lake groups emerged, founding members initially discovered the lakes when they were already in a state of disrepair. Amongst newer members, no one reported spending time at the lake before deciding to join the group. This study, therefore, exemplifies emerging stewardship where positive attachment to the place of care has evolved due to continued engagement. However, by finding out about the interviewees' backgrounds, it became apparent that their stewardship behaviour is also affected by the other place relationships

Fig. 3 The ranking exercise (**a**) shows the relative increase in importance of a few factors motivating stewardship (memories, work done, and resources found), accommodated by a slightly lower weight given to all other factors. However, as shown in diagram (**b**), all lake meanings (except 'things I do on my own') are acknowledged by more respondents today compared to when they first started working with the lakes. +During the ranking and selection exercise, the interviewee was given twenty tokens which they could distribute amongst the lake meanings as they wished
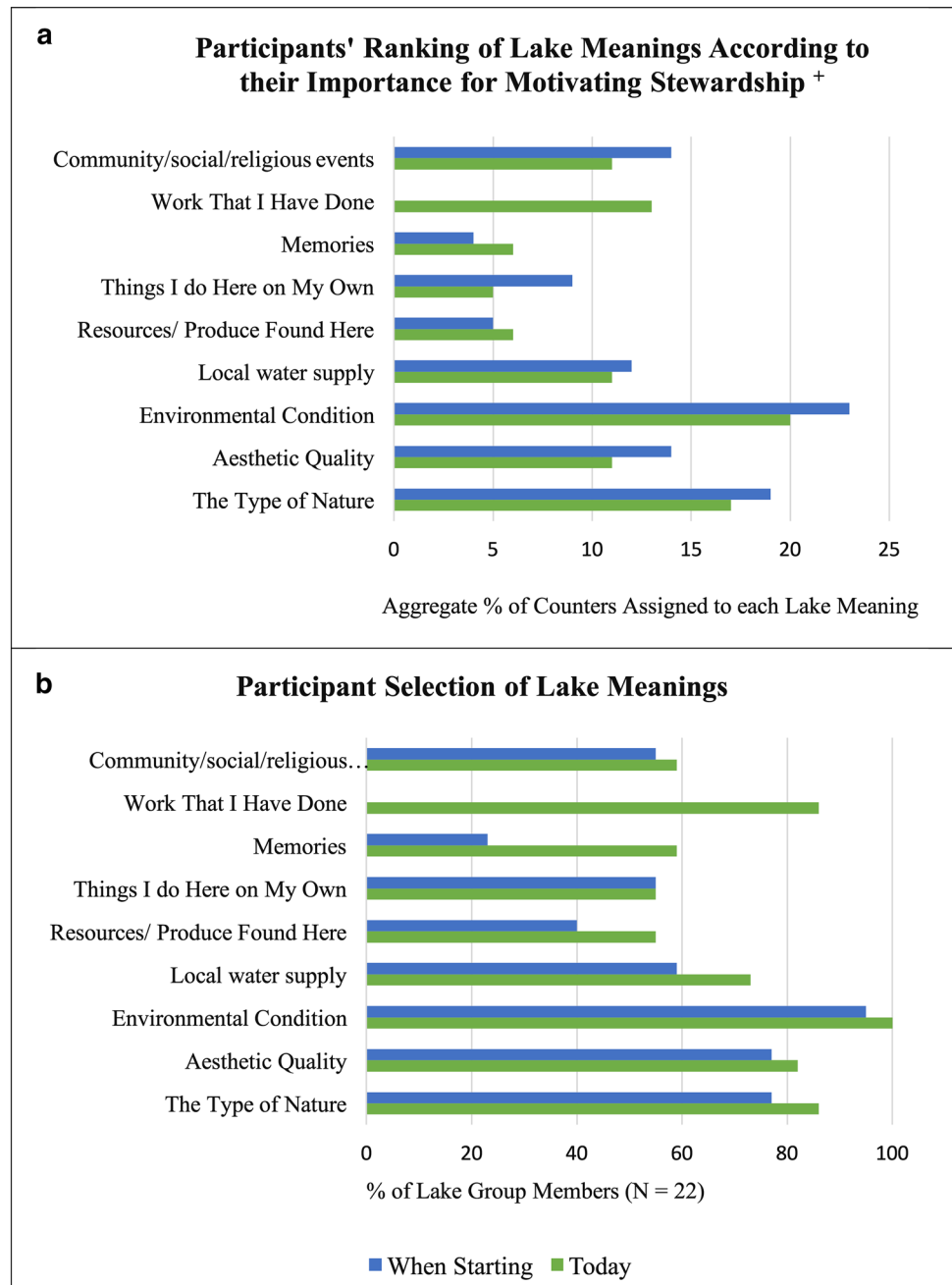
that are important to them. For example, many participants brought up memories from a "green" childhood, or the "rural", "coastal" places they were originally from, as reasons for putting time and effort into greening where they currently live:

