Resilience of racialized segregation is an ecological factor: Baltimore case study

STEWARD T. A. PICKETT [iD]

J. MORGAN GROVE [iD]

CHRISTOPHER G. BOONE [iD]

GEOFFREY L. BUCKLEY [iD]

*Author affiliations can be found in the back matter of this article

ABSTRACT

Segregation by racialized categories is common to cities across the world and its social effects are well studied. However, the environmental effects—the ecology of segregation—have received less attention. Racialized segregation persists through time and is associated with environmental hazards or lack of amenities. The environmental burdens of racial segregation are increasingly documented and this paper synthesizes the dynamics of segregation and the dynamics of ecological conditions associated with it. The 'adaptive cycle of resilience,' an important social–ecological theory, is applied and used to facilitate synthesis. The well-documented history of racial segregation in the US city of Baltimore, Maryland, is used to illustrate the systemic mechanisms that adapt segregation to changing social conditions, and hence maintain its ecological impacts. The adaptive cycle serves as a useful tool in evaluating and addressing the ecology of segregation and can thus advance urban ecology on a new horizon.

PRACTICE RELEVANCE

The adaptive cycle of resilience demonstrates that persistent racial segregation in cities results from an intentional but flexible system that includes many seemingly banal practices. These include planning, zoning, patterns of investment, influence of the real estate industry, distribution of amenities and disamenities, and access to civic power and influence. The adaptive cycle shows that the persistence of segregation is not 'natural' or inevitable. Rather, segregation persists as a result of racialized policies and practices that exclude certain groups from civic goods and processes. Acknowledging that cycles of segregation have been, and are being, institutionally maintained identifies a system that may be disrupted by community action, policy adjustment, and planning practice.

1 INTRODUCTION

Cities are residentially segregated by a variety of social identifiers. In the United States, race as popularly conceived and as represented in the decadal census is a predominant criterion of residential and recreational spatial differentiation. Those identified or identifying as Black, white, Asian, Latin, or Native American often reside in neighborhoods that are primarily occupied by people sharing a racialized identity (Braveman *et al.* 2022; Massey & Denton 1998). Between 1970 and 2010, 57 of America's cities were at some point 'hyper-segregated,' with vast majorities of people—especially Blacks and whites—living their daily lives in racial bubbles (Massey & Tannen 2015; Pietila 2010). Segregation can extend to travel as well (Candipan *et al.* 2021), with mode, wayfinding, and destination differing among racial groups. Such segregation is not confined to the US. Segregation is a global phenomenon (Mowatt 2021; Nightingale 2006, 2012) and reflects not only racial differences but also color, ethnicity, religion, economic status, immigrant or refugee status, gender, employment, *etc.* (Castán Broto & Neves Alves 2018; Grant-Thomas & Orfield 2009). Consequently, such segregation can be an important factor in the broader ecology of cities, suburbs, exurbs, and urban regions. Segregation reflects a variety of ideologies, including settler colonialism, white supremacy, zoning, and the capitalist appropriation of land and labor, among others (Van Sant *et al.* 2021).

Segregation has been the purview of social and economic sciences, which have produced deep literatures on its complex causes, socio-economic consequences, and impressive persistence over time (Cebul *et al.* 2019; Cutler *et al.* 1999; Nishime & Hester Williams 2018; Pietila 2010; Smelser *et al.* 2001). But segregation has been until very recently neglected by urban ecology (Grove *et al.* 2018; Pickett & Grove 2020; Schell *et al.* 2020). The ubiquity of segregation across many US cities, regardless of their age, size, location, and history (Lichter *et al.* 2023; Othering & Belonging Institute 2020), identifies an important knowledge gap for urban ecology.

This ecological urban knowledge gap is problematic because evidence is beginning to accumulate. The ecological literature documents spatialized environmental risks, hazards, and lack of access to resources and amenities experienced by social groups that have lower status in racialized and other rank hierarchies. For example, segregated African American neighborhoods experience shorter life expectancy, less access to quality education, and less available greenspace than wealthier or whiter areas in a given city (Mullenbach *et al.* 2022; Troy *et al.* 2007). Therefore, in the US, racial segregation is an unavoidable factor in generating and applying urban ecology knowledge.

Baltimore ranks 30th among American cities. It is an excellent study case because (1) its racialized dynamics are long-lasting and well documented, (2) race in Baltimore has until recently been characterized by Black–white contrast, and (3) it has been the location since 1997 of a long-term social–ecological research effort (Pickett *et al.* 2019) that brings ecological data to bear, and can help introduce the ecology of segregation to urban ecology. Baltimore's segregation patterns are shared by many post-industrial cities in the US (Athey *et al.* 2021; Othering & Belonging Institute 2020).

To help understand the substantial ecological impacts of persistent segregation, this synthesis considers the following questions:

- Why has Baltimore remained segregated?
- How has segregation been enforced over time in Baltimore?
- Can the dynamics of segregation be represented by the social–ecological systems (SES) theory of 'adaptive resilience'?

Increased awareness within urban ecology can understand segregation as a dynamic, co-produced environmental feature, not a simple or static 'given' that can be backgrounded in ecological research.

The paper pursues these guiding questions to expose, in turn, the nature of segregation, the operational concept of race, the ecological effects of segregation, resilience as a social– ecological mechanism of racial segregation, and the chronology of resilience of segregation in Baltimore. The paper closes by pointing to the potential of other resilience cycles, and briefly indicating how understanding resilience of segregation may suggest opportunities for breaking the cycle.

