Local Environment

The International Journal of Justice and Sustainability

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/cloe20

Planning for heat beyond the big city: comparing smaller cities' heat activities, opportunities, and constraints in California

Gregory Pierce, C.J. Gabbe, Lauren Dunlap, Bates Detwiler, Paulina Ursua Garcia, Hannah Hagen & Kyle Schmidt

LOCAL ENVIRONMENT
https://doi.org/10.1080/13549839.2025.2477015

Routledge
Taylor & Francis Group

OPEN ACCESS Check for updates

Planning for heat beyond the big city: comparing smaller cities' heat activities, opportunities, and constraints in California

Gregory Pierce [a], C.J. Gabbe [b], Lauren Dunlap[a], Bates Detwiler[b], Paulina Ursua Garcia[b], Hannah Hagen[b] and Kyle Schmidt[a]

[a]UCLA Luskin Center for Innovation, Los Angeles, CA, USA; [b]Department of Environmental Studies and Sciences, Santa Clara University, Santa Clara, CA, USA

ABSTRACT

Addressing extreme heat has emerged as a key frontier of urban climate adaptation planning. However, most studies have focused on large cities, whereas most of the existing urban population lives and urban growth occurs in small- to medium-sized municipalities within metropolitan areas in the U.S. and globally. We hypothesise based on structuration theory that these smaller municipalities face fundamentally different constraints and opportunities to enhance their heat planning capabilities than large cities. Accordingly, in this study we analyze heat planning capacity, current activities, and expansion opportunities in small- to medium-sized cities across two neighbouring but distinct regions in California: northern Los Angeles County (n = 20) and the southern San Joaquin Valley (n = 38). Using data from these 58 cities, we first comprehensively reviewed heat-related activities in their key planning documents. We then conducted 17 semi-structured interviews with local government planners, planning consultants, and utilities' staff to more holistically analyze how heat planning and implementation occurs on the ground. The planning document analysis shows that a narrow majority of cities identified heat as a general issue of concern. The most common long-term adaptation and resilience strategies were enhancing urban tree canopy, green infrastructure, and shade structures, but both prevalence and strategy type vary by heat exposure level, population size, and the socioeconomic status of cities. However, in interviews, we generally found that while local officials had high levels of heat awareness, they had low levels of focused capacity and deployed heat interventions compared with other climate adaptation efforts.

ARTICLE HISTORY
Received 28 November 2023
Accepted 4 March 2025

KEYWORDS
Local planning; heat; climate adaptation; small and medium sized cities

Introduction

Addressing extreme heat has emerged as a key frontier of urban climate adaptation planning (Walker et al. 2024). A growing number of studies have analyzed heat planning efforts in cities, including scholarship on large city municipal climate adaptation, as well as broader urban hazard resilience efforts supported through formal planning processes (Gabbe et al. 2021; Jin and Sanders 2022; Keith, Gabbe, and Schmidt 2023; Meerow, Pajouhesh, and Miller 2019; Meerow and

CONTACT Gregory Pierce gpierce@luskin.ucla.edu Luskin Center for Innovation, UCLA School of Public Affairs, 3323 Public Affairs Building, Box 951656, Los Angeles, CA 90095-1656, USA

Keith 2022; Turner et al. 2022). These studies have generally identified an increase in language regarding heat in urban planning documents. However, they also note the continued presence of governance silos and a lack of implementation specificity, especially when it comes to addressing disparities delineated by race, ethnicity, and economic status.

While there remains important scholarship to conduct on heat planning in larger cities, we focus on small- and medium-sized cities in this study for three reasons. First, most climate adaptation scholarship globally has focused on large, often mega-cities. Yet both in the U.S. (Bucholz 2020; Ofori-Amoah 2021; Kumar and Stenberg 2022) and globally (Güneralp et al. 2020; Fila, Fünfgeld, and Dahlmann 2024), most of the existing urban population and expected growth is in urban areas outside of central cities. Exceptions include the work of Ulpiani et al. (2024) on urban heat island planning. We thus focus on cities with populations of under 100,000 (small) and 500,000 (medium), referring to both groups collectively as "smaller cities" throughout the article. Second, there is limited research on climate adaptation, and especially disaster risk resilience, by smaller cities, and much of it has been more theoretically rather than empirically focused (Walker et al. 2024). This disparity reflects a pervasive neglect relative to both larger urban and rural areas of efforts to understand smaller city planning processes for environmental health issues (Wagner and Growe 2021). The lack of scholarly focus on smaller city planning processes occurs despite population size being used as a common explanatory variable in broader studies of urban climate mitigation and adaptation. For instance, scholarship generally shows that larger cities have more resources for climate-related planning (Homsy & Warner 2015; Lubell et al. 2009; Shi et al. 2015; Trego, Meerow, and Keith 2023). Yeganeh, McCoy, and Schenk's (2020) meta-analysis also finds that population size has a large positive association with urban climate policy adoption, although Stevens (2023) meta-analysis suggests that the effects of population size are much smaller than previously reported due to publication bias.

Regionally, there is more research focused on smaller cities in Europe and the Global South than in the U.S. (Birkmann et al. 2016; Jonsson and Lundgren 2015; Lioubimtseva and da Cunha 2022; Youngquist et al. 2023). Especially in South and Southeast Asia, there is robust work examining both the promise and reality of climate-related disaster resilience planning in small towns (Daniere, Garschagen, and Thinphanga 2019; Marks and Pulliat 2022), the role of governance decentralisation in resilience planning in longstanding urban areas (Rumbach 2016), as well as in newly-formed small towns (Rumbach and Follingstad 2019).

Third, there are conceptual reasons to expect important differences in both heat risk and planning and response by city size. On the one hand, the urban heat island effect poses more of a risk in large cities (Ulpiani et al. 2024). There may also be differences between the more-established smaller cities in our study context and climate resilience planning capacity in smaller cities that have recently formed due to population growth, as well as in urban decentralising efforts in low- and middle-income country contexts (Rumbach 2016). On the other hand, the theoretical framework of urban political ecology shed lights on the unequal rendering of climate adaptive capacity both within and between cities, across economic development profiles (Kaika et al. 2023).

To date, urban political ecology theory has rarely been applied to the problem of heat, except in the context of the urban heat island in mega-cities (Marks and Connell 2023; Li et al. 2024), with the notable exception of Paterson et al. (2017). This limited application may be due to the relative lack of direct, desirable and centralised infrastructure provision – often a feature in urban political ecology analyses – in reproducing inequalities in heat exposure and vulnerability, unlike water, energy and transport networks (Broto and Bulkeley 2013). However, research has demonstrated that centralised transportation infrastructure, through the development of the highway system especially, indirectly influences heat exposure through redlining. Additionally, the concentration of other uneven and undesirable infrastructure within cities reproduces uneven heat exposure (Hoffman, Shandas, and Pendleton 2020).

We accordingly argue that urban political ecology is a useful way to interrogate potential inequalities and their nature in heat planning, infrastructure reproduction and action across scales of city government (Paterson et al. 2017; Fila, Fünfgeld, and Dahlmann 2024). Broadly, unequal power dynamics and the retention of planning functions and resources by central bureaucrats may weaken local smaller city heat planning (Marks and Pulliat 2022; Indraprahasta et al. 2023). We also hypothesise that there may be limitations in smaller city capacity to document both increasing heat exposures and intra-city population vulnerabilities and thus respond adequately on the ground with supportive infrastructure and services, as similarly argued in the context of disaster planning by Rumbach and Follingstad (2019).