> See I come from an area where vegetation is high. When I see Bangalore its more of concrete, which I don't like much. So, what I see here [at the lake] makes a lot of sense. This is what I desire! This is what I am making!

ID 68—Akshaynagara (Regular volunteer for 2 years)

For others, memories and ecological knowledge from the places which they were brought up in even influence what they choose to plant at the lakes:

> I'm basically from an agricultural background. In my home, in Mangalore, we produce all sorts of coffee, betel, areca, coconut and cardamom. I have planted betel leaf [at the lake]. And pepper vines. Without much of an effort you are bringing beauty and utility.

ID 19—Chinnappanahalli (Lake group founder for 6 years)

Awareness that their upbringing is an important factor as to why they now value the environment and consider themselves *"nature lovers"* motivates the groups to programme events for city kids at their lakes:

> One of the things I started long back was "Family Time at the Lake". Because so many of us live in high-rises we may not even have a balcony garden. The disassociation for kids with the environment is huge … I want them to get their hands dirty planting something.
> ID 56—Puttenahalli (Lake group founder for 6 years)

In addition to becoming places where children can benefit from nature experiences, the groups are starting to see the lakes as arenas where folklore, and the cultural significance of specific plant species, can be preserved and passed on:

> I want to educate youngsters about the different trees we have here. There's small boards I am making to put on the plants, so that children can recognise which plant this is, why it is [there]. For example, Kadamba is this tree here where Saraswati [the goddess of knowledge] lives. We have to associate these things with culture.
> ID 8—Akshayanagara (Lake group founder for 15 years)

The greening of lakes has also made them spaces where the community in general can partake in nature-based cultural events such as *Van Mohatsav,* a "festival of trees" that is celebrated across India by planting trees before the monsoon:

> Last year we had a citizen involved Mahotsav, where we had a lot of participants. Whole month we did it. Whole of July! Every Saturday, Sunday we had a drive. A lot of citizens, corporates, schools participated.
> ID71—Jakkur (Lake group founder for 6 years)

Using the lakes to stimulate community engagement in nation-wide activities, such as *Van Mahotsav,* shows the groups' attempts to capture the public's imagination and make them associate caring for their local lake as being part of a bigger movement to green and care for India. Some group members even feel that the work which they have personally done for the lake is a symbol of caring for their country:

> See nature is God's gift. It is our responsibility to preserve it. We shouldn't complain that somebody else is not doing. What JFK once asked in the senate in America, "Don't ask what America has given to you, [ask] what you have given to America!" Same thing!

ID 19—Chinnappanahalli (Lake group founder for 6 years)

For others, reviving the lakes gives them a feeling of improving their city, which "once known for its lakes" is now in their eyes "insanely growing", "unplanned", and "lacking green space". Caring for a lake, therefore, provides an antidote to a feeling of loss regarding city meanings which they feel attached to, but can see disappearing:

> We have seen Bangalore getting spoiled. [In] at least [the last] 10, 12 years. Once, Bangalore was considered an air-conditioned city [because of its greenery]. I mean I miss that. It never crossed 32 [degrees Celsius]. Now it's like 38 or close to it.
> ID 2—Akshayanagara (Core member since 2014)

Group members also spoke about developing a feeling of reliance on the lake to facilitate certain activities. This keeps them committed to regularly visiting and monitoring the lake and its surroundings:

> I'm a retired gentleman, [without this lake] how will I pass my time? Just sitting, watching TV, or walking around on the busy ring road with the traffic and the dust? I can't do that! So here after four o'clock I just put on my jogging shoes, come straight here and walk four, five rounds, and check how things are, the new plants, etc. … since walking is a routine I'm so active! See at age 70 I have no high blood pressure, no diabetes. It is because of this lake.
> ID 15—Chinnappanahalli (Lake group trustee since 2013)

