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Research Article

Practitioner perspectives on climate mobilities in South Florida

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Abstract

Moving away from hazardous areas may be an important adaptive response under intensifying climate change, but to date such movement has been controversial and conducted with limited government or private-sector support. Research has emphasized resident perspectives on mobility, but understanding how professionals view it may open new avenues to shape future outcomes. Based on 76 interviews with professionals involved in climate responses in South Florida, we evaluate perceptions of adaptation goals, the potential role of climate mobilities in pathways supporting those goals, and associated constraints and enablers. The practitioners interviewed anticipate multiple types of climate mobilities will occur in the region, at increasing scales. Interviewees perceive climate mobilities at present, especially migration and gentrification where climate plays some role, as causing distributional inequities and financial and sociocultural disruptions, and they view existing adaptive strategies as best serving those who already have adequate resources, despite practitioners' personal commitments to social justice goals. Although many practitioners feel prepared for their own, limited roles related to climate mobilities, they judge the region as a whole as being unprepared to support the retreat they see as inevitable, with a need for a more ambitious long-term transition plan. Achieving this need will be difficult, as practitioners indicate that climate mobilities remain hard to talk about politically. Nevertheless, interviewees believe some households are already considering moving in response to climate risks. Discussions of climate mobilities, through interviews and far beyond, may encourage more mindful choices about and engagement in climate-driven transformations.

Keywords: climate mobility; climate migration; climate gentrification; retreat; climate risks; climate adaptation

Introduction

Estimates of people who may be displaced by sea level rise over the course of this century range from 88 million for those permanently inundated to 1.4 billion for overall exposure in low-elevation coastal zones [1]. Some people and communities are already relocating or moving away from highly hazardous coasts, and this number is expected to rise [2–4]. The ways people move (i.e. climate mobilities) will manifest in many ways, both reactive and proactive, as influenced by intersection of climate hazards and other factors [5–7]. Climate mobilities will emerge from the limits and failures of other adaptive responses, such as in the case of post-disaster dislocation [8, 9], as well as from deliberate, collective attempts to promote broader social goals, as in the case of planned relocations [10].

The simultaneous harms and benefits of climate mobilities pose major challenges for governments, civil society, and the private sector—whether in preventing losses, such as from displacement, or in supporting improved safety, as in planned resettlement. For instance, post-disaster displacement has disproportionately affected those with the least resources and those marginalized within government decision-making processes [11, 12]. Migrants who are moving at least in part due to climate factors are often the least responsible for global emissions of heat-trapping gases, and the lack of institutional support for these individuals is creating acute problem [13, 14]. Processes of managed retreat, despite positive aims such as moving out of hazardous locations, have raised concerns of procedural, distributive, and recognition justice among others [4, 15–17]. Climate mobilities often involve political, financial and economic, and sociocultural challenges ranging from loss of municipal tax base to loss of culture [18, 19]. To improve the ability of governments, civil society, and the private sector to engage with climate

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mobilities, a first step is to understand how professionals view climate mobilities, their roles as individuals and organizations in preventing or supporting climate mobilities, and the barriers and enablers they perceive in doing so.

This paper presents such an analysis in South Florida, USA, a region grappling with and actively preparing for severe and increasing climate-related risks and already experiencing several types of climate mobility. South Florida is low lying with immense exposure of people and assets to storm-driven flooding and winds, inundation, and chronic humid heat among other climate-related hazards at present and under future climate change [20–22]. Its sociocultural, political, and economic context creates tremendous disparities in levels of social vulnerabilities and climate-related risks, linked to high income inequality, racial injustice, and histories of migration driven by economic and political factors [23–26]. Climate risks are substantial yet uneven, and to date, climate-related mobilities have figured into regional experiences and responses to these risks in multiple ways. First, post-disaster displacement to and from South Florida has occurred following tropical cyclones in the United States and across the Caribbean Basin [27, 28]. Second, theories of 'climate gentrification' have been developed to describe patterns of shifting real estate markets, demographics, and investments [29]. And third, there have been notable legal and political sensitivities surrounding considerations of climate-related retreat such as through home buyouts or road abandonment [30, 31]. Under higher magnitudes of sea level rise especially, South Florida faces the potential for reactive, forced, or inequitable climate-related mobilities absent more deliberate, proactive planning. The combination of substantial climate risks, strong politization of climate responses, and high-profile climate mobilities makes South Florida an ideal place to assess practitioner perspectives on climate mobilities.

Materials and methods

We conducted semi-structured interviews with 76 adaptation-relevant practitioners who could provide deeply informed professional perspectives on climate responses and climate-related mobilities in South Florida.

Identification of interviewees

We identified over 420 adaptation-relevant practitioners in and relevant to South Florida using online searches and expert recommendations (including balanced snowball extensions where interviewees suggested experts who disagree with them; Supplementary Appendices 1 and 2 [32–34]). We iteratively selected 112 of those 420 practitioners to achieve maximum diversity and comprehensiveness across categories of professional affiliation: local government, state/regional government, federal government, private sector, academic research, and nonprofit organizations (Supplementary Table 1) [35]. We invited those 112 for interviews, and 76 accepted (67.9% acceptance rate). We stopped interview invitations within each category once adequate representation and saturation of perspectives were achieved.

Development of interview protocol

The University of Miami Institutional Review Board approved the interview protocol (IRB ID #20200038). The final interview protocol is available in Supplementary Appendix 1 (protocol version provided to interviewees) and Supplementary Appendix 2 (interviewer version with notes). Using semi-structured questions, we asked interviewees about their roles, major concerns about climate risks and priorities for climate responses, and perceptions about climate mobilities. In particular, we asked them to identify and define different types of climate mobility, to discuss the degree to which they think climate mobilities are occurring now and will occur in the future, and to indicate what preparations they or the region might need to take regarding climate mobilities in the context of broader climate responses. Interviewees were not required to answer every question. For example, they could skip questions outside of their expertise, comfort, or priorities.

Implementation of interviews

Our first interview was conducted in person in early March 2020. Subsequent scheduled interviews were then canceled due to the COVID-19 pandemic. Once University of Miami Institutional Review Boards allowed human-subjects research to proceed again, we conducted the remaining interviews by Zoom, and 75 interviews occurred between June and October 2021. Acknowledging the substantial burden on adaptation-relevant practitioners as well as residents in the region linked to climate research, we prioritized scheduling the Zoom interviews at times convenient for each interviewee and offered a $40 gift card as an incentive for interviewees able to accept it [36, 37]. We audio-recorded interviews after informed consent occurred and later transcribed them with Zoom and Rev. The interviews were, on average—after introductions and informed consent—53 minutes long.

Analysis of data

We assembled responses to each question across interviewees, tracking interviewee number and associated professional affiliation(s), but not name, for each response. Through directed content analysis, we coded interviewee transcript responses iteratively and inductively, informed by relevant literature, previous findings, and emergent themes [38]. A single coder (KJM) analyzed all interviewee responses, with codes checked by a second coder (JN). Discrepancies and errors were discussed and reconciled. Coded, deidentified responses are available in Supplementary Appendix 3, and the codes applied are characterized in Supplementary Tables 2–16 with example quotes. We statistically analyzed responses by code categories and interviewee professional affiliation(s) through Cochran's Q and odds ratios tests [39–41].

