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Community Forestry Service Project: Report on the Current State of Public Health and Climate Risks in Barrio Caguas Pueblo

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Abstract

Rising temperatures associated with climate change, amplified by the urban heat island effect, pose a growing public health risk in the urban centers of Puerto Rico. This study, conducted as part of the Community Forestry Service Project, examined heat perception, its health effects, and the mitigation measures prioritized by residents of Barrio Caguas Pueblo, in the municipality of Caguas. Using a descriptive cross-sectional survey design, a 27-item online questionnaire was administered to 117 participants between August 2025 and March 2026. Results indicate that residents perceive a considerable increase in heat intensity compared with 2024: the highest level of the scale predominated across all age groups and reached its greatest proportion among participants aged 61 to 70. The town center, the public plaza, and the area surrounding City Hall were identified as the hottest locations (35.1% of mentions), although a similar proportion described heat as a widespread condition throughout the urban core (36.5%). Fatigue or exhaustion was the most frequently reported symptom, with the highest prevalence among adults aged 31 to 60, while participants aged 61 and older reported fewer symptoms despite perceiving heat more intensely, suggesting a possible underestimation of risk. The community expressed strong support for nature-based solutions: 90.6% supported planting more trees and 71.8% supported creating shaded spaces. These findings highlight the need to integrate urban forestry with public health strategies and community participation to mitigate extreme heat in Barrio Pueblo.

Keywords: Urban Heat Island, Extreme Heat, Risk Perception, Public Health, Urban Forestry, Nature-Based Solutions, Community Participation, Caguas, Puerto Rico

1. Introduction

The accelerated rise in global temperature associated with climate change is one of the most complex threats facing contemporary urban environments. Increasing heat not only alters the energy and water balances of urban ecosystems but also intensifies existing socioeconomic vulnerabilities and deteriorates collective health, with disproportionate effects on low-income populations, older adults, children, and people with chronic conditions [1]. In Puerto Rico, the Puerto Rico Climate Change Council (PRCCC) reports that San Juan, the most urbanized area of the island, shows a warming trend greater than the rest of the territory, estimated at 0.022 °C per year since 1900. If this trend continues, the mean annual temperature would reach 27 °C (80.6 °F) by 2050, compared with 25.5 °C (77.9 °F) at the beginning of the twentieth century [2]. Consistently, the National Climate Assessment documents that the frequency of days with maximum temperatures above 90 °F (32.2 °C) increased at a rate of 0.5 days per year between 1970 and 2015 [3].

In urban environments, this warming is amplified by the urban heat island (UHI) effect, defined as the temperature differential between urbanized areas and their surrounding rural or natural environment. The UHI is driven mainly by the thermophysical properties of construction materials, which absorb and retain more energy than vegetation, soil, and water bodies. Dark surfaces, such as asphalt and tar roofs, have a low albedo, meaning low solar reflectance, and therefore absorb most of the incident radiation. In turn, materials such as concrete and brick have a high heat capacity or thermal mass: they store heat during the day and release it gradually at night, which limits nighttime cooling and prolongs thermal exposure [4]. In addition, their impermeability prevents infiltration and reduces evapotranspiration, eliminating the latent

cooling provided by soil and vegetation. Finally, urban geometry contributes to the phenomenon: in urban canyons, formed by tall buildings and narrow streets, radiation becomes trapped between surfaces, heat loss to the sky is reduced, and natural ventilation is limited [5].

To assess the effect of heat on people, one of the most widely used indicators is the heat index, also known as apparent temperature. This index combines air temperature with relative humidity to estimate the temperature perceived by the human body, since high humidity reduces the efficiency of sweat evaporation, the body's main thermoregulatory mechanism. In humid climates such as Puerto Rico's, the heat index often considerably exceeds the temperature recorded by the thermometer, which is why the National Weather Service uses it to issue extreme heat advisories and warnings. Figure 1 shows the spatial distribution of heat in Puerto Rico, highlighting the main urbanized areas, such as San Juan, Ponce, and Caguas. It should be noted that Figures 1 and 2 present a relative heat index score developed by the treecanopy.us platform, on a scale from 1 (lowest) to 10 (highest), which allows areas to be compared with one another and differs from the National Weather Service heat index expressed in degrees.

