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A Changing Climate and Its Implications for Health and Migration in the Pacific: Examples from the Marshall Islands

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SUMMARY Climate change impacts—temperature and rainfall changes, extreme events, sea level rise, and ocean acidification—are amplifying health risks in vulnerable populations throughout the Pacific Islands, and also influence their mobility. This nexus of climate change, health, and migration is evident in the experience of the Marshall Islands. The nation and its population are dispersed over almost two million square kilometers of ocean, with sizeable diasporas in the United States. Climate impacts in the Marshall Islands exacerbate ongoing health threats, such as limited drinking water supplies, inadequate nutrition, and poor infrastructure. The out-migration of Marshallese is largely motivated by health, economic, education, and environmental reasons; therefore, planning for migrant movements should include adaptation strategies that also reduce health risks. A better understanding of how health, mobility, and climate change interact will help shape policy responses and provide useable climate information for focused, timely interventions that maximize health and well-being among populations in motion.

The Climate, Health, and Migration Nexus

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Climate change directly and indirectly impacts health itself; at the same time, climate change impacts also shape mobility, which in turn has consequences for health. In the Pacific Islands, both public health and the public health sector are already negatively affected by changes in temperature, rainfall, extreme events, sea level rise, and ocean acidification.[1] Storms and sea level rise threaten the integrity of island infrastructure, such as homes, roads, and essential health services.[2] Drought and rising temperatures constrict freshwater supplies, and heavy rainfall events increase the risk of floods and vector-borne diseases[3] (those transmitted by bites from mosquitoes, ticks, and fleas). Food availability is reduced by ocean acidification and its effects on reef fish populations, increasing reliance on imported goods, which may exacerbate existing problems of diabetes and obesity.[4] Climate change progression is also expected to alter patterns of human migration, as has already been observed in some areas of the world.[5] Health impacts are enmeshed in this phenomenon, as both drivers of migration and effects that result from migration.[6] Complicating these relationships is the fact that individual migration-inducing environmental events cannot be attributed to climate change with absolute certainty.[7] Moreover, an individual's decision to migrate is often prompted by a confluence of factors,[8] just as health is a composite of many factors. As a result, it can be difficult to confidently identify so-called "environmental migrants."

As a threat multiplier, climate change is expected to increase migration rates in populations that have financial or extended family resources above a certain level but may actually exacerbate barriers to long-distance migration for those in vulnerable, lower-income populations. The effects of climate change have far-reaching social, political, and economic consequences[9] that become *push factors* that drive people to leave their original homes. *Pull factors*, which draw people to new places, include health reasons, job pursuits, and educational opportunities.[10] As the environmental impacts of climate change intensify in their home islands and atolls, the migration of Pacific peoples could be a new type of response to climate change impacts, including health risks.

Given the importance of understanding and addressing inequities in health, mobility, and the impacts of climate change, a better understanding of how these three factors interact can also help shape research and policy agendas. The case of the Marshall Islands provides an opportunity to consider best practices and pathways for climate-adaptive decision-making around health and migration.

Impacts of Climate Change on Health in the Marshall Islands

The Marshall Islands is a presidential republic located in the northern Pacific Ocean, just north of the equator and about midway between Hawai'i and Australia. Its 29 atolls and over 1,000 islands and islets comprise two main island chains in an Exclusive Economic Zone that spans roughly two million square kilometers of ocean. Its desirable location as a point between continents drew the attention of colonial countries, and beginning in the nineteenth century, it passed under the rule of several colonial powers: Spain, Germany, Japan, and finally the United States.[11] While under US rule, Bikini and Enewetak atolls were subject to extensive nuclear testing, rendering about 20 percent of the land in the Marshall Islands uninhabitable. The Marshall Islands became a self-governing nation in 1979 when it ratified its own constitution, with Majuro as its largest city and administrative capital. US and Marshallese relations remained strong, and the Compact of Free Association (COFA) was signed in 1986, which made Marshallese citizens eligible to live, work, and study in the United States without a visa, and there are sizeable migrant diaspora populations in Hawai'i, the Pacific Northwest, and Arkansas.[12]

