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Research Note: Demographic Change on the United States Coast, 2020–2100

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ABSTRACT Prospective demographic information of the United States is limited to national-level analyses and subnational analyses of the total population. With nearly 40% of the U.S. population being residents of coastal areas, understanding the anticipated demographic changes in coastal counties is important for long-range planning purposes. In this research note, we use long-range, county-level population projections based on a simplified cohort-component method to discuss demographic changes by age, sex, and race and ethnicity for coastal counties between 2020 and the end of the century, and we compare these changes to inland counties. Presently, coastal counties are statistically significantly different from inland counties by race and ethnicity (more diverse) and sex (more women) but not by age, yet by 2025, we expect coastal counties to become significantly older than inland counties. We note several important trajectories of predicted demographic outcomes in coastal counties across the remainder of the century: (1) the non-Hispanic White population is expected to decrease, both numerically and as a percentage of the population; (2) the population older than 65 is projected to increase, both numerically and as a percentage of the population; and (3) the ratio of women to men remains constant over the century at 1.03. These trends combine to suggest that the future U.S. coastline will likely be both increasingly diverse racially and ethnically and significantly older than it is today.

KEYWORDS Demographic shift • Coastal populations • Differential vulnerability • Climate change

Introduction

Nearly 40% of the U.S. population lives in a coastal community (Crossett et al. 2014), and coastal areas are among the most rapidly growing areas in the United States and across the world (Neumann et al. 2015). Descriptions of historical demographic change abound in both the academic and the gray literature (Creel 2003; Crossett et al. 2014; Hinrichsen 1999; Wilson and Fischetti 2010), yet reports describing *future* demographic changes are limited to national-level analyses (Gerland et al. 2014; Jiang et al. 2020; Vespa et al. 2018) or to descriptions of total population in coastal areas (Jones and O'Neill 2016; Neumann et al. 2015). Secular demographic

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trends in the United States suggest growth of both communities of color and older populations (Vespa et al. 2018) but, to our knowledge, no analyses of anticipated demographic change in coastal areas presently exist. It is widely recognized that coastal areas are at or near the forefront of climate change impacts—impacts that are unequally distributed across primary demographic classifications such as age, sex, and race and ethnicity (Barros and Field 2014; Harlan et al. 2015). Understanding the future demographic changes in coastal communities can help illuminate important, broad demographic patterns and inform decision-making for climate change, disaster, and environmental justice planning.

To investigate the anticipated demographic changes in the coastal United States, we use recently published, detailed county-level population projections (Hauer 2019) for the 258 counties the U.S. Census Bureau identifies as coastal to describe the anticipated demographic changes along age, sex, and race/ethnicity from 2020 until the end of the century.[1] These data project populations for 18 five-year age-groups (0–85+), two sex groups (male and female), and four race/ethnicity groups (non-Hispanic White, non-Hispanic Black, non-Hispanic Other, and Hispanic). These demographic population projections employ cohort-change ratios (CCRs) and cohort-change differences (CCDs) in Leslie matrix projection models. We note that the population projections do not account for potential racial identity changes over the life course—changes that are likely to occur (Alba 2018)—nor for adaptation, and this is a limitation in our analysis. See Hauer (2019) for a detailed description of the methods.

We choose 2100 as a terminal date, despite its long temporal distance, because of that year's importance in the calculations of the U.S. Climate Assessment and the Intergovernmental Panel on Climate Change. We compare the differences between coastal and inland counties along age/sex/race/ethnicity to determine if coastal counties experience secular demographic trends (i.e., become more diverse and older) (Vespa et al. 2018). Then, we describe the anticipated demographic changes in coastal counties along these primary demographic classifications.

Results

Comparison to the Inland United States

Current demographic trends show both coastal and noncoastal areas becoming more racially and ethnically diverse, having a larger older population, and being relatively even across sex categories; however, the coastal trends far outpace the rest of the country. Table 1 reports summary metrics for these trends in the coastal and inland United States, aggregated to their respective geographies.

