Urban Transformations

FRONTIERS PAPER

Open Access

Growing Older Urbanism: exploring the nexus between ageing, the built environment, and urban ecosystems

Thomas Grey[1*], Dimitra Xidous[1], Desmond O'Neill[2,3] and Marcus Collier[4]

*Correspondence:
tom.grey@tcd.ie

[1] TrinityHaus Research Centre, Trinity College Dublin, 16 Westland Row, Dublin 2, Ireland
[2] Department of Age-Related Healthcare, Tallaght University Hospital, Dublin, Ireland
[3] Discipline of Medical Gerontology, School of Medicine, Trinity College Dublin, Dublin, Ireland
[4] School of Natural Sciences, Trinity College Dublin, Dublin, Ireland

Abstract

Background: Some of the main urban issues we currently face include ageing populations, the impact of the built environment, and the treatment of urban ecosystems. Yet the dynamic relationships and synergies between these issues, and how they are influenced by urban growth and evolution, receives little attention.

Research focus: We explore the nexus between people, the urban built environment, and ecosystems as they grow, age, change, and evolve and propose an integrated approach to examine the relationships, synergies, and challenges that may emerge over time within urban neighbourhoods. We argue that this should draw on the lived-experience and wisdom of older people as part of an intergenerational approach underpinned by local, traditional, and ecological knowledge. We propose Growing Older Urbanism as an ecological, co-evolutionary, and complex-adaptive-systems-based framework to explore the nexus between ageing, the built environment, and urban ecosystems and to reveal the synergies and antagonisms that might exist between these three elements. This framework is designed to be used for various types of urban neighbourhoods, and by a diverse range of stakeholders. As part of this approach we provide a preliminary visual canvas to illustrate how the framework might be used within a selected neighbourhood over an agreed timespan.

Conclusion: This paper presents some early thinking around the Growing Older Urbanism concept, while also outlining questions and a proposed transdisciplinary research programme to further develop the framework. We argue that understanding the relationship between ageing and the co-evolution of people, place, and ecosystems may teach us about our past, present, and future, and help us grow towards inclusive and sustainable communities.

Science Highlights

- The nexus between ageing, the urban built environment, and urban ecosystems is highlighted.
- The potential synergies between people, the built environment, and ecosystems as they age and evolve are scrutinised.
- The important role for ageing, wisdom, lived experience, and local knowledge in urban transformation is discussed.

Keywords: Urban systems, Social-ecological systems, Age-inclusive design, Sustainability, Climate change, Co-creation, Resilience

Policy and practice recommendations

- Stakeholders and policy makers must comprehend the challenges and creative synergies between people ageing, places changing, and ecosystems evolving.
- Local authority planning and proposed urban development should reflect, respect, and leverage these synergies.
- Older people should be recognised firstly as important stakeholders for their knowledge and lived experience, and secondly as key contributors to intergenerational engagement and co-creation.
- Local knowledge, ecological and nature-based wisdom of place should be curated, protected, and incorporated into key development policy.

Introduction

Some of the main urban issues we currently face include ageing populations, the impact of the built environment, and the treatment of urban ecosystems.

In discussing ageing and urbanism, Buffel et al. (2012) refer to the twin forces of population ageing and urbanisation, stating that globally two-thirds of people will live in cities by 2030, and that at least one-quarter of these will be 60 years of age or older. Various challenges for older people in urban settings are identified, from traffic hazards, lack of toilets and resting places, to poor housing conditions, and fear of crime. They point to the World Health Organisation's 'age-friendly cities' framework as a response to these issues and as an attempt to "develop supportive urban communities for older citizens." (p598).

As outlined above, the urban built environment affects older people on various levels. In a wider sense, the role and impact of the built environment is felt across all aspects of society and the natural environment. The United Nations (2016), highlight the urban environment as a key challenge to human wellbeing and urban sustainability. For instance, the IPCC state how cities account for 67–76% of global energy use and for 71–76% of human-related CO2 emissions, while conversely they are extremely vulnerable to climate impacts (IPCC Working Group 2022). From a physical and mental health perspective, Giles-Corti et al. (2016) highlight the long history between health and planning and point to built environment related challenges around housing, energy, transport, healthcare, safety, security, noise, air-pollution, and a range of other issues. They argue that all urban environments have the potential to produce health inequities that are systematic and socially produced.

Focussing on urban ecology, Douglas and Philip (2015) point to historic and contemporary degradation and pollution of urban ecosystems. They highlight the importance of these ecosystems for "human, animal and plant health" (p3), while illustrating how planning and management of urban ecosystems can help deal with environmental change, support sustainability, and improve human wellbeing.