Heat and local planning efforts in California and the two study regions

California is an important place to study smaller city heat planning issues, as well as differences between municipalities across regions. It is the most populous state in one of the hottest regions of the U.S., the arid Southwest (Pincetl, Chester, and Eisenman 2016). There is a strong historical focus as well as ongoing momentum around local climate adaptation policy in the state compared to other parts of the U.S. (Bedsworth and Hanak 2013). Yet there are still major gaps across cities that present an interesting context for analyzing differences. Many of its 408 municipalities have recently self-reported that they are not planning for climate adaptation or urban heat. Only 37 percent of California cities reported having adopted urban heat island policies as of 2018; the rest either reported that they did not or were unsure (Gabbe et al. 2021). A separate and unique statewide assessment to map relevant entities, existing regulations, support and oversight of heat planning programs, and funding streams in seven key planning settings identified smaller municipalities as a key gap area, concluding that "local hazard planning efforts [in California] may not be preparing cities adequately for extreme heat" (DeShazo and Lim 2021, 7).

All cities in California are also required by state law to carry out general planning that is relevant to both broad climate and specific outdoor heat mitigation. While California cities are required to have an adopted general plan (GP), some smaller cities have not complied in a timely manner with this mandate, and many are formulaic in nature, containing large sections of similar stock text. Beyond GPs, the most relevant types of plans for local heat resilience are local hazard mitigation plans (LHMPs) and climate action plans (CAPs) (see Keith, Gabbe, and Schmidt 2023).

Municipalities come in many different shapes and sizes, yet for the purposes of formal climate adaptation planning, are often viewed as homogenous. The example of Los Angeles County – the most populous county in the U.S. with over 10 million residents – is instructive. The county's 88 municipalities have vastly different populations, resources, and needs. Populations range from 4 million in the city of Los Angeles (40% of the County's population) to fewer than 767 residents in the city of Bradbury. At the same time, there is considerable variation in current and projected extreme heat; for example, the annual number of projected days above 90 degrees Fahrenheit between 2035 and 2064 range from five at the coast (in the city of Santa Monica) to nearly 150 inland (in the city of Irwindale). Cities in the San Joaquin Valley also range widely across several characteristics, although less so than in Los Angeles County. Populations range from just over 1,200 (Maricopa, in Kern County) to Fresno's nearly 550,000. The annual number of projected days above 90 degrees Fahrenheit between 2035 and 2064 ranges from about 70 in Tehachapi to 165 in Ridgecrest, both in Kern County.

In terms of heat planning, the largest jurisdictions appear far ahead in dedicated capacity and efforts compared to smaller cities. For instance, the City of Los Angeles established a Climate Emergency Mobilisation Office within its Department of Public Works in 2020; passed a motion regarding extreme heat preparedness and related deaths reporting in 2021; appointed a Chief Heat Officer in 2022; and has begun developing a heat action plan (Los Angeles City Climate Emergency Mobilisation Office 2023). Meanwhile, Los Angeles County has published its first Climate Vulnerability Assessment, with a large focus on heat, and the county's Regional Planning Department has incorporated the findings into a draft Safety Element (Los Angeles County Planning Department 2023). We know much less, however, about heat planning efforts among the 87 smaller municipalities in the county.

By contrast, larger municipalities and the county governments in the southern San Joaquin Valley have not hired dedicated staff focused on heat, lack heat-specific plans, and have had more limited engagement in climate action planning. Heat-related planning for these local governments has largely occurred through local hazard mitigation plans, as discussed more fully below.

Based on our previous work in California, we know that smaller cities face considerable cross-cutting planning constraints, which we hypothesise extend into and affect heat planning. Some cities have only one designated planner, sometimes with this individual being a contractor rather than an employee, to cover all policy and program areas within their jurisdictions. In these contexts, climate adaptation, much less heat planning, may receive little management focus or response capacity. Additionally, local heat planning within the San Joaquin Valley has been understudied relative to the larger metropolitan areas in California, despite being hotter and having more vulnerable residents (Fernandez-Bou et al. 2023).

In addition to our focus on smaller cities, another unique aspect of our study is that we comparatively analyze heat planning efforts in two neighbouring but politically distinct regions that face major heat exposure and vulnerability challenges. We accomplish this by first conducting a comprehensive review of heat-related activities in the general plans and, when available, climate action plans of the 38 cities in the southern San Joaquin Valley (SJV) and 20 cities in northern Los Angeles (LA) County. Throughout the rest of the study, we refer to this contiguous region as northern LA County and the southern SJV. Second, we conducted 17 semi-structured interviews (plus received 10 additional email responses to interview questions) with city planners, regional planners, planning consultants, and utility staff in the study area. These interviews allowed us to more holistically understand whether and how implementation of heat planning occurs on the ground. We also match census data and heat exposure data to all city boundaries in northern LA County and the southern SJV to examine the characteristics of cities doing different types of heat planning.

Study hypotheses

This mixed-methods research approach allows us to answer two core research questions related to the capacity, state of current activities, and opportunities for heat planning enhancements in smaller municipalities, as well as to inform the broader urban political ecology literature on smaller city climate adaptation:

1. How do smaller municipalities discuss urban heat into their major written plans, and how does heat issue and strategy identification vary based on local heat exposure and vulnerability characteristics?
2. What do planners working on the ground report as their main activities, priorities, and constraints in terms of heat planning implementation, and how does implementation relate to issues and strategies stated in adopted planning documents as well as to structural disparities in capacity and power?

We use our findings to discuss the implications for incentive and regulatory policy aimed to most effectively increase heat adaptation planning for small- and medium-sized cities.

Materials and methods

Our approach in this study was informed by a preliminary analysis conducted in 2021 to examine heat-specific issue and strategy identification, including formal planning documents, on the websites of 20 randomly selected municipalities in LA County. We found limited information regarding climate adaptation, much less heat-related planning activities, in this search. This dearth of information motivated our approach to systematically analyze formal planning documents and interview city planning staff. We considered several options for geographic focus among the six major metropolitan areas within California, and ultimately chose the contiguous region of northern LA County and the southern SJV because it contains a relatively large pool of adjacent municipalities but with major differences in their small and medium-sized cities in terms of climate vulnerability (especially heat), density, and socioeconomic status (see Table 1). The SJV cities have somewhat lower density, substantially lower incomes and higher poverty rate, higher proportion of Hispanic residents, and substantially more projected heat days than the northern LAC. The contiguous region contains political and administrative diversity, and differences in larger agency climate planning emphasis, which makes for a potentially interesting contrast.

Plan content analysis approach

To answer the first research question, in 2022 through early 2023, we collected and conducted a content analysis of three types of planning documents (General Plans, Local Hazard Mitigation Plans, and Climate Action Plans) across each of the 20 municipalities in northern LA County (County Supervisorial District 5), 36 municipalities in the four adjoining counties (i.e. Kern, Kings, Tulare, Fresno) in the southern SJV, as well as the five relevant county governments (i.e. Los Angeles, Kern, Kings, Tulare, Fresno). We excluded the city of Fresno and the city of Los Angeles due to their large population sizes and these cities receiving more scholarly treatment previously, but otherwise include all incorporated cities in the contiguous region.