Climate change is expected to have broad effects on human health and well-being, natu-

ral resources, livelihoods, and traditional practices in the Marshall Islands. Health can be impacted by climate change in various ways: through direct or indirect exposure to hazards and threats, or through the resulting social and economic disruptions. In a 2011–12 study of Pacific Island countries, the World Health Organization (WHO) categorized top priorities for climate change-related health risks into direct, indirect, and diffuse categories.[4] All 13 countries listed water security and safety and vector-borne disease as high-priority risks; nearly all listed food security and safety, extreme events, and noncommunicable diseases (NCDs), as well. In contrast, heat-related illness and zoonoses (diseases transmitted from animals to humans) were listed by fewer countries, and only two countries identified health system deficiencies as a top priority issue. The study concluded that Pacific Island countries are among the most vulnerable in the world to climate-related health risks, and strategies should be identified—such as improved water sanitation and storage, and early warning systems for drought—that can both improve health outcomes and help communities adapt to climate impacts.

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Several indicators show that the climate in the Marshall Islands is already changing. For instance, average temperatures in both the northern and southern regions have been rising, and the number of hot days above 31–32°C (88–89°F) is increasing while the number of cool nights below 23–24°C (74–75°F) is decreasing. Rainfall measured at Majuro has been decreasing[13] and the nation overall has historically struggled with droughts related to the El Niño/Southern Oscillation (ENSO). Sea level has been rising, and with it the incidence of high water flooding days.[13] If ENSO events become more extreme in the future, they may cause seasonal sea level increases up to 15 percent above current sea surface heights.[14] High percentages of Marshallese have already experienced climate-related environmental stressors, according to a recent survey of 199 households on three islands and atolls.[15] Specifically, 92 percent of all respondents had been affected by droughts, 47 percent by heatwaves, and 37 percent by (exceptionally high) king tides (see table 1).

Throughout the Pacific Islands, extreme weather events cause loss of life and property, which can have *direct* impacts on human health that are immediate and traumatic. The *indirect* effects of climate change on health are extensive. During high water events or intense storms, community water tanks and household water catchments can be damaged along with sanitation facilities, limiting clean water access and hygiene. Droughts deplete water stores and can lead to saltwater intrusion in freshwater aquifers[16], whereas flooding is associated with an increased chance of diarrheal illness due to contaminated drinking water.[17] Atoll nations in the Pacific are dependent on rainwater and shallow aquifer systems and are therefore particularly vulnerable to water insecurity due to climate change. Ocean acidification threatens coral reefs and marine ecosystems, and fisheries are projected to

Table 1. Percentage of survey respondents in the Marshall Islands who say they were impacted by climate-related stressors in the past five years. n refers to number of households surveyed in each location. Source: van der Geest et al.[15]

Stressor	Majuro Atoll (n=99)	Maloelap Atoll (n=50)	Mejit Island (n=50)	Total (n=199)
Drought	88%	94%	96%	92%
Heat wave	33%	40%	82%	47%
King tide	35%	44%	36%	37%
Storm surge	13%	8%	22%	14%
Tropical cyclone	3%	8%	6%	5%

suffer catch declines of over 50 percent by 2100 if greenhouse gas emissions are not curbed.[18] Where food transport costs are already high, as in the Pacific Islands, climate change can exacerbate existing food shortages[19]; food insecurity also results in malnutrition and unbalanced diets. Vector-borne diseases, such as dengue fever, are another indirect consideration associated with climate change, especially drought and increased temperatures. The prevalence or severity of respiratory illnesses can also be influenced by weather events that may be connected to climate change.[4]