2 THE NATURE OF SEGREGATION

Segregation refers to the relative distributions of persons and groups socially categorized or identifying by race, ethnicity, nationality, religion, sexuality, indigenous status, and other social characteristics in certain neighborhoods. In the US, segregation by race continues to be most pronounced (Hess 2021; Massey & Denton 1998). There are as many as 20 statistical indices of segregation, emphasizing different dimensions of the phenomenon (Massey 2017; US Census Bureau 2020; Wiggins 2020). The dissimilarity index is most common. It measures the segregation between pairs of groups by assessing the percentage of each group that would have to move to be similarly distributed. A second common index of exposure shows the likelihood that persons of different racialized categories reside nearest to those of the same versus other categories (Athey *et al.* 2021; Massey *et al.* 2009; Park & Kwan 2018; Roberts *et al.* 2022). The US cities and metropolises are highly segregated (Othering & Belonging Institute 2020). Some time series of segregation show small declines of spatial segregation by race in some core cities, with segregation shifting to suburban fringes, but by and large, segregation in US urban regions persists (Lichter *et al.* 2023; Shertzer *et al.* 2022).

Economic segregation also exists, and sometimes intersects with that based on race. Although persons may choose to associate based on racialized identity, because such categories comprise a ranked hierarchy that governs access to power, property, status, material resources, and social networks, segregation is generally imposed by elites. The history of the US is increasingly understood to be based on the dynamics of white privilege and the ideology of 'white supremacy' (Cebul *et al.* 2019; Goetz *et al.* 2020; Pulido 2015; Yacovone 2022). In other nations with different colonial histories, the racialized, color-coded, or religious nature of the elites may differ, but global hierarchies share intertwined histories of settler and overseas colonialisms. This global system abducted, enslaved, and bred persons, practiced indigenous genocide, extracted resources, and enclosed common lands to generate capital under control of elites (Graves 2003; Van Sant *et al.* 2021).

3 THE OPERATIONAL CONCEPT OF RACE

Race is not a biological category (Graves 2003; National Academy of Sciences 2023; Wade 2014). When Linnaeus (1735) (Müller-Wille 2015) introduced the system of biological taxonomy still in use today, he divided humans (*Homo sapiens*) into four 'varieties' based on their origins in Europe, Asia, the Americas, and Africa. A social ranking was associated with the varieties from the start. By the 10th edition of *Systema Naturae* (1758–59), Linnaeus had added terminology extolling the supposed virtues of those at the top (*i.e.* Linnaeus's fellow Northern Europeans), and disparaged in increasingly negative terms those lower in his assumed ranking.

This biological view of race has been replaced (National Academy of Sciences 2023). The vernacular conception of race is seen to be a socially constructed, politically reinforced, and elite-serving tool (Pellow 2016). The social roots and elite utility of racism and the racial categories supporting it have been obscured in biology (Baker 2021). Although race is not a biological given, it remains a powerful social object, and racism a powerful social force that must be better understood as a potential driver in urban ecology (Pickett & Grove 2020; Roberts *et al.* 2022; Schell *et al.* 2020). The ecological effects of segregation, explored next, further motivate the synthesis.

4 ECOLOGICAL EFFECTS OF SEGREGATION

Segregation has social, economic, and health consequences. These social effects have been well-studied. However, the environmental effects—the *ecology* of segregation—have received less attention (Pickett & Grove 2020; Schell *et al.* 2020). Yet, environmental effects and the ecological mechanisms by which these impacts affect racialized groups or racially constrained places must be better understood. Understanding the place, roles, and options for segregated communities of color in the US or in communities segregated by various social criteria internationally (Goodell 2017; Simone 2017) is required to improve their conditions. Environmental justice activists and scholars continue to provide cogent examples (Barry & Agyeman 2020; Bullard 2007; McHale *et al.* 2018; Pulido 2017; Schwarz *et al.* 2018). Climate heating and the shifting geographic vulnerabilities resulting from human migrations of convenience or desperation place more people in harm's way

(Ernstson *et al.* 2010; Vince 2022). Here are some examples of environmental burdens associated with occupancy by racialized groups or by those experiencing poverty:

- riverine, coastal, and pluvial flooding (Elliott & Pais 2006)

- sea level rise (Goodell 2017)

- lack of managed green spaces or 'nature deficit' (Boone *et al.* 2009a, 2009b; Wolch *et al.* 2005)

- elevated heat stress; lack of cooling trees (Zhou *et al.* 2021)

- air pollution, fine particulates, and organic carcinogens (Rocha *et al.* 2017)

- soil pollution by heavy metals (Zhuo *et al.* 2012)

- disease agents such as bacteria and viruses, and vectors such as mosquitoes (Roberts *et al.* 2022; Thrasher 2022)

- emotional stress due to elevated heat, absence of vegetation, increased noise, decreased safety, and insecurity of food, employment, and housing (Roberts *et al.* 2022)

- residence, recreation, or travel through streets and sidewalks lacking effective waste removal (Mansyur *et al.* 2016).

The segregated environments of Baltimore are no exception. The neighborhoods of Black Baltimoreans have less tree canopy coverage than white neighborhoods (Anderson *et al.* 2023). Black neighborhoods have fewer large, mature trees. When trees are present they tend to be self-dispersing trees that lack arboricultural care. Woody species diversity is typically lower in minoritized neighborhoods. Vulnerability to heat extremes is concentrated in Black neighborhoods (Huang *et al.* 2011), and large green infrastructure projects to manage stormwater tend to be associated with new developments rather than underserved neighborhoods where smaller, modestly funded, or unmaintained projects predominate (Solins *et al.* 2023). Exposure to potential disease vectors, especially for West Nile virus, was associated with the low income and majority minority neighborhoods of West Baltimore (LaDeau *et al.* 2013), promoted by the presence of decaying housing infrastructure (Little *et al.* 2017). Greater vegetation on blocks with high housing abandonment was linked to greater mosquito infestation.

