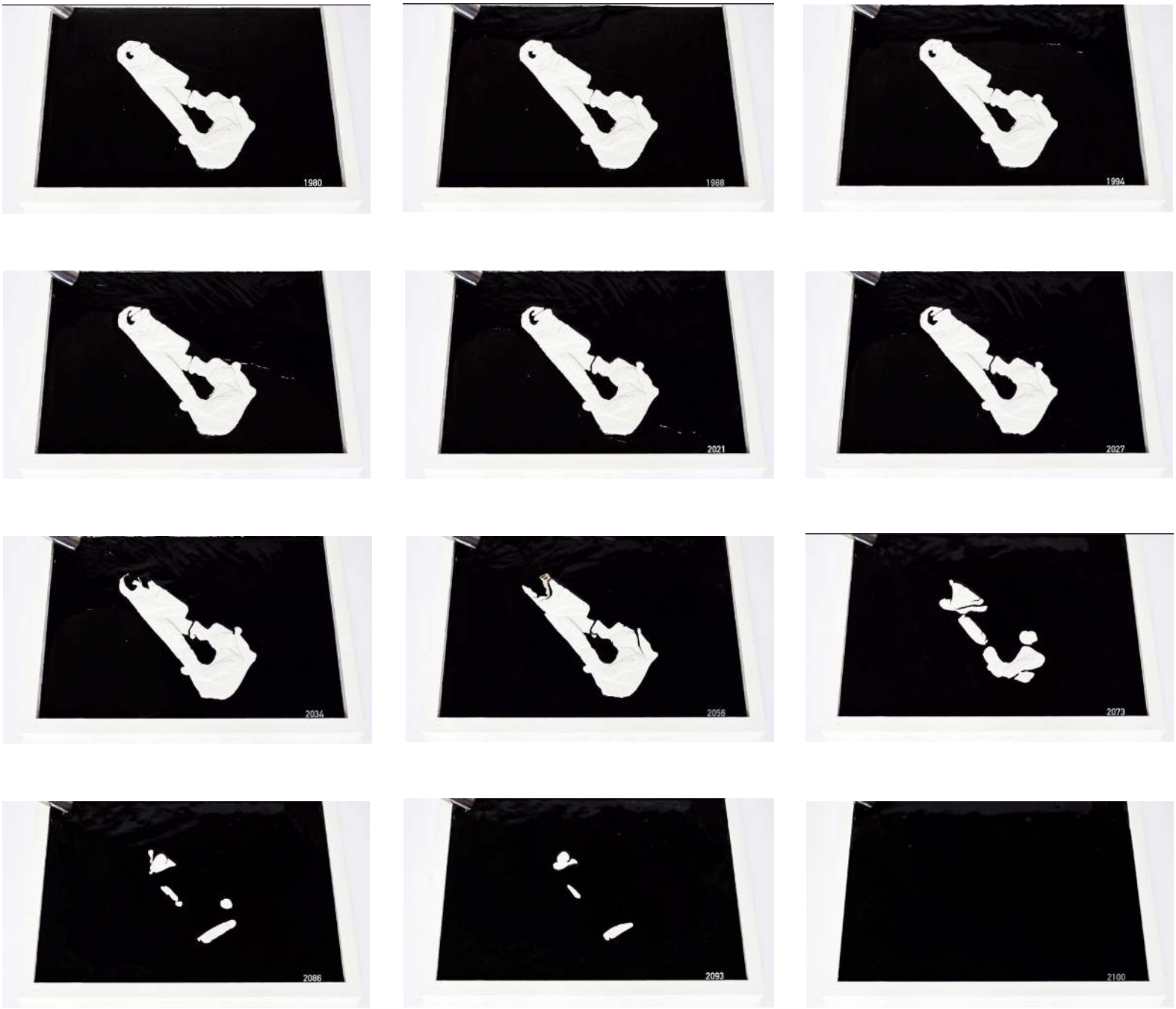
SUNK(IN) TUVALU :

Visualizing the Future of a Small Island Developing State

Kira Clingen's Dr. Massoud Javadi
Travel Fellowship 2016



Note: While I've included various photos in this essay, the majority of my project can be found online in perpetuity at: www.sunkintuvalu.wordpress.com, and the video at https://vimeo.com/187781584.