We conducted a content analysis of adopted planning documents based on an established approach. We first selected 11 criteria following a hybrid of the research approach carried out by Gabbe et al. (2021) and Keith, Gabbe, and Schmidt (2023). The criteria, shown in Table 2, span three aspects of heat planning: (1) heat issue identification and fact base; (2) long-term heat adaptation and resilience; and (3) heat preparedness and response.[1]

Two trained researchers independently reviewed and coded the plans for these criteria. The coding entailed first assigning a binary variable representing whether each criterion was found in a plan. Then the coder noted relevant page numbers for each criterion. This allowed us to reconcile differences between coders and identify key quotes. At the conclusion of this process, we calculated the Krippendorff's Alpha (KA) value, which is a commonly used measure of intercoder reliability (Krippendorff 2013). The two coders were 84.5% in agreement across the two sub-regions and the KA value of 0.68 falls at the low end of adequately reliable results (Krippendorff 2013). We addressed differences through a reconciliation process whereby the entire research team met and came to consensus on every item on which the two coders had different results.

Table 1. Means for all demographic and exposure variables, by geographic region.

		All cities ($N = 56$)	San Joaquin Valley cities ($N = 37$)	LA County cities ($N = 19$)	Interviewee cities ($N = 10$)
Population	Population	47,439	36,867	72,651	34,894
	Population Density	4,187	3,100	3,906	8,420
Race and Ethnicity	% Hispanic	54.9%	70.7%	29.2%	37.7%
	% Non-Hispanic White	28.5%	21.0%	37.7%	43.2%
	% Non-Hispanic Black	3.2%	2.7%	4.5%	2.8%
	% Non-Hispanic Asian	10.1%	3.2%	24.0%	11.6%
	% Other Race	3.3%	2.5%	4.6%	4.7%
MHI	MHI	$80,654	$57,840	$113,410	$119,267
Expected Days >100F 2035-64	Expected Days >100F 2035-64	54.4	75.8	33.8	7.9
Expected Days >90F 2035-64	Expected Days >90F 2035-64	123.5	142.7	122.2	53.1

[a]Note: The California Healthy Places Index: Extreme Heat Edition tool does not have data on heat days for all municipalities. Therefore, these numbers exclude Maricopa (SJV) and Bradbury (LAC), which the tool does not provide data for.

Table 2. Plan evaluation criteria.

Category	Criteria
Issue identification and fact base	Identifies extreme heat as an issue
	Provides heat-related data
Long-term heat adaptation and resilience	Cool roofs
	Cool pavements
	Green roofs
	Green infrastructure
	Urban tree canopy
	Other shade
Heat preparedness and response	Cooling centers
	Early warning system
	Heat education

Interview approach

To answer our second question, we conducted interviews with individuals responsible for city planning and compared these findings with our content analysis findings. We interviewed city and regional planning officials from summer 2022 through early 2023. First, we compiled lists of the most relevant contacts from city websites. Following approval from the UCLA Institutional Review Board, we then reached out to local government contacts at all 87 municipalities in LA County (except the city of Los Angeles), all 38 municipalities in 4 counties in the southern SJV, as well as officials within the five relevant county governments and metropolitan planning organisations. Each individual was contacted by email at least two times to invite them to conduct a short interview by Zoom on their heat planning efforts. Eleven planners responded indicating that they were too busy to be interviewed by Zoom but would be willing to respond to several questions by email, whereas most others not interviewed did not reply or provided very brief replies declining our request.

We guaranteed individual interviewees anonymity from name and city-specific identification and thus the attribution of specific city responses is not highlighted in our theme analysis. Table 3 summarises the number and type of individual planners with whom we conducted full interviews, as well as other patterns of response to our interview requests.

Given this study was conducted independently and without substantial funding, we necessarily relied on self-response to interview requests by city planners. Thus we acknowledge that our interview sample likely represents a set of planning officials in better-resourced cities potentially more capable of participating in heat planning than the broader municipal planner population, as Table 1 results also suggest. At the same time, we were able to conduct interviews with planners from local governments and agencies that represented a diverse range of political, climatic, and socioeconomic characteristics within the larger region. The cities represented by interviewees also varied widely in the levels of climate planning activity.

Each semi-structured interview lasted 25–45 min, was conducted over Zoom, and was guided by eight questions (see Appendix 1). We used deductive and inductive coding approaches. We first coded the interview responses in terms of eight major, pre-identified themes outlined in our interview guide, and then coded for additional themes that emerged organically from interviewee responses (Adeoye-Olatunde and Olenik 2021). We pare our discussion of interview findings down to six major themes – combining two that were overlapping – in our final analysis and

Table 3. Interview response types.

	Los Angeles county	San Joaquin valley
Semi-structured interviews	Planners from 10 cities	Planners from 3 cities
	Staff from 2 regional planning entities and 1 utility	1 Planning consultant
Responses to questions by email	Planners from 13 cities	Planners from 2 cities

employed member checking to support the accuracy of our interview results analysis (Nowell et al. 2017).

Census data matching to study cities

To understand the relationship between city-specific exposure and vulnerability characteristics and heat issue and strategy identification, we collected contemporaneous Census (ACS 2018–2022) data for each city in the study region. We focused on the following attributes: population, median household income (MHI), race and ethnicity, and future heat exposure (measured by the number of days per year expected to be over 90 or 100 degrees Fahrenheit in 2035 through 2064). We connected this with our content analysis and interview analysis data and discuss the relevant results below.

Results

Content analysis of planning documents

Turning to our findings, we first present the results of our planning document review. Table 4 and Table 5 summarise our results by category and criterion delineated by the two sub-regions. We observe that it was more common in northern LA County than in the southern SJV for small- and medium-sized municipalities to have adopted CAPs or municipal hazard mitigation plans alongside their GPs. Most of the southern SJV cities contributed to and relied on countywide hazard mitigation plans rather than city-level plans.

Heat issue identification and fact base

The majority of city planning documents across the region identified heat as an issue, although the shares were smaller than might be expected. About 57% of plans in the southern SJV and 69% of plans in northern LA County identified heat as an issue. The larger northern LA County's cities' share of heat identification is partly driven by the area's higher prevalence of climate plans and hazard plans, as only 50% of municipalities' GPs identified heat as an issue. Plans identified heat as an issue in different ways, some focusing on the urban heat island effect, others in the context of climate change more broadly, or by identifying the health risks from heat. Heat exposure or risk data were also included in 48% of southern SJV plans and 44% of northern LA County plans. The most common type of heat data referenced was a basic measure of exposure: average summertime temperatures.

Table 4. Southern San Joaquin Valley content analysis summary.

		General Plans	Climate Plans	Hazard Plans	Total
	Plans analyzed	***38***	***2***	***4***	***44***
Issue identification and fact base	Identifies extreme heat as an issue	21	1	3	25
	Provides heat-related data	17	1	3	21
Long-term heat adaptation and resilience	Urban tree canopy	35	2	1	38
	Other shade	27	2	0	29
	Green infrastructure	26	1	1	28
	Cool roofs	10	2	0	12
	Cool pavements	8	2	0	10
	Green roofs	3	1	0	4
Heat preparedness and response	Cooling centers	5	0	2	7
	Early warning system	2	0	3	5
	Heat education	2	0	1	3

Table 5. Northern Los Angeles County content analysis summary.