This basket of disamenities and vulnerabilities is not *caused* by spatial segregation. Nor are environmental burdens caused by race, even though simple statistical correlations may imply such a simple, direct link. The remainder of the paper explores how the relationships between racialized status and environmental benefit and hazard operate through the societal norms, social structures, economic, and policy devices. Having exemplified the effects of segregation on ecological phenomena in urban areas, the next section turns toward a theory to understand the mechanisms by which segregation might be maintained over time.

5 RESILIENCE AS A SOCIAL–ECOLOGICAL MECHANISM

Segregation has already been demonstrated to be widespread and persistent in cities. Such persistent patterns have raised the question of how they persist. The present authors propose that the widely used ecological theory of adaptive resilience (Gunderson & Holling 2002; Pickett *et al.* 2014; Wu & Wu 2013) is a suitable framework for understanding the persistence of segregation in ecological terms. This section presents a brief primer on the adaptive cycle of ecological resilience.

First, there are two broad conceptions of resilience (Holling 1996; Wu & Wu 2013). The one most familiar in headlines, and in many urbanist practices, is 'engineering resilience.' This is resilience in its Latin sense of 'jumping back' to a prior condition. After floods, hurricanes, or other disasters, there is an understandable desire to restore society and human wellbeing to their former state. This type of resilience, often called 'engineering resilience,' is common in scientific and public discourse.

However, this paper employs a contrasting conception that is more appropriate to open-ended dynamics of complex systems—such as cities—that are jointly constituted by interacting social and ecological phenomena. The dynamics of segregation in Baltimore relies on an ecological approach to *resilience as an adaptive cycle of disruption and adjustment*. The theory of adaptive

resilience is a mechanism of how SESs change through time, respond to disruption, and potentially adapt or adjust to disruption. This framework can expose the assumptions about how a SES might ideally respond to disturbance, and how social or ecological contingencies can alter the structure of the SES in the face of disruptions. Adaptive resilience emphasizes the ability of a system to adjust to shocks or disturbances and retain its fundamental structure (Pickett *et al.* 2014; Redman & Kinzig 2003; Scheffer *et al.* 2002). It also indicates the kinds of events that can thwart the successful regeneration and adaptation of a SES (Folke *et al.* 2002; Gunderson & Holling 2002). Adaptive resilience is neither socially good nor socially bad. It is a means to frame and understand a SES. Because of the theoretical generality of adaptive resilience (Biggs *et al.* 2015; Marcus & Colding 2014), it can be used to understand social–ecological dynamics in many urban places.

The theory of ecological adaptive resilience comprises six components:

- biological succession and ecosystem development (Holling 1973; Meiners *et al.* 2015; Pickett *et al.* 2011)
- dynamics of social complexity (Tainter 1988, 2000, 2006; Tainter & Taylor 2013)
- a potential for natural and social disturbance or disruption (Walker 2011)
- combining social and ecological processes in a potential cycle (Gunderson & Holling 2002)
- the role of lock-in resisting reorganization
- the role of resource loss preventing regrowth or renewed development (Biggs *et al.* 2010).

5.1 BIOLOGICAL SUCCESSION AS A ROOT OF ADAPTIVE RESILIENCE THEORY

The fundamental biological idealization comes from the field of ecosystem succession (Holling 1973), which is a key component of ecological theory (Scheiner & Willig 2011). Succession theory traces how ecosystems grow from an open, minimally structured state, in which resources are highly available, such as via mineral resources or light at ground level where plants first establish, to one in which resources come to be held in the complex three- dimensional structure of living organisms and dead organic components, such as those in soil, standing wood, and downed logs (Pickett *et al.* 2011). Following this logic, succession theory contrasts growth-focused systems in which the constituent organisms are adapted to rapid assimilation of resources from their external environments, compared with resource- conserving systems following long periods of resource assimilation accumulation by organisms that sequester resources into persistent organic and soil structures, represented by the horizontal axis in Figure 1.
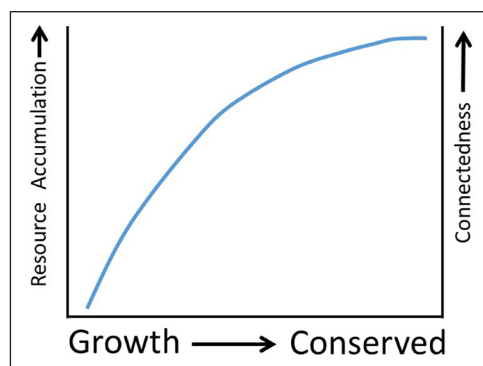

Figure 1: The ideal assumptions of the adaptive cycle of resilience.

Note: Various forms of resource or capital accumulation within the system, including natural, human, social, and financial capitals (left vertical axis), and connectedness (right axis), increase as a system tracks along the horizontal axis from a growth phase in which resources are available to a conservative phase in which resources have shifted from being available to the system, to being allocated within the system.

5.2 DYNAMICS OF SOCIAL COMPLEXITY

The key social idealization of adaptive resilience theory derives from the work of Joseph Tainter (Tainter 1988, 2006; Tainter & Taylor 2013). He proposes that societies solve problems by adding complexity, but that such complexity is never voluntarily ratcheted back. Resources or various forms of capital (natural, human, social, built, financial, *etc.*; Ostrom 2009) become embedded in the system.

5.2.1 Disturbance and disruption

In the dynamics of systems undergoing biological succession and in those experiencing increasing social complexity, disruption may occur. In both kinds of systems, 'natural' events such as floods, wildfires, hurricanes, pest outbreaks, *etc.* can disrupt the system structure. Anthropogenic disruptions such as technological disasters, civil unrest, economic booms and recessions, *etc.*, may also disrupt the existing system state or trajectory of change. Succession theory from biology and social complexity theory assume that systems have the potential to respond to disruption and regrow or repair (Grimm *et al.* 2017; Peters *et al.* 2011).