[1] Hauer (2019) controlled his population projections to the Shared Socioeconomic Pathways (SSPs) and performed an *ex-post-facto* error analysis against multiple published population projections (Raftery et al. 2012; Rayer 2008; Smith and Tayman 2003; Sprague 2012; Wilson 2016). The SSPs represent possible socioeconomic scenarios that couple potential challenges for reducing carbon emissions with challenges for adapting to climate change impacts. For a detailed description of the SSPs, see KC and Lutz (2017). Throughout our results, we derived upper and lower bounds in parentheses based on the upper/lower bounds of all five SSPs. Point estimates came from SSP2: Middle of the Road.

Table 1 Demographic trends by race/ethnicity, age, and sex aggregated to the coastal (n=258 counties) and inland (n=2,879 counties) United States in 2020, 2050, and 2100

Measure	Coastal	Inland
Non-Hispanic White (%)		
2020	47.8	65.8
2050	37.6 (37.4–37.9)	53.7 (53.4–54.1)
2100	27.8 (27.4–28.2)	38.8 (38.2–39.2)
Median Age		
2020	33.5	
2050	39.4 (37.2–41.3)	37.5 (35.2–40.1)
2100	47.9 (42.9–50.4)	44.7 (39.3–47.9)
Ratio of Women to Men		
2020	1.03	1.02
2050	1.03 (1.02–1.03)	1.02 (1.01–1.02)
2100	1.03 (0.973–1.06)	1.01 (0.965–1.04)

Notes: Upper and lower bounds, based on the upper and lower bounds of all five Shared Socioeconomic Pathways (SSPs), are shown in parentheses. Point estimates come from SSP2.

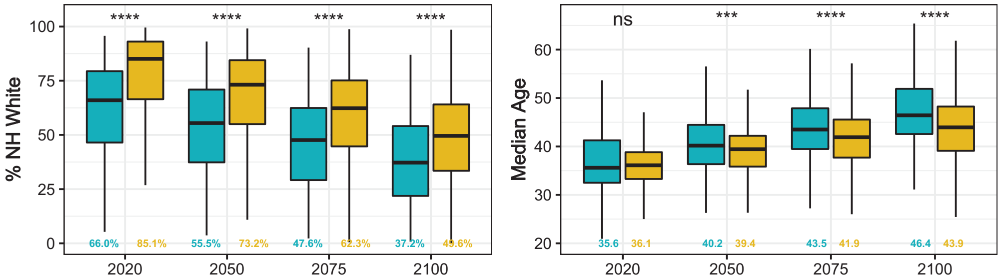
Both the coastal and inland regions are projected to become increasingly non-White, with non-Hispanic White population shares declining by 20 and 27 percentage points, respectively. The aging expected to occur in coastal areas is accelerated compared to that in inland areas, with median ages increasing by 14 and 11 years, respectively. Finally, the ratio of women to men in coastal areas stays relatively constant at 1.03 but approaches 1.01 in 2100 in inland areas.

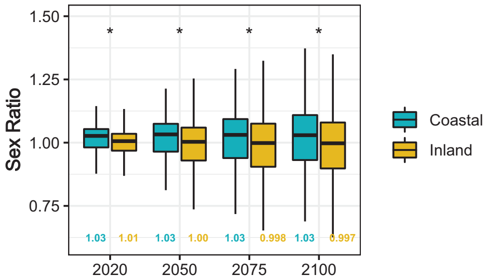
Figure 1 shows the results of Welch's unequal variances t test (Welch 1947), a nonparametric test of means, between coastal and inland areas for the year 2100 for the percentage of the population that is non-Hispanic White, the median age, and the ratio of women to men. In 2020, coastal counties are significantly different from inland counties by race/ethnicity and sex ratio but not by age. But by 2050, coastal counties are significantly different than inland counties under all three metrics, suggesting that coastal counties will continue to be more diverse, have more women than men residents, and become significantly older. We estimate that coastal counties will begin to become significantly older than inland areas around 2025 and continue aging faster than inland areas through 2100 (2025, p=.0409; 2030, p=.0064; 2050, p=.0001; 2065, p=.0000).