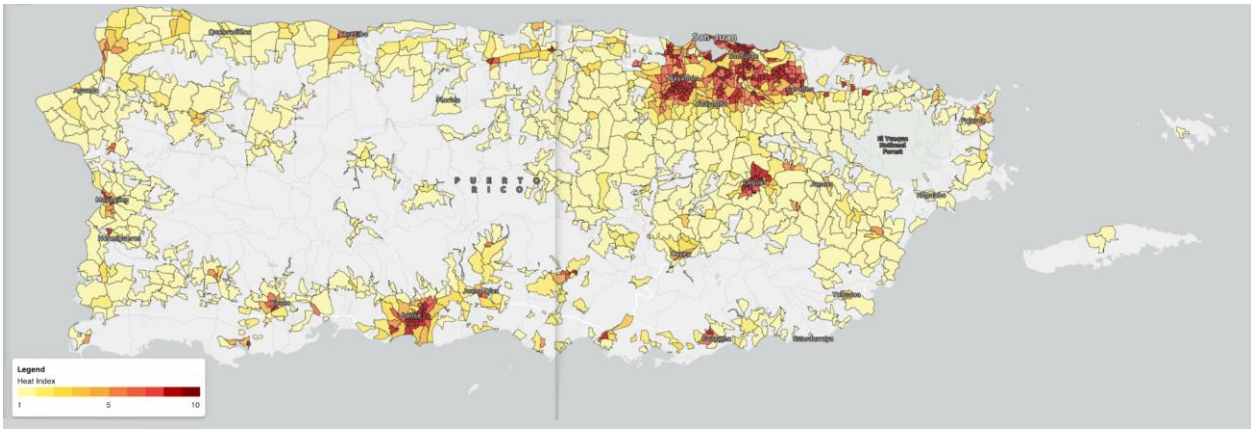


Figure 1: Relative Heat Index Score for Puerto Rico in 2026 (1 = Lowest, 10 = Highest), According to Treecanopy.US.

Despite growing evidence of increasing heat in urban conditions, there is a critical disconnect in Puerto Rico between general climate concern and the self-assessment of personal risk. Guzmán-Colón et al. conducted telephone surveys with 500 adults in metropolitan and non-metropolitan areas following the severe heat of summer 2020, and found that, although most respondents expressed concern about climate change and high temperatures, fewer than half perceived heat as a high risk to their health, and only one in four recognized a high future risk [6]. This risk perception increases significantly among people with chronic illnesses or who have already experienced heat-related symptoms.

To mitigate indoor heat stress, the population relies mainly on mechanical cooling. In the same study, air conditioning was the most frequently reported mitigation measure, used by 319 of 497 participants (64.2%) [6]. However, the effectiveness of this adaptive strategy is constrained by two structural factors. First, energy insecurity, understood as households' inability to afford their energy needs, limits access to and sustained use of these devices, since low-income households tend to occupy less efficient homes that are more expensive to cool [1]. Second, the low reliability of the electric system compromises cooling capacity precisely during periods of greatest thermal load. According to the Puerto Rico Energy Bureau, in fiscal year 2024 the System Average Interruption Duration Index (SAIDI) reached 1,432 minutes per year, compared with a benchmark of 102 minutes for similar electric systems in the United States, while the System Average Interruption Frequency Index (SAIFI) reached 7.9 interruptions per customer [7]. The Bureau has also pointed to the chronic insufficiency of reserves to cover peak demand on summer nights and the deterioration of thermal generating units, many with more than 40 years of service [8]. Together, these factors constitute structural barriers to adaptation that prolong the population's exposure to adverse thermal conditions, particularly in the most vulnerable sectors.

Moreover, dependence on mechanical cooling can constitute a form of maladaptation: it increases demand on a grid with a generation deficit and releases waste heat outdoors, which contributes to intensifying the urban heat island. This reinforces the need for passive and nature-based cooling strategies, such as urban trees and bioclimatic design, that reduce thermal load without relying on the electricity supply.