5.3 COMBINED SOCIAL–ECOLOGICAL RESILIENCE DYNAMICS

Contemporary thinking has focused on SESs, or social–ecological–technological systems, rather than separate but interacting social and biophysical systems (Folke *et al.* 2002; Levin *et al.* 2013; Machlis *et al.* 1997; Naveh 2000; Rademacher *et al.* 2019). Consequently, the dynamics of change and in the interactions with disturbance are co-products of joint biophysical and social–political–economic processes. Questions of growth and change, disruption and response require a dynamic theory that addresses the interaction of such hybrid SES (Pickett *et al.* 2017).

5.4 RESILIENCE THEORY SUGGESTS A REPEATING CYCLE OF CHANGE

This cycle of growth, disturbance, resource release, and growth again can theoretically repeat endlessly if two assumptions are met:

- It must be possible for material disturbance or social crisis to alter the structure of the system so that resources and capacities are freed for new uses that adapt to the disturbed state.
- The released resources must not be lost from the system and there must be components that are capable of rapidly using the released resources.

If these assumptions hold, the cycle of adaptive resilience (Figure 2) acts as a theoretical 'zero force law.' Zero force laws help organize thinking about phenomena that are difficult to comprehend initially in their full complexity.

5.5 RESILIENCE CAN BE THWARTED BY TWO KINDS OF LAPSE IN THE CYCLE: LOCK-IN AND LOSS

The cycle of growth, disturbance, reorganization, and growth again can in fact lapse. One kind of lapse in the cycle is social, political, or infrastructural *lock-in* (Markolf *et al.* 2018). The cultural and material investment in the complex structures may prevent the society from adjusting (Biggs *et al.* 2010; Childers *et al.* 2014). Disturbance can expose the increased social complexity itself to be a constraint that may prevent the system from responding to the altered conditions. If the system cannot overcome this constraint by expanding its resource base, or by adjusting political, economic, or institutional controls, the disturbance can go unanswered. For example, the current models for preparing for and responding to wildfires may be considered a lock-in impairing adaptation to unprecedented kinds and behaviors of wildfire (Cadenasso *et al.* 2022). Tainter (1988) provides examples based on imperial over-extension, as in Rome, or on an inflexible irrigation infrastructure confronted with extreme drought in the ancient Indigenous American Southwest.

The second kind of lapse in the cycle is impoverishment or *loss* of resources for response and reorganization. If the resources are released faster than they can be used after disturbance, the resource base of the system may be impoverished. An example from biological ecology is the removal of tree seedlings by high densities of white-tailed deer. In such a situation, openings of the forest canopy by a windstorm will go unfilled by trees. A social example of impoverishment is the inadequate emergency supplies on the island of Puerto Rico to respond to Hurricane Maria, as a result of having sent supplies elsewhere in the Caribbean after Hurricane Irma that had occurred two weeks earlier (Machlis *et al.* 2022).

Combining these six theoretical components suggests key tenets of adaptive resilience theory. First, SES dynamics depend on constraints across both social and natural processes. In other words, no system co-produced by interacting social–ecological components grows without limit. Following Ostrom (2009), the combined constraints can be cast in terms of forms of 'capital,' or social, economic, individual, and ecological capacities and resources, and not simply money (Figure 1).

The second tenet is that the growth of SESs can be interrupted by events that alter the structure of a system (Grimm *et al.* 2017; Gunderson & Holling 2002). Disturbance is an event that interacts with the structure of a system that alters the structure and functioning of the system, where structure refers to the joint effects of interacting social and ecological processes (Rademacher *et al.* 2019). The place of the concept of disturbance to adaptive resilience theory is shown in Figure 2(B).
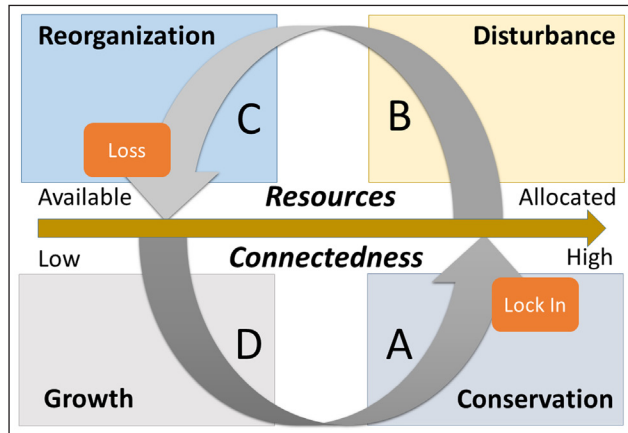
6 RESILIENCE CHRONOLOGY OF SEGREGATION IN BALTIMORE

The adaptive cycle of resilience can now be applied to the dynamics of segregation in Baltimore (cf. Pietila 2010) by taking the mid-19th-century residential structure of the city as the starting point. This structure corresponds to the conserved phase of the adaptive cycle (Figure 3: A). This period began with fine-scale racialized, immigrant, and class segregation in the city (Hayward & Balfoure 1999). This fine-grained social fabric housed enslaved and free domestic workers, factory workers, and stevedores in 'alley houses' (Hayward 2008; Olson 1997). In contrast, the middle class, business people, managers, and professionals lived on the block fronts facing main streets (Figure 4). Wealthy Baltimoreans' row houses were located on genteel landscaped squares. The segregation in this urban fabric was thus quite local, and individual neighborhoods and blocks would have housed diverse people within their hierarchy of street types.
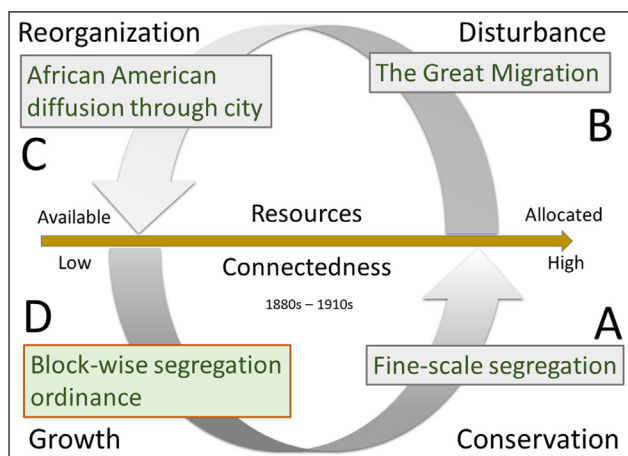

Figure 3: The adaptive cycle of resilience applied to the disruption of fine-scale racialized segregation **(A)** in 1880–1900s Baltimore, and system responses that yield a coarser pattern of block-wise racialized segregation *c.*1910 **(D)**.