Each of these three issues are place-based and are underpinned by various processes of growth, ageing, adaptation, change, and evolution. Furthermore, they are interconnected and often co-evolve in the same location. Yet the dynamic relationship and synergies between these issues, and how they are influenced by the growth and evolution of neighbourhoods, towns, and cities receives little attention. In response, this frontiers paper opens up a new enquiry and develops a framework to explore the nexus between these three challenges. The following section briefly outlines some key concepts related to evolutionary urbanism, complex adaptive systems, urban ecosystems, and knowledge and stewardship, as a starting point for this enquiry.

Background and outline of framework

> *"Shall we make our approach, then, to the study of cities, the inquiry into their evolution... beyond past and present, must we not seek into our cities' future?" (Geddes 1915, p3 & 4)*

According to Batty and Marshall (2017), Patrick Geddes introduced the theory of evolution to city planning through his work and book Cities in Evolution (Geddes 1915). For Geddes, the city was a 'living being' and he emphasised the active participation of citizens and cooperation between all organisms.

In later years, Jacobs highlighted urban evolution through a systems approach where cities are "organised complexity" evolving from the bottom-up through features and processes that are "interrelated into an organic whole" (Jacobs 1961, p433). Similarly, Alexander et al.'s (1987) theory of urban design focuses on holistic, incremental and organic growth of 'wholeness'.

Marshall (2015), building on the work of Geddes, Jacobs, Alexander, and others, argues for evolutionary urbanism that considers cities as complex adaptive and nested systems. From this perspective cities are dynamic and collective ecosystems subject to 'emergence' over time and at various spatial scales where "interactions of local components can give rise to large-scale outcomes that are unanticipated from their ingredients." (p288).

Discussing the city as a complex adaptive system (CAS), Portugali (2021) states that the addition of "adaptation" in the 1980s introduced "living systems" thinking to the complexity discourse. He argues that CAS concepts are now considered at all urban levels, from the local to the overall city, stating that "a city's resilience depends on its adaptation capabilities, to changing environmental conditions, shocks and extreme events." (p15).

In terms of urban ecosystems, Santangelo et al. (2018) refer to 'urban evolutionary ecology', and the evolutionary impact of urbanization on urban populations. They argue that a "greater understanding of how species evolve in urban environments will provide insight into both fundamental and applied biological problems and facilitate the design of more sustainable cities."(p1).

Boelens and De Roo (2016) propose greater integration between the above issues, stating that while "complexity, adaptability, co-evolution" are often considered, they are typically examined separately and without cross reference. However, through concepts such as "co-evolutionary planning" they argue that urban environments are

increasingly viewed as "the embodiments of the complex, historical co-evolution of the desires, ambitions, sociocultural frames, technology and other cultural attributes of their builders and occupiers" (p48).

Regarding these 'builders and occupiers', Van der Ryn and Cowan (1995) promote ecological design principles where 'solutions grow from place', where we 'design with nature', and where 'everyone is a designer'. They emphasise stewardship and taking a 'long-run' view based on organically grown place-based knowledge, where cultural and biological diversity co-evolve.

While the above paragraphs merely introduce some very complex topics, they begin a discussion about how people, the urban built environment, and urban ecosystems, grow, age, change, and evolve. As a way to continue and structure this discussion, we propose Growing Older Urbanism (GOU) as a framework (Fig. 1) to do the following:

A. Examine the nexus between people, the urban built environment, and urban ecosystems as they age and evolve in a specific place over certain timespan.
B. Identify synergies or antagonisms that might exist between these elements.
C. Draw on ecological knowledge, local knowledge, and the lived experience and wisdom of ageing, to support intergenerational co-research/co-creation and inform local planning and urbanism.