Race/Ethnicity

We find that U.S. coastal communities will be considerably more diverse through the remainder of the century than they are today (Table 2 and Figure 2). Currently, the coastline is majority non-White, with less than 50% of the population being non-Hispanic White. Demographic change in coastal communities will likely lead to a dwindling of this population—both in absolute numbers and as a proportion of the total population—through 2100.

All non-White racial/ethnic groups are projected to increase—in absolute numbers and as proportions of the total population—as the century progresses. By 2050, the non-Hispanic White population is projected to account for less than 40% of the U.S.





Welch's two−sample *t* test

Variable	Year	*df*	*t*	*p*
% NH White	2020	287.0	−10.709	.0000
% NH White	2100	291.3	−6.633	.0000
Median age	2020	277.7	1.311	.1909
Median age	2100	285.6	6.082	.0000
Sex ratio	2020	286.1	2.139	.0333
Sex ratio	2100	279.7	2.395	.0173

Fig. 1 Results of Welch's unequal variances *t* test between coastal ($n = 258$) and inland ($n = 2{,}879$) counties by race/ethnicity, age, and sex from 2020 to 2100. The numbers under the bars are the group medians for each region in each period. All three summary statistics are significantly different at $p < .05$ in 2100, suggesting that coastal areas are significantly more racially and ethnically diverse, are older, and contain more women than men compared with inland areas. Coastal counties are not significantly older than inland counties in 2020, but become significantly older by 2050. Note that Welch's *t* test bases the degrees of freedom on the Welch–Satterthwaite adjustment, which always yields fewer degrees of freedom. NH = non-Hispanic. ns = not significant. $^*p < .05$; $^{***}p < .001$; $^{****}p < .0001$

Table 2 Projected populations in the 258 U.S. coastal counties (in millions)

Race/Ethnicity	Population 2020	Population 2050	Population 2100	Numeric Change	Percentage Change
Non-Hispanic Black	13.3	16.9 (14.0–19.9)	18.9 (10.8–29.3)	5.63 (−2.19 to 15.7)	42 (−17 to 116)
Hispanic	26.1	40.0 (33.0–47.6)	56.2 (31.7–88.2)	30.1 (6.28–61.5)	116 (25–231)
Non-Hispanic Other	12.1	19.9 (16.7–23.3)	26.7 (15.4–40.5)	14.6 (3.56–28.1)	121 (30–228)
Non-Hispanic White	47.0	46.2 (38.7–54.2)	39.2 (22.7–59.8)	−7.88 (−23.4 to 11.8)	−17 (−51 to 25)

Notes: Upper and lower bounds, based on the upper and lower bounds of all five Shared Socioeconomic Pathways (SSPs), are shown in parentheses. Point estimates come from SSP2.

coastal population—a decline of nearly 10 percentage points and a change of −0.83 million (between −8.3 million and +7.2 million). Conversely, the Hispanic population is likely to increase by more than 50% by 2050 (between 26% and 83%), when it will account for more than 30% of the U.S. coastal population.

This shift toward an increasingly diverse U.S. coastline is not limited to specific areas. Figure 3 shows the geographic distribution of race and ethnicity in the coastal