		General Plans	Climate Plans	Hazard Plans	Total
	Plans analyzed	***20***	***9***	***7***	***36***
Issue identification and fact base	Identifies extreme heat as issue	10	9	6	**25**
	Provides heat-related data	4	7	5	**16**
Long-term heat adaptation and resilience	Urban tree canopy	17	9	3	**29**
	Green infrastructure	11	6	3	**20**
	Cool roofs	10	7	1	**18**
	Other shade	9	5	1	**15**
	Cool pavements	7	5	1	**13**
	Green roofs	5	6	0	**11**
Heat preparedness and response	Cooling centers	5	5	3	**13**
	Early warning systems	5	3	2	**10**
	Heat education	1	3	1	**5**

Long-term heat adaptation and resilience

Emphasis on long-term heat adaptation and resilience strategies, most of which also had co-benefits and may have been adopted for reasons beyond heat-specific planning motivations, was generally higher than heat issue identification and fact base establishment. However, prevalence of the many specific strategies across cities still varied, and the general prevalence of interventions was again higher among northern LA County municipalities. Urban tree canopy was the most common long-term adaptation and resilience strategy discussed in each sub-region (86% of plans in southern SJV and 81% in northern LAC). However, these urban forestry and tree canopy strategies rarely mentioned heat adaptation specifically as a justification. In the southern SJV, the provision of other types of shade was the second most prevalent strategy, including shade structures in parking lots, parks, and school playgrounds. Whereas the second most common heat adaptation strategy in northern LA County was green infrastructure provision; this was the third most common strategy in the southern SJV. Mentions of green infrastructure tended to identify the importance of landscaping features and stormwater management, but often with few specifics. Cool roofs were mentioned in half of northern LA County plans but only 27% of southern SJV plans. Other long-term heat adaptation and resilience strategies related to pavement and roof materials (i.e. cool pavements, green roofs) were also less common in southern SJV plans than in northern LA County plans.

Heat preparedness and response

Heat preparedness and response strategies were much less common across plans in the entire region than long-term adaptation and resilience strategies. Cooling centers were the most common preparedness and response strategy in both regions, but they were mentioned in a small share of plans overall, largely because of very limited treatment in GPs. Cooling centers were discussed, however, in about half of hazard mitigation plans across the two regions, and in a modest majority of climate plans in northern LA County. Mentions of early extreme heat warning systems and household awareness campaigns were much less common. We note that some plans mentioned early warning for disasters and environmental education more broadly, but our focus was on those that explicitly mentioned heat in these contexts.

Differences by city characteristics

Finally, we explored two sub- hypotheses across all strategies: (1) Cities in larger metro areas are undertaking more heat planning, and (2) Cities with more capacity (e.g. larger populations and higher incomes) are more engaged in heat planning. For this analysis, we assessed which cities had included which strategies in any of their plans.

To test hypothesis 1, we compared the strategies present for southern SJV cities (which includes several smaller metro areas) to those present for northern LA County cities (a larger metro area)

Table 6. Comparison of strategies utilised in cities by geographic region.

		All cities (*N* = 56)	San Joaquin Valley cities (*N* = 37)	LA County cities (*N* = 19)
Issue identification and fact base	Identifies extreme heat as an issue	50%	51%	47%
	Provides heat-related data	41%	46%	32%
Long-term heat adaptation and resilience	Urban tree canopy	86%	92%	74%
	Other shade	59%	68%	42%
	Green infrastructure	64%	70%	53%
	Cool roofs	39%	32%	53%
	Cool pavements	29%	27%	32%
	Green roofs	16%	11%	26%
Heat preparedness and response	Cooling centers	18%	14%	26%
	Early warning system	13%	8%	21%
	Heat education	5%	3%	11%

(Table 6). Table 6 does not clearly point to either region leading on overall heat planning; however, there are some differences in which strategies are employed where SJV cities lead on prevalence of "issue identification and fact base" strategies. Each region leads on three of the six long-term adaptation and resilience strategies. Meanwhile, northern LA County cities implement more of all heat preparedness and response strategies.

To test hypothesis 2, we compared mean population and MHI across cities with and without each strategy (Table 7). The results in Table 7 indicate mixed results about hypothesis 2 (that cities with larger populations and higher incomes are more engaged in heat planning). While some strategies (i.e. cool roofs, green roofs, cooling centers, early warning systems) are more prevalent among larger, higher-income cities – and these cities are more likely to identify heat as an issue – other strategies are either evenly distributed or more prevalent with smaller, lower-income cities (i.e. cool pavement, urban tree canopy, other types of shade).

Additionally, there are somewhat contradictory results when looking at expected heat exposure, acknowledgement of heat as an issue, and actual planning for heat. Cities with higher projected heat exposure more often identify heat as an issue and provide heat data, but they are not necessarily the ones doing the most planning. While a few strategies are more popular with cities with more

Table 7. Comparison of mean city population, MHI, and projected heat exposure by strategy.

			Mean Population		Mean MHI		Mean Proj. Days >100F, 2035-64	
	Plans analyzed	% of cities adopting strategy	Cities with	Cities without	Cities with	Cities without	Cities with	Cities without
Issue identification and fact base	Identifies extreme heat as an issue	50%	67,962	30,054	$77,056	$76,332	64.9	58.5
	Provides heat-related data	41%	50,525	47,950	$74,868	$77,967	66.7	58.2
Long-term heat adaptation and resilience	Urban tree canopy	86%	52,535	27,843	$74,511	$89,796	64.1	43.7
	Other shade	59%	56,043	38,914	$72,015	$83,409	67.2	54.0
	Green infrastructure	64%	43,605	58,733	$76,028	$77,894	64.8	56.3
	Cool roofs	39%	68,025	36,702	$88,382	$69,132	53.1	67.3
	Cool pavements	29%	54,650	46,751	$81,859	$74,628	64.2	60.9
	Green roofs	16%	72,980	44,417	$101,349	$71,973	52.7	63.6
Heat preparedness and response	Cooling centers	18%	77,815	42,745	$91,204	$73,540	60.4	62.1
	Early warning system	13%	91,238	42,975	$95,448	$74,015	56.7	62.6
	Heat education	5%	20,311	50,632	$127,049	$73,844	39.4	63.1

projected days over 100F, many strategies seem to be more common for cities with lower projected exposure.

Thematic analysis of planner interviews

Next, we describe our findings from the interviews we conducted with planning professionals in the two regions. Table 8 summarises the key takeaways from synthesising the results of each of the six coded themes of the interview responses, which we then discuss in detail below by theme, noting any heat exposure or socioeconomic differences that may explain responses.

Heat exposure and vulnerability indicators

Overall, interviewees did perceive heat to be a major and relatively urgent problem facing residents in their city, so issue identification was high. Most were also familiar with broader projections of future extreme heat, but not within-city variation in current or future heat. On the other hand, respondents could rarely systematically identify geographic areas or specific populations particularly vulnerable to heat within their cities, so the heat fact base was moderate overall. Most planners whom we interviewed said that they used non-heat specific, albeit heat-relevant, tools for measuring environmental and socioeconomic inequality in their city, such as the CalEnviroscreen tool for identifying disadvantaged communities in California. This lack of issue targeting may be because user-friendly, heat-specific tools with differentiation at the sub-city scale only became available in 2022, and were still not well advertised to smaller municipalities at the time (for instance see the California Healthy Places Index: Extreme Heat Edition 2022).

When prompted, most interviewees identified some general categories of particularly heat vulnerable populations within their cities, most commonly seniors and children. Only one interviewee mentioned outdoor workers and the incarcerated as vulnerable groups. However, no city planner outlined specific strategies for heat emergency response or adaptation specifically for vulnerable groups. There was also limited recognition of potentially important differences in racial and ethnic group composition in terms of vulnerability, whether at the household or neighbourhood level.