After the American Civil War (1861–65), people enslaved in the rebellious states were emancipated. For roughly a decade after the war, labelled Reconstruction, federal troops protected the civil rights of Black people that had been enshrined in the 1865 'reconstruction amendments' to the constitution. These guaranteed voting rights, citizenship, and due process. Black political engagement flourished during Reconstruction.

This period of Black flourishing ended abruptly in 1877 when a deal to resolve the contested presidential election of 1876 resulted in the withdrawal of federal troops from the South. White elites throughout the South violently took back control of government and economic opportunity, enacting racially repressive statutes. Sharecropping, which was a form of debt peonage that was very hard to quit, became a predominant form of Black employment. Violent extra-judicial gangs, such as the Ku Klux Klan, harassed or killed Black persons to reinstate the racialized hierarchy that had existed before the Civil War.

The discriminatory and violent social controls imposed across the South after Reconstruction drove many Black people and families to move to more northerly cities in the Great Migration (McCammack 2017). The Great Migration began in the late 1870s and extended until well after World War II. It was the largest internal relocation of people in US history, including both Black and white migrants from the South. The Great Migration disrupted the racial status quo, *i.e.* the conserved state of the cycle (Figure 3: B) in many cities (Leibbrand *et al.* 2020; Winling & Michney 2021). Baltimore, by 1870 the sixth largest US city, was an attractive destination because it had developed a thriving free Black community before the Civil War, and remained an important seaport and manufacturing city.

The alley houses that had previously welcomed Black immigrants (Figure 3: A), were inadequate to absorb the flux of the Great Migration (Figure 3: B). Black Baltimoreans had to seek housing beyond traditional alley locations (Figure 3: C). The white elite perceived this diffusion of Black people beyond their former spatial limits to be an intolerable disruption (Figure 3: B). The city passed an ordinance in 1911 (Power 1983) that forbade Black and white residents from living on the same city block (Figure 3: D). This ordinance, the first in the nation to legally segregate Black people in an entire city, was modeled by other cities. This turn of the cycle (Figure 3) thus ended with block-wise spatial segregation of the urban form, as opposed to the within-block segregation that began the era (Figure 4).

Figure 4: Housing for the elites on the main streets **(A)** and for enslaved, free Black, or immigrant groups on alleys **(B)** behind the main street housing.

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A new turn of the adaptive resilience cycle ensued (Figure 5). The block-wise segregation ordinance (Figure 3: D) did not last long. In 1917, the US Supreme Court invalidated such ordinances (Figure 5: B). The court's rationale had nothing to do with the morality of racialized segregation. Rather, it protected the right of a person to sell their property to whomever they pleased. This legal disturbance to the conserved state of block-wise segregation (Figure 5: A) caused Baltimore's white power structure to adopt new ways to maintain the segregationist system. This may be considered redundancy, as new mechanisms of segregation were substituted when existing ones were invalidated or superseded by events.
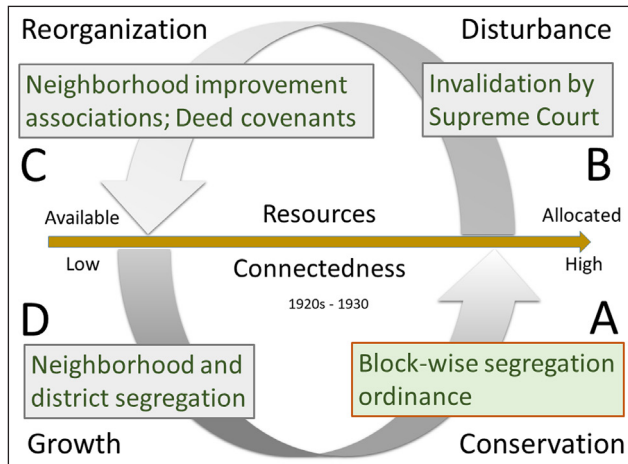
Figure 5: The adaptive cycle of resilience applied to the disruption **(B)** of the block-wise segregation ordinance **(A)** by the US Supreme Court, and system responses **(C)** that generated coarser patterns of segregation **(D)** by neighborhood subject to redlining in the 1930s.

Note: This figure continues from Figure 3(D), linking the two turns of the cycle.

The new ways brought to bear to contain Black residents in Baltimore are examples of adaptive reorganization adapting to disturbance (Figure 5: B). These included neighborhood improvement associations (Bain & Buckley 2019; Buckley 2010; Buckley & Boone 2011) and racially restrictive deed covenants (Figure 5: C). Neighborhood improvement associations sprouted in wealthy white neighborhoods to bring pressure on the city concerning zoning, the location of perceived disamenities, or to attract investment in neighborhood amenities. Association minutes illustrate anti-Black racial bias as a motivation for their activities (Box 1). The other main device, deed covenants, legally limited to whom a house could be sold.

Box 1: Examples of neighborhood improvement association goals.

