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BACKGROUND PAPER:

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Preamble

Everyone knows islands are different. People who have lived most of their lives on islands think of them as normal, regarding vast, almost-limitless landmasses as alien. People whom as adults encounter islands for the first time may wonder how anyone reached such apparently marginal places and can continue to survive there today. These differing perceptions of islands and their inhabitants demonstrate their commonalities but also explain why, in today's globalized world, islands are often portrayed as fragile environments, uncommonly exposed to global climate change.

At the other end of the scale, global challenges nurture global responses. A UN Framework Convention on Climate Change (UNFCC) was proposed at the 1992 'Rio Summit' and adopted in 1994: practically all countries (called 'Parties to the Convention') have signed on. Pursuant to the goals of the UNFCC, the Intergovernmental Panel on Climate Change (IPCC) provides periodic scientific assessments of climate change and its political and economic impacts: it was awarded the Nobel Peace Prize in 2007. And in December 2015, the 21st annual 'Conference of the Parties' (hence COP 21) met in Paris and negotiated an agreement to set a goal of limiting global warming to less than 2 degrees Celsius (°C) compared to preindustrial levels.

This Paper

This paper discusses why islands should not be treated like continents and how, be they islands in the middle of an ocean or part of a continent, they have shared physical and cultural characteristics that justify them being placed in a single category of places on Earth. The ways people live on islands today are often not sustainable, typically owing to their increasing continentalization[1], and likely to be stressed by future climate change. The paper reviews selected types of past impacts of climate change on island environments and societies and explains the most widespread types of likely future impacts.

This paper also shows that most islands are not inevitably highly exposed to climate change but that both their ecosystems and societies have much inherent resilience. Future climate change will bring both opportunities for harnessing and strengthening that resilience but also challenges that will inevitably require adaptation by island peoples to ensure their continued occupation of islands. The paper concludes by proposing that the best chance for islands in the future to realize shared opportunities and challenges is to allow their leaders to speak with a common voice.

1. Islands and continents; what is 'normal'?

In the 1770s, when Captain James Cook found himself sailing repeatedly across the Pacific Ocean in search of *Terra Australis*, sighting populated islands hundreds of kilometres apart, he asked "how shall we account for this nation spreading itself so far over this vast ocean?" In this he echoed the bemusement of many continent-bred persons of his age who encountered a vast ocean peppered with islands. It seemed obvious to many such people that there must have once been a continent in the Pacific (because having an ocean covering one-third of the planet's surface was clearly not 'normal'), something that led to the enduring belief that continents had 'vanished' here and in the Atlantic and Indian Oceans[2]. Contrast this with the long-held view of Pacific island peoples that they occupied an 'ocean filled with islands', one they crossed at will, maintaining long-distance support networks entailing voyages of sometimes thousands of kilometres[3].

Such diverse views of islands within the world's oceans demonstrate the importance of perception in evaluating livelihood possibilities of islands compared to continents. For islands, be they located within an ocean thousands of kilometres from their nearest neighbour or along the fringes of continents, are different; they cannot be adequately understood as continents in miniature[4].

2. Why and how are islands different?

Irrespective of their locations, islands differ from larger landmasses because of their boundedness; their terrestrial limits are rarely forgotten by their inhabitants, particularly on smaller islands[5]. Indeed, on many, the surrounding water may appear omnipresent, both an opportunity and a threat, ever a reminder of what it means to live on an island, perhaps even a major determinant of islander psyche[6].

Islands are ecotones, places where two contrasting ecosystems (terrestrial and oceanic) connect to "create a unique environment different from both".[7] The unique environment is one that is dominated by the coast – in fact many islands are entirely 'coastal' – in contrast to continents where the coast is merely one of numerous environmental units. On most islands, most people live along the coast, a reflection of both the comparative ease of food acquisition there as well as the topographic and trade (overland and cross-water) advantages of such locations compared to others on the same island.

Most islands contain a diversity of potential food-production systems that may appear large compared to total land area. Many tropical islands, for example, are fringed with coral reefs, some of which enclose shallow lagoons, from which food is available throughout the year. These systems might be complemented by estuaries, mangrove forests, coasts, river valleys, and upland areas; in addition, most island peoples access foods from the deep ocean[8]. Inevitably, islands in extra-tropical regions generally have a lesser such diversity although it is clear that island peoples adapted their livelihoods to particular contexts[9].