Other ways in which interviewees expressed place attachment included seeing the lakes as places that give them a sense of purpose, feeling of responsibility, connection to nature, and community interaction. In some cases, understanding what it feels like to depend on the lake for particular activities and experiences has made group members more aware of how others rely on the lake. This awareness makes them more locally sensitive custodians than the government agencies, who when doing infrastructural work often unknowingly disturb things they do not realise are important, like newly planted trees, or sites of worship:

> See snakes are carved on these stones! The villagers here… believe that performing puja [ritual offering] for the snake god clears skin disease. So they come and perform puja. When this bund was being constructed, unknowingly, Bangalore Development Authority people removed them. I said this will not do [and] I have made to reinstall it and asked my team to clean up this area. Now every villager in and around this place, thanks me for creating a clean atmosphere for their puja.

ID 8—Akshayanagara (Lake group founder for 15 years)

Certain place-making decisions are also motivated by wanting to overcome a feeling of separation between who lake groups refer to as the "villagers" or "locals" and themselves, who they self-reference as "urbanites", "aliens" "the well to do". Conscious of initially being perceived as outsiders when starting to manage the lakes, one way which the groups attempt to gain trust with the previous users is by trying to convince government agencies to relax lake policies in a way that better suits local realities. For example, legally cattle are not supposed to be kept in the city, or be allowed onto lake property, but some lake group members, as "managers on the ground", think differently:

> There are cows and buffalos in this 'village'. Right! Now cows and buffalos are not supposed to be in cities. Fine, agreed. But they exist! And right now those cows graze here… So we insisted there should be a bathing place, for the cows and the buffalos.
> ID 29—Mestri Kere (Lake group founder for 16 years)

As co-managers, lake groups are also starting to negotiate with the government agencies regarding restoration methods that might affect the place dependence of other users, and seek compromises between the needs of different stakeholders, rather than proceeding with the standard protocols:

> This dirt path, of course when it rains its un-run-able! It will just stick to your shoe. But… we don't want to pave it [because that] spoils everything for a whole bunch of animals, and even the villagers who come and cut grass and take it for fodder. They don't want paving stones. So we'll keep it this way. It's ok if you can't run for 3, 4 months.
> ID 21—Jakkur (Lake group trustee for 1 year)

As well as attempting to cater for different uses, groups are also trying to maintain the lakes in a way that provides a different type of urban nature experience, one that is not widely catered for within the city:

> If you see the well-known lakes around Bangalore they are commercializing them. You will see a lot of vendors selling balloons and ice-creams, and a lot of steel, cement, chairs, benches. If you modernize this lake, then the whole thing is gone… you could as well walk around our building. It's concretized, it's got the paving blocks. It's nice to walk but it's better to walk here. On the mud! On the soil!
> ID 49—Jakkur (Volunteer for 6 years, Trustee for 1 year)

As government agencies gain more trust in the co-management system, they are becoming more open to group

suggestions about leaving the lakes more "natural". Examples of how the groups are getting government agencies, and the public, to rethink what type of place which an urban lake can be include "putting a natural hedge" around the water's edge to provide habitat for butterflies and insects, instead of "metal fences", and opting for dirt paths, instead of paving stones, to make the lake more "reptile friendly", "provide a better absorption during monsoons", and, "create a walking surface that is gentler on the joints" (Fig. 4). Groups are also changing the plant assemblages found at their lakes by putting a strong emphasis on planting for function rather than aesthetic, and selecting native over non-native species. Choosing plants for their function is again linked to place meanings, such as seeing the lakes as important "lung spaces" in a congested city:

> All the abuse your lungs get during the day elsewhere can be sufficed when you come here for one hour. There are about 2500 plants as well as different medicinal and herbal species. These give an aroma.
> ID 19—Chinnappanahalli (Lake group founder for 6 years)

Given the legacy of Bangalore's lakes as places that once made the city "known for its birdlife", wanting to encourage the return of birds has also guided planting choices:

> Initially BBMP had given these 112, very common saplings. They were like "This is Cassia, that side is Thespecia". After that, we got our own trees! We got this list prepared by one professor, a birdwatcher, and environmentalist. We went largely by the suggestions he made when we got these trees, which are all fruiting and flowering species. We want to see this place full of birds, and butterflies, and dragonflies, and insects.
> ID 56—Puttenahalli (Lake group founder for 6 years)

This style of planting and ensuring water supply for the lakes (through clearing storm-water drains, rainwater harvesting, or feeding the lakes with secondary treated water

Fig. 4 Changing lake restoration norms: initial restoration design of paved walkway and fenced waters' edge (left) and emerging lake group initiative of dirt paths and leaving natural hedges (right)

from nearby sewage treatment plants), has, according to the groups, contributed to an increase in the number of local land and water birds. The groups at Jakkur (157 acres) and Puttenahalli (13 acres) have been monitoring this increase on e-bird (an online database of bird observations) and now report attracting 187 and 44 species, respectively.