> Before the passage of strict zoning laws, neighborhood improvement associations wielded a great deal of power in Baltimore. Many of these associations—of which there were approximately 70 scattered across the city in 1910—were known for supporting the city's proposed segregation ordinance and for later embracing restrictive covenants and other exclusionary housing practices. For example, the Peabody Heights Improvement Association passed a resolution in October 1910 advocating:
>
> > the enactment of such proper State or City legislation as will make it difficult or impossible for negroes, as dwellers, to invade those blocks or neighborhoods where there is a preponderance of white occupants.
>
> In 1930, a promotional pamphlet published by the Mount Royal Improvement Association boasted that its greatest achievement has been:
>
> > the subjecting of the property in its area to a restriction for white occupancy only.
>
> <div align="right">(Buckley & Boone 2011: 57, 59)</div>

This growth phase of the resilience cycle coarsened the scale of spatial segregation in Baltimore in the 1920s and 1930s (Figure 5: D). These dynamics combined federal and local policies and reflected collaboration with real estate and banking industries in pursuing racialized exclusions (Markley 2023; Rothstein 2017; Winling & Michney 2021). The stock market crash of 1929 initiated the Great Depression, which hit all demographics. In response, the New Deal established federal programs to ease the financial blow to homeowners. The benefits of the New Deal were inequitably applied by race, however, and the mechanisms of that injustice facilitated the growth of segregation in space, and the depth of economic disadvantage intensified for Black people (Michney 2022).

A key strategy of the New Deal was to reconfigure the mortgage industry, which required two new agencies. The Home Owners' Loan Corporation (HOLC) was charged with reducing foreclosures by refinancing existing mortgages, while the Federal Housing Administration (FHA) financed new construction (Fishback *et al.* 2022). HOLC did not exclude Black homeowners from its loan portfolio, but to prepare for any future foreclosures of its own loans, it mapped neighborhood credit worthiness in 239 cities across the US (Figure 6). The FHA had its own mechanisms for assessing where to support

new construction. Although the FHA had access to HOLC maps, it appears that it relied on its own techniques for assessment, and any maps it created were apparently destroyed (Fishback *et al.* 2022).

Although both HOLC and FHA were federal agencies, they collaborated closely with local white power structures, and their actions were consonant with the established discriminatory practices of the US real estate and banking industries (Fishback *et al.* 2021; Winling & Michney 2021). Avoiding 'racial inhomogeneity' became an article of professional practice according to national real estate organizations (Winling & Michney 2021). The University of Richmond's 'Mapping Inequality' project provides access to many of the digitized maps and associated neighborhood assessments (Nelson *et al.* n.d.). The website points to the racial nature of the assessments for grading neighborhoods:

> Among that information was the neighborhood's quality of housing, the recent history of sale and rent values, and, crucially, the racial and ethnic identity and class of residents that served as the basis of the neighborhood's grade.

The federal HOLC map of Baltimore (Figure 6) illustrates the patterns of segregation that accompanied the multiple discriminatory practices operating in the 1920s and 1930s. That is, the HOLC maps provide a window into diverse discriminatory practices rather than causal tools in and of themselves. According to Hillier (2003), Michney (2022), and Fishback *et al.* (2021, 2022), it is unlikely that the HOLC maps were used to establish or reinforce segregation. Rather, these maps reflect the congruence of local discriminatory practices with the racial biases in the federal policy apparatus and the real estate industry in the early 20th century (Markley 2023) covered by this turn of the resilience cycle (Figure 5). Although the HOLC maps are not determinative of segregation practice, their classificatory logic is telling (Figure 6).
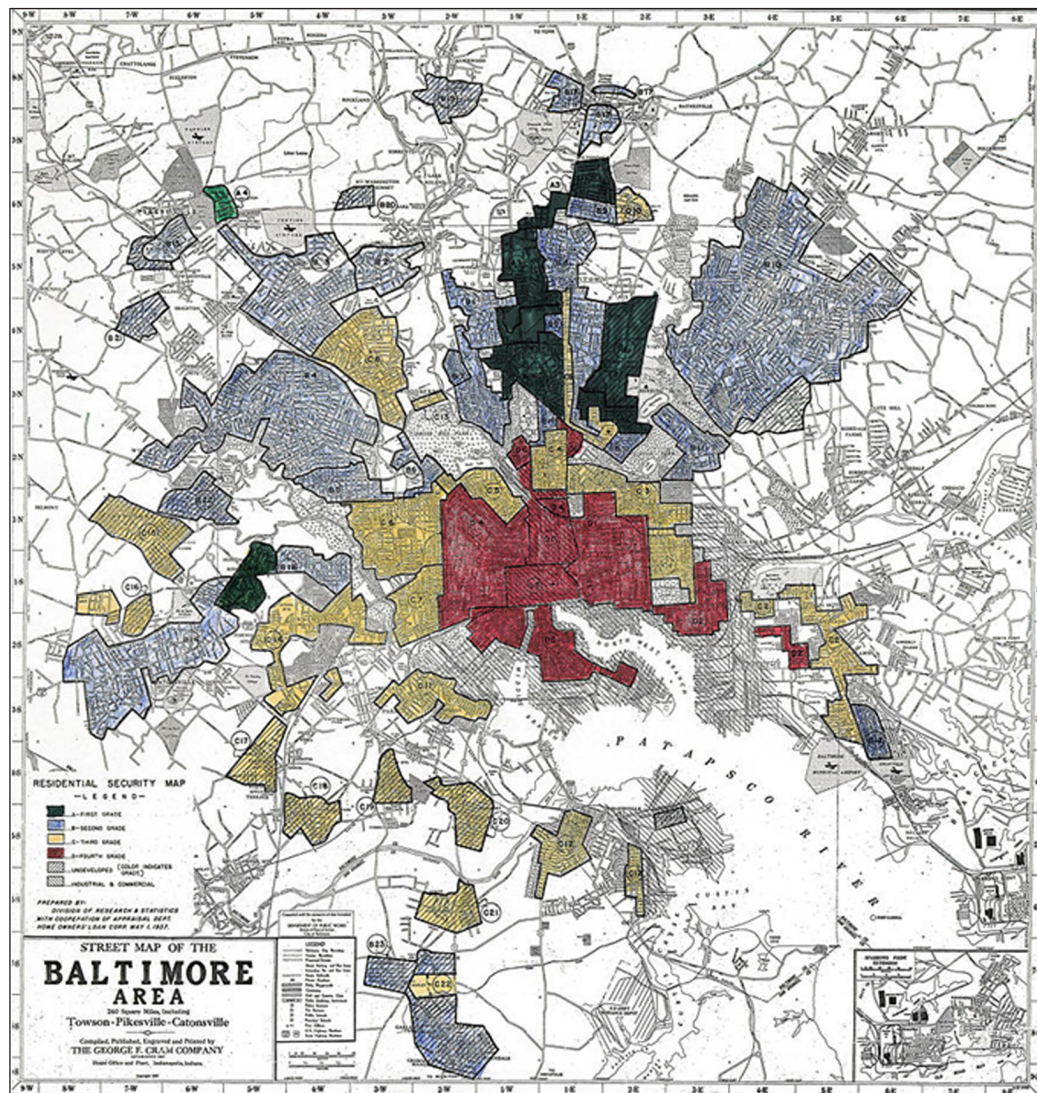