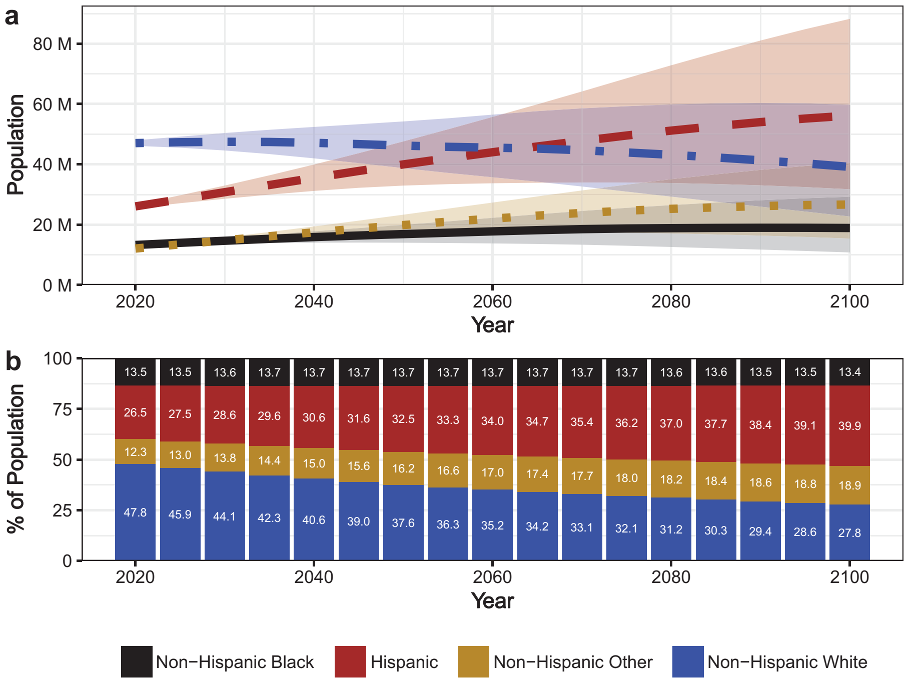


Fig. 2 Projected populations by race/ethnicity in the 258 coastal U.S. counties. Panel a shows numeric population in millions. Upper and lower bounds are based on the upper and lower bounds of all five SSPs. Point estimates come from SSP2. Panel b shows the relative distribution of population by race/ethnicity.

United States in 2020 and projected in 2100 as a bivariate choropleth. The dominant racial/ethnic group in each county is uniquely colored, and the deepness of the color corresponds with the percentage of the population that the dominant group represents. Even though the overall U.S. coast is majority non-White, most coastal counties contain 75%+ non-Hispanic White population, as exhibited by the dark blue color in the majority of counties. Only pockets of counties in parts of California, southern Texas, and south Florida are dominantly Hispanic—shown by the light reds—but they are decidedly less dominant than the non-Hispanic White populations. Alaska and Hawaii contain significant populations that are Native American, Pacific Islander, and Asian racial/ethnic groups. Isolated pockets of non-Hispanic Black dominance are also found in parts of the U.S. South.

By 2100, however, the dark blue counties indicating a non-Hispanic White dominance are considerably reduced in number and in hue (suggesting a smaller non-Hispanic White dominance by 2100), and many areas across the entire coastline contain significant Hispanic majorities—especially in the Northeast and California.

Age

Through the remainder of the century, the coastal communities are likely to be considerably older than at present (Figure 4, panel a). Today, the U.S. coast contains approximately 16.1 million people over the age of 65, representing 16% of the coastal