Compared to larger landmasses, many islands have lower (fauna and flora) biodiversity than continents and a higher exposure to invasive species. The former may mean that options for terrestrial wild-foods are limited, the latter that 'natural' ecosystems may be comparatively easily upset by aggressive new arrivals, including humans[10]. Islands are generally more exposed to disaster than other landmasses. Ocean-sourced disasters (like storm surge and tsunami) are more likely to threaten the viability of (coastal-) island living while atmospheric-sourced ones (like hurricanes) have the potential to wipe out food-production systems across entire islands.

Yet, when you consider that people have inhabited even some of the world's remotest islands for millennia, surviving on most continuously[11], it demonstrates that many island societies have remarkable adaptive abilities[12], perhaps the most significant and widespread of which are the support networks and self-sufficiency exhibited by island communities[13]. Recent responses to short-onset natural disasters in island contexts (like hurricanes, tsunamis, storm surges, volcanic eruptions, and earthquakes) illustrate the conflict between traditional and globalized knowledge. Traditional coping during the aftermath of disaster was well-embedded in cultural practice on many islands[14], although communities that have latterly lost this knowledge are often more vulnerable to disaster impact[15].

Islander responses to past climate changes have been, largely on account of their intergenerational time span, generally less effective: sometimes causing cultural transformation, sometimes cultural collapse, and occasionally leading to islands being abandoned[16]. In recent decades, as the pace of climate change (especially sea-level rise) has quickened on islands, most island decision-makers have adopted global strategies for climate-change adaptation. These have generally proved difficult to localize and on many islands have failed because they are (or appear to be) neither environmentally nor culturally appropriate[17]. The key challenge for future adaptation on many islands, especially those in mid-ocean locations that are governed independently of continental powers, is that this be effective and sustainable. 'Effective' requires that the strategy be appropriate to the environment where it is to be applied and 'sustainable' means that local residents support it and are committed to sustaining it into the future.

3. The world's islands: what have they in common?

Islands occur in a variety of geographical and climatic contexts; they vary in size, relative relief, and population density. Yet owing to the special characteristics of their environments (like boundedness, risk exposure, ocean dominance) and societies (like mutual support and networks, limited human/financial resources, comparatively low populations), they have much in common that set them apart from larger landmasses. This section looks at the commonalities of the global family of islands under four themes: cultural heritage, food security, renewable energy, innovation.

The special nature of (long-enduring) island cultures has been argued as having implications for all of us living together on 'spaceship Earth'.[18] For island people have long realized that individual survival depends on group survival: that assuring your neighbour's well-being ultimately ensures your own. Much **cultural heritage** on islands reflects this; there are cultural practices celebrating times of plenty just as there are adaptations to time of less; there are monuments (tangible heritage) erected to implore the gods to relieve hardship[19] and there are often rich bodies of traditional (oral) knowledge that contained ancestral wisdom (intangible heritage) to ensure that each subsequent generation was as prepared as possible to survive in an island environment[20]. Today, it is clear that some island cultures are inherently well-equipped to deal with environmental adversity[21], others less so, and that there is value to incorporating culturally embedded information into plans for future climate-change adaptation[22].

Embedding **food security** in island societies was achieved in many ways: through intensified production systems (like irrigation, terracing), through food-preservation techniques and the routine production of surpluses, and through the empirically informed management of (integrated) food-production systems. Such supply-focused strategies were complemented by demand-reduction ones on many islands, ranging from infanticide and warfare to ones involving use of appetite inhibitors (like *kava*). Today, while most island societies exhibit more globalized consumption behaviours, there have been calls for traditional practices to be revived in order to achieve sustainable production[23].

All island societies today need energy and most depend on imports for this. With their traditional emphasis on self-sufficiency, island cultures are often well-configured for strategies that involve producing their own energy and, in geographically constrained contexts, these most likely involve renewables. Wave and tidal power are hardly used on many islands but, owing to their lengthy coastlines, clearly have the potential to be used more. The same is true of wind power. The use of hydro-, solar, and other types of **renewable power** is more context-specific. Today, many islands have overcome the challenges associated with their small markets (and comparatively high distribution costs) to generate significant amounts of renewable energy[24].