Another aspect to making the lakes look and feel "natural" is having to re-imagine the existing grey infrastructure, which restoration agencies have already put in place. At Jakkur, for example, which was first restored in 2009 by the BDA, the initial vision was to showcase the lake as a modern public amenity with street lamps installed all around the lake's 5 km circumference, and a jetty, built for commercial boating. Since deciding to co-manage the lake with the BBMP, the lake group, not wanting to disturb the local bird-life and nearby residencies with unnecessary light pollution, has decided not to use the street lights, which had anyway fallen into disrepair due to lack of maintenance. Instead, they plan to green the posts with planted vines and bird boxes. They have also chosen not to use the jetty for commercial boating, which would interfere with the work of local fishermen, as well as the lake's many water birds. Now, it is used as a stage for free outdoor concerts, where performances in keeping with the lake's character are held:

> We want to be careful about how much sound we create at the lake. It should be something that goes with the environment here, so we don't use any sort of amplification.
> ID 92—Jakkur (Volunteer since 2014)

Being able to shape the lakes in a way that facilitates the meanings which they perceive as important has contributed to the lake groups' growth in place attachment over time. The importance of being able to do this, for cultivating attachment, can be clearly seen in the survey results (Fig. 5), where the group working at Mestri Kere is the only group who feel that, in certain respects, their attachment to the lake has gradually decreased. These results reflect the struggles which they have experienced trying to persuade the BDA to follow a detailed restoration plan, put together by local experts within the group, which include a landscape architect, an ecologist, and an environmental consultant:

> When we presented the plans to the BDA we asked them… to include the ecological aspects of the lake. But unfortunately they did exactly what they wanted. The wire mesh fence they put around the lake edge… they put double height because they made double money out of it. Also… the inlet and outlet levels have not been done accurately. This is now a very big problem as it could create flooding issues… If it was completely naturally left I would want to go back there every day. I don't want to do that now!

ID 41—Mestri Kere (Core member for 8 years)