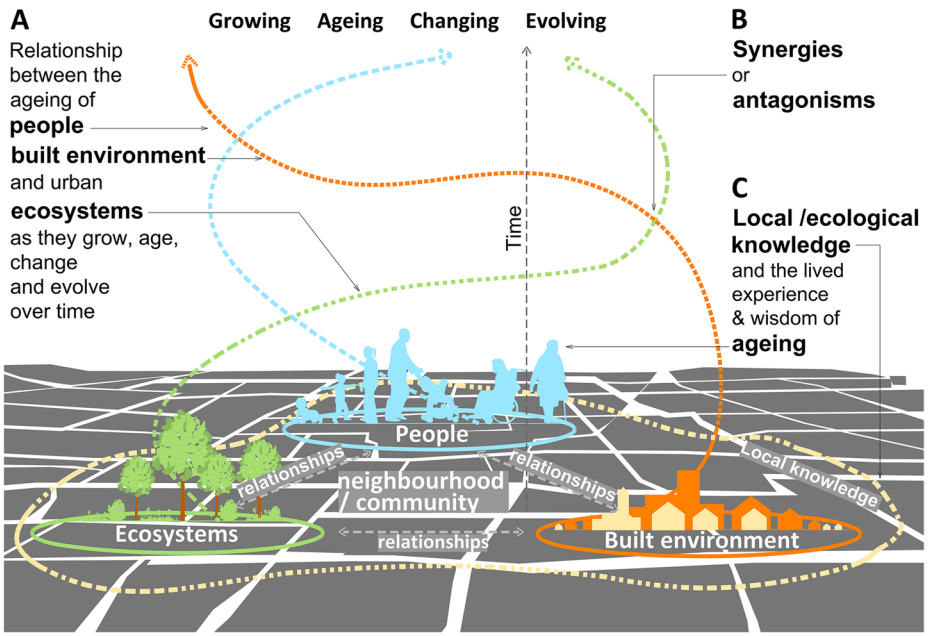

Fig. 1 Integrated approach to (**A**) people, urban environment, and ecosystems, (**B**) synergies or antagonisms, and (**C**) local knowledge and wisdom of ageing

Theories of urbanism, ageing, and ecosystems to inform the Growing Older Urbanism Framework

The previous section discussed urban evolution, systems thinking, ecosystem and ecological approaches, and also place-based and local knowledge. Next, we examine some concepts related to these areas to delve deeper into this new research topic and to help delineate a theoretical framework for the GOU approach.

Ecological urbanism, systems, and ecologies

Ecological urbanism and social-ecological systems

According to Mostafavi and Doherty (2010), the complexity of urban relations requires an "equally complex range of perspectives and responses that can address both current conditions and future possibilities". Through 'ecological urbanism' they bring together ecology and urbanism to "provide the knowledge, methods, and clues of what the urban can be in the years to come." Verma et al. outline key aspects of 'urban ecology' (Verma et al. 2020), and define urban areas as "human ecosystems where social, economic, biological and ecological components work together forming a system of feedback loops and interactions" (p5), where interactions are influenced by "human values and perceptions" together forming a "social-ecological system" (SES).

Cities as social-ecological systems / complex adaptive systems

Discussing the city as a social-ecological system (SES), Nel et al. (2018) describe how an SES is also a CAS "consisting of entities linked in networks of both proximate and distant relationships, and interacting across hierarchies of scales and levels" (p251). Citing Waldrop (1993, p302), the authors state how this happens at a point 'between order and chaos'. Furthermore, they highlight how "SESs are complex in that they are diverse and made up of multiple interconnected elements, and adaptive in that they have the capacity to change and learn from experience." (p251).

In the context of CASs, Nel et al. (2018) propose a framework to help understand change in dynamic urban environments. This 'Urban Change Framework' contains 3 key parts: firstly, describing the system; secondly, identifying patterns and drivers of change across key spatial scales; and finally, mapping change over time. Considering how GOU focuses on people, the urban environment, and urban ecosystems change, in specific place, and over certain timespan, this 'Urban Change Framework' is worth examining further.

The first part, describing the system, involves a) setting the boundaries around the enquiry itself (key issues to be considered), temporal boundaries (overall timespan and discrete time steps), and spatial boundaries (the physical extent of the focus area), and b), describing the properties of the CAS including "the agents, network and its structure, emergent behaviour, and adaptation through changes in diversity and redundancy" (p254).

The second part of the framework identifies patterns and drivers of change over time and across key spatial scales. Critical here are 'frozen accidents' or key events that cause changes in the system. Events that affect the system at

higher and lower spatial scales should also be examined as these impact the focal system.

Finally, with mapping change over time, the authors refer to the 'adaptive cycle' where the typical characteristic changes in a system involve: growth (e.g. a new neighbourhood); conservation (e.g. ageing of a population); release (e.g.demolition or land subdivision); and, reorganisation (e.g. change in demographics or redevelopment).

Ecological approaches to ageing

Ecological approaches are used to examine the contextual factors and dynamic environmental interactions affecting older people (Lawton 1974). Satariano (2006) uses an ecological approach for his epidemiology of ageing, describing how "patterns of health and well-being are affected by a dynamic interplay among biologic, behavioural, and environmental factors, and interplay that unfolds throughout the life course of individuals, families, and communities." (p41). Moore (2014) takes an ecological approach in his 'framework of place for aging' where "place is a milieu involving people ("place participants"), the physical setting, and the program of the place, all catalysed by situated human activity and changing over time." (p184). 'Program' is largely the implied shared understanding, rules, and roles that shape physical settings. Settings occur at different scales (i.e. building/ site, neighbourhood/community, and settlement) and are experienced in 'multivalent' time at different temporal scales, from rapid changes such as day to night, to longer periods of change over the life course.