Figure 6: The 1937 Baltimore City 'residential security' map.

Note: Shading refers to Home Owners' Loan Corporation (HOLC) classes of mortgage worthiness: green, or **A**, was best; blue, or **B**, still desirable; yellow, or **C**, indexed definitely declining; and red, or **D**, was classed as hazardous for mortgage lending.

Source: Used under a Creative Commons Share Alike license.

It is worth exposing the blatantly racist motivations used to support the practice of redlining as discriminatory lending that were reflected in the HOLC maps (Nelson *et al.* n.d.). According to the graders' field notes for area D4 in West Baltimore (linked through Nelson *et al.* n.d.), the neighborhood was said to have 'Infiltration of Negro,' along with 'mixture' 15% foreign-born. The blank for 'Negro' was filled in as 80%. The only specific racialized label called for on the blank grading forms was Negro, consonant with the acknowledged use of anti-Black racial bias as an HOLC grading criterion. The expected trend of real estate desirability of the neighborhood over the next 10–15 years was 'downward.' An adjacent grade C or 'declining' area (C5) was noted as experiencing conversion from owner occupancy to rental units. 'Negro infiltration' was also listed for C5.

The HOLC maps and associated notes are emblematic of the decades of discriminatory and segregationist practices of the early 20th century rather than causes of racist practice (Markley 2023). The discrimination they evinced had been previously established by lenders, realtors, and academicians (Fishback *et al.* 2022). Importantly, the maps were made after HOLC's own mandate for making loans to distressed homeowners had been 90% fulfilled (Michney 2022). The FHA, in contrast, was charged with insuring loans for new construction, and did discriminate against Black applicants. The FHA's policy of making only 'economically sound' loans was interpreted in such a way that the agency avoided granting loans in core urban neighborhoods, locations to which Black residents had already been restricted to by previous practices. The FHA instead favored new construction on suburban fringes. Fishback *et al.* (2022: 2) conclude that the FHA was:

> part of a new federal system of mortgage finance that institutionalized and reinforced racial discrimination in the housing markets during the 1930s.

The FHA was causal while HOLC maps were not.

These two linked cycles of the resilience of racialized segregation in Baltimore (Figures 3 and 5) are clear from well-known historical triggers and well-documented discriminatory practices (Grove *et al.* 2018; Light 2009; Locke *et al.* 2021; Massey & Denton 1998; Rothstein 2017; Trounstine 2018). But as many scholars indicate, the legacy and impact of the redlining as a discriminatory financial process rather than a mapped pattern (*e.g.* Hillier 2003), and more to the point, the social and economic ideologies underwriting it, extend through time down to today (Boone *et al.* 2009a, 2009b; Brown 2021; Grove *et al.* 2018; Yacovone 2022). That is, spatialized policies and activities having anti-Black effects continue (Dyson 2020; Pulido 2017; Schell *et al.* 2020; Sharkey 2013), well past the cycle illustrated here (Figure 5). A difficulty in bringing adaptive cycles up to date is the fact that contemporary mechanisms are seemingly race neutral, and hence hard to document (Shertzer *et al.* 2022). The result of these ongoing and cumulative effects are a kind of redundancy that can reinforce the resilience of spatial segregation, while at the same time broadening the scale of racial disadvantage (Boustan 2011; Kruse & Sugrue 2006). For example, in Baltimore the spatial pattern of segregation of Black residents is informally called the 'Black butterfly and the white L' (Brown 2021). Notably, this pattern has spread from within the city limits in 1930s (Figure 6) to the larger metropolitan region that includes parts of five adjacent counties today (Figure 7).