Flying into Funafuti International Airport, our landing was delayed. Already, the journey had taken two and a half more days than expected. I flew to Hong Kong for a brief layover and change of planes, followed by a 22 hour flight to Port Moresby, Papua New Guinea. From there, we were to fly to Nadi, in Fiji, and then directly to Tuvalu. If only the weather cooperated.

A level 3 typhoon warning was called, which in Hong Kong looks like nothing more than an afternoon thunderstorm - in Papua New Guinea, the rain was enough to ground all planes as the runway temporarily flooded. Philippine Airways offered all passengers vouchers, and I spent a night in Port Moresby at the only hostel in the city. The next morning, the typhoon passed, the rainstorm's only remnants a few puddles being mopped away from the runway, we boarded the rescheduled flight for Nadi, and then Funafuti.

Sitting next to me was a businessman employed by HSBC in Hong Kong. A native of Tuvalu, he left the island nation at 16 to attend his last two years of high school in Auckland, New Zealand, where the largest expatriate community of Tuvaluans currently resides.

"When you grow up in a place so stranded, so unknown, you desire to see more, to understand the places that are so much greater than your speck on the map," he reflected, "I've been off the island for 38 years. My parents passed away there, and I could not take the time from work to attend their funerals. My nieces and nephews were born there. I piece together events from photos."

His story is common. Over the next three and a half weeks that I spent in Tuvalu, first on the island of Funafuti where I worked with scientists to create a model to showcase sea level rise on the island, and the next on the island of Vaitupu, where I spent three weeks unexpectedly helping with a project meant to simultaneously combat sea level rise and bring a community of fishermen a new means of income.

Working with the Tuvalu Meteorological Service at the Funafuti Weather Office, I spent time with Mr. Bikenibui Toufua, who helped me to model the threats of sea level rise, using models that have been collected. While from the outside the Tuvalu Meteorological Service looks like a single-story house, made of concrete blocks with palm trees swinging on the outside, the interior reveals an agency in dire need of international expertise. Current mapping techniques that are used to accurately project sea level rise in developed nations that have university pipelines providing scholars studying environmental issues have not reached an appropriate resolution to accurately study Tuvalu. Instead, we extrapolated measurements from the weather station, including a bell buoy off the shore before the fringing reef to see trends in sea level rise and storm surges, and combine these with the International Panel on Climate Change (IPCC) data on sea level rise. The result is a video that shows the eclipse of Vaitupu, and its residents, over the next 100 years, with the island disappearing. While the video represents the worst possible scenario for sea level rise, we felt it appropriately posited the fear that scientists and government members feel regarding the rising sea. The model is made of rice paper cut into hundreds of contour layers using an exacto knife, and bound together by a rice paste, ensuring that it is completely biodegradable. The model was flooded using a combination of India ink and boiling water, fully disintegrating within 15 minutes, washed away to nothing. Spending time with the scientific community on Funafuti, it was clear that increasing international expertise is needed to take more accurate measurements and ensure that technical data is available for more exact modeling.

The scientists at the Meteorological Services then helped me to model coral bleaching on the island, and create a time frame of six reefs around the island which have been affected by coral bleaching. Corals serve as a proxy for environmental degradation, as they are ruined by "degree heating days," which are effectively days in which temperatures are 1 degree Celsius above expected averages. The health of the reef is critical in ensuring that the island does not erode, and that storm surges are broken on the leeward side of the reef. Without healthy reefs, the susceptibility of the island to extreme weather events, such as Cyclone Pam in 2015, is exacerbated. These events are likely to become more frequent due to climate change and increases in sea surface temperature. In addition, corals proximity to mangroves, which help to prevent erosion, is a good proxy for the health of lagoon environments. By modeling coral health based on NOAA data of nearby corals, it's possible to understand the health of an entire lagoon ecosystem, and determine the health of the water, which sustains a high

percentage of the population in Tuvalu.

There was clear frustration that the majority of the population sees typhoons and cyclones as weather events that are not related to climate change, and therefore there is little emphasis on migration away from coastlines, but there are initiatives to promote the planting of mangrove trees to prevent erosion, as well as deconstructing jetties and other piers that increase rates of erosion, threatening the fragile coastline. All of the sand in Tuvalu is from the coral reef, and therefore the white sandy beaches are testament to the destructive power of the sea.