Ageing and time: people, place, and ecosystems

Earlier sections of this paper mention urban evolution, CASs, and health and wellbeing throughout the life course. To investigate these issues further, and to understand the nexus between people, the urban environment, and ecosystems over time, the next section examines these elements individually, and some of the ways that people, the urban environment, and ecosystems age and evolve.

People: ageing and growing older

Sigelman and Rider (2009) define life-span human development as the "systematic changes and continuities over the life span, involving gains, losses, and neutral changes in physical, cognitive, and psychosocial functioning." (p2). They break the lifespan into: Prenatal (conception to birth); Infancy (< 2); Preschool period (2–5/ 6); Middle childhood (6–12); Adolescence (12–20); Early adulthood (20–40); Middle adulthood (40–65); and Late adulthood (> 65). They describe the limitations of viewing ageing purely in biological terms such as "growth in early life, stability in early and middle adulthood, and decline associated with aging in later life." They argue that ageing is more than 'biological ageing' by pointing out how expertise, life experiences, wisdom, and generativity increase for many people as they age.

Urban environment: ageing, change, and development

Urbanisation and the inward flow of people is a key driver of urban change (UN 2018), supporting the "continuous, complex and contested processes and dynamics manifesting

in cities" that act as dynamics that "alter urban functions, local needs and interactions between cities and their surroundings". Conversely, population growth in some European cities has stagnated, for instance the population of Paris started to decline in 1932 (Bosselmann 2012). Growth and decline also depends on location, with some urban core areas remaining unchanged or declining, while growth takes place at the urban periphery. Bosselmann (2012) also refers to changes in population density, citing Berlin, where in the 1900s the city had a density of 120 people per acre, dropping to 12 people per acre in the early 2000s.

In the US, Delmelle identified neighbourhood 'change pathways' including: 'white-flight', the establishment of multi-ethnic neighbourhoods, densification of single family neighbourhoods, gentrification in relatively diverse neighbourhoods, and upgrading of white single family neighbourhoods (Delmelle 2017).

Urban ecosystems: evolution, growth, and change

Urban ecosystems are described as "…any ecological system located within a town, city or other densely settled area or, in a broader sense, the greater ecological system that makes up an entire metropolitan area" (Douglas and Philip 2014). These ecosystems can form the smallest spatial scale (e.g. balconies, green walls and roofs) up to larger areas such as forests, wetlands, lakes, or sea coasts (Rall et al. 2015). These spaces and ecosystems are dynamic; homeostasis is maintained through feedback loops that counteract the effects of perturbations and maintains a stable system.

While ecosystems grow and change through processes of succession and ecosystem evolution (Wang and Zhai 2019), they also experience age-related decline, for instance, due to physiological changes in plants.

Urbanisation is also a major driver of change in ecosystems, including changes in habitat cover; nutrient flows; light levels; water cycles; noise levels; ground and air temperature (Gaston 2010). Gaston also lists habitat fragmentation; species dispersal and migration; and biotic interactions (including parasites and diseases). While urbanisation may cause ecosystem degradation, it can also produce 'novel ecosystems' which are "composed of non-historical species configurations that arise due to anthropogenic environmental change, land conversion, species invasions or a combination of the three. They result as a consequence of human activity but do not depend on human intervention for their maintenance" (p2).

Growing knowledge and growing older

The previous two sections present ecological approaches to ageing, the urban environment, and urban ecosystems, underpinned by gradual and constant change. In line with gradual change, Orr (1996) promotes the idea of 'slow knowledge…shaped and calibrated to fit a particular ecological and cultural context" (p700). Gómez-Baggethun et al. (2013) argue that this "Traditional Ecological Knowledge" comprises "knowledge, beliefs, traditions, practices, institutions, and worldviews developed and sustained by indigenous, peasant, and local communities in interaction with their biophysical environment" (p1). They show that this knowledge improves livelihoods, supports ecosystems and biodiversity, and helps to make social-ecological systems more resilient.

This traditional ecological knowledge is often associated with older people and indigenous elders (Rowe et al. 2020). In broader terms, O'Neill (2011) points to the advantages that come with ageing including "wisdom, strategic thinking, and highly developed social cognition" (p1829). He argues that these are evident in many aspects of life, from late creativity to the effectiveness of older politicians and workers, and these should be seen as a "longevity dividend".

Looking specifically at co-production and age-friendly communities, Buffel argues that social engagement gained through co-production can be good for older people, however, more importantly, they can influence change within their community by drawing on their life experiences and attachments to their neighbourhoods. She states that "older adults are an undervalued natural resource, bringing important skills which have the potential of bringing tangible improvements to the communities in which they live." (Buffel 2018) (p58).