Results and discussion

Adaptation-relevant practitioners and their goals

Practitioners interviewed come from a wide range of professional contexts relevant to climate adaptation in South Florida (Fig. 1 and Supplementary Table 1). Many interviewees (32 of the 76 interviewees, 42.1%) have multiple affiliations across local to federal government, the private sector, academia, and nonprofit organizations. For example, some private-sector actors such as developers may also serve on the boards of nonprofit organizations, and some government officials are also associated with academic institutions. In such cases, we designate a primary affiliation based on the practitioner's most visible role in the region related to climate adaptation and the topic of climate mobility, while also noting all professional affiliations of each interviewee (Fig. 1) and evaluating responses accordingly. Likely because of the frequency of multiple affiliations, interviewee responses across categories of professional affiliation often do not differ significantly (Figs 2, 4–6 and Supplementary Figs 1–5). Although climate adaptation measures are frequently

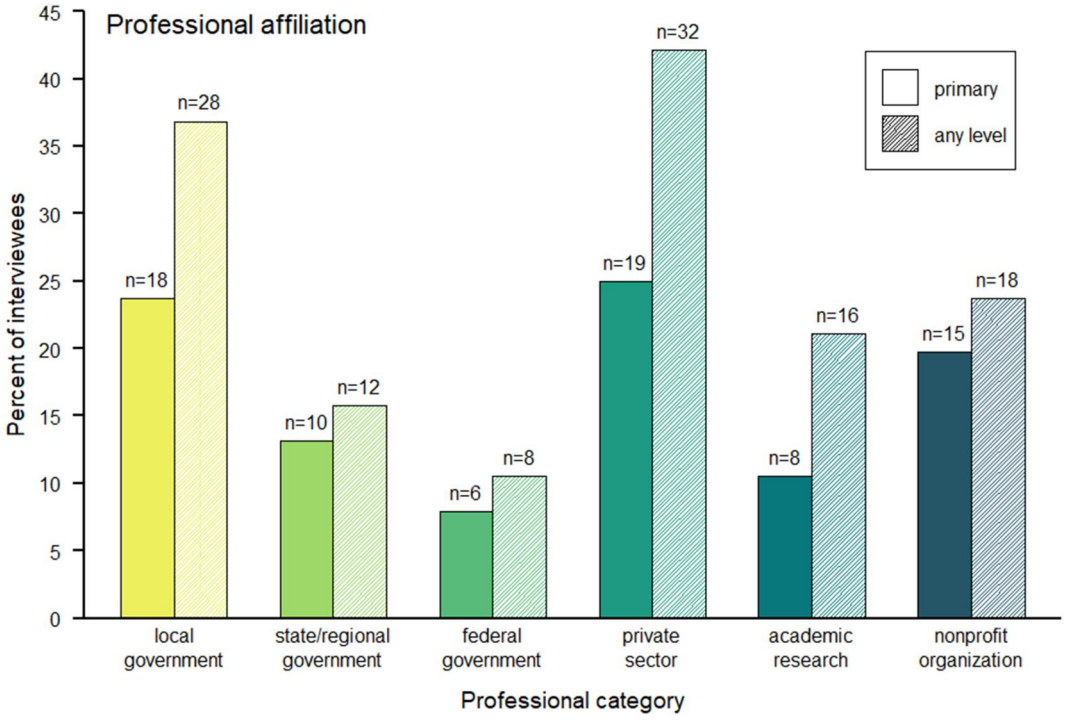

Figure 1. Interviewees have wide-ranging and often several professional affiliations. The percent (y-axis) and number (top of bars) of interviewees are indicated for each professional-affiliation category, considering each interviewee's professional affiliation most relevant to the climate-mobilities interview (primary) and all professional affiliations each of the 76 interviewees has (any level).

distinguished across levels of government, the private sector, and categories of civil society (e.g. [42, 43]), the overlap across interviewee professional affiliations also implies a potential for climate responses to interact in their motivations and negotiations across the social contexts and scales of South Florida, as part of evolving adaptation governance [44, 45].

The practitioners view infrastructure improvements and finance as the highest priorities in current climate responses in South Florida (cumulatively 52.4% of weighted total; Fig. 2B, bottom). They express a desire for a broader range of priorities to motivate responses in the future, especially including social equity and justice and disaster risk reduction (cumulatively 53.7% of weighted total; Fig. 2B, top). In other words, the practitioners personally desire an emphasis on more diverse climate-response priorities that go beyond those they perceive as dominant at present in the region. Such an emphasis may link with increasing recognition of the degree to which equity, priorities beyond those readily expressed in monetary terms, and adverse side-effects of responses themselves have been challenging to incorporate into climate adaptation planning and implementation to date [11, 45–47].

The climate hazards of most concern to interviewees are flooding, hurricanes, sea level rise, and extreme heat (Fig. 2A). Concern about sea level rise and extreme heat in South Florida increases for the long term, compared to the next 1–3 decades (Fig. 2A, top versus bottom), perhaps because sea level rise is viewed as a long-term threat (e.g. as found in [48]) and extreme heat as a threat that will increasingly affect all residents in the region. Indeed, South Florida is particularly flood prone given its low-lying topography, permeable substratum, and multiple flood drivers [49]; gravity-based regional stormwater management systems face reduced discharge capacities as seas and groundwater rise [50]; and the exposure of people and assets to intensifying flooding and inundation is stark, including potential inundation of 647,000 acres, 103,000 residents, and billions of dollars of property and asset value already by 2040 [20, 50, 51]. These hazards pose major challenges in part because practitioners express doubts in the ability of seawalls (25.7% of the 35 interviewees responding), pumps (25.7%), and stormwater management systems (22.9%) to address flooding, storm surge, and sea level rise (Supplementary Fig. 5B). For instance, Interviewee 6 (primary affiliation: local government) notes, 'There's about four different ways we can get flooded out and [a seawall] only addresses one of the four … that's the biggest piece of policy myopia I've seen so far,' and Interviewee 23 (nonprofit organization) says, 'Pumping is like a temporary band aid … it's not going to take you into the next century as a solution, and it's extremely polluting' (Supplementary Table 14).

Interviewees from nonprofit organizations particularly emphasized concerns about extreme heat, related to personal priorities for social equity and justice in climate responses, whereas those in the private sector downplayed heat hazards (Fig. 2A, top). For example, Interviewee 31 (local government) underscores that 'social justice and equity are being raised in our consciousness on a daily basis … when we start thinking about heat island impacts,' and Interviewee 15 (academic research) describes the interconnections as follows:

> By not having universal health care, you have somebody that has effects of a heat stroke, of a heat event, and they can't even go to the doctor. Not only do they not have the AC [air conditioning] or if they do, they can't even pay for it, because they don't have the money for it … everything is part of one giant problem, which is our lack of focus on taking care of our vulnerable populations (Supplementary Table 6).

