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L'influence des conditions socio-économiques sur les interprétations du changement climatique sur l'atoll de Takuu, Papouasie Nouvelle-Guinée

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Influence of socio-economic stressors on perceptions of climate change on Takuu Atoll, Papua New Guinea

by

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ABSTRACT

Low-lying South Pacific islands are widely reported by the media to be rendered imminently uninhabitable by the effects of anthropogenic climate change. Yet, there is often a stark contrast between what the media reports and what is occurring, or not occurring, on the ground. On Takuu Atoll, Papua New Guinea, socio-economic conditions, more than environmental ones, are presently at the forefront of concern and debate. The paper discusses the three main environmental changes observed by local residents, namely increasingly unpredictable weather patterns, shoreline erosion, and increasing salinisation of garden plots. It further explores how specific socio-economic conditions, such as high reliance on imported food, increased population mobility and lack of livelihood opportunities influence local interpretations of the information about climate change received from external sources.

Keywords: Takuu Atoll, climate change, local environmental perceptions, mobility, livelihoods, media reports

RÉSUMÉ

Les médias déclarent fréquemment que les îles basses du Pacifique seront très bientôt inhabitables en raison des effets du changement climatique anthropique. Pourtant, le contraste entre ce que les médias rapportent et ce qui se passe, ou non, sur le terrain est souvent frappant. Sur l'atoll de Takuu, en PNG, ce sont les conditions socio-économiques, davantage que celles liées à l'environnement, qui sont actuellement au premier plan des préoccupations et des débats. Cet article traite des trois principaux changements environnementaux observés par la population locale, à savoir les régimes climatiques de plus en plus imprévisibles, l'érosion des côtes et la salinisation croissante des parcelles de jardin. Il explore en outre comment des conditions socio-économiques spécifiques, telles que la forte dépendance de la population à l'égard des denrées alimentaires importées, l'accroissement de sa mobilité et l'insuffisance des moyens d'existence auxquels elle a accès, influencent les interprétations locales des informations exogènes sur le changement climatique.

Mots-clés : atoll de Takuu, changement climatique, perceptions environnementales locales, mobilité, moyens de subsistance, médias

"Our family in town sends us messages about climate change impacts. They watched the film ("There Once was an Island") and now they think that it is all true." (Takuu fisherman, aged 45)

Small island developing states in the Pacific have been at the forefront to the detrimental effects of anthropogenic climate change over the past several decades. These impacts include sea level rise, increased flooding and droughts, erosion of shorelines, salinization of water tables, and more extreme weather events such as increased storm intensity and frequency of king tides (Kelman and West, 2009; Mimura *et al.*, 2007). Environmental changes are a feature central to everyday life on low-lying island habitats; people are highly cognizant of this and make adaptations in response to them. However, unprecedented environmental changes largely attributed to climate change are also being felt across some parts of the

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South Pacific region, making it more difficult to adapt, especially in low-income contexts.

Climate change can be thought of in two distinct categories. Climate change, in the way that we are used to hearing about it, can be viewed as physical changes to natural landscapes. However, social scientists are paying more attention to climate change as a discursive framework and seek to analyze the narratives that are in circulation about this empirical global phenomenon (Farbotko and Lazrus, 2012; Rudiak-Gould, 2012, 2014). Perceptions of and responses to climate change rely not only on what is happening in the physical world setting, but also on how the scientific and media predictions are taken up in a specific socio-cultural context. The latter is just as vital as the former because it often informs the subsequent actions that are taken by those affected to cope with and mitigate deleterious impacts. Social, cultural, historical, political and economic contexts all shape our ideals, values, expectations, and actions, and this needs to be considered if one is to understand how people on the local scale perceive and respond to environmental changes.

While the global media often reports on the physical impacts climate change has on people, especially in tropical and polar settings, they often fail to appreciate the effect such reporting has on perceptions of the people affected and how this, in turn, shapes their behaviors. As succinctly stated by Mortreux and Barnett, "there is a certain dramatic appeal about an island nation facing total inundation" (2009: 105). By broadly deeming low-lying island communities as imminently uninhabitable, media reports are creating, perpetuating and imposing a narrative that portrays certain populations as victims. In one such example, large areas of the Pacific – including Takuu Atoll (Autonomous Region of Bougainville, Papua New Guinea) – are grouped together, irrespective of local contexts, and doomed to an uncertain future away from their island homes:

> "The people of Tuvalu and Kiribati in the north Pacific, Takuu (Mortlock Islands) and the Carteret Islands in Papua New Guinea, and Australia's Torres Strait Islanders, are now voyaging towards an uncertain future. Rapidly rising sea -levels and massive king tides are encroaching on their villages and salt is affecting arable land. The mass migration of entire island communities is imminent." (Cochrane, 2010)

In an earlier and more specific conservative prediction, a journalist for the New Zealand Herald writes about Takuu Atoll:

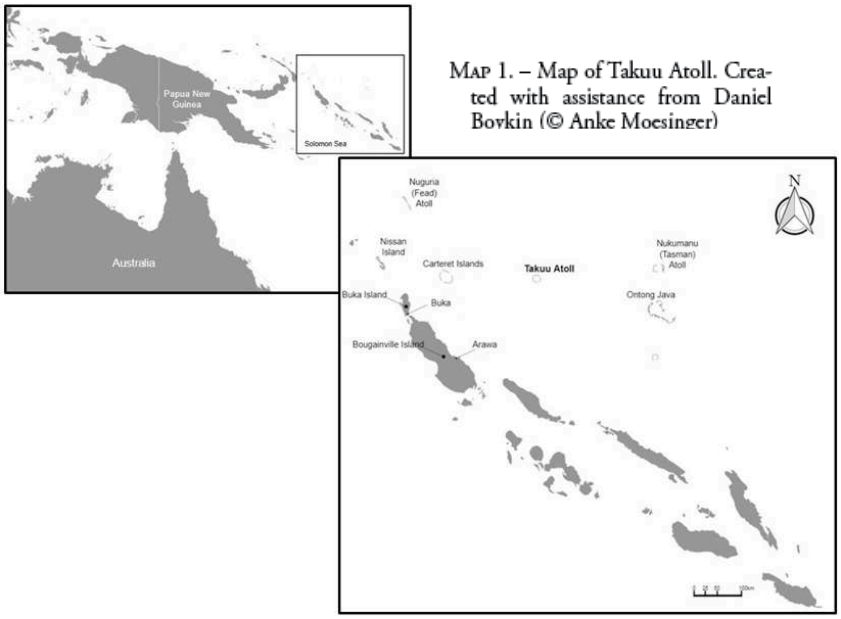
> "On Takuu, 400 people with a unique culture are in a similar plight (as the Carteret Islands). The inhabitants of the low-lying atoll, who have a memorized repertoire of 1,000 songs, have seen their gardens flooded and their sand dunes swept away. It could be months, at most five years, before the waves swallow their houses." (Marks, 2000)

Various claims, including the ones above, have been made that islands such as Takuu Atoll could prove uninhabitable by 2015 or even earlier – which did not happen. Inaccurate predictions as this one undermine the message of urgency that the climate-related media reports are trying to communicate to the public. In this sense, talks of literally "going down in history" and "sinking islands" are not only counterproductive, they also influence local reception of the Western climate message in a negative way. The above dimensions were exemplified in the 2010 documentary about the residents of Takuu Atoll, *There Once was an Island: Te Henua e Nnoho* (March and Collie, 2010), which prominently featured the imminent struggle that Takuu Islanders are said to face: whether to migrate to mainland Bougainville or stay and ultimately sink beneath the rising sea. The film discussed the incompatibility of Takuu Islanders, categorized as a Polynesian people, settling and integrating into a Melanesian setting. Its environmentally deterministic leaning, designed to appeal to Western audiences, did not provide a nuanced account of the local point of view, which is shaped in large part by local experience and understanding of climate change. Also, several predominant socio-economic stressors that greatly influence and drive both migration and interpretations of outside messages went largely unnoticed. These stressors are, as discussed in detail in what follows, a lack of adequate transportation services, a high reliance on imported food, and too few livelihood opportunities.

In this paper, I first present a brief background of the setting and methodology of my ethnographic study for contextualization before detailing some of the key perceptions of environmental changes on Takuu that participants voiced. Next, I explore how population mobility and socio-economic stressors influence Takuu residents' reception of the climate change message disseminated by outside actors, in particular global media reports. I then discuss the livelihood and employment strategies that are available to the atoll's residents and how these shape interpretations of environmental narratives. Lastly, I provide a brief discussion and highlight the importance of understanding site-specific contexts so that future climate change adaptation plans can be successfully implemented.

The Setting of the Research: Takuu Atoll

The setting for this case study is Takuu Atoll, a Polynesian outlier situated 273 kilometers northeast of Buka in the Autonomous Region of Bougainville, Papua New Guinea (map 1). Takuu Atoll consists of a coral ring composed of 13 islands, with a total land area of less than 1 square kilometer (Bayliss-Smith, 1975). All 316 residents of Takuu lived in 86 households on the 6-hectare village island of Nukutoa during my fieldwork, in March 2014. Directly south of Nukutoa lies the 74-hectare uninhabited garden



Map 1. – Map of Takuu Atoll. Created with assistance from Daniel Bovkin (© Anke Moesinger)

island of Takuu where swamp taro (*Cyrtosperma merkusii*) and true taro (*Colocasia esculenta*) are the staple crops cultivated for consumption. The other 11 islands are uninhabited and uncultivated. In the absence of supply ships bringing flour-based products and rice, residents' daily diet is derived from subsistence means and consists largely of fried and boiled fish supplemented by swamp taro, coconuts (*Cocos nucifers*) and bananas (*Musa* cvs) and, to a lesser degree, true taro.

Takuu Islanders have long been integrated in myriad ways with the larger world. They trace their origins to the east, in the Polynesian triangle, arriving on ocean-going canoes approximately 800-1000 years ago (Bourke and Betitis, 2003). The voyagers likely came from Samoa by way of Tikopia, Nukumanu, Sikaiana, Liuanuia and Peilau[1]. Though geographically isolated, Takuu residents have had protracted contact with Europeans dating back to 1616, when Dutch sailors first encountered the island (Willis and Booth, 1968). Two years after ethnologist William Churchill's arrival in 1884, relatives of the English Queen Forsayth purchased the island from the chief and began a lucrative copra plantation (Parkinson *et al.*, 1999). The copra business necessitated an increase in the number of coconut palms being planted, which has likely affected the topography of the island and subsequent rates of coastal erosion, although no empirical studies of the influence of vegetation have been conducted on Takuu. The copra trade also initially required laborers to be brought in from disparate parts of Papua New Guinea, leading to further increased connectedness and integration with the outside world.