As histories of long-established island societies show, **innovative solutions** to the vagaries of island living proved essential to survival. The initial colonizers of many islands sought simply to replicate the ways they had lived on continents, but most groups, upon seeing the effects this was having on (wild-) food supply, later developed strategies that were better aligned with both the limits and the opportunities afforded by island environments[25]. Today, realizing that continental solutions are often unworkable, many island governments have started to make bold decisions both about how to improve life for their inhabitants but also how best to shield their livelihoods from future climate-change and other environmental stressors[26].

4. Climate change and islands

The chapter on 'small islands' in the 5th Assessment Report of the IPCC[27] identified four major future climate-related risk drivers: sea-level rise, hurricanes (tropical cyclones), increasing temperatures, and changing rainfall. While it is important to acknowledge the great diversity of risk profiles, insularity confers commonalities in exposure to risk that justifies islands being regarded as a distinct group of global environments[28].

Of these risk drivers, ***sea-level rise*** is the most widespread and potentially most concerning in terms of its impacts on human livelihoods. In the Pacific, the world's largest ocean, there is considerable longitudinal variation in the rate of recent sea-level rise; from negligible in the east, to around average (3-4 mm/year) in Fiji, to some of the highest rates in the world in western island groups (10-12 mm/year) like Solomon Islands and the Federated States of Micronesia[29]. On most islands, sea-level rise causes erosion/recession of soft shorelines, amplifies both the frequency and magnitude of coastal-lowland flooding, and increases groundwater salinization. Islander responses to the associated problems have been mostly piecemeal, not cognizant of the long-term nature of the underlying climatic stressors [30].

Shoreline erosion has generally been tackled by emplacing hard-structure solutions, most of which in rural/poorer island contexts have failed to remain in place for more than 18-24 months, many of which degrade inshore environments and sometimes cause erosion to intensify elsewhere. Revegetation of eroding shorelines has often proved a more sustainable solution[31]. As a result of shoreline erosion, atoll islands in many tropical oceans may 'disappear' as a result of rising sea level within a few decades[32].

Along many of the world's coasts, but critically in island contexts, coastal-lowland flooding is commonly regarded as similar in cause to historical floods, most planners failing to acknowledge the connection between an observed increase in the frequency and magnitude of lowland floods and sea-level rise; it is common to attribute such flooding to upstream land clearance or storm intensification [33]. Responses reflect the usual interpretation of lowland flooding as precedented and involve river dredging, increased artificial drainage, and even diversion of river mouths. Many coastal-island locations, particularly those where relative sea-level rise is amplified by subsidence (as in deltas), will experience increased numbers of (severe) floods in the future, so more far-sighted solutions (like relocation of people from areas most severely affected) are needed.

Groundwater salinization is a major threat to lowland agriculture and aquifers in many island contexts. Many crops that people have been accustomed to grow in island lowlands are saline-intolerant[34]. Although this is a problem destined to worsen, little long-term action has been put in place on most affected islands, perhaps because there has to date been only slight economic impact. The only long-term option involves relocation of vulnerable agriculture to less vulnerable areas, something that requires its diversification in many islands, and identification of new water sources.

Hurricanes affect many (near-) tropical islands and can have devastating effects on islander livelihoods[35]. Recent increases in intensity of the strongest events seem likely to continue, so it is a priority for islanders to adapt their food production (and other essential aspects of life) to the impact of these. At the heart of adaptation is education: awareness-raising of what might happen and how society should respond in order to minimize impacts. This is not easy of course, but awareness of similar hazards has been helped by an understanding of the nature of appropriate responses in pre-globalization times[36].

Rising temperatures may benefit many island economies by extending growing seasons and increasing ecological dynamics, for example, on cooler-climate islands[37], but will inevitably impact negatively elsewhere. For tropical islands, some of the most profound impacts will arise from thermal stress of coral reef ecosystems on which most islanders depend[38].

Yet the most serious effects on island ecosystems (including food-production systems) will come from ***changing patterns of rainfall***, something that is still not able to be adequately forecast for most island situations. The uncertainty surrounding future rainfall (annual, seasonality, event intensity) has led many island planners to ignore potential effects of future changes.