In adaptation planning within the region and beyond, extreme heat has received increasing attention with understanding that heat risks and inadequate policy responses to date are associated with substantial and intersectional inequities, for example with

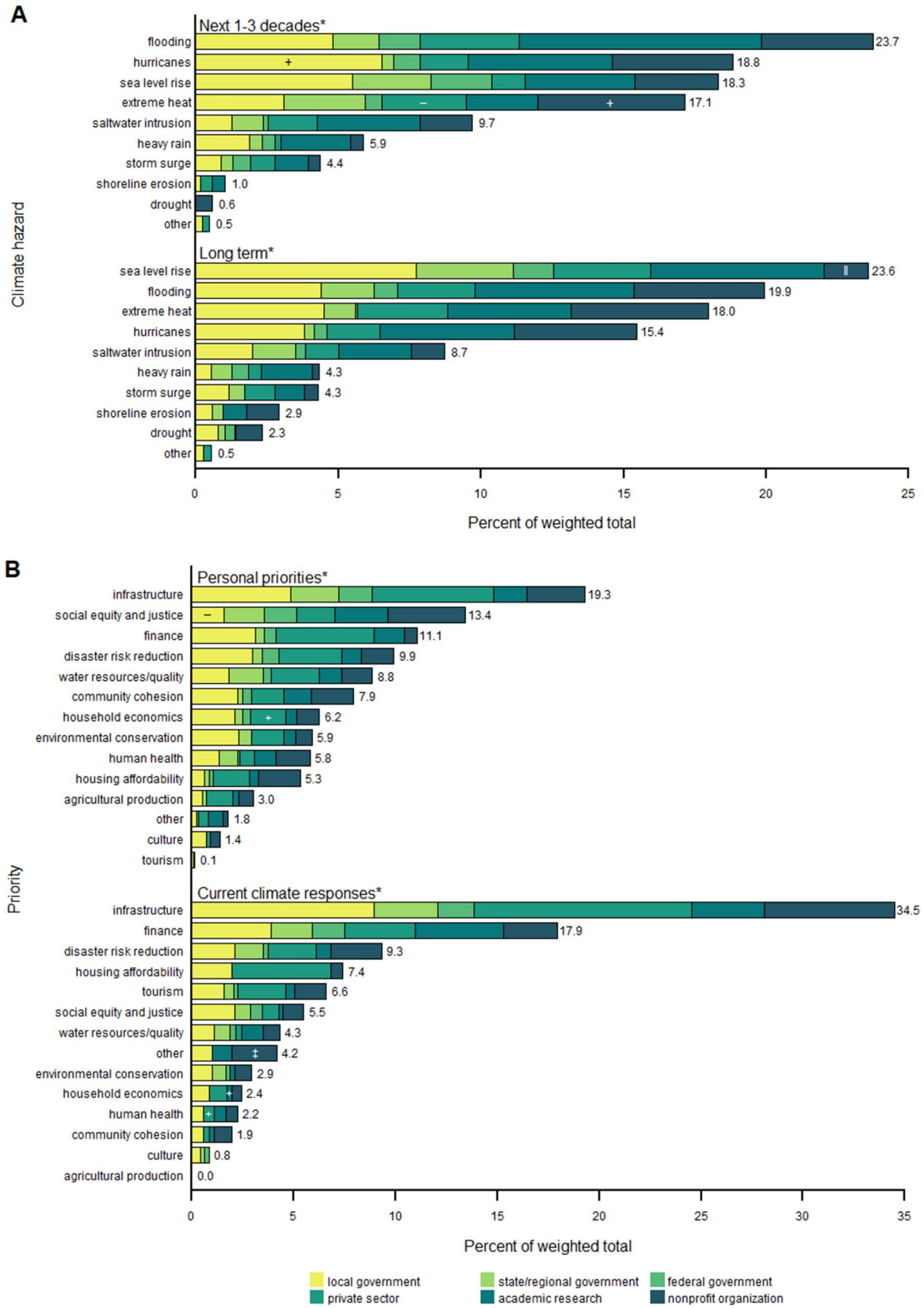

Figure 2. Practitioners have multiple climate hazards of concern and response priorities. (A) Interviewees specified the top-three climate hazards they are most worried about in South Florida in the next 1 to 3 decades (top, 73 interviewees responding) and in the long term around the end of the century (bottom, 65 interviewees). (B) For responses to climate change in South Florida, interviewees specified their top-three personal priorities (top, 73 interviewees responding), compared to goals currently prioritized (bottom, 60 interviewees). Some interviewees listed more or fewer than their top three, so responses are weighted such that responses from each interviewee have a total weight of 3. Percent of the weighted total (number at end of bars) is given by category of professional affiliation (color shading). Statistically significant differences in response proportions across hazards and priorities categories are indicated (* for $P < 0.05$, Cochran's Q test). Statistically significant odds ratios are also specified, where odds of a hazard or priority are greater or lower for a given professional affiliation (+ or – for $P < 0.1$, ‡ or ‖ for $P < 0.05$).

heat exposure shaped by livelihoods, housing and energy insecurity, and histories of discrimination and disinvestment [52–54]. As seen in such examples, climate concerns and priorities intertwine in shaping how interviewees perceive future needs for climate adaptation, including for climate mobilities expected to occur at greater scales across South Florida through time.

The role of climate mobilities in adaptation pathways

Practitioners interviewed distinguish different types of climate mobilities with distinct attributes and challenges for responses. They define climate mobilities as migration, gentrification, or permanent retreat where climate-related extremes or changes play some role (Supplementary Fig. 3 and Supplementary Table 2). The interviewees distinguish the degree to which each mobility type is influenced directly or indirectly by climate and the locations where people move after. They generally view climate migration as a direct response to climate change or climate-related impacts or risks (92.0% of the 50 interviewees responding), with some explicitly noting climate adding to existing migration drivers (20.0%) and some describing the destination location as important (24.0%). By contrast, they perceive climate gentrification as an indirect, secondary, or cascading consequence of climate change or climate-related impacts or risks (90.9% of the 55 interviewees responding), occurring at the same time as development continues and real estate prices rise in risky locations (Supplementary Table 4). Some explicitly note climate adding to ongoing gentrification drivers (29.1%; Supplementary Fig. 3) or relocation often being to areas of greater risk, for example through displacement to lower-ground areas more prone to flooding that are also farther from livelihoods and social networks (20.0%). Interviewees largely view retreat as a permanent or definitive response to climate change or climate-related impacts or risks (97.6% of the 41 interviewees responding) that often involves dedicated government planning, policies, interventions, or finance, in contrast to individual- or household-scale climate migration. Some note that the destination has not been inherent in retreat, instead with more of a focus on the move away from a location (22.0%). The interviewees perceive climate migration and retreat as causing climate gentrification (59.4% of the 32 interviewees responding). For example, Interviewee 27 (state/regional government) notes that, 'Retreat or … climate migration does not always need to result in gentrification or displacement, though certainly can, and it has (Supplementary Table 3).'

The academic literature has emphasized that climate mobilities—and immobilities when people get stuck or do not want to move—take different forms that are important to disentangle given different drivers and impacts, as well as legal and financial dimensions (e.g. [55, 56]). The views of the interviewees may demonstrate more nuance and understanding of critical distinctions across forms of climate mobilities than is often credited to practitioners.