The impact of the climate crisis extends beyond physical well-being and reaches the psychological dimension of communities. In a study on the perception of global warming and its impact on the well-being of the Puerto Rican population, Alers Jaime found that 99% recognize the existence of global warming and that 66.7% fall within a high level of alarm about its consequences [9]. From the perspective of ecopsychology, recurring disasters and rising temperatures generate a notable prevalence of acute stress, solastalgia, and eco-anxiety. This distress translates into changes in daily routines and greater reliance on home cooling to alleviate the discomfort associated with the environment. Therefore, any effective urban mitigation strategy must integrate

public health approaches that address both infrastructure and the socio-emotional impact of heat.

At the physiological level, direct and prolonged exposure to severe heat stress entails well-documented risks. In outdoor work settings under extreme conditions, about 89.7% of workers experience at least one adverse symptom, such as severe dehydration or respiratory or dermatological conditions, which considerably reduces their performance and productivity. Factors such as low water intake and the absence of shaded rest areas can triple the likelihood of these conditions [10]. Heat-related health damage is concentrated in vulnerable sectors due to dynamics of exclusion and institutional precarity, with dehydration being the most common condition [11]. Although these findings come from agricultural settings, their public health implications are transferable to paved urban spaces, where construction workers, landscape maintenance staff, and pedestrians interact daily, without protection, with urban surfaces.

Age and health status also modulate vulnerability. Older adults have a higher prevalence of cardiovascular, pulmonary, and immune conditions, and experience physiological changes associated with aging: reduced skin blood flow and a lower sweating capacity decrease thermoregulatory efficiency compared with younger people. This risk is aggravated in older adults with chronic illnesses and in patients who use diuretics, which increases their susceptibility to dehydration [12].

Recurrent exposure to extreme heat events therefore requires an analysis that links scientific evidence with community perception and institutional response capacity. To extend this line of research to the local scale, the study area focuses on Barrio Caguas Pueblo, in the municipality of Caguas, part of the metropolitan region of Puerto Rico.

2. Methodology

A descriptive cross-sectional survey design was used to document residents' perceptions and experiences regarding extreme heat, its health effects, and adaptation strategies in Barrio Caguas Pueblo, in the municipality of Caguas, Puerto Rico (Figure 2). Each participant completed the questionnaire once; however, data collection extended from August 19, 2025, to March 7, 2026, which made it possible to capture responses during both the hottest months and cooler periods, and to reduce the likelihood that results reflected only the influence of a single event.