Associated with direct climate-change risks are those originating offshore that affect islands, which are particularly vulnerable owing to their comparative smallness, their boundedness, and their often low levels of biodiversity. Offshore risks include airborne dust (from the Sahara and Asia) and ocean swells originating from distant sources[39]. Climate change, manifested as sea-surface temperature increases, is causing perhaps unprecedentedly rapid migrations of ocean species which may result in their introduction (as invasives) to island contexts. For the same reason, the spread of aquatic pathogens may be facilitated by a warmer climate[40].

Yet if the physical vulnerabilities of islands to climate change appear well-known (above), the mechanics of how island jurisdictions might adapt to these in order to ensure minimal disruptions to the way their people live are inevitably less certain. A key issue is jurisdictional autonomy – how much control a particular island has over its future – for, with little, the special situation of islands is more likely to be sidelined than in situations where islands have a high level of self-determination. Another key issue is the timeline for effective and sustainable adaptation on islands that is often something mapped conservatively because of the political context in which it must be framed; adaptive actions that have economic impacts are less palatable to the electorate than no-regrets or cost-neutral adaptation; short-term (quick-fix) adaptive action is generally more popular than longer-term, more disruptive actions – even those that may be well-understood by island decision-makers to be the better investments.

5. Key questions

Islands are often popularly portrayed today as being on the 'front line' of climate change, the 'canaries in the coal mine' that will experience its full impacts soonest. Besides being driven largely by media hype[41], such negative views contribute towards a widespread global pessimism about the futures of many islands. In reality, while climate change poses many challenges for islands and their inhabitants, it also creates many opportunities for development that might otherwise have been overlooked or sidelined. This section looks in turn at the principal opportunities and challenges for island peoples arising from the various aspects of future climate change, followed by a number of 'key questions' that may merit further discussion.

5.1. Opportunities

Cultural heritage

There is solid evidence showing that reinforcing (rather than surrendering) cultural identity helps particular groups, like those on islands, cope better with adversity, specifically that which may arise from climate change. Rediscovering earlier food-production systems (see below) and acknowledging that an essential key to sustainable living on islands necessitates a degree of societal cohesion and interdependence rarely found elsewhere are good examples. There are thus practical advantages in renewing cultural identities through an understanding of both tangible and intangible cultural heritage in ways that are inclusive, meaning that heritage is understood as being a celebration of island life, as relevant to today's islanders as to those centuries earlier.

Food security

Particularly since becoming part of a globalized world, typically within the last 50-150 years, most island ecosystems have been managed in increasingly unsustainable ways: typically a result of increasingly less-diverse food production focused on non-subsistence markets, the spread of the cash economy, and increasing (coastal-) population densities[42]. The unwelcome effects of this, especially on diet and health, have been widely documented[43]. On islands, future climate change will stress many food-producing systems, especially in coastal areas; costs of food imports will inevitably rise owing to climate impacts on food production elsewhere (particularly on continents). An opportunity – some might call it an imperative – exists for island peoples to consider ways of producing more food on home soil, perhaps by reviving/adapting methods that their ancestors used in pre-globalization times[44].

As elsewhere, climate change is forcing many communities and countries to identify and excise inefficiencies in their systems of food production and consumption[45]. An opportunity exists to overhaul inefficient management systems more generally as a result of climate change. Indeed, there is a linked opportunity for other development challenges, especially those associated with disasters, to be met by the same kinds of adaptation in island contexts, thereby reducing the human and financial resources needed[46].

If climate change is giving island communities the opportunity to look farther into the future to minimize its undesired impacts on livelihoods, then it might also be seen as encouraging island communities to look farther into their pasts to identify what – on many islands – made ancestral communities more resilient than many currently appear to be[47]. Such backward looks might involve food production (see above) but also details like the once-low dependence on imports (surely uncharacteristic of island societies) and the location of former settlements in places that were less (rather than more) than averagely vulnerable[48].

In addition, climate change gives island peoples an opportunity to reassert their 'islandness', to question and perhaps redefine what their relationships with people beyond their shores should be. This is not about a naïve otherness but about practical changes to the ways islanders interact with others. It might involve trying to reduce (costly) import dependence, to grow more food on-island; or, within island groups, it might involve low-profit trade arrangements, and formalizing the provision of mutual support in various situations[49].