Heat strategy focus

Planners reported great diversity in the implementation of cities' heat-related strategies. Consistent with our plan document analysis but drawing the connection more explicitly, interviewees cities generally focused on the role of trees as providing cooling and shade, especially shade for transit riders waiting outside. The most common specific strategy mentioned was tree planting and ongoing tree care to provide cooling and shade. Several interviewees in the southern SJV reported seeking out and receiving technical assistance and state or federal grants for tree planting. Shade

Table 8. Key interview themes and summary takeaways.

Theme	Summary takeaways
Heat exposure and vulnerability definitions	Cities use off-the-shelf climate and environmental justice vulnerability tools that are broader than municipal boundaries.
Heat strategy focus	Trees and transportation were mentioned most as adaptation strategies, but there were generally diverse responses.
Heat's relationship to other climate issues	Interviews about heat planning commonly segued to discussing water and wildfire planning, but rarely explicitly connected these climate planning domains to heat.
Funding support for heat planning	Challenges were voiced related to grant limitations and unfunded mandates, but there was a general desire to find funding sources and engage in more heat planning.
General local government capacity for heat planning	Limited capacity for heat planning due to other core city planning needs, but state support could be used to build more capacity.
Staff activity relation to city planning documents	There was an unclear relationship between on the ground heat adaptation activities and planning documents' guidance.

trees were also emphasised in planting requirements in small area plans and specific plans. As mentioned above, there was a large focus on transportation, especially shade for transit riders. Human-built shade structures were also sometimes mentioned in the context of cities' long-term heat adaptation and resilience strategies for parks and parking lots. But much broader concepts of multimodal street design, commonly known as Complete Streets, and overall transit efforts were also featured in responses, despite their connection to heat adaptation being less clear mechanistically, and less emphasised in planning documents and scholarly literature.

Secondary heat strategies mentioned by several respondents include directly operating cooling centers (e.g. air-conditioned libraries, community centers, other public buildings) or directing residents to other public air-conditioned spaces during extreme heat events. Other occasionally-mentioned strategies focused on direct installation of green infrastructure, which was more highlighted in planning documents, as well as promoting adoption of energy efficiency and weatherization incentive programs run by other public and non-profit agencies. In particular, two interviewees in affluent, predominantly white LA County cities emphasised REACH building codes as a pathway to decarbonising cities and simultaneously reducing energy use in buildings to adapt to climate change.

By contrast, the installation of indoor air conditioning units and direct drinking water provision for hydration during heat events were rarely mentioned. These omissions were seemingly in part because these services were viewed as the responsibility of energy and water utilities rather than cities per se.

The relationship between heat and other climate issues

Relatedly, during our interviews, many of the observations voiced about local heat strategies shifted into the respective cities' broader climate adaptation or sustainability issues, which did not involve heat per se. In particular, there was an expressed centrality of concern regarding water supply, fire protection and, to a lesser extent, clean energy supply issues. Several interviewees, especially in the smallest cities in politically conservative areas, but spanning income and racial composition differences, reported that planning related to climate change and heat was primarily done without explicitly stating climate change as the motivation – instead citing factors like economic benefit or water supply protection as the publicly-stated motivation. In other cases, heat and other climate adaptation domains were framed as a complementary or co-benefit with traditional environmental domains. However, in a few instances of especially high-income cities, addressing heat was framed as competing for effort and resources with goals of obtaining water supply and reducing fire risk which were perceived to be more pressing. City planners we interviewed most commonly brought up water availability and conservation as a key climate concern, with every interviewee in the SJV raising the issue. Water availability's higher salience for than heat for many interviewees, is not surprising given the historic drought and politically-contested water supply restrictions, experienced in the two sub-regions at the time of the research (State of California 2023). Moreover, water availability issues were framed as a constraint on broader urban greening efforts (i.e. landscaping, tree planting, maintenance) which have cooling benefits.

A second commonly raised climate issue in the Los Angeles area, but less so in the SJV, was local wildfire protection. Wildfire issues were more typically framed as stemming from growing heat, although again introducing the need for water availability for firefighting efforts and to reduce flammability of ground cover. Otherwise, interviewees tended to view wildfire mitigation and heat as separate planning concerns, except with regard to planned electricity service shutoffs to reduce power utility infrastructure-caused wildfires, which in turn often coincide with extreme heat events.

Funding support and opportunity awareness

Nearly all cities we interviewed reported challenges related to the adequacy of existing financial resources and limitations to existing grant or loan programs to address heat concerns. Lack of funding thus caused many cities to be more reactionary and opportunistic than proactive in terms of heat planning. Most expressed interest in learning more about state funding opportunities, which have grown rapidly very recently, but lacked familiarity with heat-related programs.

The range of barriers to securing funding for heat resilience varied considerably. Some interviewees suggested that broader climate resilience funding programs are much more focused on wildfires than heat. Most suggested that smaller cities are functionally overlooked and outcompeted in the application process compared to larger cities, and thus needed additional targeted technical assistance support, a long-identified roadblock in the rural development space (Brown 1980). Others, especially the lowest income and with higher minority populations, attributed lack of awareness of possible resources to the broader constraint of their city's limited staff capacity to fulfil basic planning functions – let alone pursue grants – and some had outsourced their modest planning services to consultants.

Limitations of existing funding programs and authorities to specific heat-adaptation strategies were also featured. One specific example came from a city reporting that shade structures were not considered "infrastructure," thus their understanding was they could not fund shade structures through a specific grant program. Another city representative stated that although it saw the need, it would not plant trees for shade near a highway because state transportation regulations would make the permitting process too time intensive compared to staff capacity.

Finally, city planners especially in the southern SJV and in politically conservative areas of LA County expressed that given limited staff time and resources, they chose to focus on economic development activities that could yield additional tax revenue to fund basic services and other activities with climate-related co-benefits.

General planning capacity

While some interviewees expressed concerns about new general plan requirements from the state of California, none specifically reported concerns about additional heat planning requirements. In fact, some interviewees, especially in LA County, stated that as climate-concerned planners they welcomed additional guidance from either the county or state as an exogenous means to compel further action within their jurisdiction. They expressed concern that their cities were not acting fast enough on climate, particularly when their populations were not motivated by climate issues or expressed climate change scepticism.

At the same time, the planners we interviewed reported wearing many hats, especially in the smallest cities, making climate adaptation (including heat) one of their many responsibilities. For example, in at least one smaller city, senior planners and the city manager were among the city employees directly staffing the city's cooling center. Most interviewees expressed concerns that their ability to scale adaptation actions related to heat, including compliance with future regulations and guidance, necessitated more grant funding and direct technical assistance. They tended to expect that grants and technical assistance would be more abundant in the future, and that these would come from the state rather than counties or the federal government.

Staff activity relation to city planning documents

Interviewees were generally aware of local CAPs and LHMPs, and often referenced climate adaptation language in their cities' GPs. That said, with one notable exception in a wealthy, predominantly non-Hispanic white city, planning staff we interviewed across the two regions did not draw a direct relationship between their heat planning activities and official city planning documents, although we have noted functional links and apparent disconnects above.

Interviewees' lack of direct references to heat-specific language in planning documents contrasts with the prevalence of our identification of heat awareness and activities in planning documents, although this may reflect the heavy role of consultants in planning document writing and the indirect or vague language in the writing of formal planning documents (Loh and Norton 2013). For instance, while the connection was not explicitly drawn by planners in our interviews, an emphasis on both shade and green infrastructure (which are potential heat interventions) was present in both planning documents and interviews, especially among smaller, lower-income cities. Moreover, heat may be such a ubiquitous part of life in the southern SJV and northern LA County that it is largely assumed as a concern of general planning rather than explicitly called out in written planning documents.