While spending time with the Tuvalu Meteorological Services, I realized that the scope and focus of my project might change. Tuvaluans do not see themselves as climate refugees. In fact, in conversations with Mr. Toufua, he discussed how the term climate refugees is effectively diminishing, turning his people into a statistic, and failing to recognize the incredible strides that they've taken to build a nation over the past fifty years since the end of British colonial rule. Climate change may threaten their land, but it also threatens the dignity of the population, which may be forced to move without have achieved the levels of development and luxury consumption that nations like the United States have enjoyed for hundreds of years.

From a Tuvaluan perspective, the labeling of the nation as a vulnerable paradise slowly sinking beneath the waves reduces a hard-fought national identity and rich cultural identity to a statistic, an example for the world, less a country of great human achievement than an example of what's gone wrong with the rest of the world. In particular, the community members I spoke to voiced their frustration that the initiatives that Tuvalu has taken to bring awareness of their vulnerability to the world are largely taken as a warning - but the very real action that Tuvalu has taken - including selling their internet domain, .tv, to a United States company to raise funds for government action against climate change, are not widely reported, thus further diminishing the agency of the population. The idea that Tuvalu is a doomed nation to sink beneath the waves further marginalizes the real problems that the island faces - in terms of bringing education, sanitation, and other basic necessities - including water, to the island in a sustained manner. Suggesting that the islands will soon be uninhabitable also suggests that the international community should not assist the nation in its development if the country will have to migrate to Fiji or another nearby island with a greater portion of land at higher elevations.

As the Prime Minister of Tuvalu, Mr. Enele Sosene Sopoaga said in a communication to the United Nations, "whilst Tuvalu appreciates these considerations for small island developing states in the respective processes, we appeal for more concrete recognition, particularly by the donor community, of our "special case" situation to enable us cope with the challenges that we face, particularly with regards to capacity building through quality education and health, access to fresh water and affordable energy, infrastructures and sanitation."

In Tuvalu, sea level has risen 5 mm per year every year since 1993. The change seems insignificant and surmountable. Until it's taken into account that every single one of Tuvalu's nine islands lie less than three meters above sea level. And that rates of sea level rise are significantly less in other parts of the world, generally around 1.3 mm annually elsewhere. The first consequence of rising sea levels is not inundation and drowning islands: it is a loss of drinking water. The freshwater lens that belies Tuvalu's supply of drinking water faces increasing levels of salinization and uncertainty. Fresh water, without salt particles, is generally lighter than salt water, and effectively "floats" on top of sea water, allowing small island developing states from the Caribbean to the Pacific to drink from the rivers and lakes within the borders of their nations.

Tuvaluans speak English and Tuvaluan, a language similar to the dialects spoken in Fiji and on other islands in the south Pacific. During the colonial period, Tuvalu was taken over by the British in 1876, and known as the Ellice Islands until 1978, when Tuvalu rejected its state as a British dependency and became an independent nation. During the colonial period, Kiribati and Tuvalu were seen as one entity - known as the Gilbert and Ellice Islands - with several battles during WWII fought on the islands, as the Gilbert Islands were occupied by the Japanese, and the British used the Ellice Islands as a base to fight sea battles. The ecology of the islands were heavily damaged during this area, and several non-native plants were introduced, threatening the ecology of the broadleaf rainforest that grows naturally on the islands.

One of the legacies of the colonial period throughout the Pacific is the degree of interconnectedness of the islands. Different islands became known for various industries, encouraging migration to work in the phosphate mines in Kiribati, tourism in Fiji, and to attend university in New Zealand, primarily in Auckland.

The population of the island is therefore mixed, with significant migration to other nations, and dwindling numbers of inter-island migrants.

During this period the sense of identity in Tuvalu was damaged - the islands were considered yet another Pacific outpost, and the British frequently moved the islanders throughout the Pacific as a labor force - damaging familial relations and upsetting the culture - which had formerly included migration between the island in small numbers of people by sailboat - not massive displacement by the steel hulls employed in the British Royal Navy.

When framing the discussion of climate migration, the colonial period is referenced often. One family in Vaitupu traces its roots to Fiji, where a grandfather was stationed during WWII, to them, proposed relocation plans to Fiji, whose land mass is significantly higher than Tuvalu's, have a mixed sentiment. "With independence, we know freedom to pick our islands. Other people shaping our islands should not drive us out. Our home island is in Fiji, but our home today, that we chose, is here, in Tuvalu."