Renewable energy

Climate change might be regarded as a catalyst for renewable energy development on islands. The alternative is to continue accessing increasingly costly and generally non-renewable energy from sources beyond island shores. The unattractiveness of this option should motivate island decision-makers to invest in renewable energy sources despite the limited economy of scale, knowing that it will be economically beneficial in the long term.

In addition, in an era when low-carbon economies are becoming increasing popular, there are opportunities for islands to develop (even to spearhead the development of) energy sources that lead to 'clean growth'. Renewable energy on different islands could be supplied from different sources but wind and waves seem common and island jurisdictions should closely monitor new technological developments.

Innovation

Islanders have long been innovative thinkers; by necessity, they are some of the world's most innovative (albeit least celebrated). To understand this legacy, and not to subordinate innovation to continental thinkers (in an era of globalization), are perhaps two valuable lessons for people occupying islands worldwide. That the impacts of climate change on islands will require island-specific adaptive solutions is self-evident, but that many of these solutions are not yet fully articulated and need innovation is perhaps less so.

5.2. Challenges

Entire islands are likely to be rendered uninhabitable by rising sea levels in the next 10-30 years, some perhaps even 'disappearing' shortly thereafter. For the same reason, many other islands are likely to have their coastal geographies involuntarily reconfigured within a few decades, something that will create a myriad of challenges for the human occupation of such places. Compared to our ancestors, whose ways of life were also impacted – sometimes quite profoundly – by climate change, we are in the fortunate position of understanding sufficient of its causes to be able to predict the future with a high degree of certainty. What happens to humanity as a result of climate change over the next few decades may be unwelcome, but most of it is likely reasonably well-known today.

For many island societies today, the greatest challenge is bridging the gap between what science says is likely to happen in a particular place and what is currently being planned for. There are numerous examples – from islands and elsewhere – that demonstrate this conspicuous disconnect. In some places, often supported by non-scientific beliefs, there is denial of climate change that is inhibiting efforts towards adaptation[50]. The challenge is therefore more of a psychological and political nature than a physical one: convincing reluctant or sceptical decision-makers at every level (individual, community, sub-national/ island-wide, and national) of the credibility of the science and the associated need for action.

Then there are the physical challenges, the most widespread being those that threaten continued coastal living on many islands[51]. Owing to their high shoreline-to-area ratios, it is generally impractical to construct artificial structures along every part of an island's coast. In fact, even localized seawall construction can impact coastal ecosystems that play key roles in current (subsistence) livelihoods. The only long-term widely applicable solution is relocation of people and activities from vulnerable to less vulnerable areas (in-island or offshore). Relocation is commonly resisted because of its long-term nature (which requires absolute faith in climate-change projections) and the associated expense, which is beyond imagining for many island jurisdictions. For islands in poorer (developing) countries, this provides an opportunity for donor partners to intervene, work with island governments to identify places to which vulnerable communities/towns might relocate, and then underwrite the costs of developing an enabling infrastructure (roads, services).

Other physical challenges refer to the conservation of key food-producing systems; on tropical islands, these typically include mangrove and coral-reef ecosystems, while for most islands, deep-water fishing is generally important. While there is clear evidence that the latter fishery has generally been managed unsustainably, the conservation of mangroves and coral reefs often has to compete with other uses; these include the clearance of mangroves, their use as a source of firewood; the recreational value of coral reefs, yet also sometimes their break-up for aggregate[52].

Meanwhile, discussions at the global level continue apace, and suggest local initiatives: COP 21 established the enhancement of adaptive capacity, strengthening resilience, and reducing vulnerability to climate change as global goals. And COP 22, scheduled for November 2016, in Marrakesh, Morocco, will set its sights on climate finance and adaptation.

For a country like Canada, a bold and proactive approach to climate change would need to address the reduction of future risk – which requires long-term planning that goes beyond normal political life cycles – and not just current risk, and short lead-in operational time-lines. For an island like Prince Edward Island, the smallest Canadian province and the one most at risk from climate change, its very existence may depend on championing and addressing such ambitions.