The far-reaching effects of climate change can also lead to *diffuse* health impacts. Due to continued sea level rise and high heat conditions, the ability to support local food growth declines, leading to a poor diet and an increased prevalence of NCDs such as diabetes[20] and other chronic diseases. Extreme weather events are associated with stress-related psychiatric disorders and trauma and can inflict economic strain on families and individuals, potentially leading to stress and depression.[21] As climate change threatens the habitability of some atolls, people who choose not to migrate or are unable to migrate are prone to developing *solastalgia*, the distress of watching one's home environment decline.[22]

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Migration in the Context of Climate Change and Health

As detailed above, the progression of climate change has manifested in direct, indirect, and diffuse public health impacts in the Marshall Islands, as well as damage to essential infrastructures and resources, ultimately jeopardizing habitability. The International Organization for Migration (IOM) reports that natural hazards such as droughts and floods have already led to relocations within the country[23], and climate change is predicted to exacerbate these hazards. Meanwhile, intra- and inter-country migrations have been on the rise in recent years. Out of 199 Marshallese households surveyed in a recent study, 49 percent identified poor health care as one of the top five most pressing problems on their home island.[25] Furthermore, respondents who reported experiencing negative health impacts due to events such as drought, king tides, and heat waves in the past five years were significantly more likely to migrate internally, as well as internationally.[15] From 2000 to 2010, the nation's urban population grew from roughly 35,000 to 41,500 people, with the majority of people now residing in Majuro, which has a population density of 2,800 per square kilometer. On Ebeye, over 15,000 people reside in a total area of 0.36 square kilometers[24], a population density comparable to that of Manila, the world's most densely populated city. Moving to crowded urban centers from remote atolls can increase access to health care but the transition to urban lifestyles can have negative health implications, such as a reliance on imported foods that tend to be high in fats and sugars, leading to increased risks of diabetes, obesity, nutritional deficiencies, and secondary issues that cascade from these health conditions.[20] Overpopulation that occurs with intense urbanization can further affect public health by jeopardizing clean water access and sanitation. Two overcrowded and understaffed hospitals are located in Majuro and Ebeye[9], which generally lack the technology, infrastructure, and funding to manage chronic or serious conditions.[23]

Of the nation's approximately 76,000 citizens in 2011, about 70 percent lived in the Marshall Islands while the remainder resided largely in the United States.[24] Between 2000 and 2010, the diasporic Marshallese population in the United States tripled from approximately 6,700 to 22,400, becoming what many are calling "permanent non-immigrants."[10] More recent studies and intercensal estimates have shown that numbers of Marshallese in Arkansas and Hawai'i alone have climbed to over 14,000 (Fig. 1). While reasons for migrating are varied and complex, former president Hilda Heine and the IOM have cited education opportunities, health purposes, and job searches as a few main drivers of this trend, while also acknowledging that the threats of climate change likely play a role.[10, 23] Such benefits of migration are further borne out by survey data from Marshallese who have already migrated to the United States: a recent study of Hawai'i and Pacific Northwest migrants