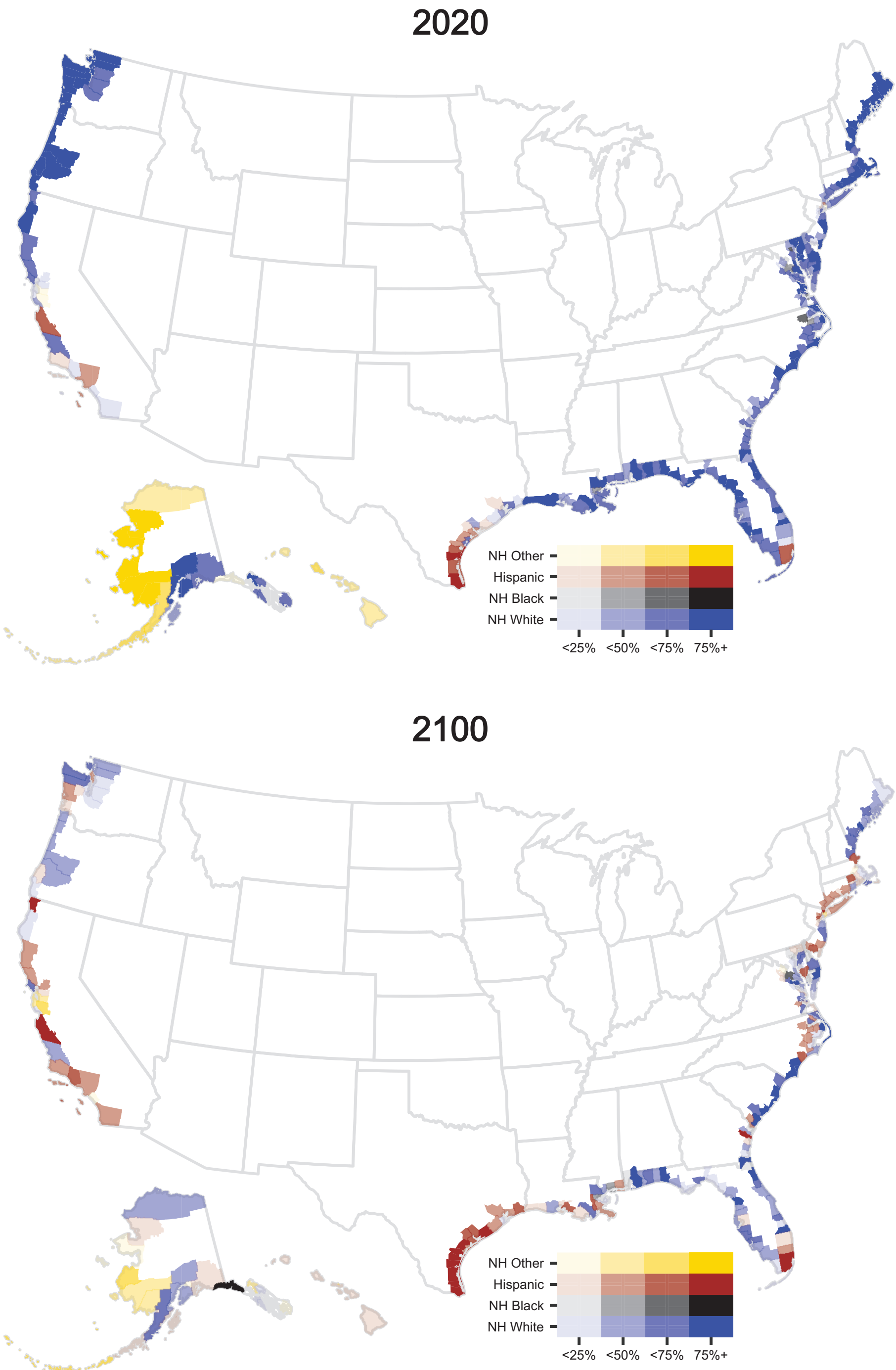


Fig. 3 Racial composition of U.S. coastal counties in 2020 and 2100. The colors along the coastline represent the largest racial/ethnic group in each county, and the hue indicates the percentage of the total population composed by that group. NH = non-Hispanic.