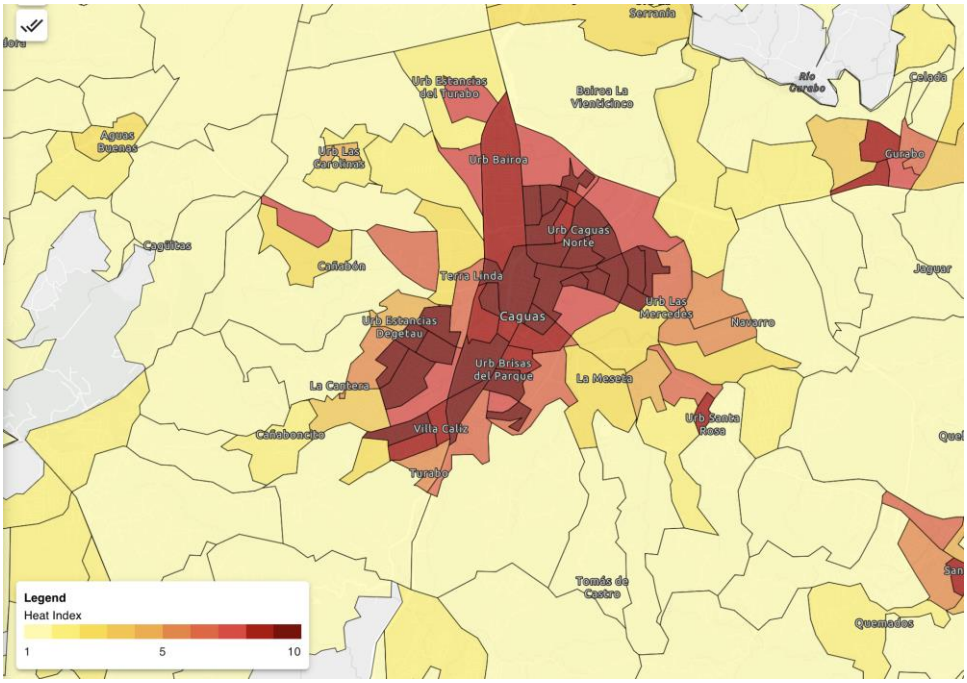


Figure 2: Location of Caguas Pueblo Showing the Relative Heat Index Score in the Area (1 = Lowest, 10 = Highest), According to Treecanopy.US.

The sample consisted of 117 participants, recruited through non-probability convenience sampling. The questionnaire was distributed online and through QR codes displayed at community activities and local businesses within the study area. The largest group of participants lived in Barrio Pueblo, although residents of other barrios of Caguas and of neighboring municipalities also responded; because of their connection to the urban core of Caguas, they were included in the analysis.

Data were collected through an online questionnaire designed on the JotForm platform, consisting of 27 questions. The instrument addressed the following dimensions: sociodemographic profile, including age and place of residence; perceived heat intensity compared with 2024; the places perceived as hottest; heat-

related physical and emotional symptoms; mitigation measures the municipality should prioritize; and tree species preferred for reforestation.

Responses were analyzed using descriptive statistics, including frequencies and percentages, with Microsoft Excel, which was also used to tabulate the data and produce the charts. To examine differences in heat perception and symptoms by age, cross-tabulations were performed between age group and these variables. Open-ended responses, such as the places perceived as hottest, were grouped into thematic categories.

3. Results and Discussion

This section presents the results of the survey on heat perception in Barrio Caguas Pueblo, administered to 117 participants through a 27-item questionnaire. The results are organized into five areas of analysis: the participants' residence profile; the perceived intensity of current heat compared with 2024, disaggregated by age group; the places perceived as hottest within the urban core; the physical and emotional symptoms associated with heat by age group; and the mitigation measures the community considers a priority, including the tree species proposed for reforesting the neighborhood. Because some questions were not answered by all participants, percentages were calculated based on the valid responses to each question, unless otherwise indicated.

Regarding the residence profile (Figure 3), the largest group of participants lived in Barrio Pueblo (39 people, 33%), followed by residents of other barrios of Caguas, such as Cañaboncito (12), Bairoa (10), Turabo (9), Tomás de Castro (8), and Río Cañas (7). The remaining 20 participants did not indicate their barrio or lived in neighboring municipalities. Although the sample includes people from outside Barrio Pueblo, all participants responded based on their experience in the urban core of Caguas, so their responses are considered relevant for characterizing the thermal conditions of the study area.