Services on the atoll are highly limited and consist of a small aid post (though a healthcare worker was only present for 3 of the 9.5 months research on Takuu), few trade stores and canteens selling basic necessities after the arrival of a ship. A single radiophone and one satellite telephone in the Council of Elders office provide inter-island communication for all residents of Takuu. The island lacks permanent electricity; some homes possess solar panels that charge batteries. Freshwater is provided by over twenty 9,000-gallon rain tanks placed around the village island, provided for the atoll by the Autonomous Bougainville Government (ABG). The sole primary school with 4 classrooms was opened in 1962. After grade 8, those wishing to continue education must move to Buka or other urban centers to obtain their secondary education. An elected Council of Elders oversees local activities in conjunction with the chief, or *Te Ariki*.

Methodology

Ethnographic research, focusing on various aspects of local understandings, uses and perceptions of the atoll environment and changes thereof, was conducted over 14 months, from April 2013 to June 2014, in Bougainville, Papua New Guinea, with 9.5 months from August 2013 to May 2014 on Takuu Atoll. Due to transportation restrictions, I spent 4.5 months of research in the town of Buka interviewing Takuu islanders who had migrated from the atoll primarily for socio-economic reasons such as employment opportunities, continued education or healthcare needs. Data was gathered from participant observation of natural resource use, including fishing and gardening practices, construction and maintenance of the seawalls that surround large parts of Nukutoa, school and church activities, special events as well as all community meetings organized by the Council of Elders. I supplemented my field notes with 55 semi-structured interviews with both female and male Takuu residents. Participants in the interviews were chosen by utilizing snowball sampling, since initial participants identified others

1. As is common in Polynesian societies, Takuu islanders follow a patrilineal kinship system, and matrilocality is practiced. The local population belongs to one of the five clan houses, namely *Hare Ata, Hare Mania, Hare Maasani, Hare Naaoro and Haare Ania.* The paramount chief, or *Te Ariki*, of the island is the head of *Hare Ata*, while *Hare Mania* designates the second ranked chief of the island, *Te Pure*.

who they deemed to have insight into particular topics of focus. These interviews covered various topics such as how Takuu residents understood and made use of their island environment, including modifications of resource use in response to environmental and social changes that are occurring, how perceptions of environmental changes were distributed socially, and how local perceptions have been shaped through interactions with external actors like visiting scientists, a film crew, non-governmental organizations, local, provincial and national government officials and Takuu Islanders who return to the island. Further, interviews focused on demographic data and population mobility, perceptions of the efficacy of the seawalls and opinions of resettlement strategies. Also, I conducted 4 focus group discussions with men and women to elicit insight into the varying perceptions of environmental and social changes occurring on the atoll, and I engaged in numerous informal discussions about these issues with key informants. All interviews and discussions were conducted in Tok Pisin or English. In addition, two ethnographic censuses, one in January 2014 and one in March 2014, were conducted between the arrival of a ship carrying passengers to ascertain the demographic changes on the island that occur when transportation services are temporarily restored.

Photo 1. – The western shore of Nukutoa island, facing the lagoon, is shielded from strong wind-generated waves by the seawall consisting of coral rubble, with coconut tree stumps and rubbish packed in fishing nets between the existing coconut palms (© Anke Moesinger)

Key observations and perceptions of environmental changes

Three main observations of rapid environmental changes emerged from interviews and discussions, namely decreased predictability of weather patterns, shoreline erosion and saltwater incursion into the taro gardens. Unpredictability of weather patterns, specifically increased monsoon wind and precipitation variability, was the most widely cited change among those interviewed. The predominant winds on the island are the southeast trade winds (*te anake*) and the northwest prevailing winds (*te laki*). *Te anake* occurs from approximately May to October, while *te laki* prevails from December to March. Participants cited significant changes in wind direction and intensity uncharacteristic of the respective season. This forces fishers using both line (*matau*) and net (*kupena*) fishing methods to increasingly alter their resource use patterns for their subsistence needs in the absence of a supply ship. The majority of men interviewed stated that it was becoming progressively more difficult to determine when and where to go fishing. Additionally, there is a concern that rapidly declining local knowledge, coupled with these increasingly erratic weather patterns, will create problems with regards to future food security on the atoll in times when store-bought provisions are scarce or depleted through lack of transportation services. Many fishers live off the island for an extended period of time, especially during their formative years while they are attending secondary school. Local elders voiced dismay that local knowledge is not being transmitted down through the generations as in previous times, when less young men received a secondary education. While some Takuu Islanders return to the atoll following their schooling, many favor staying in other towns and cities to integrate themselves more into the cash economy of urban centers.

The second observed environmental change is the occurrence of shoreline erosion. Takuu residents are deeply divided over shoreline erosion both in terms of if it is occurring and the rate thereof. However, over half of participants claimed that shoreline fluctuations were cyclical in nature. They explained that strong winds from northwest push the sand from the lagoon onto the points of the atoll's islands. When the wind direction changes to a prevailing southeast wind between May and October, the sand accumulated on the points of the islands is pushed back into the lagoon, thereby decreasing the size of the islands again. This inclines many to assume that external predictions of cumulative shoreline erosion making Nukutoa island uninhabitable can be ignored. Interestingly, these local observations concur with a remote sensing study of Takuu Atoll which showed evidence of overall island accretion trends from 1943 to 2012 for most of the atoll's islands (Mann and Westphal, 2016). Fewer participants held the opposite view, which align more with widely circulated media reports citing coastal erosion throughout the Pacific. Takuu Islanders who had spent extended time away from the atoll claimed that the land was eroding at an alarming rate, necessitating immediate intervention through the construction of more robust seawalls to avoid relocation.