7. WILL THE CIRCLE BE UNBROKEN? CONCLUSIONS AND PROSPECTS

Applying the resilience cycle in Baltimore shows that the ideology of white supremacy was supported by an adaptive system from the late 19th to the mid-20th centuries, with ecological implications that are legible today (Grove *et al.* 2018). The adaptive cycle of resilience, as an operational theory, is thus adequate, useful and essential to synthesize the interactions maintaining and spreading racial segregation across time in Baltimore. The synthesis helps to link ecological knowledge with processes of racial segregation already well understood by social and political researchers. This test of the resilience cycle over a long but coherent period of social-ecological history in a changing American city, suggests broader application.
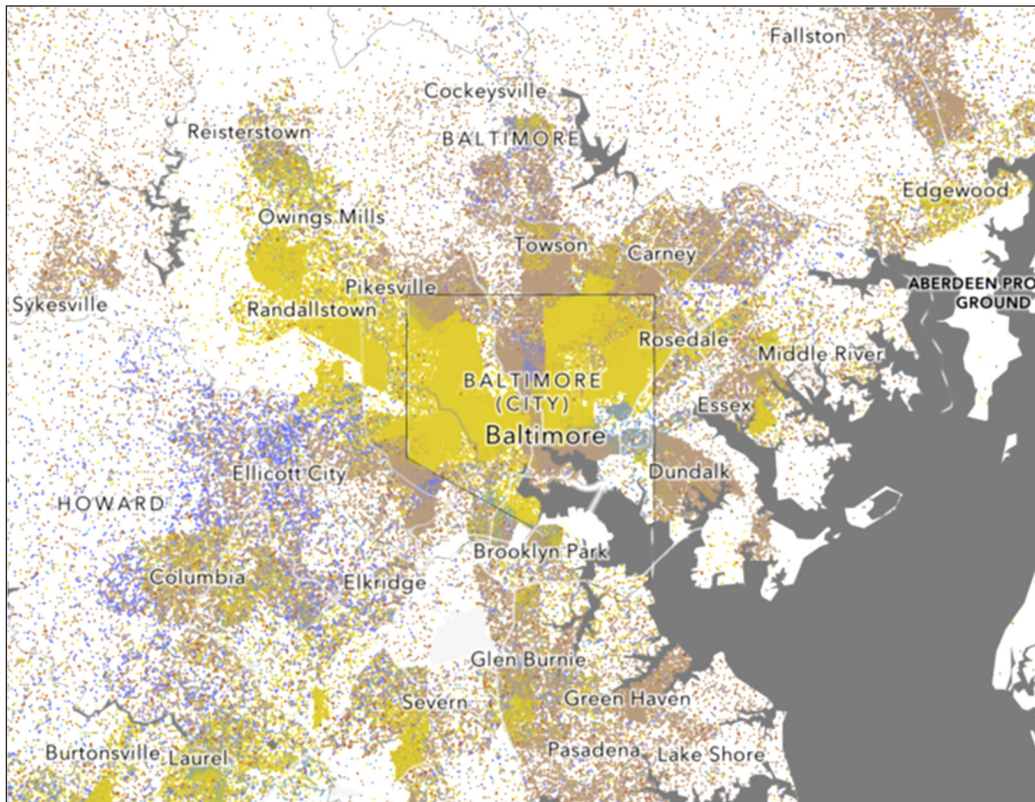
Figure 7: Map of 24 persons per dot for Baltimore City, and adjacent counties.

Note: Yellow is Black alone; buff is white alone; blue is Asian alone (original colors).

Source: Data are from the 2020 US Census. For all US Census categories and the map, see Environmental Systems Research Institute (ESRI).

Resilience is used here as a mechanistic concept (Pickett *et al.* 2014), not a normative one. The segregation history of Baltimore shows how the mechanisms of resilience have maintained white supremacy, with its continued subjugation of people of color (Bonilla-Silva 2018; Braveman *et al.* 2022). However, adaptive resilience per se is neither good nor bad; it can serve positive goals, such as those of sustainability (Cadenasso & Pickett 2018), or unethical ends of racism and exploitation. All three pillars of sustainability—economic vitality, ecological integrity, and equitable practice and outcome (Redman 2014)—are the normative standards against which the good or bad of resilience must be judged.

This core idea is crucial and forward looking: If the underlying norms, social devices, economic investments, or lack thereof, generate both racialized segregation and burdensome segregated environments, it is possible to intervene in those devices. Acknowledging the operation of social–ecological mechanism might help those who struggle against segregation to identify or exploit crisis points within the adaptive resilience cycle. Racially segregated communities and allies can work against the damaging norms and ideologies, and thus improve the environments they experience (Dyson 2020; Nishime & Hester Williams 2018; Roane & Hosbey 2019). In essence, framing and examining the long-term dynamics of institutionalized racism and segregation through the lens of adaptive cycles of resilience can invite new tools for change.

Nesting of resilience cycles suggests ways to thwart adaptation of segregationist practice. A given adaptive cycle may be nested in and constrained by larger cycles (Gunderson & Holling 2002). The larger cycle can change key controls in the included smaller cycles, such as those in Baltimore. A negative outcome of nesting was the withdrawal of federal troops that ended Reconstruction in the formerly rebellious states after the Civil War. Those troops had enforced voting rights, political access, and prevented vigilante violence against the Black population. By the mid-20th century, positive outcomes of resilience nesting occurred. In the 1950s–60s federal actions promoted school desegregation (1954), voting rights (1964), and fair housing (1968), and thus helped bring the long Civil Rights struggle to fruition. These last two acts finally invalidated legally sanctioned real estate discrimination, but they are not immune from degradation (Pulido *et al.* 2019).

Acknowledging the adaptive cycles of resilience of racial discrimination and segregation can improve social ecological research in urban places by adding the ecology of segregation to its priorities. It can also help urban ecology—as a field and as a practice—to support anti-racist progress toward environmental quality for all persons, regardless of their racialized identity.

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AUTHOR AFFILIATIONS

Steward T. A. Pickett orcid.org/0000-0002-1899-976X
Cary Institute of Ecosystem Studies: Millbrook, NY, US

J. Morgan Grove orcid.org/0000-0002-7803-074X
US Department of Agriculture, Forest Service, Baltimore, MD, US

Christopher G. Boone orcid.org/0000-0001-7643-0806
College of Global Affairs, Arizona State University, Tempe, AZ, US

Geoffrey L. Buckley orcid.org/0000-0001-7356-5289
Department of Geography, Ohio University, Athens, OH, US

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