Discussion

The results from this study suggest several important takeaways for scholarship, as well as for heat equity planning. Small- and medium-sized cities face some similar, but also many different opportunities and challenges than the large cities primarily studied in the heat planning literature. We found fewer, clear trends influenced by differences in population-level socioeconomic status in the heat planning documents of smaller cities than we expected. Disparities by city size were clearer in our interviews, with several small affluent, predominantly racially white cities also appearing as positive outliers in terms of heat planning capacity and activity.

In larger cities, a main barrier to heat planning often siloed efforts within and across sizable city agenices (Turner et al. 2022). However, major challenges which we identified for smaller cities in California commonly include limited overall staff capacity for any environmental planning, which necessitates contracting out core planning functions and in turn weakens long-term institutional knowledge (Ferris and Graddy 1986); a lack of even indirect funding for heat planning and implementation; and related competing time and funding demands on city staff. Some of these factors have similarly been identified as obstacles in climate adaptation for smaller cities in the work of Daniere, Garschagen, and Thinphanga (2019) as well as Marks and Pulliat (2022). However, the diffuse and everyday nature of heat exposure, as well as the subtle science of heat sensitivity, contrast with other adaptation spheres and present a unique challenge to smaller city staff without climate science expertise. The greatest planning opportunity for smaller cities may be investing in heat-related adaptation activities that further other local goals, including economic development objectives which otherwise may compete (Marks and Pulliat 2022).

Additionally, smaller cities reported more eagerness to participate in and facilitate more vertical (e.g. with other levels of government, nongovernmental stakeholders) or horizontal (e.g. with neighbouring cities, energy utilities, county governments) partnerships to further local heat resilience (Hughes 2015), if sufficiently funded to do so. In terms of the content of heat-related planning, there appear to be concerted efforts to engage especially in nature-based greening solutions, reflecting language from larger-city plans, as also illustrated by Mabon (2023). However, these strategies do not appear to be sufficiently implemented to affect heat outcomes.

This analysis also points to several important topics for future study regarding small- and medium-sized cities in the context of both urban environmental management and broader urban political ecology globally. First, there needs to be further research on whether and how collaboratively urban planners interact with those from other professional disciplines and departments in smaller cities, similar to Keith et al.'s research (2023) on large cities. Second, community-based research may fill existing gaps in the capacity of smaller city staff to complete problem identification (Rumbach 2016) in order to better understand how vulnerable residents actually experience heat, adapt to heat, and prioritise interventions to improve heat health (Gabbe et al. 2023; Hamstead 2023). Third, there remains insufficient research on how different aspects of horizontal and vertical planning related to heat, and unequal power dynamics embedded in them (Marks and Pulliat 2022), affect local heat resilience. In particular, we need to better understand the conditions and specific strategies in which smaller city coordination with both similar -sized (more typical in water) and much larger utilities (more typical in energy, with attendant power asymmetries, see McGee and Swaroop 2019) and county governments is feasible. Study of coordination possibilities and experiencnes will both inform whether and how they are enabling or further constraining for smaller city heat planning, as well as thinking on the role of urban political ecology theory in explaining infrastructural and social inequalities in smaller city heat outcomes.

Local city heat planning is both a growing imperative and activity globally, not just in California. The methods employed and results found here are transferable to other regions worldwide. The interview approach we employed can be similarly if not identically utilised in many places. While the exact local planning documents to study will vary, and data availability remains a concern, Ulpiani et al. (2024) illustrate a means to use large data processing tools to conduct similar analyses as we take here. In terms of our findings, it is important to reflect on the fact that some heat strategies such as cool pavement and tree planting, which are popular both in California and internationally, may yield less tangible improvements in cooling than practitioners assume (Schneider, Epel, and Middel 2024). Establishing a local urban heat exposure and vulnerability fact base may also be a constraint, as most heat risk and vulnerability tools available globally do not approach the granularity of tools such as the California Healthy Places Index: Extreme Heat Edition.

We offer several policy recommendations to overcome these challenges and to expand heat-related work in smaller cities in California and beyond. By 2022, California state laws (SB 379, SB 1035) require municipal governments to update the safety elements of their general plans to address climate adaptation and resiliency. Even since our interviews for this study were completed, the state of California has already substantially increased its funding and technical assistance for local climate adaptation planning (Governor's Office for Planning and Research 2023). This new era of state funding combined with technical assistance presents a potential model for other states. However, the extent of cities' compliance with the general plan requirements and ability to uptake climate adaptation planning funding remains undetermined. More importantly, this study brings into question whether and how compliance will translate into tangible, heat-specific management outcomes. While plan updates are a helpful first step toward preparing for the effects of climate change, the implementation of heat-reduction strategies may require further investments in building staff capacity and funding implementation, as well as specifying the types of strategies which would be most impactful.

We do not suggest with our focus on smaller cities in this study that they can or should bear the burden of adapting to heat for their residents entirely on their own. In fact, our results confirm that smaller municipalities face fundamentally different constraints in their heat planning capabilities than larger cities. In addition to the adaptation tools under direct municipal control, energy utilities, counties, and water utilities – to a lesser extent – have climate adaptation responsibilities and funds at their disposal. However, drawing on structuration theory, we maintain that even smaller cities currently do and can creatively employ some agency in heat planning activities despite broader structural constraints, and this agency can inform structural changes in broader policy systems iteratively (for instance, see Phipps 2001) City climate adaptation planning may incorporate horizontal or vertical planning efforts. It is essential that cities work with these parallel local and regional agencies to ensure efficient and equitable distribution of funds to residents, and that the role and responsibility of smaller cities in broader metropolitan efforts be both properly defined and held to account.

In summary, smaller cities should not bear the burden of adapting to heat on behalf of their residents on their own. Without dedicated state financing assistance, similar planning mandates have led to inequalities in governance capacity. Better-resourced communities are more likely to train staff, plan, and coordinate across collaborating agencies than lower-income communities (Cutter, Boruff, and Shirley 2012). Local jurisdictions are largely responsible for funding emergency and disaster programs for heat, as opposed to other disasters (Borunda 2024), which may create both opportunities if resources are available or further disparities in levels of heat emergency preparedness (for instance, see Rumbach 2016). We have found previously that while there are programs that can support one or more heat risk-reducing measures, there were no state-level grant programs whose primary objective was heat risk reduction, heat mitigation, or heat adaptation in general, much less for low-capacity municipalities (DeShazo and Lim 2021), although this has begun to change in very recent times. The need for heat planning and adaptation in smaller cities, on the other hand, remains as pressing as in larger cities, and as our findings here show, deserves further study and policy attention.

Note

1. We initially considered but ultimately did not employ the coding of documents using an institutional grammar analysis approach (Crawford and Ostrom 1995). We did not employ this approach because it required more detailed information compared to the specificity of the text available to analyze on the topics within written planning documents.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by UCLA Sustainable LA Grand Challenge.