Such experiences have dampened this group's motivation to continue monitoring the lake's restoration and they are now coming to terms with the fact that poor re-construction work will need redoing.
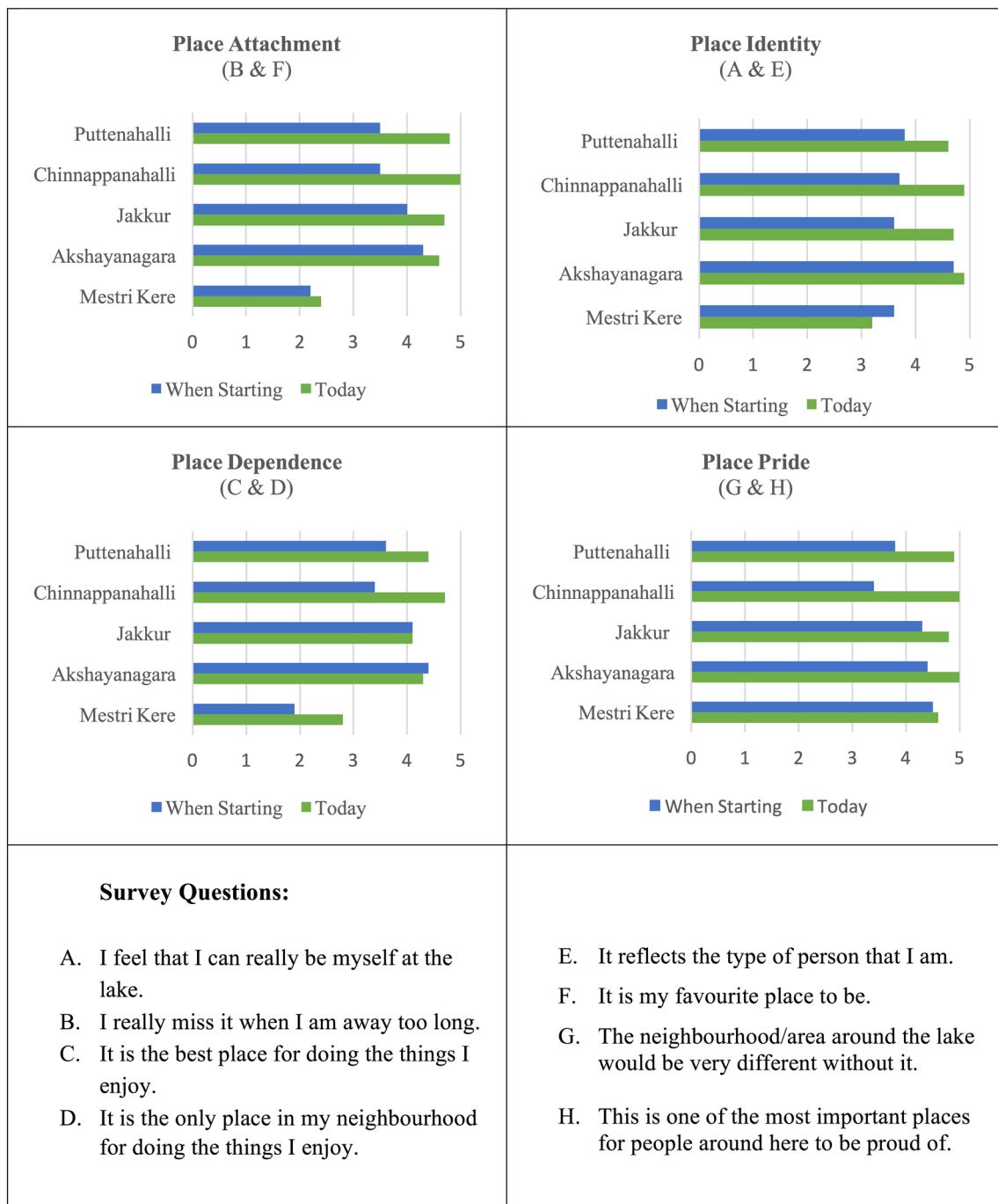
Amongst the other groups, survey results show an overall increase in attachment (Fig. 5). Interestingly, the pattern in survey responses was most similar for the groups working at lakes that now look alike and have undergone a similar transformation, i.e., PNLIT at Puttenahalli and CLDT at Chinnappanahalli, showed the highest increase in attachment. These lakes were both described as *"dump yards"* when the groups started but are now fully planted with trees that are just 6 years old. For the groups at Jakkur and Akshaynagara, which are working in less urbanized contexts, even though both lakes were suffering from sewage pollution and illegal dumping when the groups emerged, they were still green places that had grown semi-wild. For these groups, who have experienced less extreme change at the lakes, the shift in survey responses is less pronounced.

Discussion

This paper investigates how lake group members' sense of place has changed over time, what implications that these changes have had on their approach to place-making and lake stewardship, and what effect lake group initiatives have had on the conventional lake restoration and management amongst the municipal authorities. Overall, the results show that, by working to change the norms surrounding lake restoration, lake groups are helping to (1) enhance the ecological condition and function of restored lakes, (2) improve lake access for domestic users and lower income communities, (3) promote lake awareness and care in a wider community, and (4) create places that lake group members want to work in and protect.

The survey responses revealed that the dominant place meanings that influence the groups' stewardship efforts are the lakes environmental condition and the nature found there (trees and birds in particular). By comparing the survey results with the qualitative data, a deeper insight was gained as to what 'nature' and 'environmental condition' meant to group members in the context of their local lakes. This helped understand their approach to place-making, and revealed that they prefer certain types of aesthetics, biodiversity, and uses, because they want the lakes to feel more 'wild' than 'manicured' and provide diverse 'ecosystem services' beyond the recreational.

The majority of lake group members identify as 'nature people'. The process of restoring and protecting the type of nature found at the lakes, therefore, affirms this aspect of

Place Attachment
(B & F)

Place Identity
(A & E)

Place Dependence
(C & D)

Place Pride
(G & H)

Survey Questions:

A. I feel that I can really be myself at the lake.
B. I really miss it when I am away too long.
C. It is the best place for doing the things I enjoy.
D. It is the only place in my neighbourhood for doing the things I enjoy.

E. It reflects the type of person that I am.
F. It is my favourite place to be.
G. The neighbourhood/area around the lake would be very different without it.
H. This is one of the most important places for people around here to be proud of.