Most interviewees believe climate mobilities are already occurring in South Florida, and they expect that they will continue, increasingly, into the future (Figs 3 and 4, Supplementary Fig. 2, and Supplementary Table 4). Specifically, 70.9%, 67.8%, and 59.3% of responses indicate that interviewees believe climate migration, climate gentrification, and retreat, respectively, are already occurring in South Florida (Fig. 3). By contrast, 98.0% of responses anticipate that these forms of climate mobilities will occur in the region in the future. In reflecting on how climate migration, gentrification, and retreat are occurring now in South

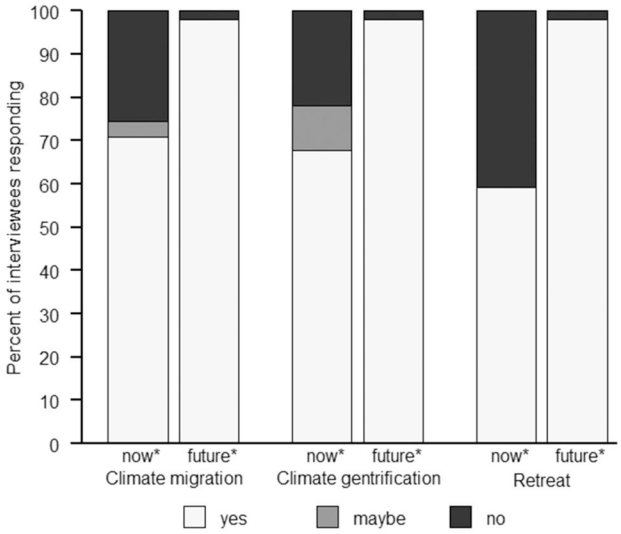

Figure 3. Practitioners largely perceive climate mobilities to occur now and more so in the future. Interviewees indicated whether they believe climate migration, gentrification, and retreat are occurring now (55, 59, and 54 interviewees responding for climate migration, gentrification, and retreat, respectively; left bars) or will occur in the future (50, 50, and 51 interviewees responding; right bars) in South Florida. Statistically significant differences in response proportions across occurrence categories are indicated (* for $P < 0.05$, Cochran's Q test).

Florida, interviewees note that the relative importance of climate as a causal driver compared to other factors is often unclear (41.7% of the 60 interviewees responding; Fig. 4; e.g. as in [57]), that development and real estate markets are starting to incorporate climate risks (33.3%; e.g. as in [58]), that political dynamics shape how climate mobilities are occurring now (31.7%), that climate mobilities are occurring now only at small scales (28.3%), and that public awareness of climate mobilities is increasing (26.7%). For instance, Interviewee 24 (local government) notes that at present, 'It's hard to define what is regular gentrification, regular migration, versus climate,' and then continues further, saying, '… how much does it matter what the causes are for us' (Supplementary Table 4)—that is, the relative importance of climate versus other drivers may not be clear, but despite this lack of clarity, some policy responses might effectively address outcomes of concern without needing to disentangle intersecting causal mechanisms and factors.

Interviewees indicate long-term transition plans are inadequate to avoid potentially chaotic adjustments. In reflecting on how climate mobilities will occur in the region in the future, interviewees note the potential need for long-term planning (60.6% of the 66 interviewees responding) and cooperation and coordination of responses (36.4%; Fig. 4). Given expected occurrence at increasing scales and the inevitability of retreat (36.4% and 33.3%, respectively, mentioned unprompted) (33.3%), they highlight that there is no transition plan to support adequate adaptations through time (33.3%), which may result in surprising or non-linear outcomes as has been found in other circumstances (e.g. [59]). As an example, Interviewee 37 (local government) reflects on inevitable climate-mobility increases into the future:

> There are areas where … you'd have to have a pump producing or operating at 6,000 cubic feet per second, in order to maintain the current groundwater table … even if you could do that, where would you discharge the water? … how long can you keep up with that? What does the decay of that community

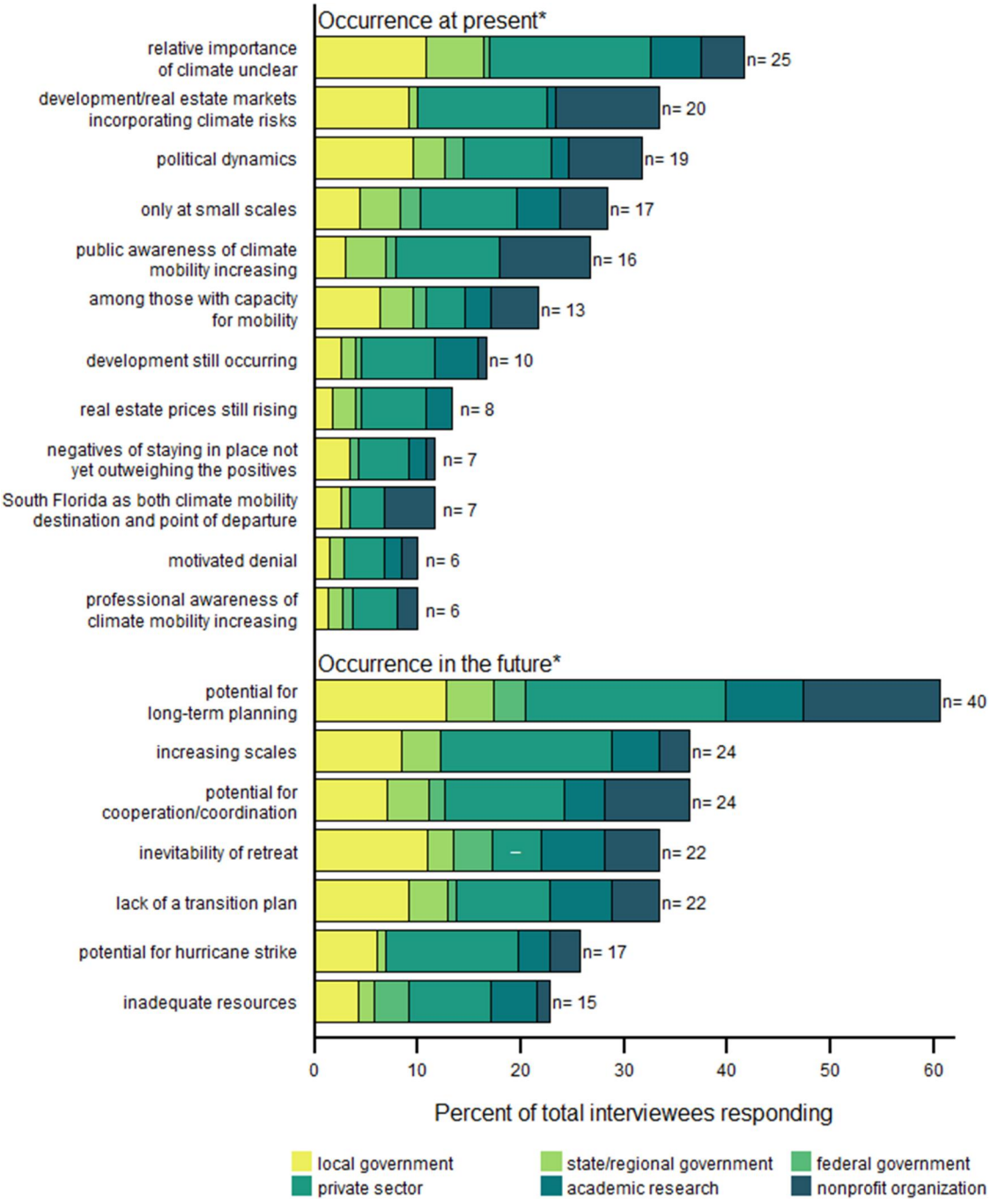

Figure 4. Practitioners view climate mobilities shifting in how they occur. Interviewee perceptions about how climate mobilities occur at present and in the future in South Florida (60 and 66 interviewees responding, respectively). Percent (x-axis) and number (end of bar) of total interviewees responding are specified for each response type. A response from any given interviewee could be coded under multiple categories. Statistically significant differences in response proportions across categories are indicated (* for $P < 0.05$, Cochran's Q test). Statistically significant odds ratios are also specified, where odds of a response type are greater or lower for a given professional affiliation (+ or – for $P < 0.1$, ‡ or ‖ for $P < 0.05$).