There is an intense pride in the self-government and local cabinet that sits to govern the islands of Tuvalu, with community leaders well-known throughout the islands. Many of the community leaders are active in the religious community, further establishing institutional traditions on the islands, and promoting informal ties between church and state that ensure there are always places for traditional dance and song, rituals that have survived for hundreds of years, even throughout the colonial period. I was more than privileged to observe and even partake in one of these ceremonies, dancing in the fakaseasea, traditional for unmarried women and performed barefoot in the Christian church in Vaitupu. Sweating in the middle of the concrete church, women dressed in traditional sarongs, called sulu, which are colorful and printed with flowers, along with white tee-shirts and fous, head garlands made of flowers collected the morning of spiritual events.

Vaitupu is unique in having the largest inter-island migration in Tuvalu, as the main secondary school is located on the island, as well as one of the largest Christian churches on the island. The main village is divided into rows of three houses, almost all of which are constructed from aluminum and filao wood. The island gives way in the center to a shallow lagoon, with streaking white sand that's pulled by the tide. Vaitupu also has one of the largest rates of remittances in Tuvalu - after students are educated to the secondary level, they are more likely to go off island to seek higher education at institutions in New Zealand and Australia. Education remains a highly divided issue. While 99% of the population is literate, only about 77% of the population has attained secondary education, and this rate is significantly greater for females than males, many of whom are encouraged to employ themselves as early as possible, whether fishing or farming for natural resources, or setting out to the mines and other hotspots for natural resource extraction in the Pacific.

Living in Vaitupu, I was hosted by the Karruti family, a mother and father educated in Auckland who returned to work with 1000 Tuvaluans (http://10000.tv/), a local NGO that strives to highlight the connection to climate change by photographing Tuvaluans and bringing awareness to the threat of climate change in a way that highlights the adaptive capacity and resourcefulness of the population -instead of depicting native Tuvaluans as victims of a crisis they cannot control. Vaitupu is hot and muggy. I woke up each morning in a pool of sweat, and carried out interviews with the local community during the morning and evening, before dining with the Karruti's children. I devised a questionnaire on vulnerability, and another on adaptation, focusing on flooding during 2015's Cyclone Pam (attached below). Collecting interviews from 40 people around the island, I provided the data to the Meteorological Services in Funafuti before leaving, providing a case study for affliction by Pam. From my research, it was clear that there is a lack of government aid to those directly affected - grants from international organizations often do not reach their intended beneficiaries, and many citizens who have attended education only to primary school still don't know about maintaining reserve food supplies and first aid kits, as well as having tools to break down windows in the event of flooding. Pam devastated the islands, with massive swells and waves that ripped down trees along the coastline, furthering erosion, and flooding that inundated houses, threatening the fresh water lens. In my interviews, I was shocked at how welcoming people were - they were happy to invite me into shops and houses for a drink of water and a snack, eager to discuss ways that the government could further help. During this time walking around, I made a second map, which shows the community in Vaitupu, and the institutions most likely to be afflicted by climate change, including the local school, hospital and church, all of which could be inundated by sea level rise of a meter, projected by the end of the century.

These institutions are critical, not only because they provided places of refuge during flooding,

but because aid is concentrated in these community institutions, which form the backbone of the community. In interviews, it was clear that the figures that came together during flooding events were church members and other community leaders who created aid funds before international aid could be dispensed by the government. The community was able to scramble together aid for houses that were destroyed in the flooding and donate money immediately without the bureaucratic delays of government and international aid.

During the course of my interviews, what I learned was incredibly surprising for the scope of my research: the people of Tuvalu are largely unconcerned about climate change as a cause for migration. Instead, worries about the decaying economy and a lack of opportunities dominate the narrative for migration. Climate change has largely been reduced to tangential matters of environmentalism: , and while there is an emphasis on an international platform to combat climate change in order to save Tuvalu from slipping under the waves, on a national level, economic concerns remain supreme, with a significant amount of remittances coming from Tuvaluans residing abroad. Almost half of all family members in Tuvalu have family members abroad who send money home at weekly or monthly intervals, providing the families with a means of affording life on the island, which has increasing prices with few connections to the global economy - all goods must be imported, and Tuvalu is designated as a food importing country.