Photo 2. – Takuu residents repairing the existing seawall in front of their property, made of coconut stumps, and mixing cement to build a more robust one in addition to the latter. This marked the first time cement had been used as building material for a seawall on Takuu, 2014 (© Anke Moesinger)

In line with the local perceptions on shoreline erosion, participants are completely divided over the efficacy of the seawalls (*te pae*) (photo 1). The seawalls were first erected in the early to mid-1980's, using coconut tree stumps and gabion baskets, because the strong northwest winds were causing large waves to crash onto the shore, often times forcing water into people's houses. Building the seawalls was a large community project, as the island was extended a few meters using sand mined from the adjacent uninhabited islands before the coconut tree stumps were put in place. Few residents thus stated that the purpose of erecting the seawalls was to make more room for kitchen houses rather than to mitigate effects of shoreline erosion. In 1989 each resident with a house on the shoreline was issued 2 gabion baskets by the Autonomous Bougainville Government to mitigate the effects of coastal erosion. These gabion baskets, comprised of a large wire mesh rectangular enclosure that is filled with coral rubble, have long since deteriorated. Locals now use fishing nets packed with household rubbish and coral "stones", which they acquire by hammering into the patch reef in front of the village island or gather from the reef passages. It is strenuous work to continuously build and repair these seawalls, especially during northwest prevailing winds when the waves regularly knock the coral and rubbish-filled nets out of place (photo 2). As one man claimed: "my son, and his son, and his sons after that will be repairing this seawall". This statement highlights the common notion that, despite having access to reports detailing climate change prophecies, many Takuu Islanders believe that the island will be habitable for a long time to come. Views on the efficacy of the seawalls are divided, yet this temporary fix is giving those residents that believe in the seawalls' effectiveness an illusion of control and agency over the impacts of the global phenomenon of climate change. By continuing to invest time and energy into seawall construction and maintenance, some residents view themselves as being able to negate any future detrimental effects of shoreline erosion, despite increasing concern and consensus in the scientific community that these deleterious impacts will prove inescapable for large parts of the Pacific region.

The third widely cited environmental change was the incursion of saltwater in the garden island affecting staple crop cultivation. Salinization due to sea level rise was highlighted in *There Once was an Island* (March and Collie, 2010) as one of the main impacts of anthropogenic climate change. Yet, in interviews, residents revealed that the problem of salinization had been persistent for as long as they could recall, and previous generations had also lamented this occurrence. One informant stated that "after the scientists came", namely the geomorphologist Scott Smithers and oceanographer John Hunter who provided some scientific background for *There Once was an Island*, he had come to realize that it was solely attributable to anthropogenic climate change. While these scientists did not provide data on the rate of saltwater incursion into the gardens, following their visit a few residents already aware of the potential impacts of climate change became more alarmed about their future ability to cultivate staple crops on Takuu. In other words, information from these outside actors had, in the case of the taro gardens, inflated perceptions of existing local environmental perturbations and attributed a new singular causation to it.

While unpredictability of weather patterns, increased shoreline erosion and salinization were widely cited as being the most dominant environmental changes occurring on the atoll, these changes were not discussed often in daily life. Discourses of more immediate and pressing concerns, namely lack of shipping services and of livelihood opportunities,circulated much more dominantly on Takuu.

Lack of shipping services

Infrequent and irregular shipping services is the main concern voiced by the residents of Takuu, vastly overshadowing any mention of concerns over environmental perturbations. During the time of fieldwork and at present, there is no ship routinely servicing the islands. Throughout the 1980s, during the peak of the economic boom brought about by the Panguna copper mine on mainland Bougainville, ships traveled from the port of Kieta to Takuu on at least a quarterly basis. During the 1990s, a rise in tensions between local shareholders and the provincial and PNG national government over disproportionate sharing of benefits from the mine ultimately lead to the decade-long bloody Bougainville conflict (Regan, 1998). Des-

pite this, the MV Sankamap was commissioned as the "atoll ship" and made routine visits to the island. The MV Sankamap was followed by the MV Sankamap II in the early 2000s, but by 2008 both ships were out of commission. The MV Sankamap II now sits rusting in Buka passage, providing a powerful symbol for Takuu Islanders that reinforces a widely held perception that they have been overlooked and neglected by the Autonomous Bougainville Government and Papua New Guinea as a whole.

PHOTO 3. – The MV Marunga II, loaded with supplies for the atolls, arriving at Nukumanu on a round trip from Buka to the Carteret Islands, Takuu and Nukumanu (Tasman) and back, 2014 (© Anke Moesinger)

Ships are now sporadically commissioned by the provincial government, and occasionally by Members of North Bougainville in the PNG Parliament. Since 2008, the ships came from other ports such as Port Moresby and Lae to bring supplies to the Bougainville atolls, including Takuu, the Carteret Islands, Tasman Islands and Fead Island, and transport students to schools and back, along with other passengers. Over the span of two years between 2013 and 2014, the MV Marunga II (photo 3) was commissioned and only made three trips from Buka to the Carteret Islands followed by Takuu, Nukumanu, and back. Thus, store-bought items including food, clothing, medicine and hygienic articles are often in short supply and run out for months before the next ship or small powerboat arrives. Small powerboats, some no more than 7 meters in length, thus make the perilous journey from Buka passage to Takuu a few times a year, usually with no more than a single 40 or 60 horsepower motor attached, to bring supplies or pick up sick villagers (photo 4).