> look like with time? Maybe … we end up utilizing taxpayer dollars to acquire those properties in order to create larger scale storm water management areas (Supplementary Table 4).

Interviewees perceive climate mobilities as effective in climate-related risk reduction when relocation destinations are less climate exposed and as potentially socioeconomically and environmentally beneficial (Fig. 5). In reflecting on potential positives, they especially invoke the potential for community-driven visions (39.7% of the 58 interviewees responding), innovations (25.9%), reduction of inequities across neighborhoods (25.9%), climate-related risk reduction (22.4%), and environmental restoration (19.0%). For example, Interviewee 21 (state/regional government) underscores, '[I]nnovation and creativity, if we can harness that and work together to do it, I think that's an amazing positive because, again, I think we need a pretty fundamental restructuring of how we conceive of the goals of our political and economic systems and if we can manage that, wow, that is—it's a challenge and opportunity' (Supplementary Table 5).

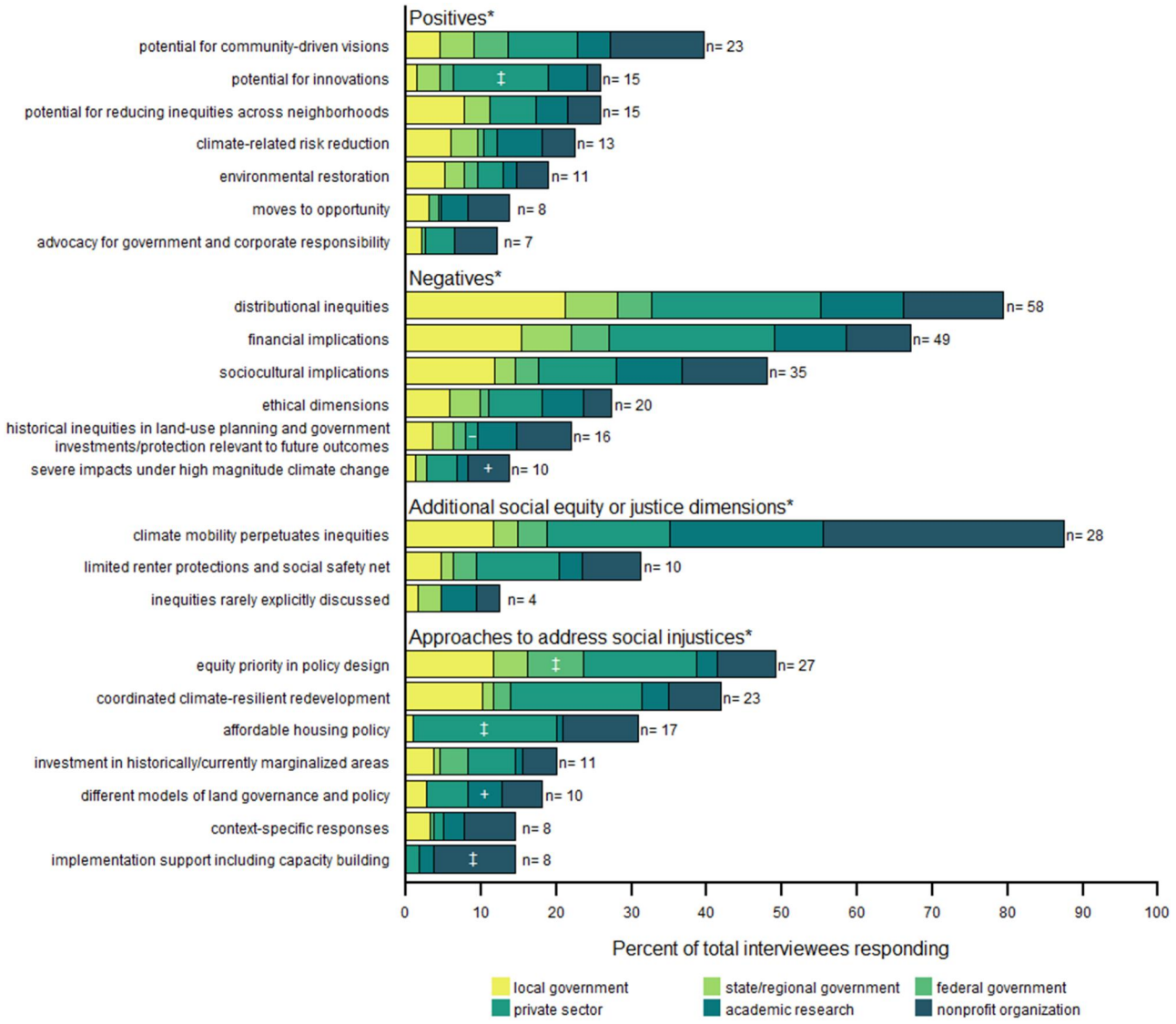

Figure 5. Practitioners perceive negatives and some positives of climate mobilities and identify options for addressing social injustices. (Top to bottom) Interviewee perspectives on the positives and negatives of climate mobilities, including social justice and equity dimensions and strategies for addressing them (58, 73, 32, and 55 interviewees responding for each respective topic, top to bottom). Percent (x-axis) and number (end of bar) of total interviewees responding are specified for each response type. A response from any given interviewee could be coded under multiple categories. Statistically significant differences in response proportions across categories are indicated (* for $P < 0.05$, Cochran's Q test). Statistically significant odds ratios are also specified, where odds of a response type are greater or lower for a given professional affiliation (+ or – for $P < 0.1$, ‡ or ‖ for $P < 0.05$).

The interviewees are concerned that such movements will perpetuate inequities and create disruptions (Fig. 5). For potential negatives, they note distributional inequities (79.5% of the 73 interviewees responding), financial (67.1%) and sociocultural (47.9%) implications, and ethical dimensions (27.4%) of climate mobilities. For example, Interviewee 29 (local government) says, 'We look at the Seminole tribe, we look at Little Haiti, we look at Overtown, we see historical communities of colors being pushed out … putting them in more vulnerable areas' (Supplementary Table 5). And Interviewee 31 (local government) notes, 'As soon as you put a location on a map saying we're going to need to plan to retreat from this area, you have robbed those people of the property value' because the future value of the property is no longer guaranteed and local municipalities 'fear … devaluing those locations' (Supplementary Table 5). In other words, concerns about devaluing property and losing tax base may be more salient politically than the inverse: the potential for gentrification and displacement that may occur with increasing property values and development in a neighborhood.

In reflecting on how past and present injustices should be addressed, interviewees stress the need to prioritize equity in policy design (49.1% of the 55 interviewees responding), coordinate climate-resilient redevelopment (41.8%), and pursue affordable housing policy (30.9%; Fig. 5). For example, in considering areas currently flooding, Interviewee 46 (local government) reflects that:

> [E]xisting residents that are there today, that their families have been there for generations, they're looking for solutions … They understand that retreat is an option, but they want an understanding that that retreat will not mean to just completely shift out of the area that they know so well. If it means that maybe we're transitioning to a more higher-land area … working with the community on what those strategies

> are, there's some positive ideas that are coming out, making sure that the people that have ownership in their land they're getting an appropriate return on their investment for that retreat (Supplementary Table 6).

Although theories of justice are relevant in informing practitioner actions, both the theories and associated guidance often struggle to resolve these types of core dilemmas articulated by the interviewees, including how to handle simultaneous harms and potential benefits and address the backdrops and legacies of historic injustices [17].