Sharing of skills and knowledge between generations is also an important part of sustainable communities and social cohesion (Buffel et al. 2014). While older people can certainly share lived experience and traditional knowledge, especially knowledge at risk of being forgotten (Yembuu 2021), Buffel et al. (2014) promote a "shift from the one-way traditional teaching pedagogy (the young learning from the old)" to intergenerational practice supporting "reciprocal learning relationships between people of all ages, promoting a greater understanding between generations" (p1786).

Towards a framework for Growing Older Urbanism

Drawing on the concepts explored in the previous sections, we now outline a preliminary framework for GOU based on:

A. **Co-evolutionary and ecological** approaches to **urbanism, ageing, and ecosystems** focussing on the interconnectness and interdependencies between these elements over time in a specific urban community.
B. **Complex adaptive systems** with i) temporal boundaries – **over a certain timespan**, and spatial boundaries– at the **neighbourhood scale**; ii) the identification of key **events and drivers of change**; and, iii) an exploration of key **neighbourhood changes over time**.
C. **Local ecological knowledge, and wisdom and experience of older people as part of an intergenerational approach.** Co-research and co-production used to collate local geographical, topographical, and historical information, along with cultural, traditional, and ecological knowledge within the locality. This information and knowledge will be used to explore the drivers of change and key changes as described above.

To illustrate the overall framework and to provide an outline template for exploring this nexus, we present a draft 'visual canvas' (Fig. 2). The encircling

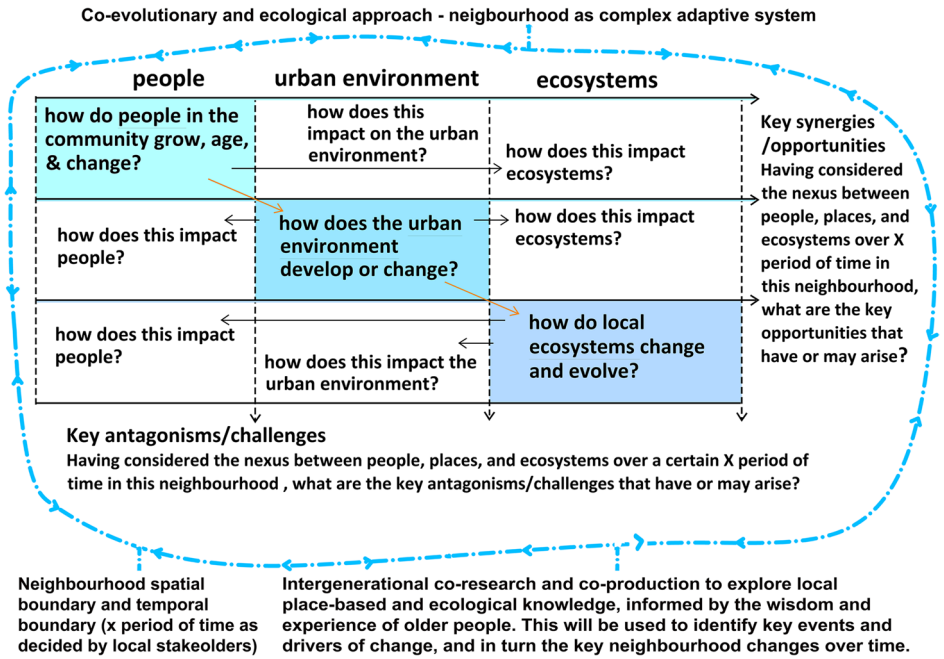

Fig. 2 Visual canvas as an outline template for the GOU Framework

blue dashed line represents the neighbourhood, the temporal and spatial boundary, and the co-research and co-production related to local ecological knowledge, wisdom and experience. This encloses a 3×3 matrix of people, urban environment, and ecosystems. As we move down diagonally from left to right, we can consider firstly how each element changes, and secondly examine how these changes impact on the other two elements in each row. Key synergies (or opportunities) can be listed to the right of the matrix, while key antagonisms (or challenges) can be outlined below.

Tables 1, 2 and 3 below provide examples of how people, the urban environment, and ecosystems age and change over time, while also giving examples of impact or influence on the other two elements. At the end of each table, one example of a synergy and an antagonism is provided. While these will be subject to the circumstances of the local area, the examples demonstrate the kinds of issues that may emerge.

This framework draws on diverse urban thinking to enable an exploration of potential synergies and antagonisms between people, the urban environment, and ecosystems in neighbourhoods as they grow, age, change, and evolve. In doing so, we envisage that the framework may help communities, planners, and other stakeholders to explore and understand key dynamics and drivers in a neighbourhood. And in turn help to engage with challenges such as age-inclusive urbanism, sustainable development, and green infrastructure/biodiversity.