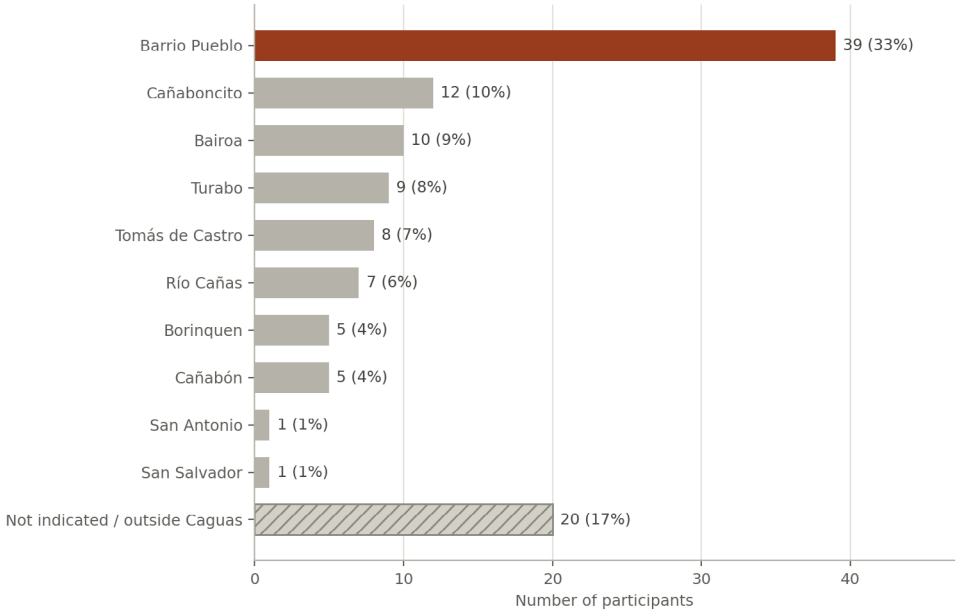


Figure 3: Number of Participants by Barrio of Residence in Caguas (N = 117).

Based on a visual comparison with the heat index map of Caguas (Figure 2), approximately half of the participants (those residing in Barrio Pueblo, Bairoa, and Turabo) live in areas with moderate to very high relative heat index values, while about a quarter come from cooler or peripheral barrios. This distribution supports the relevance of the results for characterizing conditions in the urban core, although future studies should increase participation from high heat index sectors with low representation in the sample, such as Caguas Norte, Villa Caliz, and Las Mercedes.

Across all age groups, most responses were concentrated at the highest levels of the scale, indicating that participants perceive a considerable increase in heat intensity compared with 2024 (Figure 4). Intensity 5 was the predominant category in every age group and, together with intensity 4, accounted for the vast majority of responses, while intensities 1 to 3 were minimally represented. The perception of extreme heat increased with age: the 61-to-70 age group recorded the highest proportion of intensity 5 responses (approximately 88%), followed by the 71-and-older group (approximately 79%), while among the 18-to-50 age groups this proportion was close to half of the responses. This pattern is consistent with the literature, which identifies older adults as the group most vulnerable to heat due to lower thermoregulatory efficiency [12]. These results correspond to question 6 of the questionnaire, which asked participants to rate the intensity of current heat compared with 2024.

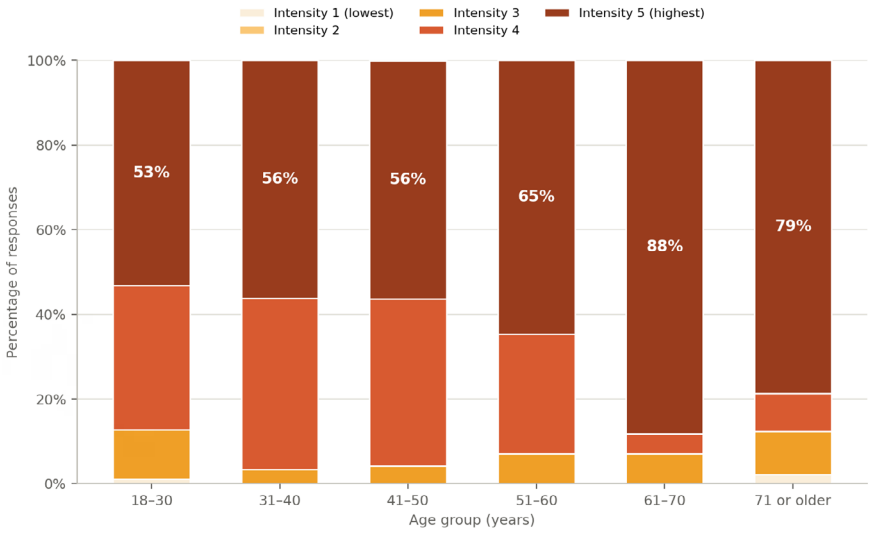


Figure 4: Perceived Intensity of Current Heat Compared with 2024, by Age Group (Scale from 1 = Lowest Intensity to 5 = Highest Intensity).