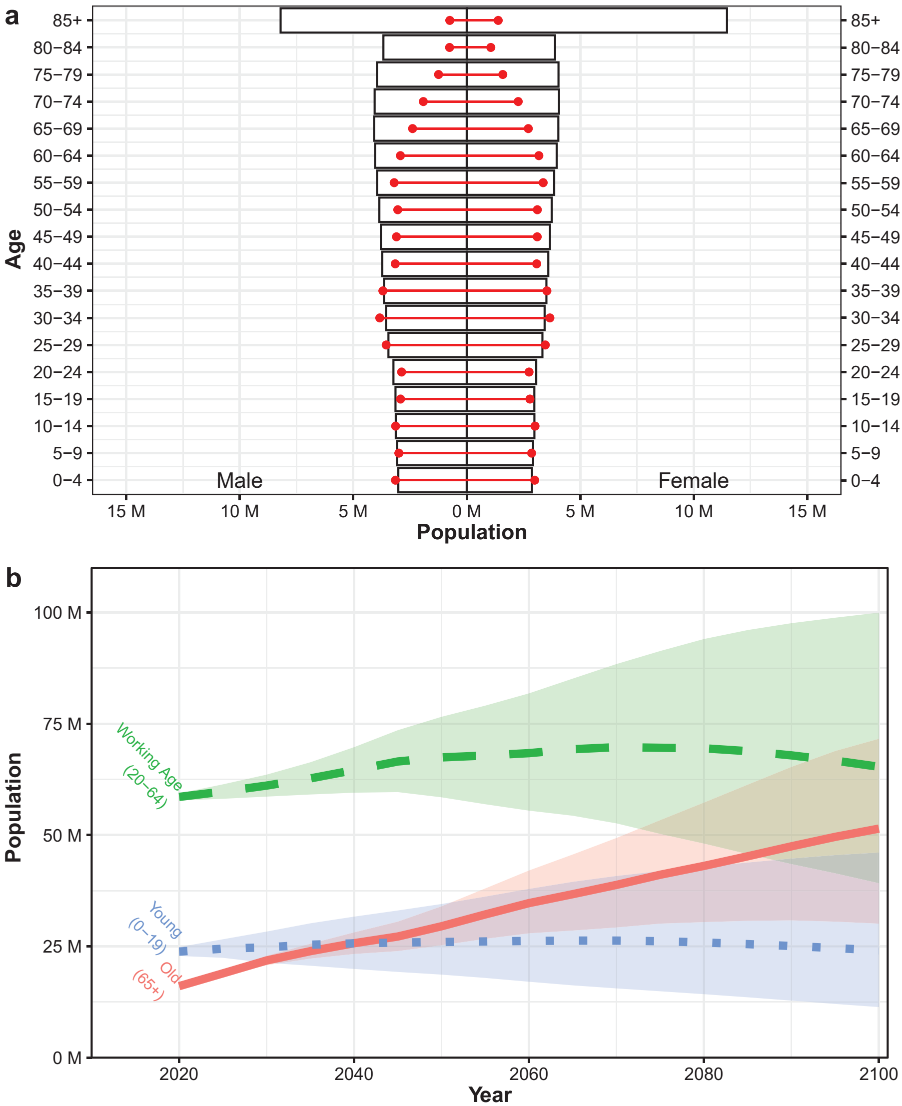


Fig. 4 Population projections by age for the 285 coastal U.S. counties. Panel a shows the population age distribution (in millions) in 2020 with the lollipop lines and the projected population in 2100 in the hollow boxes. Panel b shows the change in three demographic age-groups between 2020 and 2100. Upper and lower bounds are based on the upper and lower bounds of all five SSPs. Point estimates come from SSP2.

population. However, by 2100, the population older than 65 is projected to more than triple to 51.5 million people (30 million–70 million) and will account for 37% (33%–42%) of the coastal population. This would increase the proportion of the 65+ age-group from approximately 1 in every 6 coastal residents to more than 1 in every 3. This represents a significant demographic shift from a relatively youthful coastal population to a decidedly more elderly population.

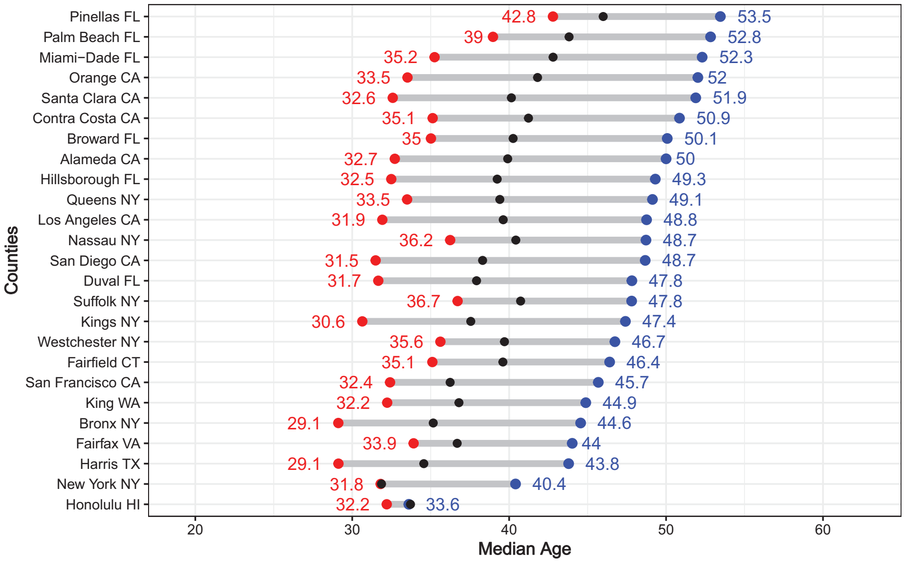


Fig. 5 Median ages in 2020, 2050, and 2100 for the 25 most populous U.S. coastal counties. The red dots correspond to 2020, the black dots to 2050, and the blue dots to 2100.