While completing my interviews, I also helped with another community-based project, this one attempting to begin a mariculture project within the lagoon in Vaitupu. By culturing crabs within the lagoon, fishermen who have seen their catch degraded, both by oceanic pollution from the introduction of a failed textile industry near the lagoon that threatens the water with toxic run-off that causes eutrophication and algal blooms, and overfishing, will have another means of income that they can rely on, and ensure that during periods that the catch is diminished, they will still have a source of income, and, more importantly, protein. The traditional diet in Tuvalu is largely rice and fish, both of which I happily ate my fill of almost every night I was on the island. While my involvement with the project was a take-off on my original intentions, I found that it did justice to the aim of my project - engaging directly with local communities affected by climate change, and helping by not contributing to the degrading narrative that sees native Tuvaluans as vulnerable without hope against climate change, something that I was highly aware of during my time in Tuvalu.

Upon leaving, my host mother for my weeks in Tuvalu draped a flower garland, another fou, around me, smiled, and walked me to the ferry to return to Funafuti, from which the plane took off, the runway dry, for now.

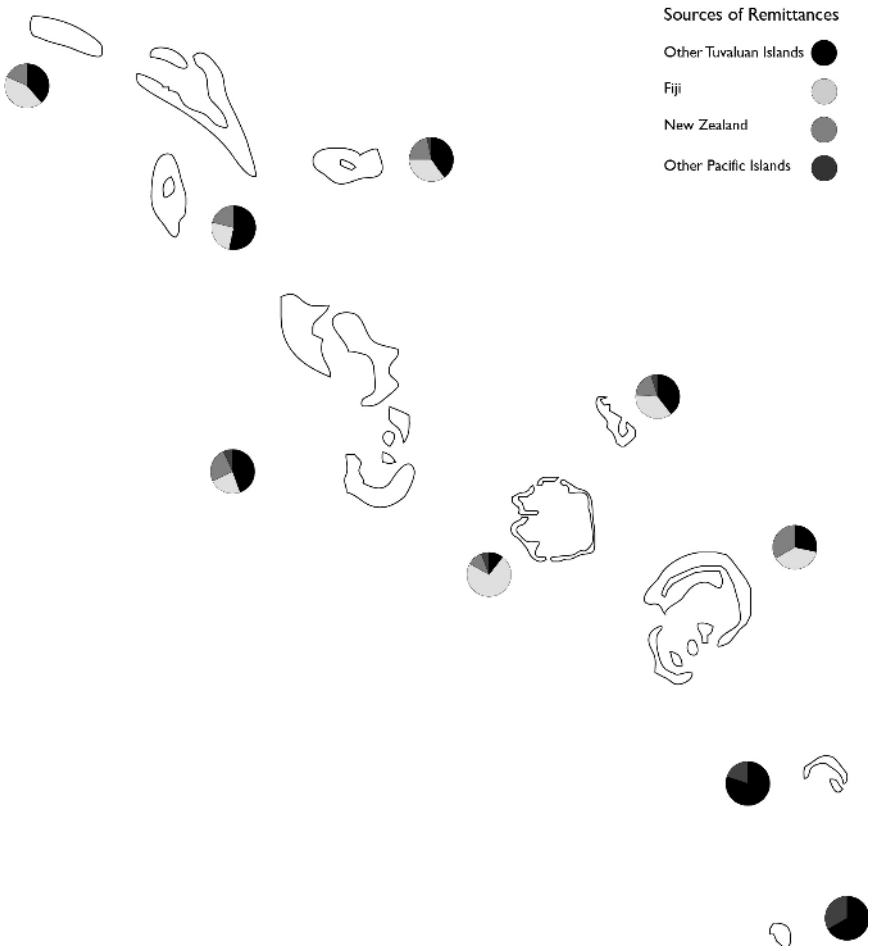
The hospitality of the people throughout Tuvalu was incredibly kind. I am so grateful for the people that I met, and to the Dr. Massoud Javadi Foundation for providing this once-in-a-lifetime opportunity to travel and pursue both science and art.

Mr. Toufoua in his living room during the 2015 aftermath of Cyclone Pam. The house was fully inundated and remained flooded for six days before the fire department pumped the mud and sediment from the house. All the furnishings had to be replaced.

Corals serve as a proxy for the epipelagic environment. The polyps covering layers of calcium carbonate detect minute stresses and changes in their biophysical surroundings. Bleached, detached corals were collected from six fringing reefs, and a program run in R using Tuvalu Meterological Servicesdata collected between 1982 and 2012 to approximate dates of major coral bleaching events, which are represented here in an abstracted linear timeline. By abstracting the 3-dimensional coral into a pen and ink drawing, the decay of the coral becomes readable and accessible, translating an indiscernible pattern of isotope and metal changes into a diagram of environmental change.