In response to question 12 ("Among the places where you usually walk, which one do you find the hottest?"), participants provided a total of 74 mentions, which were grouped into seven categories (Table 1). The most frequently identified area was the town center, including the public plaza and the area surrounding City Hall, with 26 mentions (35.1%). These were followed by responses describing heat as a widespread condition throughout the town (14 mentions, 18.9%) or in the urban core in general terms (13 mentions, 17.6%). Together, these two categories add up to 27 mentions (36.5%), indicating that a considerable proportion of participants do not perceive heat as a localized phenomenon but as a condition extending across the entire urban core; some explicitly attributed it to the lack of vegetation, noting that it is hot "everywhere because there are no trees."

Unshaded streets and sidewalks received 10 mentions (13.5%), while pedestrian walkways, such as Paseo Gautier Benítez, and sun-exposed parking areas received 4 (5.4%) and 2 mentions (2.7%), respectively. Finally, 5 mentions (6.8%) corresponded to specific sectors outside the center, such as Bairoa, Villa Blanca, Avenida Troche, and Urbanización Delgado.

Area or location	Mentions	%	Examples of responses included
Town center, plaza, and City Hall	26	35.1%	Public plaza, area near City Hall, town center
Everywhere in town	14	18.9%	The entire urban core, "everywhere because there are no trees"
Urban core in general	13	17.6%	The town of Caguas, the historic center
Streets and sidewalks	10	13.5%	Unshaded sidewalks, street pavement
Pedestrian walkways	4	5.4%	Paseo Gautier Benítez, downtown walkways
Parking areas	2	2.7%	Public parking lots exposed to the sun
Other specific sectors	5	6.8%	Bairoa (2), Villa Blanca (1), Avenida Troche (1), Urb. Delgado (1)
Total	74	100%	

Table 1: Places Identified by Participants as the Hottest in the Urban Core of Caguas.

These results align with the factors that, according to the literature, intensify the urban heat island: the places identified are characterized by a high proportion of paved and impermeable surfaces, scarce tree cover, and high exposure to direct solar radiation. Moreover, since these are the spaces where participants walk and carry out their daily activities, the results reflect pedestrian heat exposure in public space, making these areas priorities for shade and reforestation interventions.

Fatigue or exhaustion was the most frequently reported symptom in the sample, with a prevalence ranging from 50.0% to 89.5% depending on the age group, and reached its highest values among participants aged 41 to 60 (87.5% and 89.5%) (Table 2). Discomfort when walking outdoors and mood changes also showed high prevalence, especially in the 31-to-40 (90.0%) and 41-to-50 (81.2%) age groups, respectively. Headaches were most frequent in the 31-to-40 age group (70.0%), while respiratory conditions remained relatively stable across groups, ranging from 18.2% to 31.6%.

Symptom or perceived effect	18–30 (n = 22)	31–40 (n = 20)	41–50 (n = 16)	51–60 (n = 19)	61–70 (n = 19)	71+ (n = 20)
Fatigue or exhaustion	72.7%	70.0%	87.5%	89.5%	68.4%	50.0%
Discomfort when walking outdoors	54.5%	90.0%	75.0%	63.2%	47.4%	45.0%
Mood changes	50.0%	60.0%	81.2%	63.2%	26.3%	25.0%
Headache	45.5%	70.0%	31.2%	42.1%	31.6%	10.0%
Skin conditions (rash or spots)	40.9%	45.0%	37.5%	31.6%	10.5%	10.0%
Respiratory conditions (asthma or shortness of breath)	18.2%	25.0%	31.2%	31.6%	26.3%	25.0%

Table 2: Prevalence of Heat-Related Physical and Emotional Symptoms by Age Group (Percentage of Participants in Each Group Who Reported the Symptom).

Adults aged 31 to 60 showed the highest prevalence of symptoms. One possible explanation is that these groups tend to have greater work-related mobility and carry out more daily activities outdoors, which increases their direct exposure to heat in public space. In contrast, the prevalence of almost all symptoms decreased among participants aged 61 and older; for example, mood changes dropped to 26.3% and 25.0%, and skin conditions to around 10%. This result contrasts with the higher perceived heat intensity in these groups (Figure 4) and with their greater physiological vulnerability described in the literature [12]. This apparent contradiction could be explained by less outdoor exposure, the use of home cooling strategies, or a tendency among older adults to underestimate or not recognize heat-related symptoms, as documented by Guzmán-Colón et al. [6]. This finding suggests the need to study the experience of heat among older adults in greater depth.