When I asked Takuu Islanders about what things they have heard about climate change or, alternatively, their perceptions of environmental changes, these inquiries were often met with statements such as "if the ship would come more often, we would not have to worry about this". Not only does this underscore a dependency which Takuu Islanders have developed following regular monthly shipping services during the 1980s and 1990s, it also drowns out any concerns about the continued habitability of the atoll from increasing environmental perturbations. The climate change messages circulated by external actors such as scientists, global media reports and returning Takuu Islanders, while acknowledged, are largely overshadowed by more immediate concerns over lack of services.

There is a common notion on Takuu that an abundance of material goods such as store-bought food items negate current or future environmental disturbances, and climate change predictions are thus, at present, largely disregarded by Takuu residents when shipping services are restored. This is perhaps because the concept of a future where Takuu is rendered uninhabitable appears as an abstract concept to many, while a more comfortable lifestyle with material goods provides an immediate tangible benefit. With the regular arrival of a ship carrying rice, flour-based products, and other store-bought commodities, local residents were less inclined to discuss and focus on saltwater incursion into the taro gardens or increasing unpredictability of wind patterns affecting fishing practices. Any detrimental environmental changes were perceived less when there was not a great need to rely solely on natural resources for dietary needs. One potential reason for this is that a surplus of store-bought goods after the arrival of a ship temporarily shifts local residents' focus away from the subsistence practices that are otherwise necessitated on the atoll to ensure livelihood needs. Hence, in the context of this temporary decline of fishing and gardening activities, rapid environmental changes may go unnoticed to some degree. Alternatively, perceptions of the scale of environmental changes are magnified in times of stress when store-bought resources are scarce and residents interact more on their surrounding environment to meet their livelihood needs. Frustrations over infrequent shipping services has also led more residents to relocate to towns and cities in other parts of Papua New Guinea, especially those desiring the security of knowing they can reach healthcare and other facilities in times of need.

Population Mobility and Exposure to Climate Change Information

Demographic Changes

A comparison of the two ethnographic censuses conducted during fieldwork between two ship arrivals on January 15, 2014 and March 25, 2014, respecti-

Photo 4. – A heavily laden banana boat (skiff) preparing to leave Takuu for the return journey to Buka, 2014 (© Anke Moesinger)

vely, highlight significant changes in the island's population structure. During the January 15, 2014 census, the atoll had a population of 303. When the MV Marunga II arrived in Takuu from mainland Bougainville in March 2014, 58 individuals boarded the ship to leave Takuu and were replaced by 71 individuals who were returning home after residing on mainland Bougainville or elsewhere in PNG. Post ship, Takuu thus had a population of 316, only 13 more individuals than the initial census conducted two months prior. However, roughly 20 percent of the atoll's population had changed completely. In fact, the majority of the atoll's population had already experienced town life at some point for extended periods of time (at least one year). From the age of 16 to around 30, youths tend to emigrate to go to school, look for employment, or seek a different atmosphere than the perceived conservative one than the atoll allows for. By remaining on the island, youths are under the watchful eye of village elders and family members living in close proximity, and they are required to participate in subsistence activities. The close living conditions as well as various local codes of conduct are thought of by many youths to be more restrictive than the relative anonymity afforded to them in more populated urban settings, where they have more freedom to meet diverse people and have access to commodities like electricity, mobile phones, internet connections, betel nut, and a variety of alcohol. However, men and women aged 31-35 tend to move back to the atoll to raise their children, since living in urban centers is frequently a financial hardship. Then women often stay behind on the atoll, while men between 36 and 45 commonly leave again in search of employment in the oil, gas, gold or copper mining sector. The overall local population has decreased markedly over the past 20 years for all these reasons (table 1). Deleterious impacts from climate change, however, were not an articulated reason for migration during the time of this fieldwork. Though the global media often presents a monocausal narrative of migration as climate-related relocation, for Takuu the prediction of "it could be months, at most five years, before the waves swallow their houses" did not come to fruition (Marks, 2000). A certain amount of deniability has thus been built up among some residents due to failed past predictions.

Exposure to Climate Change Messages in Urban Centers

In urban areas such as Buka, Port Moresby or Lae, residents who travel off Takuu are exposed to myriad sources of information that are limited or inaccessible on the atoll. Newspapers such as the PNG Post Courier, national and international television stations, radio broadcasts and the social media all serve as a conduit to spread media narratives of climate change impacts, said to be occurring throughout the wider Pacific, to the Takuu diaspora. These reports largely note widespread sea level rise, increased flooding and rapid erosion of shorelines in other areas such as Tuvalu, Kiribati and the Marshall Islands. For social media such as Facebook, which is widely used by Takuu Islanders residing in urban centers, information is often circulated without rigorous fact- checking standards. While a Facebook group named "Mortlock (Takuu) Island Climate Change Association" exists, it only has 74 members and there are limited posts, that do not really discuss climate change issues, but rather other topics like provincial political appointments, food supplies to be distributed to the Bougainville atolls, and disruptions in telecommunication services. This is in contrast to Takuu's neighboring atoll of the Carteret Islands, where the local climate change NGO named Tulele Peisa has made global headlines and solicited funding for well over a decade. Takuu Islanders living off the atoll, however, have yet to mobilize and form concrete plans for future mitigation and adaptation measures in the face of environmental changes. This is likely because they are chiefly concerned about restoring transportation services, although Takuu Islanders in

Table 1. – Census figures at various dates, Takuu Island (Adapted from Moyle, 2007)

Year	Population	Source
1884	64	Churchill 1909
1950	274	Boag and Curtis 1959
1957	356	Boag and Curtis 1959
1969	530	Willis 1970
1980	508	PNG 1980 census
2000	443	PNG 2000 census
2002	491	Village census; Sep. 2002
2014	303	Moesinger Village census, Jan.
2014	316	Moesinger Village census, Mar.