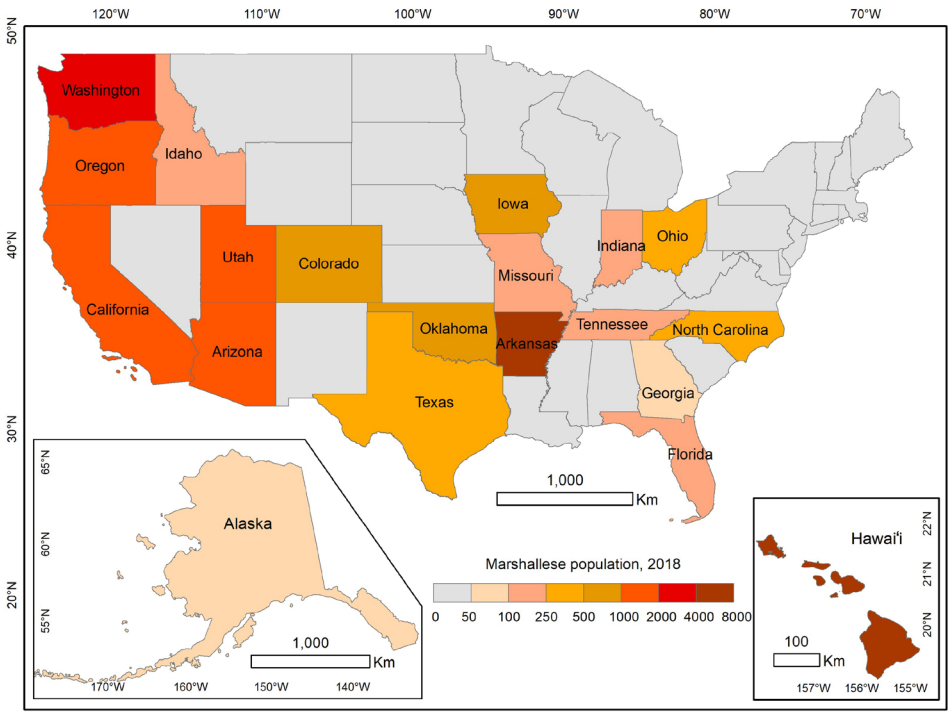

Fig 1. Marshallese population by US state. Only states with populations greater than 50 are labeled. Data from the 2014–2018 American Community Survey (ACS) five-year estimates.

found that respondents reported positive changes to their well-being related to improvements in health care, social services, employment, and education.[25] Importantly, although climate change is rarely cited as a primary driver of outmigration from the Marshall Islands, 62 percent of survey respondents were also fearful of returning home due to climate change.[15]

Science-Informed Policies for Adaptation Planning

Migration is sometimes considered a last resort "adaptation plan," but relocations of any sort are complex and come at high political, economic, environmental, cultural, social, and emotional costs with prolonged implications.[26] Marshall Islands climate activist Kathy Jetñil-Kijiner and former president Heine recently described the difficult personal experiences of living and migrating as Marshallese, arguing that "policies must also address and support adaptation so that migration is a choice, and those that decide to stay are able to maintain our land, our identity, and our culture."[27]

'Policies must also address and support adaptation so that migration is a choice, and those that decide to stay are able to maintain our land, our identity, and our culture'

The complexity of interactions among climate change, health, and migration means that few policy approaches in the Pacific Islands adequately address them. To do so will require that research emphasizing the myriad experiences of migrants, their environmental contexts, and health outcomes be integrated with policies that reduce risk and vulnerability. Because the Marshall Islands government considers climate change to be the greatest threat to the nation's low-lying atolls and communities, it has established robust science-informed policies for building resilience. Networks of agencies and communities can coordinate monitoring and reporting activities, which will strengthen climate adaptation planning. These efforts will increase climate awareness among health professionals and enable them to better integrate climate indicators and information into preparation and response. The Marshall Islands Office of Environmental Planning and Policy Coordination

recently published the 2050 Climate Strategy, which outlined a strategy for developing the country's National Adaptation Plan (NAP).[28] The NAP is working across multiple sectors (health, emergency response, education, housing, infrastructure, ecosystems management, etc.) to reduce vulnerability to the impacts of climate change and facilitate the integration of climate change adaptation into national policy. Ensuring habitability of the islands and atolls—through the protection of livelihoods, culture, physical well-being, and mental health—is central to the purpose.

Health, Mobility, and Climate —Future Directions

The health risks associated with climate change are expansive, including those that stem from migrations. The experience of the Marshall Islands illuminates the complex and nuanced nexus of health, climate change, and migration in the Pacific region (see Fig. 2) and provides an opportunity to consider best practices and pathways for climate-adaptive decision-making. The issues surrounding migration and health in Pacific Islands are expected to be further complicated and exacerbated by the progression of climate change, whose negative health impacts many communities are already experiencing. For diverse reasons, many citizens of the Marshall Islands have migrated from the outer atolls to the urban centers of Majuro and Ebeye, where overcrowded and unsanitary conditions are public health concerns. Thousands more have left the nation entirely, seeking health care, employment, and education in the United States under the terms of the COFA. Access to health care continues to be a strong driver of out-migration from the Marshall Islands, whereas many who have already migrated consider climate-related threats to be a barrier to their return home. It remains to be seen if environmental deterioration in places like the Marshall Islands will trigger migration among those who are most vulnerable to the health risks of climate change.