Participants showed a marked interest in reforesting the neighborhood as a response to heat. When asked what measures the municipality should take (question 21), 106 of the 117 participants (90.6%) selected planting more trees and 84 (71.8%) the creation of shaded spaces. In the open-ended option, some participants also proposed installing green roofs and reducing asphalt surfaces, measures that align with the passive cooling and depaving strategies described in the literature on heat island mitigation.

Among the species suggested for reforestation, the most frequently mentioned were roble (22 mentions), flamboyán (17), fruit trees (14), and ceiba (4). Participants also highlighted other native and ornamental species, such as maga, guayacán, guaraguao, capá, and uva de playa (sea grape). These preferences reflect local knowledge of the species in the area and provide a basis for designing a reforestation plan that responds to both technical criteria and the community's values and preferences.

Taken together, these results highlight the importance of community education and awareness about climate change, the role of anthropogenic activities in rising temperatures, and the risks of extreme heat to health and well-being. Likewise, the broad support for tree planting represents an opportunity for urban forestry initiatives with community participation, such as those developed by La Maraña to reforest urban areas and reduce the effects of the heat island.

4. Conclusion

This study examined heat perception and its health effects in Barrio Pueblo of Caguas, the urban core of the municipality, where high building density, the predominance of paved and impermeable surfaces, and scarce tree cover favor the development of the urban heat island. This phenomenon is defined as the presence of higher air and surface temperatures in urban areas than in the surrounding suburban and rural areas [13].

The results indicate that residents perceive a considerable increase in heat intensity compared with 2024: the highest intensity on the scale was the predominant response in all age groups and reached its greatest proportion among participants aged 61 to 70. Participants identified the town center, the public plaza, and the area surrounding City Hall as the hottest places, although a similar proportion described heat as a widespread condition throughout the urban core, attributed in part to the lack of trees. Regarding health effects, fatigue or exhaustion, discomfort when walking outdoors, and mood changes were the most frequently reported symptoms, with the highest prevalence among adults aged 31 to 60, possibly due to their greater work-related and daily exposure to public space. In contrast, participants aged 61 and older reported a lower prevalence of symptoms, despite perceiving heat more intensely and their greater physiological vulnerability. This finding could reflect less outdoor exposure or an underestimation of heat-related symptoms, a pattern documented in other studies in Puerto Rico [6].

The community expressed broad support for nature-based solutions: 90.6% of participants supported planting more trees and 71.8% the creation of shaded spaces, while some proposed green roofs and the reduction of asphalt surfaces. This support, together with local knowledge of native and ornamental species, provides a solid foundation for a reforestation plan with community participation.

Since extreme heat is a public health problem because of its effects on morbidity, mortality, and population well-being, addressing it requires a preventive approach that anticipates health harms before they occur. In this regard, mitigating the heat island in Barrio Pueblo must integrate urban forestry with public health strategies, in collaboration with the municipality and the community. These strategies should include expanding tree cover in the spaces with

the greatest pedestrian exposure, depaving, community education on heat risks, and prioritizing the most vulnerable groups.

Limitations

The results of this study should be interpreted in light of several methodological limitations. First, non-probability convenience sampling was used, so the findings reflect participants' trends and cannot be generalized to the entire population of Barrio Pueblo. In addition, only 33% of participants (39 of 117) lived in Barrio Pueblo, while the rest came from other barrios of Caguas or neighboring municipalities, or did not indicate their place of residence, which limits the representativeness of the sample with respect to the study area.

Second, distributing the questionnaire online and through QR codes may have favored the participation of people with internet access and greater interest in the topic, introducing potential self-selection bias. This bias could particularly affect the representation of older adults and low-income households, precisely the groups most vulnerable to heat.

Third, the data are self-reported and perception-based, and are therefore subject to recall bias, subjective risk perception, and social desirability bias. This is especially relevant for the question comparing current heat intensity with that of 2024, which depends on participants' memory. Likewise, the reported symptoms were not clinically verified, so it is not possible to confirm that they were caused exclusively by heat exposure.