Y-axis – Mean response from strongly disagree (1) to strongly agree (5)

Fig. 5 How lake group members (*n* = 22) feel their place attachments have changed over time

their identity and helps which make the previously degraded lakes feel more congruent with their sense of self. As the lakes continue to change, the improved ecological condition also gives rise to new place meanings, such as "lung space", and "bird sanctuary" that group members now value. Similar to Krasny et al. (2014) who studied the motivations of volunteer oyster gardeners in New York City, this emphasizes how peoples' sense of place is shaped not only by aesthetics, landscape features, and social interactions, but also by ecosystem health and function. Ecosystem health can even have a direct effect on the emotional well-being people experience when interacting with the natural resources

where they live (Sultana 2011). Our findings indicate that contributing to improved ecosystem health is an empowering experience that gives a sense of accomplishment and helps sustain stewardship long term. This is reflected in the memories which lake group members associate with their work, such as watching saplings grow into trees, lakes refill with water, and local bore wells get recharged. The degree of compatibility between local actors' preferred place meanings, and their perception of social–ecological change can be utilized as a way of assessing the future stability of places in transition and assessing variability in the perceptions of change amongst different stakeholders (Stedman 2016). The memories listed above are, therefore, interesting to analyse as phenomena that are (1) highlighted by lake group members as indications of transformation, and (2) exemplify changes that correspond with favoured lake meanings.

The experiential aspect of memorable interactions with urban nature is also important for developing ecological place meaning and visions of what a city's environment and ecology can provide (Russ et al. 2015). In this study, the initial identification with the lakes as natural places was influenced by the interviewees' places of origin and upbringing, which, in many cases, were described as "rural" or "green". This supports the previous arguments that place-based stewardship behaviours are shaped by practitioners' life-paths (Chawla 1998). For many of the interviewees, emotional attachments to their place of origin have now become associated with their revived local lakes, and the more "wild", "natural", "un-manicured" aesthetic which they are promoting is being imported from specific childhood places. Similar to Manzo (2005), this illustrates how some adults, to create meaningful residences where they currently live, end up reproducing places that were special to them as children. The study also joins Stern's and Chawla's work in providing empirical data that shows how establishing a connectedness to nature in the early childhood encourages a propensity to engage in environmental stewardship later on in life (Stern 2000; Chawla 2006). This further emphasizes the importance of ensuring opportunities for urban children to engage in nature-based activities where they grow up (Giusti et al. 2014; Giusti et al. 2018). For other lake group members, their relationship to nature was described as a component of their national identity, and sense of pride in one's country was expressed through the re-greening of lakes with plants and trees that have mythological and cultural significance throughout India. This finding captures how stewardship behaviour can be motivated by a wish to preserve 'the symbolic dimensions of environmental knowledge' that are culturally inherited (Winthrop 2014; McMillen et al. 2017).

With these developments in lake meanings and attachments, the stewardship of Bangalore's lakes is shifting from being a recurring clean-up exercise, to a new set of behaviours that are influenced by the improving health of the lakes, and their increased community use. This shift is allowing a more "culturally reflexive" form of stewardship to be expressed, which is influenced by values, beliefs, and ideas regarding human-nature relationships and the environment (Winthrop 2014). In this case, using sense of place theories helped reveal how these values and beliefs are underpinned by a combination of nationality, culture, religion, and upbringing, and how engaging in lake stewardship is helping to sustain and mould these values over time. As argued by Morales and Harris (2014), paying attention to these more subjective dynamics of participatory natural resource management makes it clear that for participatory governance interventions to be equitable and sustainable which they must not only attend to structural and institutional dynamics, but also people's personal experience of participation.

Amongst lake group members, participation in lake maintenance, as well as being seen as a meaningful endeavour, is also seen as a process of continuous learning and not a "project" that will end. This makes their approach to place-making more adaptive than that of their formal co-managers. Similarly, Andersson et al. (2007) found that informal management practitioners who expressed a strong sense of place for urban green spaces in Stockholm were more likely to engage in experimental or adaptive management compared to formal managers, whose sense of place was weaker and who primarily followed the managerial protocols. In Bangalore, the municipal officials cannot regularly engage in lake upkeep due to lack of manpower and resources. Lake groups with their on-the-ground presence have, therefore, become sources of knowledge and ideas for the lakes' formal managers. Given that lack of adaptive capacity amongst the actors managing natural resources is often a contributing factor in the persistence of social–ecological traps (Carpenter and Brock 2008), this burgeoning communication and exchange of ideas between lake groups and local authorities is a positive step towards dismantling command-and-control lake management.