For nearly every age-group below age 40, the projected populations exhibit very little change. On the other hand, each age-group above age 40 shows much larger growth. The coastal communities for the remainder of the century are likely to be populated by considerably older residents, with the open-ended age interval (85+) showing the greatest numerical and percentage increase in population. Older women (in particular, women aged 85+) represent the largest population increase. Broad demographic groupings of young (0–19), working age (20–64), and old (65+) help illuminate the aging trend by midcentury (Figure 4, panel b). Despite the fact that the coastal United States is known as a retirement destination, the young population in coastal communities is presently larger than the old population. However, within 20 years, the older population will numerically outnumber the young population.

This demographic shift to older populations is especially profound in some of the largest U.S. coastal counties. Figure 5 presents the median ages in 2020, 2050, and 2100 for the 25 most populous coastal counties. Pinellas County, Florida, is expected to be the oldest by 2100 with a median age of 53.5—an increase of more than 10 years. We expect some counties to age much faster than others: Miami-Dade, Florida, and Alameda, California, in particular, will see considerable aging by 2050, while other counties, such as New York, New York, and Fairfax, Virginia, will see relatively little aging by 2050.

Sex

Our results regarding sex composition in the coastal United States are markedly different from the results for race/ethnicity and age (see Figure S1 in the online supplement). We find that coastal counties today contain approximately 1.3 million more

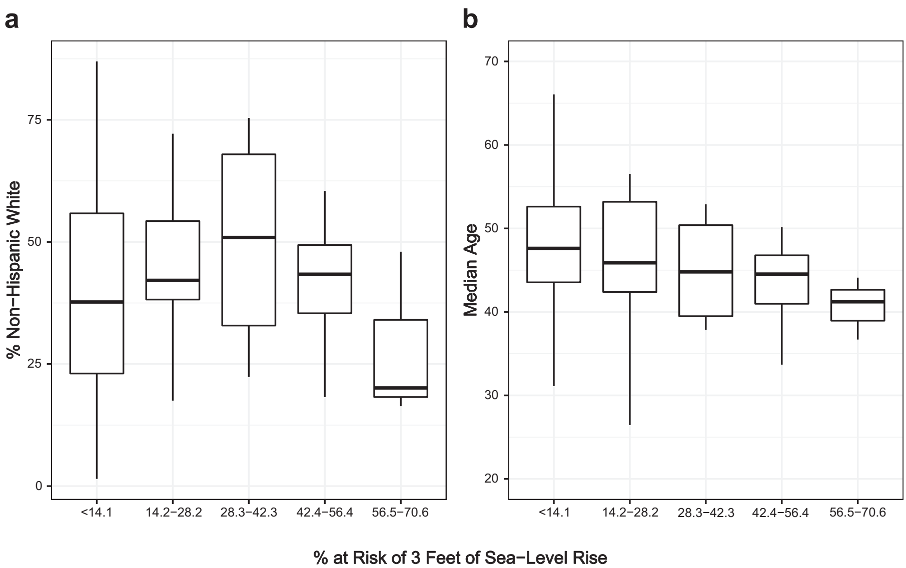


Fig. 6 Projections of the percentage of non-Hispanic White population and the median age in U.S. coastal counties in 2100, stratified by the risk to 3 feet of sea-level rise. Risk projections are from Hauer et al. (2016). The riskiest counties are likely to have more racial/ethnic diversity in 2100 and to be younger compared with less risky counties.

women than men (49.9 million women to 48.6 million men), and this disparity grows by more than 0.5 million women to 1.9 million more women than men by 2100 (71.4 million women to 69.5 million men). However, the ratio of women to men remains constant over the next 80 years at 1.03 women per man.

Differential Vulnerability to Sea-Level Rise

Most analyses concerning vulnerability to sea-level rise focus on total populations in the future (e.g., Hauer et al. 2016; Neumann et al. 2015) or examine vulnerability within present demographic conditions (e.g., Emrich and Cutter 2011; Spanger-Siegfried et al. 2017). Here, we combine the counties most at risk to inundation from sea-level rise with our demographic projections to examine differential vulnerability to sea-level rise.