Regarding preparation, practitioners note a divide. Many of the interviewees feel prepared for their own, limited individual and institutional roles related to climate mobilities, and yet most interviewees responding also feel that the region as a whole is unprepared for increased climate mobilities (Supplementary Figs 4 and 5). With respect to themselves, 66.7% of the 48 interviewees responding indicate they feel prepared for their role as it might relate to climate migration, gentrification, and retreat, whereas 33.3% did not. For example, Interviewee 27 (state/regional government) says, 'I feel prepared in the sense that I feel that I have the resources and knowledge, the ability to learn, network, and access those who are studying these issues … I have that ability to go out and find supporting information to do my job better,' and Interviewee 42 (academic research) states, 'I am prepared in the sense of being very well-connected in the university community' (Supplementary Table 7). Notably, 28 interviewees (36.8% of the 76 total interviewees) did not respond to this question. 93.5% of the 46 interviewees responding indicate they have received professional resources and support related to climate mobilities, especially scholarly and technical evidence (63.6% of the 44 interviewees listing specific examples; Supplementary Fig. 4). However, when asked about their organizations or the region as a whole, and its preparation for increased levels of climate mobility, practitioners are less optimistic, perhaps because they judge that adaptation more broadly has been incremental [10, 42]. For instance, Interviewee 11 (local government) states, 'I don't think anybody can say that they're prepared for this frankly … the incentives for local government to address climate migration are negative—there's a lot of disincentives,' while Interviewee 21 (state/regional government) says, 'I think my organization is completely incapable at this point of really confronting the political situation in the state, and at all presenting these topics' (Supplementary Table 7). In discussing types of preparation—or its absence—interviewees note the importance of collaboration (31.3% of the 48 interviewees responding), necessary policy innovations (31.3%), representation (25.0%), self-directed learning (22.9%), and disincentives that must be overcome (20.8%; Supplementary Fig. 4).

Interviewees are actively preparing for climate mobilities through their work and professional capacities. They mention taking actions such as raising climate-mobilities awareness (41.3% of the 63 interviewees listing specific examples; Supplementary Fig. 4). For instance, Interviewee 2 (local government) explains, '[T]here are some people who are in complete denial [that climate gentrification is happening] or don't necessarily believe that gentrification itself is a bad thing … And so yeah, step one was just literally being like, okay, this is actually a thing that residents in this city are experiencing, and this is not a thing that we should just let happen' (Supplementary Table 8). Interviewees also mention actions such as assessing climate-mobilities response options (28.6% of the 63 interviewees listing specific examples; Supplementary Fig. 4). Interviewee 43 (private sector) notes, '[I]n a local government that we're looking at right now … what we have advised them is that road abandonment is probably going to be a tool that they need to consider … to be able to make those priority investments that are going to serve greater numbers of people' (Supplementary Table 8).

The interviewees believe the inherent controversy and political, financial, and social justice implications of climate mobilities substantially limit discussions at present (Fig. 6). Most interviewees indicate there are responses related to climate migration, gentrification, or retreat that are hard to talk about or hard to consider for both political and emotional reasons (95.2% of the 62 interviewees responding). For example, Interviewee 76 (state/regional government) explains:

> The sheer cost of it all. Where's that money coming from? … and where do you move them? And how do you tell them, 'I know you're the high value waterfront property', but as we retreat, that stuff's already taken, because it's the people that were behind you that are going to be the high value waterfront … And which of course leads to gentrification, right? Well, those people aren't as wealthy as I am, so I'm going to buy them out, and shove them, and keep them in motion. And where do they go then? And so, I just think it trips everything from emotional to financial triggers. And I think it's always hard to have conversations where there aren't winners. Everybody's losing (Supplementary Table 9).

And Interviewee 11 (local government) emphasizes, 'In terms of climate retreat and migration, the fears are loss. I mean it's, like, loss of property value, it's loss of community, it's loss of tax base', while Interviewee 34 (federal government) says, 'I think that the potential to have a financial collapse driven by the impacts to the coastal real estate market and how that could cascade to the mortgage industry, that is so scary for folks that it's hard to talk about' (Supplementary Table 9). Further, most interviewees believe that climate migration, gentrification, and retreat are discussed too little (76.9% of the 52 interviewees responding), some believe they are discussed about enough (21.2%), and some believe they are discussed too much (7.7%). For instance, Interviewee 11 (local government) explains:

> When the city has outreached to [especially flood prone] areas … some of the property owners didn't want us to talk about it … because it would result in reduction in their property value. And so the vulnerable people themselves didn't want to talk about it … it really depends on who is most vocal and influential with the elected officials (Supplementary Table 9).

In reflecting on the nature of these discussions, interviewees note the lack of a transition plan (41.7% of the 60 interviewees responding), ethical dimensions (26.7%), inadequate resources (26.7%), inadequate nuance (25.0%), opportunities to connect dots (25.0%), a lack of understanding (23.3%), and siloed conversations (23.3%; Fig. 6). For example, Interviewee 12 (local government) says, 'We don't, as I say, right now have any sort of glide path or path forward. How will you transition a place that is inundated? … I don't think we even have the visuals of how that will happen … once you get into lower levels of density … the math doesn't support it', and Interviewee 40 (local government) notes, '[O]ne of the things that we've been very steadfast on is approaching our climate change strategy, our resiliency strategy, through incremental adaptation. And so we have yet to identify areas that we would consider for retreat' (Supplementary Table 9).