Table 1 People and ageing

People age throughout the lifecourse resulting in different experiences, needs, abilities, health status, and desires (Sigelman and Rider 2009). At a community level, demographic ageing influences the percentage of children, teenagers, younger or older adults, or those living with illness or disabilities. This impacts household composition (e.g. single occupants, couples, families, widowed older adults) and influences population increase / decrease through birth and death rates associated with the population age structure (Bongaarts 2009).

Impact on urban environment (examples)	**Impact on Ecosystems** (examples)
Population change causes urban expansion or shrinkage, growth upwards (e.g. taller buildings) or downwards (e.g. underground buildings or infrastructure), increased or decreased density, or change of use (Bosselmann 2012). Childcare, education, health, transport or housing needs are also influenced by local demographics (EC 2020).	Demographic and population changes affect local ecosystems through development, resource consumption, waste production, pollution, impacts on habitats, among other things (Gaston 2010). At an individual level, different life stages result in varying impacts including increased consumption or waste associated with infants (Gibson et al. 2013), or the impacts of adults commuting to work (Roberts et al. 2018).

Example of synergy: Older population in community advocating for age-friendly city interventions, including improved green space (van Hoof et al. 2021), that ends up enhancing the neighbourhood for all ages, and improving human and ecosystem health.
Example of antagonism: Increased older population resulting in the provision of additional aged care facilities. Due to the energy and resource intensive nature of this building use (Liu et al. 2021), these facilities may contribute to local air pollution, and global climate change.

Table 2 Urban environment, growth, and change

Urban areas grow, shrink, and undergo fine-grained adaptations at the level of buildings, materials, technology (Friedman 2020). Emigration, development, de-industrialization, gentrification, and other environmental, economic, political or cultural forces also bring about change in a community (Delmelle 2017).

Impact on People (examples)	Impact on Ecosystems (examples)
Urban development impacts community health on multiple levels including housing, safety, air quality, physical activity, and accessibility (Institute of Public Health in Ireland 2006). Meanwhile, urban change, that results in dereliction and vacancy, can also negatively affect community and individual health and wellbeing by undermining community confidence, creating conflict between neighbours, attracting crime, or creating a sense of fear (Garvin et al. 2013).	The provision as parks, green roofs or green walls can protect and enhance local ecosystems (Tzoulas et al. 2007). However, development can degrade or destroy ecosystems through altered land uses, disruption to biodiversity and hydrosystems, waste discharge, or air pollution (Grimm et al. 2008).

Example of synergy: Neighbourhood public realm upgrade and greening programme, firstly improving accessibility for older people, and secondly increasing biodiversity and ecosystem resilience.
Example of antagonism: Urban regeneration displacing existing housing occupied by older people, while and also destroying ecosystems through development of local green areas.

Table 3 Ecosystems changing and evolving

As urban areas mature or as natural features are added (e.g. parks or water), local ecosystems may grow, evolve or become more resilient (Moglia et al. 2021). However, as mentioned above, they may also be damaged or destroyed through human activity, or a combination of human, animal or natural causes (e.g. drought, erosion, floods, fire) (Adger and Kelly 2001).

Impact on people (examples)	Impact on urban environment (examples)
Healthy ecosystems support human health and enhance local wellbeing through food production, improved air and water quality, and access to nature. Conversely, the lack of certain ecosystems, or depleted ecosystems can increase human vulnerability to heat, flooding, disease, and other threats (Bullock et al. 2018).	The relationship between place and local ecosystems depends on the extent of green and blue areas, habitats, and other natural features within a community. The evolution and changing of ecosystems impact local built and natural environments through vegetation, biodiversity, erosion, heat, wind, ground water and flood regulation, among other issues. These elements affect urban spaces, buildings, and infrastructure in multiple ways including weathering, climate-related damage, or structural impacts (Tzoulas et al. 2007).

Example of synergy: Creation of a new neighbourhood park providing older people with space for physical exercise, social engagement, and access to nature, while also providing new urban ecosystems within the area.
Example of antagonism: 'Green gentrification' linked to urban greening (Rigolon and Collins 2022) can negatively impact a local community, but may place additional burdens on older people due to economic vulnerability, social exclusion, and other gentrification related forces (Buffel et al. 2012).

Concluding remarks

This frontiers paper presents early thinking around the GOU concept and also sparks more questions to develop the framework including:

- What knowledge domains (in addition to ageing, the urban environment, and ecosystems), scientific discourses, and disciplines (e.g. planning, urbanism, ageing, ecology) might contribute to the development of the GOU concept?
- Considering the importance of complex adaptive systems for this concept, how can this systems approach be further explored and integrated into GOU?
- What challenges (in addition to age-inclusive urbanism, sustainable development, and green infrastructure/biodiversity) could this engage with or address?
- What co-creation processes and tools could be used by a community to apply the framework in a specific location?
- How can intergenerational practices and co-creation processes be used?
- How can the framework be tested, and validated with communities and stakeholders?
- How might the framework be developed to contribute to:
    - caring, and inclusive understanding of ourselves as we age and our capacity to be meaningful shapers and stewards of our communities?
    - a reconsidered ageing process experienced by people, places, and ecosystems?
    - a sense of connectedness to, with, and in the natural world and how we create meaning across time and space in the context of place?
    - bridging the gap between urban settings and the natural world so that they can co-evolve together?
    - informing urban design in terms of local authority planning, property development, and economic models?