We stratify U.S. coastal counties by the percentage of the population at risk to 3 feet of sea-level rise in 2100 into five quartiles (Figure 6). We find that race/ethnicity compositions follow an upside-down U shape based on sea-level rise risk, where counties with the most and least risk are likely to have lower non-Hispanic White percentages of the population, with the counties most at risk to sea-level rise having the lowest such percentage (Figure 6, panel a). We also note that most counties—regardless of sea-level rise—are likely to be increasingly non-White as the century progresses. Regarding aging, we find that the oldest counties tend to have the lowest risk of sea-level rise and the counties with the highest risk tend to have the youngest populations (Figure 6, panel b).

Discussion

Two major, secular trends will come to a head in this century: demographic change and climate change. As we demonstrate, people of color and the elderly will likely predominate in coastal regions in the future and, at the same time, climate impacts due to intensified warming are expected to worsen as we approach the end of the century. Our results suggest that climate change hazards in coastal regions will likely threaten an increasingly diverse and older coastal U.S. population, potentially amplifying already existing inequalities. Environmental justice and related disaster planning issues are likely to become more important in the future.

While many of the trends are rather homogeneous (i.e., aging and diversification), these trends are not uniform across the U.S. coastline nor within areas more or less threatened by sea-level rise. In fact, considerable heterogeneity exists across the coastline in terms of the speed of demographic change and the ultimate amount of demographic change. The implications of an aging and diverse coastal population are also markedly different for different regions of the United States, given the historical twin legacies of racism/segregation (Massey 1990) and long-term depopulation (Johnson and Lichter 2019). However, our results emphasize the importance of understanding localized demographic change within the broader context of climate change. Marginalized groups could face the brunt of climate change in unexpected ways.

We recognize that over long time frames any number of circumstances may arise—not the least of which involves climate change—that may alter the composition of coastal populations and therefore acknowledge important limitations in using these projections in our analysis. First and foremost, our projections do not account for climate change impacts in the projections themselves; these population projections are strictly demographic projections. Climate change broadly, and sea-level rise specifically, is likely to spur migration in this century (Black et al. 2011). Sea-level rise could alter residential mobility patterns (Hauer et al. 2020), fertility rates (Grace 2017), and mortality rates (Huang et al. 2011). Government-sponsored managed retreat programs to relocate individuals away from risky coastal areas (Siders et al. 2019) could also markedly alter the underlying demographic processes.

Additionally, it is entirely possible that the demographic changes alone predicted here could be different. For example, aging in coastal areas could attract more working-age people as salaries rise for scarce elder-care labor. The COVID pandemic, unforeseen at the time Hauer (2019) published his projections, almost certainly will alter the future demographic trajectory of the United States, though the extent of this alteration remains to be seen. Alternative demographic futures could naturally arise over the course of the century, thus it is possible that our findings will not fully capture the projected demographic change in the U.S. coastal population over this time frame.

Second, the population projections are limited to the county level. These projections cannot distinguish who resides in the most environmentally vulnerable locations in coastal communities and, presumably, those who might be most impacted. While it is true that those closest to the shoreline are most at risk to sea-level rise hazards, it is also true that those more distant from the shoreline will still experience impacts. Besides complete inundation (the conversion of habitable dry land to inhabitable water), many sea-level rise impacts affect areas broader than neighborhoods and may spread over the entire coastal region (McAlpine and Porter 2018). In this note, we are not interested in any specific environmental hazard that would necessitate the projections of individual coastal hazards, but rather we situate the changing demographics of the coastal United States within the contexts of broader vulnerability to hazards associated with climate change and invite future research into more specific, localized, and regionalized patterns of climate impacts.

Finally, the projections we employ in our analysis explicitly assume that past demographic rates predict future demographic rates. This assumption likely holds over a few decades, but any deviation in predicted rates could result in sizable errors over long time horizons. While it is possible that any single finding we describe might not manifest in the future (i.e., particular differentials between coastal and inland areas), the general trends we describe are likely to unfold. ■

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