Both corals and mangroves gauge the health of an ecosystem, serving as proxies for the health of the intertidal zone. Recent research has noted the symbiotic relationship between coral and mangroves, in which coral bleaching appears to be slowed in shaded areas offered by colonies of mangroves. Current conservation techniques prioritize the evacuation of corals away from land (and human activity) to rehabilitate in deepwater refuges, ignoring pre-existing relationships between plant and animal life that can allow for the multi-faceted preservation of entire ecosystems without the forcible removal of the natural world beyond human reach.

Source artwork for the project.

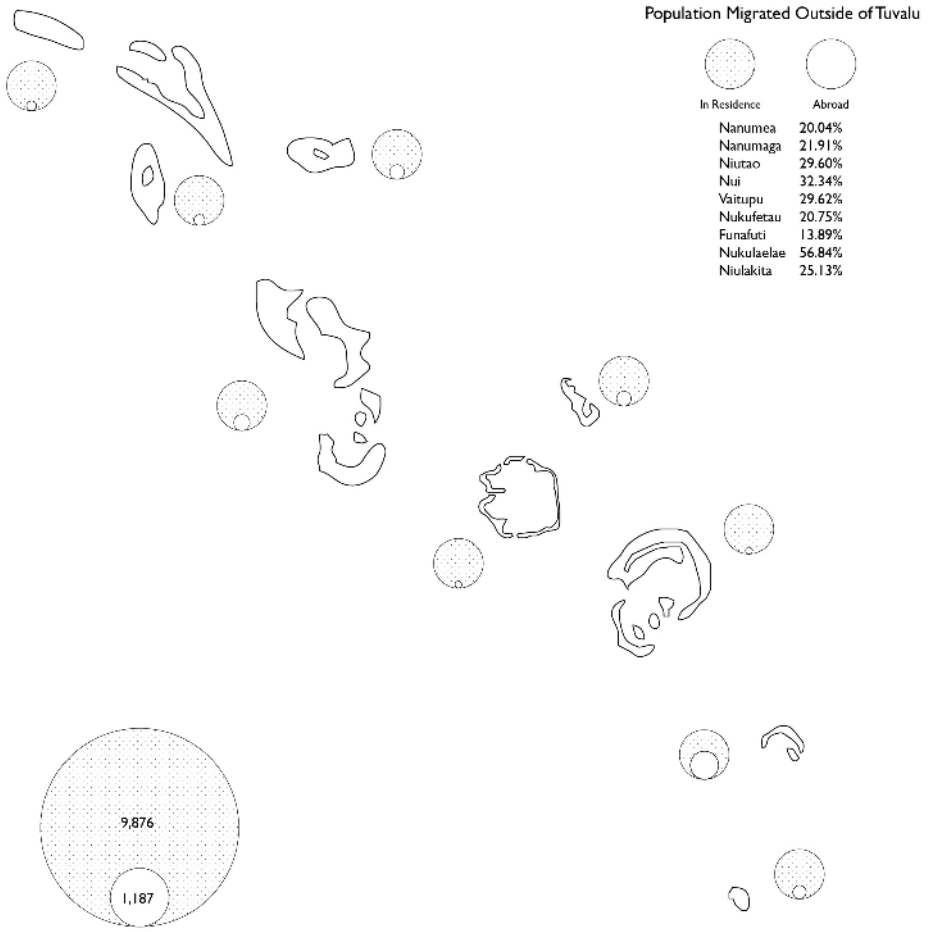


Details on the sources of remittances across Tuvaluan islands, showcasing the relationship between migration internationally and islands. It should be noted that islands with secondary schools have higher rates of international remittances - as students on those islands will seek higher education opportunities in Fiji and New Zealand, and later tend to find employment off-island.

Statistics gathered while in Funafuti from the Department of Labor and Immigration

Details on migration within and internationally in Tuvalu.

Statistics gathered while in Funafuti from the Department of Labor and Immigration



A small Christian shrine in Vaitupu. The original missionaries to the islands that made up Ellice Islands during the British colonial periods were Christian, and the religious tradition has been maintained. Today, aid that is focused on helping citizens recover from natural disasters largely stems from religious funds, around which communities mobilize.

Constructing cages for mariculture in Vaitupu.