Buka are continuously exposed to the climate change debates and developments thereof occurring on the Carteret Islands. Takuu Islanders residing in urban centers and more exposed to various forms of information were more likely to perceive climate change predictions disseminated by the media as a more imminent threat. After being exposed to both traditional and new media reports in urban centers, information is subsequently relayed by word of mouth to family and other island residents when returning to the atoll.

Climate Change Interpretations on Takuu

All residents interviewed on Takuu claimed little understanding of the exact scientific underpinnings of the climate change phenomenon. While one may take this observation for granted given the geographical isolation of the atoll, Takuu's population is still exposed to climate change narratives through reading old newspapers brought when ships arrive, listening to radio reports, and from community members who have traveled to other parts of PNG, Melanesia and beyond. In this context, the predominant messages of climate change circulated on the island often come in the form of poorly-sourced and potentially alarmist media reports echoing notions such as "sinking islands". This can undercut future adaptive measures being enacted at the local level for two reasons: 1) respondents are stripped of their agency and view themselves as victims in a losing global battle or 2) respondents believe that outside actors have little knowledge of what is actually occurring on Takuu and believe reports to be largely inflating the dire environmental conditions on the ground. While few respondents claimed that, after being exposed to these reports, they see no way of continuing to reside on Takuu, most took the opposite view and mocked the notion that outside actors view them as not being able to remain on their island home. Despite the ubiquity of alarming climate change narratives about Pacific island nations that they had access to, most Takuu islanders felt anything but helpless. Residents on the atoll who had not spent significant time (1 year or more) away from the atoll in recent years were quicker to either dismiss reports of shoreline erosion, flooding, and sea level rise. Several informants came to believe that the media reports were wholly inaccurate, written by journalists with no first-hand knowledge of the local cultural and socio-economic context. As one man, aged 38 years old, stated:

"They say that the island will sink by 2015. Well, that is next year. Have a look around, we are sitting and drinking and enjoying our Christmas celebration. They just make it up, that nonsense. Next year you and I will still be here."

A woman, aged 44, expressed a similar sentiment:

"I was here when the scientists (oceanographer John Hunter and geomorphologist Scott Smithers) came. And I watched the movie ("There once was an island"). You can't listen to all of that climate change talk anymore. They keep saying that we are about to sink. And still nothing happens. They've been saying it for 20, 30, even 40 years."

Some informants further perceived media reports to be wildly exaggerated and used for mere politicking by local and national government officials aiming to manipulate the population to relocate to the mainland. They believed the Provincial Government would rather relocate the population to the mainland than continue to incur heavy costs to commission ships to service the atoll region. One villager, aged 34, stated his opposition to relocation:

"People don't need to move. The ABG (Autonomous Bougainville Government) comes and talks about climate change to get more votes during elections. They keep talking about it but there are no solutions after the election. Personally, I don't want to go to Banio (plantation). My life won't be very good-not the same as here. I'd be losing my culture, but mostly, many fish…I don't think the island is sinking."

The notion held by many that media reports are inaccurate, yet still used by provincial and national governmental actors to force relocation, is further amplified by the perceived unwillingness for these government officials to assist the local population in creating more livelihood and economic opportunities.

Livelihood opportunities

Livelihood options play a crucial role in how Takuu residents interpret climate change messages. Many employment opportunities available to surrounding areas are not viable in an unconducive atoll environment. The labor-intensive copra trade collapsed during the 1980s, and the limited space and lack of fertile soil makes cocoa production, a major economic contributor on mainland Bougainville, impossible.

The main employment opportunity on the atoll since the early 1980s has been the harvesting and selling of *bêche-de-mer* (sea cucumbers) to buyers from mainly Hong Kong, Singapore and Taiwan. While quantitative data from *bêche-de-mer* exports is scarce, one account reports a total of 3.69 tonnes produced on Takuu from January 1982 until December 1983 (Dalzell, 1990). 2.60 tonnes and 12.08 tonnes were produced by Fead Island and Carteret Islands, respectively, over the same time frame for a total of 18.37 tonnes. The main target species remains the white and black teatfish (*Holothuria fuscogilva* and *Holothuria nobilis,* respectively). Informants listed 14 other commercially viable species of *bêche-de-mer*, with prices soaring prior to the closing of the harvesting seasons by the PNG National Fisheries Authority (NFA) in the late 2000s. In the example of the white teatfish, prices ranged from 190-200 Kina/kg during the season and increased up to 310-320 Kina/kg just before the season closes.

Interestingly, none of the fishers interviewed on Takuu believed that bêche-de-mer would go extinct on the atoll from overharvesting. However, due to un-

sustainable harvesting in some provinces, a national moratorium was passed by the nfa in 2009, enacted in 2010, and was extended annually until 2017. This ban on the harvesting and sale of bêche-de-mer forced Takuu residents to be almost entirely dependent on remittances. This further bolstered their reliance on shipping services in order to receive funds, in a context where there are very few livelihood opportunities besides the sale of bêche-de-mer. Data from the png 2012 National Election shows that, of the 283 Takuu residents included in the election data, 167 women considered their primary role as taking care of "household duties". Men identifying as subsistence fishers and subsistence farmers totaled 57 and 36, respectively. Church workers do not receive a salary on the island. Thus only 19 out of 283 residents included in the election data received an income during the previous year, and this was due to involvement in local level government, or Council of Elders (called Community Government as of 2019), in positions such as Chairman, Vice Chairman, Executive Officer, Women's representative, Youth representative, and a Church representative. While about 40 fishers harvest *bêche-de-mer*, all the residents of Takuu, and family members residing elsewhere, benefit from this export.