Fourth, data collection extended from August 2025 to March 2026, spanning both warmer and cooler months. Although this reduces the influence of a single event, heat perception may have varied according to the time of year each person responded, a factor that was not controlled for in the analysis.

Fifth, the age groups were small, between 16 and 22 participants, so differences between groups should be interpreted with caution. In addition, the analysis was exclusively descriptive and did not include statistical tests to determine whether these differences are significant. Some questions were not answered by all participants, which reduced the number of valid responses in certain analyses.

Finally, the categorization of open-ended responses, such as the hottest places, involved interpretation by the research team, and the study did not include objective temperature measurements to compare participants' perceptions with the actual thermal conditions of the neighborhood.

Recommendations for Future Research

Based on these limitations, it is recommended to increase the sample size through probability sampling, with greater representation of Barrio Pueblo residents, and to extend the study to other highly urbanized areas of Puerto Rico. It is also recommended to complement perception data with objective measurements, such as temperature sensors and satellite imagery of land surface temperature, and to apply statistical tests to assess differences between groups. In Barrio Pueblo, further research is needed on the experience of heat among older adults, whose low prevalence of reported symptoms merits more detailed analysis, as well as among landscape maintenance workers and other outdoor workers, for whom no information was found. Finally, it is recommended that key questions in the questionnaire be made mandatory to ensure data completeness.

Overall, the results demonstrate both the magnitude of heat exposure in Barrio Pueblo and the community's interest in reforesting its surroundings, and underscore the need to continue this type of study in Puerto Rico's urban areas as a basis for action plans in response to rising temperatures.

References

1. U.S. Environmental Protection Agency. (2025). People and heat islands.
2. Council, P. R. C. C. (2013). Puerto Rico's State of the Climate 2010-2013: Assessing Puerto Rico's social-ecological vulnerabilities in a changing climate. San Juan: Puerto Rico Coastal Zone Management Program, Department of Natural and Environmental Resources, NOAA Office of Ocean and Coastal Resource Management.
3. United States Global Change Research Program (USGCRP). (2018). Fourth National Climate Assessment Volume II: Impacts, risks, and adaptation in the United States.
4. Pratiwi, S. N. (2018). A review of material cover features for mitigating urban heat island. *International Journal on Livable Space, 3*(2), 71-80.
5. U.S. Environmental Protection Agency. (2024). *What are heat islands?*
6. Guzman-Colon, B., Guido, Z., Amaya-Ardila, C. P., Cabrera-Rivera, L. T., & Méndez-Lázaro, P. A. (2025). Heat risk perception and vulnerability in Puerto Rico: insights for climate adaptation in the Caribbean. *International Journal of Environmental Research and Public Health, 22*(8), 1197.
7. Notiuno. (2025). Informe de métricas de desempeño de LUMA y Genera destaca aumento en apagones.
8. Metro Puerto Rico. (2025). Presidente de LUMA reacciona a informe del Negociado sobre apagones de 2024.
9. Jaime, M. A. (2023). La percepción sobre el calentamiento global y el cambio climático y su impacto en el bienestar en una muestra multigeneracional puertorriqueña. Universidad Ana G Méndez-Gurabo.
10. Quintana, V. M. F. (2014). Percepción de productividad y estado de salud asociado a calor extremo en trabajadores agrícolas de una finca del área sur de Puerto Rico (Doctoral dissertation, Ponce Health Sciences University).
11. Calvario Parra, J. E. (2026). Impacto de las altas temperaturas en la salud de las personas trabajadoras agrícolas en Sonora, México: análisis de las condiciones de vulnerabilidad social (2019-2023). Población y Salud en Mesoamérica.
12. Balmain, B. N., Sabapathy, S., Louis, M., & Morris, N. R. (2018). Aging and thermoregulatory control: the clinical implications of exercising under heat stress in older individuals. BioMed research international, 2018(1), 8306154.

13. Carrasco, R. S. (2023). Urban heat island (UHI). In Research Starters: Environmental Sciences. EBSCO.

14. Tree Canopy. (2026). Heat index map of Puerto Rico [Interactive map].

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