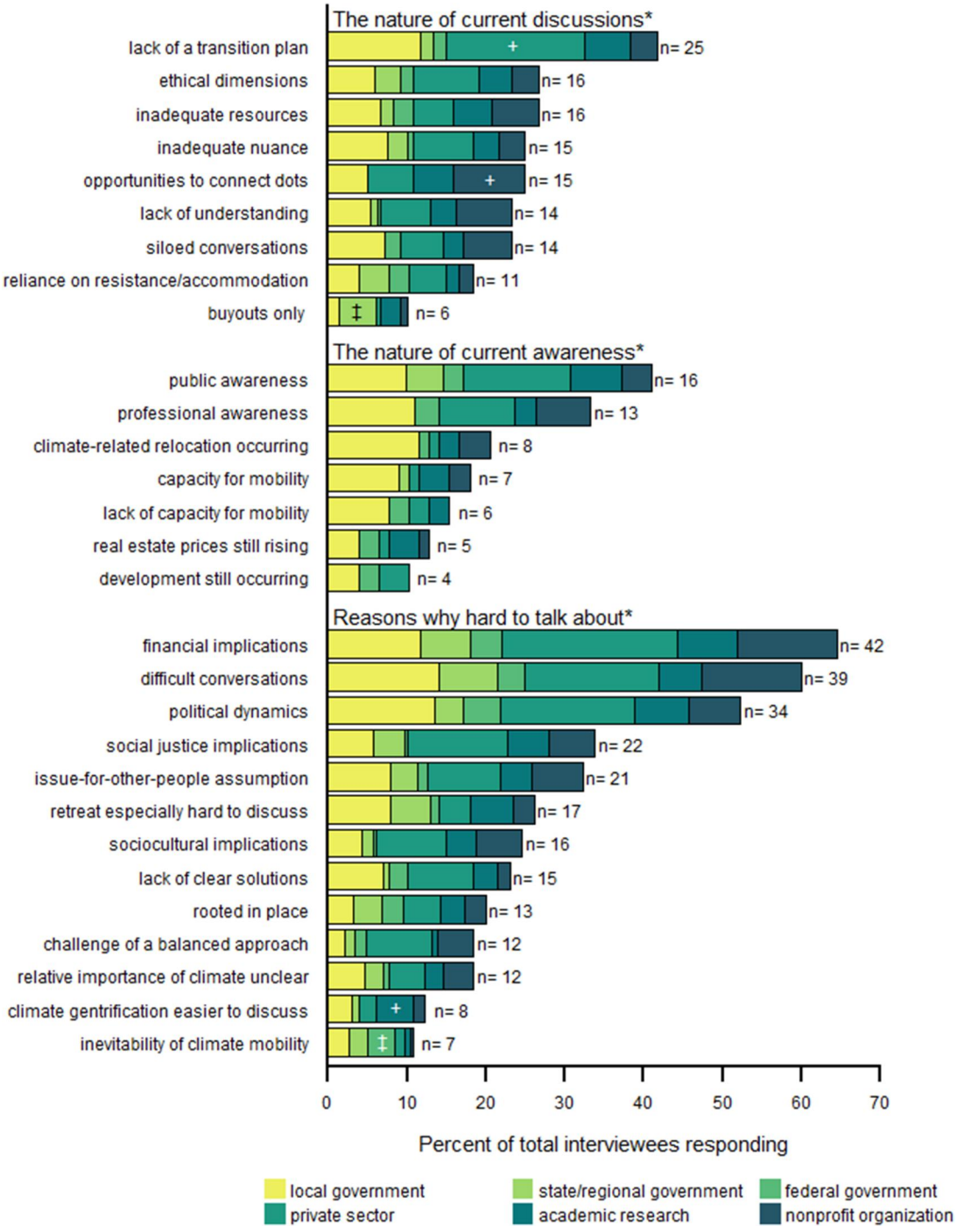

Figure 6. Practitioners perceive increasing but inadequate consideration of climate mobilities. Interviewee perspectives on discussions and considerations of climate mobilities in South Florida (60, 39, and 65 interviewees responding, respectively). Percent (x-axis) and number (end of bar) of total interviewees responding are specified for each response type. A response from any given interviewee could be coded under multiple categories. Statistically significant differences in response proportions across categories are indicated (* for $P < 0.05$, Cochran's Q test). Statistically significant odds ratios are also specified, where odds of a response type are greater or lower for a given professional affiliation (+ or – for $P < 0.1$, ‡ or ‖ for $P < 0.05$).

Most practitioners interviewed believe at least some people in South Florida are aware of or considering relocation related to climate change (72.1% of the 43 interviewees responding), whereas some thought they are not (23.3%) or they only do so if necessary reactively (7.0%). In discussing the nature of such consideration, interviewees note both public awareness (41.0% of the 39 interviewees responding) and professional awareness (33.3%; Fig. 6). For example, Interviewee 31 (local government) says, 'I had someone who knew that I had some knowledge about some of this stuff and they asked me if I could help them understand the data of the long-term impacts in their neighborhood and I provided them with some … bathtub maps of flooding inundation and based on that information they sold their house' (Supplementary Table 9). However, Interviewee 3 (private sector) underscores that '[I]t's the same people talking about it in the same terms to the same people. We the environmentally aware

speak to each other a lot and we don't speak to the community that needs to hear these conversations in ways that they will understand and in the platforms and in the fora where they will be', and Interviewee 52 (nonprofit organization) says, 'I feel that we live in two different worlds. Some people who believe in it and see the writing on the wall and some people that continue to deny it' (Supplementary Table 9).

Constraints and enablers for adaptation

For climate adaptation overall, practitioners interviewed prioritize wide-ranging responses for the next few decades in South Florida (Supplementary Fig. 5A). Desired responses especially include infrastructure adjustments (33.8% of the 68 interviewees responding), development of long-term vision (32.4%), financial mechanisms (32.4%), and resilient housing (32.4%). For example, Interviewee 19 (local government) indicates, 'Septic to sewer is number one', underscoring the importance of transitioning neighborhoods from septic tanks to sewer systems, whereas Interviewee 27 (state/regional government) says, '[T]here needs to be … a clarion call for much bigger thinking, action, and vision across all parts of our society in Southeast Florida to deal with these things' (Supplementary Table 10). Given its low-lying topography and permeable substratum, South Florida faces particularly large challenges and trade-offs in the joint management of flooding, water supply, and environmental conservation under continuing climate change [60].

Interviewees do not believe all residents are benefiting equally, though, from existing adaptation and resilience strategies (Supplementary Fig. 5A). In thinking about their desired adaptive responses, they envision underserved communities (37.3% of the 59 interviewees responding), residents (33.9%), and the whole community, all of 'us' (27.1%), as their targeted beneficiaries for resilience efforts. For instance, Interviewee 3 (private sector) reflects on the center of their individual vision as '[l]ow-income communities … This is one of the most unequal cities and counties in the country … low-to-middle-income communities that don't have the resources and don't know what's about to happen' (Supplementary Table 11). For urban climate adaptation overall, concerns about equity indeed emerge from the distribution of climate-related harms, the capacities for and benefits from responses, and the social and political processes that govern urban spaces, development, and land use [61]. In considering existing adaptation and resilience strategies, interviewees perceive those with adequate resources (62.1% of the 58 interviewees responding) as best served, and those without adequate resources (68.9% of the 45 interviewees responding) as least well served (Supplementary Fig. 5A). For example, Interviewee 29 (local government) indicates, 'I feel affluent communities are being best served. They're the one who're getting access to that information regularly [following government awareness campaigns] opposed to the folks who need to survive', and Interviewee 10 (private sector) says, 'The people well served are the people who don't even need to be well served' (Supplementary Table 11). In terms of those least well served, Interviewee 27 (state/regional government) explains:

> Our local electeds are going to prioritize investments and adaptation responses in areas where we have highest property values and assets and that just keeps that cycle of underinvestment running … there is a huge disparity across the region, also in terms of … the capacity of governments to respond … a local government like the city of Miami versus, you know, a small municipality … right now most of this work has been on the backs of local governments through … bonds or … service fees, stormwater fees (Supplementary Table 11).

Across interviewees, there is focus on climate risks and adaptation needs for those already living in South Florida, as compared to the potentially substantial number of residents projected to arrive in the region into the future [51].

In considering ongoing adaptation and resilience strategies in South Florida, the interviewees view some responses as relevant to climate mobilities, at least to some degree (Supplementary Fig. 5B). In particular, they perceive more holistic climate responses (40.7% of the 54 interviewees responding) and early topic-specific policy discussions (40.7%) to encompass climate mobilities. For instance, Interviewee 10 (private sector) says:

> With Broward County … if you want to develop, you have to incorporate those groundwater modeling and future conditions, which I think is really good. And the adaptation action areas is a great tool, for … leveraging which areas you want to focus on … permitting problems … Honestly if it's that hard to adapt it kind of makes it a case for retreat. Right, I think that's the point, but nobody's going to say that, except if it's anonymous (Supplementary Table 12).

As in this statement, throughout the set of questions, multiple interviewees emphasize the importance of anonymity in enabling open reflections on a controversial topic and shared insights that might otherwise remain private. Our interview protocol and process of informed consent indeed underscored that interviewees would be identified only by category of professional affiliation, not by name. In this way, the interviews are an intervention in themselves [62], supporting conversation and awareness that can be difficult to surface otherwise.