Throughout the Pacific, fragmented, sector-based approaches to climate adaptation are being replaced by cross-sector policies that integrate science

Throughout the Pacific, fragmented, sector-based approaches to climate adaptation are being replaced by cross-sector policies that integrate science. The Marshall Islands and other Pacific Island countries are also looking to multilateral funding sources like the Green Climate Fund[29]

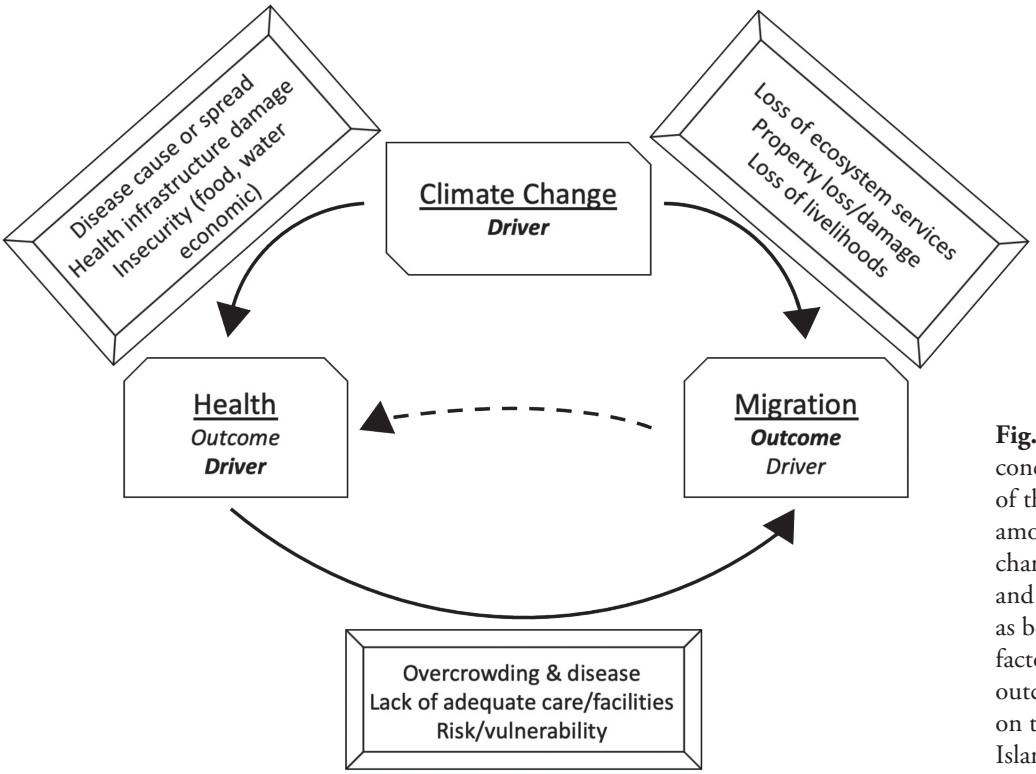

Fig. 2: A conceptualization of the interactions among climate change, health, and migration as both driving factors and outcomes, based on the Marshall Islands example.

for infrastructure, knowledge transfer programs, and climate early-warning systems. A shared vision at the local, national, and regional levels seeks to strategically engage health professionals with climate planning processes, and funding proposals that explicitly consider health are likely to be "more ambitious, more sustainable, more effective, and more efficient," according to the Green Climate Fund's health specialist.[30] The unique environmental, political, and geographic context of the Pacific Islands has generated considerable policy and research interests at the nexus of climate change, migration, and health, and future work in the Marshall Islands will take place within a research framework that explicitly connects these three interacting factors. These dynamics will likely continue to shape priorities and debates into the future, with Pacific peoples at the forefront of change.

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