As in the rest of the Bougainville atolls, Takuu Islanders have been negatively affected by this ban from 2010 to 2017, furthering marginalization and resentment towards the government for their continued failure to deliver promised aid such as monetary compensation and extra bags of rice and sweet potato for affected families. In 2017, the NFA determined that *bêche-de-mer* stocks had presently adequately recovered, and the harvesting season is opened for a short time each year. When the harvesting season was opened in 2017, the total allowable catch (TAC) for all of Bougainville Province was 28 tonnes (Tarawa, 2017); the same TAC was set for the 2018 harvesting season . The brevity of the 2017 and 2018 harvesting seasons led to fewer boats being chartered in that timeframe, thus Takuu Islanders have not (yet) benefitted as greatly from harvesting of *bêche-de-mer* for Asian markets as compared to before the ban. Two informants residing in Buka estimated that the total export of *bêche-de-mer* from Takuu for 2017 and 2018 were less than 1 tonne and 3 tonnes, respectively, harvested by a total of around 30 male fishers and approximately 10 women who gleaned them from the reef crest and in the shallow water around the islands. For 2018, this provided a revenue estimated between 50,000-70,000 Kina (14,700-20,580 USD in late August 2019), much of which was then circulated on the island for household goods and services such as payment of school fees and purchase of material goods such as petrol, generators, solar panels, hygienic articles, non- perishable food items and medicines. Income from the sale of *bêche-de-mer* also allows Takuu Islanders to charter boats more frequently to bring these supplies and transport sick passengers in the event of an emergency.

Takuu islanders aspire to the same kind of development that is increasingly taking place elsewhere, and the climate change narrative widely circulated by the global media may indeed be largely obscuring current developmental challenges in the region (Kelman, 2014). The lack of income generated by *bêche-de-mer* during the years when harvesting was banned, coupled with infrequent shipping services, has stripped local residents of many necessities and comforts. This, along with an increasing exposure to external climate change messages through local mobility has increased a development-oriented uptake of an outsider climate change prophecy. Feeling largely left behind as globalization occurs, some residents stated that they could use the climate change message to their benefit, to fulfill their desire for development not met due, in particular, to the *bêche-de-mer* ban. This instrumentalization of the climate change message was observed to be applied at three different levels: the international audience, the provincial and national governments, family networks. This narrative imposed on them by outsiders could perhaps be used, they thought, to attract the Western nations' and international NGOs' sympathy on them and thereby increase their development aid. When government officials from the provincial and national levels come to Takuu, some also admitted to overexaggerating impacts so that they may receive compensation or increase services that would make their lives more comfortable on the atoll. One woman on Takuu, aged 62, introduced another aspect, related to communication with family networks:

> "Villagers here will say that the island will sink. They lie to all of the family members and others in town and that they don't have any food or supplies because of the weather. But the fish is usually hanging in the basket. Every time a wave comes now, they will call town over the satellite phone and ask for help. But these changes are nothing new."

Takuu residents are keenly aware that outsiders, including Takuu Islanders residing off the island, think that the atoll is at high risk, but have no real oversight and seem not to understand, or worse yet, care about the essential needs of the islanders. For instance, Takuu residents are largely dependent on aid from the Autonomous Bougainville Government (ABG), which continues to provide them with large rain tanks to ensure adequate fresh water supplies are available in the event of a drought, even though this is no longer needed. In early 2014, Nukutoa island already housed more than 20 tanks, and 3 more arrived on the March ship. Even with months of drought, water supply would not be a concern due to the surplus of rain tanks. In this context, when ABG officials arrive to discuss options about climate change adaptation, their messages are largely disregarded because of the held notion that any agenda that the government is pursuing is self-serving and

not well- informed about the current needs of the local population.

Discussion

A glaring contrast exists between global media reported narratives of climate change in the Bougainville atolls and the local reality with regards to the severity of environmental conditions, the causes thereof, and the impact that it has on the local populations (Connell, 2018). Media reports on climate change predominantly put forward a monocausal narrative that the effects of climate change are the primary driver of migration and is thus creating "sinking islands" and "environmental refugees". They often take an overly simplified "garbage can" approach, attributing migration and other changes solely to the effects of anthropogenic climate change, yet the reality experienced on Takuu, as in many low-lying South Pacific islands, is much more complex (Connell, 2003, 2018).

Despite the geographically remote location of Takuu, the atoll's residents are still caught up in the flow of narratives about climate change, and they refashion them to their worldviews. While they perceive various environmental changes such as unpredictability of weather patterns, salinisation of garden plots and shoreline erosion, the majority are not overly concerned about any imminent catastrophic impacts and necessary large-scale migration as portrayed by outside media reports. Environmental concerns are trumped by socio-economic ones such as inadequate transportation services, insufficient healthcare, and lack of employment opportunities, even though the effects of climate change may soon compound these problems and the development challenges people face.