ORCID

Gregory Pierce http://orcid.org/0000-0002-8164-5825
C.J. Gabbe http://orcid.org/0000-0002-0084-580X

References

Adeoye-Olatunde, O. A., and N. L. Olenik. 2021. "Research and Scholarly Methods: Semi-Structured Interviews." *Journal of the American College of Clinical Pharmacy* 4 (10): 1358–1367. https://doi.org/10.1002/jac5.1441

Bedsworth, L. W., and E. Hanak. 2013. "Climate Policy at the Local Level: Insights from California." *Global Environmental Change* 23 (3): 664–677. https://doi.org/10.1016/j.gloenvcha.2013.02.004

Birkmann, J., T. Welle, W. Solecki, S. Lwasa, and M. Garschagen. 2016. "Boost Resilience of Small and mid-Sized Cities." *Nature* 537 (7622): 605–608. https://doi.org/10.1038/537605a

Borunda, A. 2024. "Why isn't Extreme Heat Considered a Disaster in the U.S.?". https://www.npr.org/2024/06/18/nx-s1-5003785/extreme-heat-disaster-fema-climate.

Broto, V. C., and H. Bulkeley. 2013. "Maintaining Climate Change Experiments: Urban Political Ecology and the Everyday Reconfiguration of Urban Infrastructure." *International Journal of Urban and Regional Research* 37 (6): 1934–1948. https://doi.org/10.1111/1468-2427.12050

Brown, A. 1980. "Technical Assistance to Rural Communities: Stopgap or Capacity Building?" *Public Administration Review* 40 (1): 18–23.

Bucholz, S. 2020. "Urban. Suburban. Rural. How Do Households Describe Where They Live?." https://www.huduser.gov/portal/pdredge/pdr-edge-frm-asst-sec-080320.html.

Crawford, S. E., and E. Ostrom. 1995. "A Grammar of Institutions." *American Political Science Review* 89 (3): 582–600.

Cutter, S. L., B. J. Boruff, and W. L. Shirley. 2012. "Social Vulnerability to Environmental Hazards." In *Hazards Vulnerability and Environmental Justice*, 143–160. New York: Routledge.

Daniere, A. G., M. Garschagen, and P. Thinphanga. 2019. "Why Focusing on Urban Climate Change Resilience in Southeast Asia is Relevant and Urgent." In *Urban Climate Resilience in Southeast Asia*, edited by A. G. Daniere and M. Garschagen, 1–16. Cham: Springer International Publishing.

DeShazo, J. R., and L. Lim. 2021. *Assessing Gaps in State-Level Policies and Funding Opportunities*. Los Angeles: UCLA Luskin Center for Innovation.

Fernandez-Bou, A., J. M. Rodríguez-Flores, A. Guzman, J. Pablo Ortiz-Partida, L. M. Classen-Rodriguez, P. A. Sánchez-Pérez, and J. Valero-Fandiño. 2023. "Water, Environment, and Socioeconomic Justice in California: A Multi-Benefit Cropland Repurposing Framework." *Science of the Total Environment* 858:159963. https://doi.org/10.1016/j.scitotenv.2022.159963

Ferris, J., and E. Graddy. 1986. "Contracting out: For What? With Whom?" *Public Administration Review* 46: 332–344. https://doi.org/10.2307/976307

Fila, D., H. Fünfgeld, and H. Dahlmann. 2024. "Climate Change Adaptation with Limited Resources: Adaptive Capacity and Action in Small-and Medium-Sized Municipalities." *Environment, Development and Sustainability* 26 (3): 5607–5627. https://doi.org/10.1007/s10668-023-02999-3

Gabbe, C. J., J. S. Chang, M. Kamson, and E. Seo. 2023. "Reducing Heat Risk for People Experiencing Unsheltered Homelessness." *International Journal of Disaster Risk Reduction* 0 (0): 1–17.
Gabbe, C. J., G. Pierce, E. Petermann, and A. Marecek. 2021. "Why and how do Cities Plan for Extreme Heat?" *Journal of Planning Education and Research* 44: 0739456X211053654.
Governor's Office of Planning and Research. 2023. The Community Assistance for Climate Equity Program. https://opr.ca.gov/climate/planning-resources.html.
Güneralp, B., M. Reba, B. U. Hales, E. A. Wentz, and K. C. Seto. 2020. "Trends in Urban Land Expansion, Density, and Land Transitions from 1970 to 2010: A Global Synthesis." *Environmental Research Letters* 15 (4): 044015. https://doi.org/10.1088/1748-9326/ab6669
Hamstead, Z. A. 2023. "Thermal Insecurity: Violence of Heat and Cold in the Urban Climate Refuge." *Urban Studies* 61: 00420980231184466.
Healthy Places Index: Extreme Heat Edition. 2022. https://heat.healthyplacesindex.org/.
Hoffman, J. S., V. Shandas, and N. Pendleton. 2020. "The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas." *Climate* 8 (1): 12. https://doi.org/10.3390/cli8010012
Homsy, G. C., and M. E. Warner. 2015. "Cities and Sustainability: Polycentric Action and Multilevel Governance." *Urban Affairs Review* 51 (1): 46–73.
Hughes, S. 2015. "A Meta-Analysis of Urban Climate Change Adaptation Planning in the US." *Urban Climate* 14: 17–29.
Indraprahasta, G. S., S. Amir, A. Nastiti, and R. Ufaira. 2023. "Governing Climate Mitigation in a Megacity: Tapping Opportunities in the Multi-Level Governance System?" *Journal of Urban Affairs*: 1–22. https://doi.org/10.1080/07352166.2023.2274554
Jin, A. S., and K. T. Sanders. 2022. "Analyzing Changes to US Municipal Heat Response Plans During the COVID-19 Pandemic." *Environmental Science & Policy* 128:347–358. https://doi.org/10.1016/j.envsci.2021.11.022
Jonsson, A. C., and L. Lundgren. 2015. "Vulnerability and Adaptation to Heat in Cities: Perspectives and Perceptions of Local Adaptation Decision-Makers in Sweden." *Local Environment* 20 (4): 442–458. https://doi.org/10.1080/13549839.2014.896326
Kaika, M., Y. Tzaninis, T. Mandler, and R. Keil. 2023. *Turning up the Heat: Urban Political Ecology for a Climate Emergency*. Manchester: Manchester University Press.
Keith, L., C. J. Gabbe, and E. Schmidt. 2023. "Urban Heat Governance: Examining the Role of Urban Planning." *Journal of Environmental Policy & Planning* 25 (5): 642–662. https://doi.org/10.1080/1523908X.2023.2244446
Krippendorff, K. 2013. *Content Analysis: An Introduction to its Methodology* (Third edition. New York: SAGE.
Kumar, T., and M. Stenberg. 2022. "Why Political Scientists Should Study Smaller Cities." *Urban Affairs Review*. 10780874221124610.
Li, Y., T. Yang, G. Zhao, C. Ma, Y. Yan, Y. Xu, L. Wang, and L. Wang. 2024. "A Systematic Review of Studies Involving Canopy Layer Urban Heat Island: Monitoring and Associated Factors." *Ecological Indicators* 158:111424. https://doi.org/10.1016/j.ecolind.2023.111424
Lioubimtseva, E., and C. da Cunha. 2022. "Community Engagement and Equity in Climate Adaptation Planning: Experience of Small-and mid-Sized Cities in the United States and in France." *Justice in Climate Action Planning*: 257–276. https://doi.org/10.1007/978-3-030-73939-3_13
Loh, C. G., and R. K. Norton. 2013. "Planning Consultants and Local Planning: Roles and Values." *Journal of the American Planning Association* 79 (2): 138–147. https://doi.org/10.1080/01944363.2013.883251
Los Angeles City Climate Emergency Mobilization Office. 2023. https://www.climate4la.org/about/.
Los Angeles County Planning Department. 2023. https://planning.lacounty.gov/climate-action-and-sustainability/.
Lubell, M., R. Feiock, and S. Handy. 2009. "City Adoption of Environmentally Sustainable Policies in California's Central Valley." *Journal of the American Planning Association* 75 (3): 293–308.
Mabon, L. 2023. "At the Margins of the International Community, but Inside Global Knowledge and Policy Flows? How Cities in Taiwan and Scotland Position Themselves Within Intergovernmental Rhetoric on Nature-Based Solutions." *Nature-Based Solutions* 4:100086. https://doi.org/10.1016/j.nbsj.2023.100086
Marks, D., and J. Connell. 2023. "Unequal and Unjust: The Political Ecology of Bangkok's Increasing Urban Heat Island." *Urban Studies* 61: 00420980221140999.
Marks, D., and G. Pulliat. 2022. "Urban Climate Governance in Southeast Asian Small and mid-Sized Cities: Undermining Resilience and Distributing Risks Unevenly." *Journal of Integrative Environmental Sciences* 19 (1): 141–160. https://doi.org/10.1080/1943815X.2022.2127774
McGee, A., and S. Swaroop. 2019. "The Power of Power." *Ecology Law Quarterly* 46 (4): 985–1016.
Meerow, S., and L. Keith. 2022. "Planning for Extreme Heat: A National Survey of US Planners." *Journal of the American Planning Association* 88 (3): 319–334. https://doi.org/10.1080/01944363.2021.1977682
Meerow, S., P. Pajouhesh, and T. R. Miller. 2019. "Social Equity in Urban Resilience Planning." *Local Environment* 24 (9): 793–808. https://doi.org/10.1080/13549839.2019.1645103
Nowell, L. S., J. M. Norris, D. E. White, and N. J. Moules, N. J. 2017. "Thematic Analysis: Striving to Meet the Trustworthiness Criteria." *International Journal of Qualitative Methods* 16 (1): 1609406917733847.
Ofori-Amoah, B. 2021. "Small Towns in the Planning System: The Experience of the United States." In *The Routledge Handbook of Small Towns*, edited by J. Bański, 373–385. New York: Routledge.