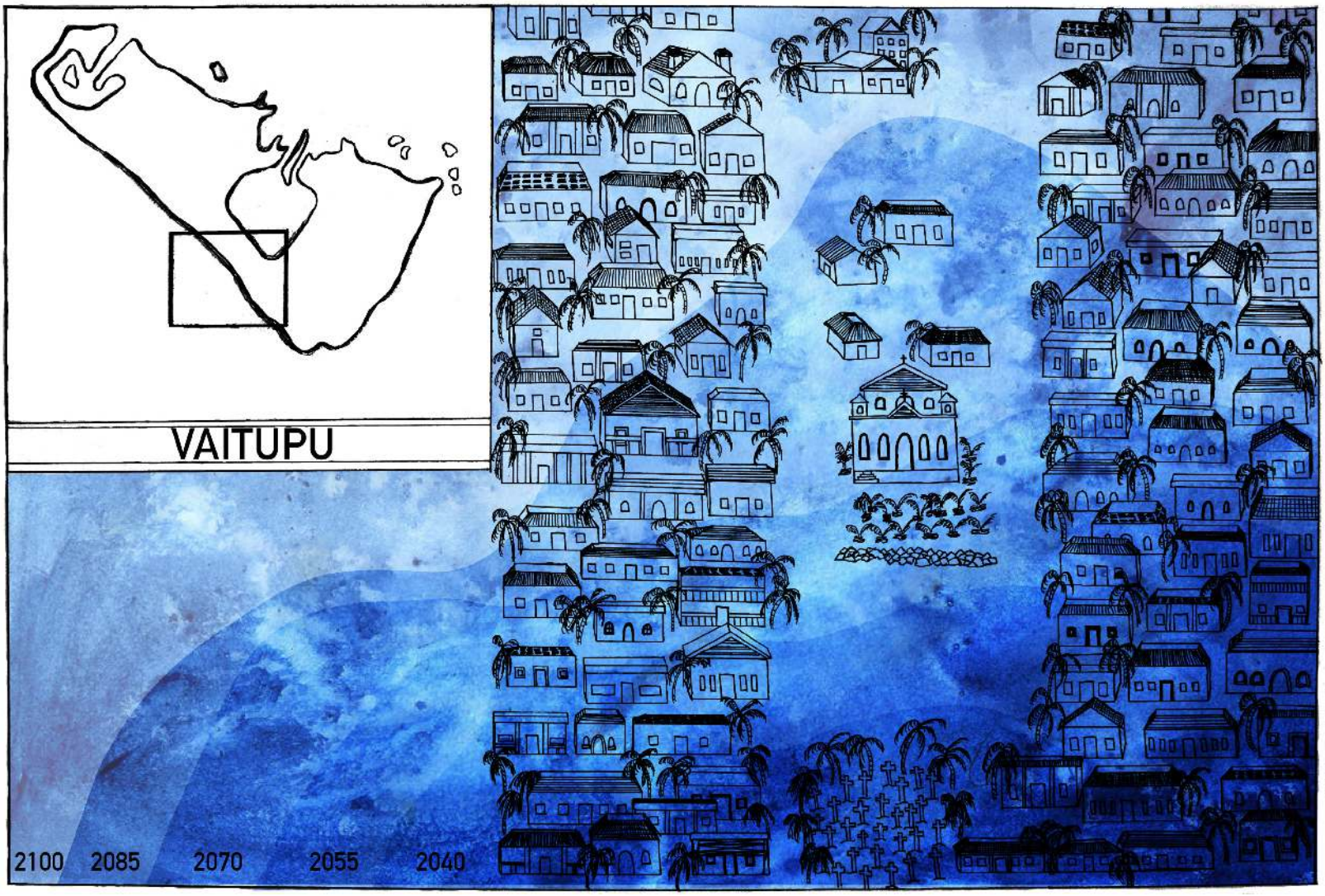
Garbage in the mangroves around Vaitupu.

A woman burning garbage on Sunday morning.

More family photos from Mr. Toufoua of the 2015 cyclone aftermath.

Conducting interviews in Vaitupu, and cleaning the lagoon area where the mariculture project will be implemented.

The lagoon area in Vaitupu with crumbling basalt foundation, and a fishermen partaking in a clean-up event near the lagoon.



A final map of Vaitupu, showing the relative projections of sea level rise using data from the Funafuti Meteorological Services. The church in the center of the community and the school (top center) are particularly vulnerable to sea level rise. The cemetery located nearest the coast poses another question: how to preserve the sanctity and maintain respect for the dead when the living population migrates inland or away from the islands.