Media reports of sea level rise and other environmental changes attributed to climate change provide a benefit in some instances by increasing aid funding for local adaptive strategies especially in isolated areas. However, conservative/apocalyptic predictions also undermine future credibility when they do not come to fruition in a rigid projected timeframe. When projections of environmental impacts of climate change necessitating extreme mitigating and adaptive measures do not occur, Takuu residents begin to view them as baseless, and they begin to wholly dismiss them. This impacts reception of the climate change message by making residents potentially less likely to enact adaptation measures that will strengthen local adaptive capacity when future environmental perturbations arise. Alternatively, scientific or media reports shape some residents' perceptions by confirming local observations, such as salinization of the swamp taro gardens. For these residents, these reports shift perceptions away from thinking about many environmental changes as cyclical and bolsters a view among some that total destruction of their island home is inevitable.

While insular regions, by their very nature, all face some similar environmental challenges, the specificities of key cultural and socio-economic contexts are overlooked in media accounts and in some adaptation planning as well. In the example provided in the introduction, the report noted that residents of Tuvalu, Kiribati, Torres Strait, Carteret Islands and Takuu would be imminently displaced. The regions cited together are both geographically and culturally miles apart. The two closest and neighboring atolls of the Carteret Islands and Takuu have different languages, customs, traditions and, in some aspects, socio-economic circumstances. The roughly 1,200 Carteret Islanders reside on an atoll with a landmass of around 60 hectares, while Takuu's 316 residents live on 90 hectares, 74 of which is taro gardens. This gives rise to potentially disparate scenarios surrounding present and future food security and other challenges said to be exacerbated by climate change in coming times. If future adaptation plans are to be meaningfully implemented, a site- and context-specific approach is paramount.

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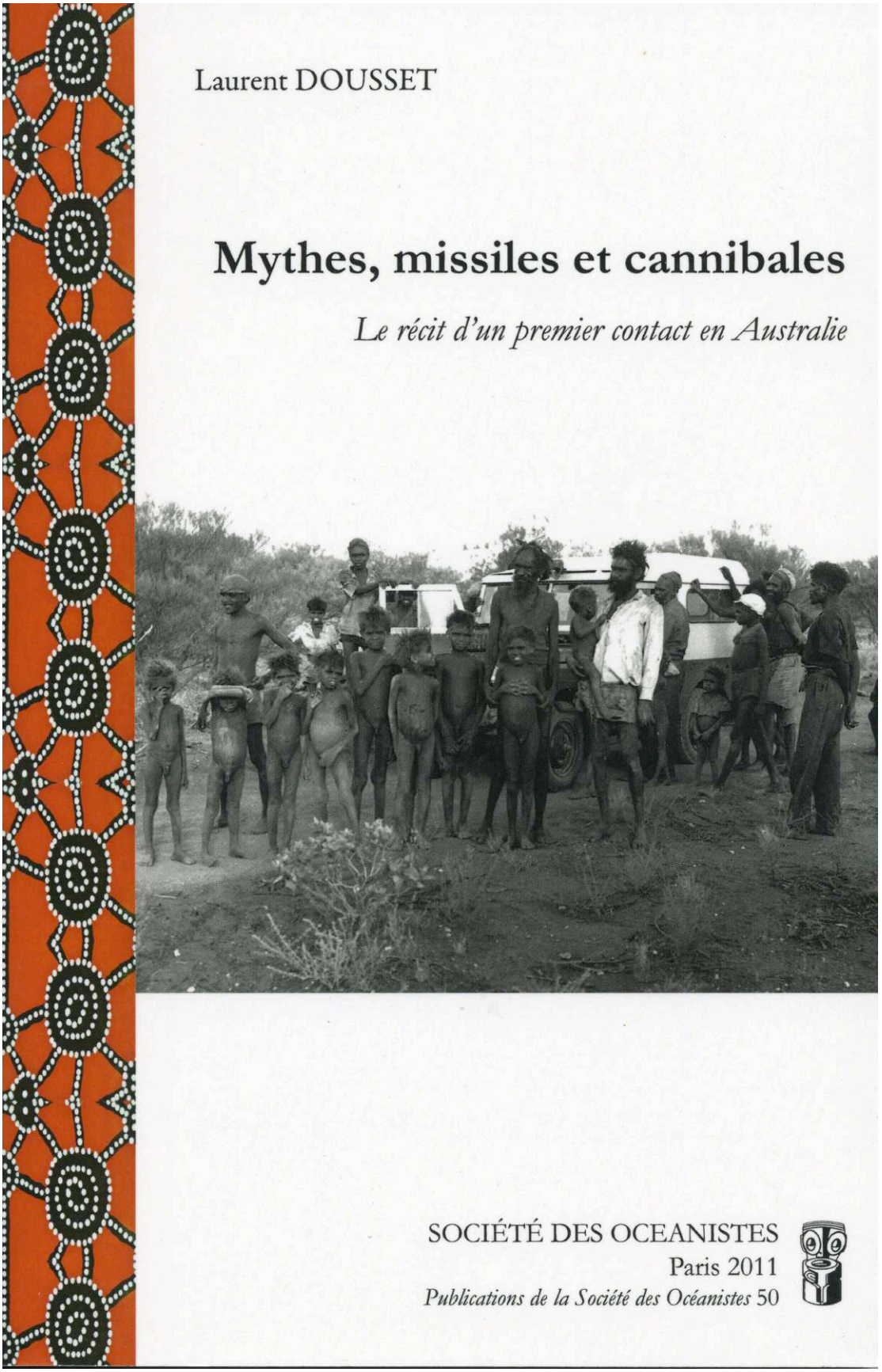

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