Based on the concept, proposed framework, and questions outlined above, we propose a small-scale international and transdisciplinary research programme bringing together communities, local authorities, practitioners, and researchers to develop and test the GOU concept and framework in selected neighbourhoods. In line with the change and growth embraced by GOU, we hope that this programme will evolve and produce useful insights, along with unexpected and emergent results.

Understanding the relationship between ageing and the co-evolution of people, the urban environment, and ecosystems, may teach us much about our past, present, and future, and help us grow towards urban transformations that support inclusive and sustainable communities.

Abbreviations

GOU	Growing Older Urbanism
CAS	Complex adaptive system
SES	Social-ecological system

Acknowledgements

None

Authors' contributions
Conceptualisation TG, DX, MC; Article contributions, review, editing and sign off TG, DX, DO'N, MC. The authors read and approved the final manuscript.

Authors' information
The authors conduct research and practice in the areas of urbanism and architecture (TG); urban ecology and nature-based solutions (MC); geriatrics and gerontology (DO'N); and stakeholder engagement and co-creation (DX). They have worked on previous ecology, ageing, and planning projects, and are currently collaborating to devise a research programme to examine how co-creation can be used to investigate the nexus of urbanism, ageing, and ecosystems.

Funding
None

Availability of data and materials
Not applicable.

Declarations

Competing interests
None

Received: 17 September 2022 Accepted: 16 March 2023
Published online: 11 April 2023

References

Adger WN, Kelly PM. Social vulnerability and resilience. In: Adger WN, Kelly PM, Ninh NH, editors. Living with environmental change: social vulnerability, adaptation and resilience in Vietnam. London: Routledge; 2001.
Alexander C. A new theory of urban design. Oxford: Oxford University Press; 1987.
Batty M, Marshall S. Thinking organic, acting civic: the paradox of planning for Cities in Evolution. Landsc Urban Plan. 2017;166:4–14.
Boelens L, De Roo G. Planning of undefined becoming: first encounters of planners beyond the plan. Plan Theory. 2016;15:42–67.
Bongaarts J. Human population growth and the demographic transition. Philos Trans R Soc Lond B Biol Sci. 2009;364:2985–90.
Bosselmann P. Urban transformation: understanding city form and design. Washington: Island Press; 2012.
Buffel T. Social research and co-production with older people: developing age-friendly communities. J Aging Stud. 2018;44:52–60.
Buffel T, De Backer F, Peeters J, Phillipson C, Reina VR, Kindekens A, De Donder L, Lombaerts K. Promoting sustainable communities through intergenerational practice. Procedia Soc Behav Sci. 2014;116:1785–91.
Buffel T, Phillipson C, Scharf T. Ageing in urban environments: developing `age-friendly' cities. Crit Soc Policy. 2012;32:597–617.
Bullock C, Joyce D, Collier M. An exploration of the relationships between cultural ecosystem services, socio-cultural values and well-being. Ecosyst Serv. 2018;31:142–52.
Delmelle EC. Differentiating pathways of neighborhood change in 50 U.S. metropolitan areas. Environ Plan A Econ Space. 2017;49:2402–24.
Douglas I, Philip J. Urban ecology: an introduction. London: Routledge; 2014.
Douglas I, Philip J. Urban ecology: an introduction. 2015.
EC. European Commission report on the impact of demographic change. 2020.
Friedman A. Fundamentals of sustainable urban design. Switzerland: Springer International Publishing; 2020.
Garvin E, Branas C, Keddem S, Sellman J, Cannuscio C. More than just an eyesore: local insights and solutions on vacant land and urban health. J Urban Health. 2013;90:412–26.
Gaston KJ. Urban ecology. Cambridge: Cambridge University Press; 2010.
Geddes P. Cities in evolution: an introduction to the town planning movement and to the study of civics. London: Williams & Norgate; 1915.
Gibson C, Farbotko C, Gill N, Head L, Waitt G. Household sustainability: challenges and dilemmas in everyday life. Cheltenham: Edward Elgar Publishing; 2013.
Giles-Corti B, Vernez-Moudon A, Reis R, Turrell G, Dannenberg AL, Badland H, Foster S, Lowe M, Sallis JF, Stevenson M, Owen N. City planning and population health: a global challenge. Lancet. 2016;388:2912–24.
Gómez-Baggethun E, Corbera E, Reyes-García V. Traditional ecological knowledge and global environmental change: research findings and policy implications. Ecol Soc. 2013;18(4):72.
Grimm NB, Faeth SH, Golubiewski NE, Redman CL, Wu J, Bai X, Briggs JM. Global change and the ecology of cities. Science. 2008;319:756–60.
Institute of Public Health in Ireland. Health impacts of the built environment: a review. Dublin; Belfast: Institute of Public Health in Ireland; 2006.
IPCC Working Group. IPCC, 2022: Climate change 2022: mitigation of climate change. Contribution of Working Group III to the sixth assessment report of the Intergovernmental Panel on Climate Change. Cambridge and New York: Cambridge University Press; 2022.
Jacobs J. The death and life of great American cities. New York: Random House; 1961.