Paterson, S. K., M. Pelling, L. H. Nunes, F. de Araujo Moreira, K. Guida, and J. A. Marengo. 2017. "Size Does Matter: City Scale and the Asymmetries of Climate Change Adaptation in Three Coastal Towns." *Geoforum; Journal of Physical, Human, and Regional Geosciences* 81:109–119. https://doi.org/10.1016/j.geoforum.2017.02.014

Phipps, A. G. 2001. "Empirical Applications of Structuration Theory." *Geografiska Annaler: Series B, Human Geography* 83 (4): 189–204. https://doi.org/10.1111/j.0435-3684.2001.00106.x

Pincetl, S., M. Chester, and D. Eisenman. 2016. "Urban Heat Stress Vulnerability in the US Southwest: The Role of Sociotechnical Systems." *Sustainability* 8 (9): 842. https://doi.org/10.3390/su8090842

Rumbach, A. 2016. "Decentralization and Small Cities: Towards More Effective Urban Disaster Governance?" *Habitat International* 52:35–42. https://doi.org/10.1016/j.habitatint.2015.08.026

Rumbach, A., and G. Follingstad. 2019. "Urban Disasters Beyond the City: Environmental Risk in India's Fast-Growing Towns and Villages." *International Journal of Disaster Risk Reduction* 34:94–107. https://doi.org/10.1016/j.ijdrr.2018.11.008

Schneider, F. A., E. Epel, and A. Middel. 2024. "A Disconnect in Science and Practitioner Perspectives on Heat Mitigation." *Npj Urban Sustainability* 4 (1): 1–9. https://doi.org/10.1038/s42949-023-00137-6

Shi, L., E. Chu, and J. Debats. 2015. "Explaining Progress in Climate Adaptation Planning Across 156 US Municipalities." *Journal of the American Planning Association* 81 (3): 191–202.

State of California. 2023. "Current Drought Conditions." https://drought.ca.gov/current-drought-conditions/#:~:text = Overview%20of%202021,-The%20water%20year&text = All%2058%20counties%20in%20California,homes%2C%20businesses%2C%20and%20farms.

Stevens, M. 2023. "Do Large, Educated, Left-Leaning Cities Really Adopt More Climate Change Policies? Testing for Potential Bias in Planning and Policy Research" *Urban Climate* 50:101563. https://doi.org/10.1016/j.uclim.2023.101563.

Trego, S., S. Meerow, and L. Keith. 2023. "Heat planning in small and medium-sized cities: A collaborative application of PIRS™ for heat in Kent, WA, USA." *Socio-Ecological Practice Research*.

Turner, V. K., E. M. French, J. Dialesandro, A. Middel, D. M. Hondula, G. B. Weiss, and H. Abdellati. 2022. "How are Cities Planning for Heat? Analysis of United States Municipal Plans." *Environmental Research Letters* 17 (6): 064054. https://doi.org/10.1088/1748-9326/ac73a9

Ulpiani, G., A. Treville, P. Bertoldi, N. Vetters, P. Barbosa, L. Feyen, G. Naumann, and M. Santamouris. 2024. "Are Cities Taking Action Against Urban Overheating? Insights from Over 7,500 Local Climate Actions." *One Earth* 7 (5): 848–866. https://doi.org/10.1016/j.oneear.2024.04.010

Wagner, M., and A. Growe. 2021. "Research on Small and Medium-Sized Towns: Framing a new Field of Inquiry." *World (Oakland, Calif)* 2 (1): 105–126. https://doi.org/10.3390/world2010008

Walker, S. E., E. A. Smith, N. Bennett, E. Bannister, A. Narayana, T. Nuckols, K. Pineda Velez, J. Wrigley, and K. M. Bailey. 2024. "Defining and Conceptualizing Equity and Justice in Climate Adaptation." *Global Environmental Change* 87:102885. https://doi.org/10.1016/j.gloenvcha.2024.102885

Yeganeh, A. J., A. P. McCoy, and T. Schenk. 2020. "Determinants of Climate Change Policy Adoption: A Meta-Analysis." *Urban Climate* 31:100547. https://doi.org/10.1016/j.uclim.2019.100547.

Youngquist, K., M. Shrestha, B. Ryan, and C. Mitra. 2023. "A Global Scoping Review on Sustainability, Climate Migration, and Climate Resilience of Small and Medium-Sized Cities (SMSC)." *Urban Climate* 49:101546. https://doi.org/10.1016/j.uclim.2023.101546

Appendix: Interview guide

1. How has heat impacted your city? Are there equal impacts across the city?
2. How do you measure heat impact (tracking tools, metrics)? Do you focus on priority settings?
3. Has your city drafted and implemented any long-range heat mitigation policies? Indoor vs. outdoor?
4. What on the ground measures/steps has your city taken to combat rising temperatures, worsened especially by climate change? What's unique about your approach?
5. Do any departments in your city address heat issues without labelling their efforts as such (i.e. building codes, groundskeeping)? If so, which?
6. Does your city coordinate with energy or water utilities or the county on heat adaptation?
7. Do you believe that these steps are adequate to address the worsening problem? If not, what do you foresee yourself having to do in addition?
8. Are there specific ways (e.g. funding mechanisms, TA, ordinance/code drafting, etc.) in which your city could be supported to do more?