The strengths and weaknesses of ongoing adaptation and resilience strategies may modulate the scales of and needs for climate-related mobilities (Supplementary Fig. 5B). Reflecting on the greatest strengths of regional climate responses overall, practitioners interviewed note professional collaboration and coordination (44.3% of the 61 interviewees responding) and capacities (41.0%). For instance, Interviewee 11 (local government) indicates, 'I think our region is outstanding in terms of the level of cross-sector collaboration and cross-jurisdictional and corporate collaboration. The social capacity of people who are working on this issue … that's truly one of our greatest strengths' (Supplementary Table 13). As in other leading regions (e.g. [63]), South Florida has strongly emphasized collaboration and coordination, such as through the notable example of the Southeast Florida Regional Climate Change Compact that since 2010 has aimed to catalyze climate actions by governments, utilities, businesses, and civil society [64]. As a theme that appeared repeatedly in response to different interview questions, though, the interviewees view the greatest weaknesses to be the lack of a longer-term transition plan (45.8% of the 59 interviewees responding), as well as the dominance of short-term economic and political dynamics (30.5%; Supplementary Fig. 5B). For instance, Interviewee 71 (federal government) reflects that, '[T]he institutions we have now won't work, and there's a general lack of creativity about thinking about designing things that don't exist yet' (Supplementary Table 13).

Into the future, effective adaptations to support climate mobilities will likely combine high-quality deployments of existing legal and regulatory options with policy innovations [65, 66]. However, practitioners in the region face intense constraints and limits on such adaptations. These barriers include designing legal

and policy tools that are able to address the complex interactions inherent in climate risks and responses, the diversity of priorities across stakeholders, low consensus on framing both problems and solutions, difficulties in conflict resolution, and mismatched incentives across scales and actors through time [67, 68]. Moving towards more transformative climate adaptations relevant to climate mobilities and equitable, enduring well-being will also be complicated by uneven power dynamics and short-term economic and political benefits for a few [69–73]. Possible avenues involve trialing and evaluating fundamental adjustments first at small scales, such as in adaptation action areas. Such pilot activities can test approaches for achieving coordination across levels and agencies of government, and they can involve monitoring and evaluation of metrics relevant to transformational climate risk reduction and social justice [74, 75]. Proactive preparations for market and institutional shifts, such as availability of insurance or federal aid, as well as hurricane strikes that may force transformation also represent core opportunities to smooth transitions into futures outside the bounds of historical experiences.

Practitioners interviewed identify ways researchers could be contributing, related to climate mobilities in South Florida (Supplementary Fig. 5B). Such contributions especially involve co-production (50.0% of the 58 interviewees responding), provision of trusted relevant information (48.3%) and policy-relevant research (46.6%), and identification of policy and response options (48.3%). For example, Interviewee 36 (nonprofit organization) asks, 'When we think about research design, who do we involve in the process? I think a critical component is building that relationship with communities so that we understand their history, we build that trust', and Interviewee 75 (nonprofit organization) similarly ponders:

> How do we marry up researchers with the actual execution of these projects so researchers aren't scrambling around to try to cobble stuff together and figure out what happened after the fact? Like, how do you get a community when it's doing a buyout program to bring researchers in on the front end to actually talk to people and understand what the experience looks like and find out where people go and who the hell were they? (Supplementary Table 16).

Examples and communities that could particularly inform approaches related to climate mobilities in South Florida include New York and New Jersey (23.2% of the 56 interviewees responding), other Florida communities (19.6%), Louisiana (19.6%), and the Netherlands (17.9%; Supplementary Table 15).

Conclusions

In this study, we assess the perspectives of diverse adaptation-relevant practitioners about many dimensions of climate mobility in the highly climate-exposed region of South Florida. The interviewees distinguish multiple types of climate mobilities that will occur in the region, anticipating increasing movement of people and assets away from hazardous areas and inevitability of retreat. These expected evolutions are concerning because interviewees perceive climate mobilities already to cause distributional inequities and financial and sociocultural disruptions and climate adaptations to date as best serving those who already have adequate resources. Further, although the practitioners feel generally prepared for their own roles related to climate mobilities and perceive tremendous professional regional capacities and coordination, they view the region as a whole as unready to support the climate mobilities and retreat they see as inevitable. This status quo may contribute to collective-action failures: there is a disconnect between practitioners' incremental actions and household discussions about potential relocations, as compared to more fundamental transformations that may be in store and overall lack of preparedness for them. The need for a more ambitious, long-term transition plan will be difficult to address, though, if climate mobilities remain hard to talk about.

This study is an intervention itself. First, the inherent controversy of climate mobility has limited its proactive consideration to date. Therefore, the interviews with their anonymity foster insights and reflections that might otherwise remain private and limit the effectiveness of government, the private sector, and civil society in both preventing and supporting climate mobility into the future. Second, we as adaptation-science researchers and co-authors of this study ourselves represent different forms of mobility—and climate mobility—into and out of the region, in some cases having moved into the region for jobs and education related to climate risk and adaptation. For the practitioners interviewed, for us as co-authors, and for residents and practitioners more broadly, the findings of this study may inform, in diverse ways, the adaptation processes and policies we advocate for and support through our work. For example, we were surprised by the openness of interviewees in articulating concerns about collective-action failures and inadequate readiness for higher magnitudes of climate change despite the highly skilled and dedicated efforts of so many professionals in the region. Such findings underscore the importance of enabling more transformative climate adaptation, as well as addressing known challenges of inequities in ongoing responses.

Climate mobilities—so clearly resulting in harms as well as benefits—are in many ways a litmus test for adaptation planning and policies more broadly: What are mechanisms for going beyond awareness, proactively, by a few, towards meaningful incorporation into policy planning? Where are fundamental innovations needed in laws, policies, and incentive systems, and what options should be tried and tested? When might we see shifts, potentially sudden or surprising, in the dynamics of real estate, wealth accumulation, and population flows? Where do entrenched structural factors, such as legacies of redlining and racism shaping housing inequities, need to be redressed in order to achieve more equitable outcomes from climate mobilities? South Florida, with its high-risk geography, rapid development, and large inequalities, creates near-term entry points for deliberately supporting and preventing climate mobilities—and learning how to do so.

Supplementary data

Supplementary data are available at *Oxford Open Climate Change* online.

Data availability

The data underlying this article are available in the article and in its online supplementary material and data.

Authors' contributions

Katharine Mach (Conceptualization [equal], Data curation [equal], Formal analysis [equal], Funding acquisition [equal], Investigation [equal], Methodology [equal], Project administration [equal], Supervision [equal], Validation [equal], Visualization [equal], Writing—original draft [equal]), Jennifer Niemann (Data

curation [equal], Formal analysis [equal], Investigation [equal], Methodology [equal], Software [equal], Validation [equal], Visualization [equal], Writing—review & editing [equal]), Rosalind Donald (Methodology [equal], Writing—review & editing [equal]), Jessica Owley (Methodology [equal], Writing—review & editing [equal]), Nadia Seeteram (Methodology [equal], Writing—review & editing [Equal]), A.R. Siders (Methodology [equal], Writing—review & editing [equal]), Xavier Cortada (Writing—review & editing [equal]), Alex Nyburg (Writing—review & editing [equal]), Adam Roberti (Writing—review & editing [equal]), and Ian Wright (Writing—review & editing [equal])

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Conflict of interest

KJM holds the position of Editorial Board Member for *Oxford Open Climate Change* and is blinded from reviewing or making decisions for the manuscript. The authors declare no other conflicts of interest.

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