LAWTON MP. An Ecological Theory of Aging Applied to Elderly Housing. J Archit Educ. 1977;31:8–10.
Liu A, Miller W, Chiou J, Zedan S, Yigitcanlar T, Ding Y. Aged care energy use and peak demand change in the COVID-19 year: empirical evidence from Australia. Buildings. 2021;11(12):570.
Marshall S. Cities design and evolution. London: Routledge; 2015.
Moglia M, Frantzeskaki N, Newton P, Pineda-Pinto M, Witheridge J, Cook S, Glackin S. Accelerating a green recovery of cities: lessons from a scoping review and a proposal for mission-oriented recovery towards post-pandemic urban resilience. Dev Built Environ. 2021;7:100052.
Moore KD. An ecological framework of place: situating environmental gerontology within a life course perspective. Int J Aging Hum Dev. 2014;79:183–209.
Mostafavi M, Doherty G. Ecological urbanism. Zürich: Lars Müller Publishers; 2010.
Nel D, du Plessis C, Landman K. Planning for dynamic cities: introducing a framework to understand urban change from a complex adaptive systems approach. Int Plan Stud. 2018;23:250–63.
O'Neill D. The art of the demographic dividend. The Lancet. 2011;377:1828–9.
Orr DW. Slow knowledge. Conserv Biol. 1996;10:699–702.
Portugali J. Handbook on cities and complexity. Cheltenham: Edward Elgar Publishing; 2021.
Rall L, Niemela J, Pauleit S, Pintar M, Lafortezza R, Santos A, Železnikar Š. A typology of urban green spaces, eco-system services provisioning services and demands. Report D3. 2015; 1–68.
Rigolon A, Collins T. The green gentrification cycle. Urban Stud. 2022;60:770–85.
Roberts J, Popli G, Harris RJ. Do environmental concerns affect commuting choices?: hybrid choice modelling with household survey data. J R Stat Soc A Stat Soc. 2018;181:299–320.
Rowe G, Straka S, Hart M, Callahan A, Robinson D, Robson G. Prioritizing indigenous elders' knowledge for intergenerational well-being. Can J Aging. 2020;39:156–68.
Santangelo JS, Rivkin LR, Johnson MTJ. The evolution of city life. Proc R Soc B Biol Sci. 2018;285:20181529.
Satariano W. Epidemiology of aging: an ecological approach. Massachusetts: Jones and Bartlett Publishers; 2006.
Sigelman CK, Rider EA. Life-span human development. 6th ed. Belmont: Wadsworth/Cengage Learning; 2009.
Tzoulas K, Korpela K, Venn S, Yli-Pelkonen V, Kazmierczak A, Niemela J, James P. Promoting ecosystem and human health in urban areas using green infrastructure: a literature review. Landsc Urban Plan. 2007;81:167–78.
UN (United Nations). The world's cities in 2018. New York: UN Department of Economic and Social Affairs; 2018.
United Nations. The new urban agenda. New York: United Nations; 2016.
Van der Ryn S, Cowan S. Ecological design. Washington: Island Press; 1995.
van Hoof J, Marston HR, Kazak JK, Buffel T. Ten questions concerning age-friendly cities and communities and the built environment. Build Environ. 2021;199:107922.
Verma P, Singh R, Singh P, Raghubanshi AS. Chapter 1 - Urban ecology – current state of research and concepts. In: Verma P, Singh P, Singh R, Raghubanshi AS, editors. Urban ecology. Amsterdam: Elsevier; 2020.
Waldrop MM. Complexity: the emerging science at the edge of order and chaos. Harmondsworth: Simon and Schuster; 1993.
Wang K, Zhai X. The creation of "Ecosystem Core" hypothesis to explain ecosystem evolution. BMC Ecol. 2019;19:33.
Yembuu B. Intergenerational learning of traditional knowledge through informal education: the Mongolian context. Int J Lifelong Educ. 2021;40:339–58.

Publisher's Note