Recognising the ecological significance of traditional land uses, which are often inhibited in the name of environmental restoration, is another important form of knowledge generation for escaping social–ecological traps (Long and Lake 2018). In Bangalore, seeing the benefits of a healthy and biodiverse lake—not only for its environmental value but for its ability to provide multiple types of benefits to humans—is helping to facilitate this process and generate a more social–ecological understanding of the lakes amongst group members. For example, learning that fodder collection by local subsistence farmers aids nutrient cycling in the lakes' wetlands and that local fishermen help to promote water birds by removing invasive lake weed when they fish. This learning helps to build appreciation amongst lake group members for skill sets traditionally associated with 'lower

class' professions, skills that are being lost along with the widespread destruction of lakes. The studied lakes, therefore, exemplify how effective stewardship requires skills and expertise to be transmitted across social groups. Importantly, they also demonstrate that a desire to care for a place can help to facilitate the coming together of different knowledge if the mixed use of that place is seen as an opportunity for collaboration rather than conflict—described in the place-making literature as "championing mixed use" (Carmona 2014) and "acceptance of controversy" (Flora and Flora 1996; Manzo and Perkins 2006).

Collectively, these findings exemplify how stewardship has emerged as an interplay between a growing sense of lake care, increased local knowledge, and the eventual acquisition of agency to influence lake management. This draws on previous characterizations of stewardship (Andersson et al. 2017; Enqvist et al. 2017), which highlight care, agency, and knowledge building as important factors for generating engagement in the management of urban landscapes. In Bangalore, the groups' learning processes are being guided by the place meanings that they care about; for example, the information which they gather from local experts is guided by a wish to re-establish the lakes as historically important bird habitats. As a result, the diversity of native fruiting trees that now prevail at the selected lakes distinguishes them from the city's parks, which, according to Nagendra and Gopal (2011), contain 77% non-native tree species—a legacy from colonial-era preferences for flowering trees and an important example of how strongly cultural preferences can shape urban ecology. This emerging contrast between Bangalore's parks and lakes also demonstrates how exploring the place meanings that drive local stewardship gives a more in-depth understanding of what type of ecological knowledge is being generated in a place and what ecological outcomes can be expected. As illustrated by Tidball (2011) and Krasny et al. (2014), it also shows how the collective memory of a landscape's ecological history, whether it has been directly experienced or not, can be used to inspire and motivate a shared vision for the restoration of a place.

Conclusions

The growing recognition of the Bangalore lake groups and their work, the willingness of the authorities to engage in co-management partnerships, and a rediscovery of the lakes as interlinked social–ecological systems, means that local stewardship initiatives are carving out different pathways for lake governance. Findings also show that the longer the groups work with the lakes, the more complex and diverse their understanding becomes. Therefore, allowing space for long-term community engagement in local stewardship can help champion mixed use and an integrated

social–ecological perspective when urban ecosystems are being restored and maintained. As suggested by Enqvist et al. (2016), this could contribute to dismantling the trap dynamics of institutional lake governance and stimulate alternative approaches to urban water management. Experimenting and learning are key components in this process of rediscovery and the groups' efforts to create spaces for innovative lake restoration.

Sense of place literature offers further understanding of how to break trap dynamics by drawing attention to the subjective nature of practitioners' system understanding (Stedman 2016). Lake groups complement authorities' technocratic view of lakes with a more personal sense of care for, and attachment to, both the physical lake sites and a vision of what they can become. Hence, an important aspect of their work involves sharing their sense of place and encouraging a broader public to engage with the lakes as public commons. Cultivating this relational aspect of stewardship (West et al. 2018) requires an understanding of, and ability to engage with, the needs, values, and desires of local residents, a task that community or grassroot groups can more readily take on than local authorities. In this work, lake group members draw on the previous experiences of sense of place, as well as their understanding of, and identity in relation to, culture, nation, and nature, in general. Here, sense of place theories are useful for helping researchers to better understand stewardship practitioners' motivations, and their approaches to place-making and environmental restoration (Andersson et al. 2017; Masterson et al. 2017). These findings are, therefore, instructive for supporting community-based stewardship in other cities, and identifying the benefits which it can deliver.

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