5.3. Key questions

A. How will reinforcing island-cultural identity help island peoples adapt to climate change?

B. How can an understanding of past (culturally grounded) interactions between island peoples and their environments help manage the future?

C. How does climate change provide opportunities for improving on-island (including near-island) food production?

D. What opportunities exist for improving islanders' nutritional health in a warmer world?

E. What pathways for renewable energy development on islands exist in a warmer world?

F. What are the major opportunities for developing renewable energy within island contexts?

G. How can the innovative abilities of island people be harnessed?

H. How might the importance of island-specific solutions to climate-change challenges be explained effectively?

I. Where are our greatest opportunities, as islanders, in the current policy landscape (international, national, regional, local)?

J. What are the barriers to be overcome in order to engage in more ambitious long-term adaptation (addressing *future* risk and implementation)?

6. A common voice

Island jurisdictions seldom speak with a single voice. Some groups of islands do, like the group of 52 *Small Island Developing States* (SIDS) that was recognised by the UN as a distinct group of developing countries in 1992[53] and has become an effective force in international negotiations through the Alliance of Small Island States (AOSIS). There may be value in either extending such a grouping to include *sub-national island jurisdictions* (SNIJs) – like Prince Edward Island – that are part of other states, or to have a separate grouping altogether – in acknowledgement of their shared geographies, their common cultural traits, their jurisdictional capacity (even if limited), and the similarity of the opportunities and the challenges afforded them by future climate change.

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ENDNOTES

[1] By ‘continentalization’, I mean the tendency of island societies and their interactions with island environments to become more like those of continental contexts. Typically, this entails a loss of traditional island-specific knowledges and coping systems, for example, and a corresponding increase in barely questioned ‘global’ (i.e., continental) solutions.

[2] See Sprague de Camp (1970) and Nunn (2009b).

[3] See Waddell et al. (1993). Examples of long-distance networks are discussed by Fitzpatrick (2008).

[4] It is argued that external interventions on islands “demande en particulier qu’on ne les traite pas comme des milieux continentaux de faible taille; toute catastrophe y a des effets irréversibles” (*requires particularly that one does not treat them [island environments] as simply continental environments on a small scale; a disaster here may have irreversible consequences*) (Doumenge, 1987: 15), a point also made by others (DeLoughrey, 2013; Nunn, 1987).

[5] To me, this does not equate with ‘containment’ that Hay (2013b) then uses to inform his discussion of the psychological character of island peoples.

[6] Of the many expressions of this, perhaps that of Montesquieu in 1748 is one worth repeating. “Les peuples des îles sont plus portés à la liberté que les peuples du continent. Les îles sont ordinairement d’une petite étendue; une partie du peuple ne peut pas être si bien employee à opprimer l’autre; la mer les sépare des grand empires, et la tyrannie ne peut pas s’y prêter la main; les conquérants sont arrêtes par la mer; les insulaires ne sont pas enveloppés dans la conqête, et ils conservent plus aisément leurs lols” (*The inhabitants of islands have a higher relish for liberty than those of the continent. Islands are commonly of small extent; one part of the people cannot be so easily employed to oppress the other; the sea separates them from great empires; tyranny cannot so well support itself within a small ambit; conquerors are stopped by the sea; and the islanders, not having access to [continental] arms, more easily preserve their own laws*) (1844, 18(v): 190).

[7] (Gillis, 2014: 155).

[8] A well-documented example of the integration of island food-producing systems is the *ahupua’a* (integrated land-ocean production systems) of Hawai’i that “represented the foundation of the agricultural economies of the island of Hawai‘i and parts of Maui in the centuries before European contact” (Kagawa & Vitousek, 2012: 161).

[9] These include the food-preservation techniques evolved by the peoples of Fiji (South Pacific) and the Faeroe Islands (North Atlantic) (Aalbersberg et al., 1988; Svanberg, 2015). In the Faeroes, it is becoming clear that early-period livelihoods were underpinned by the sustained management of food resources, especially pigs and birds (Brewington et al., 2015).

[10] Humans provide good examples, from the extirpation of flightless birds and iguanas throughout the Pacific (Steadman et al., 2002) to the extinction of monk seals in the Caribbean (Baisre, 2013).

[11] Following a minimum 2300-km ocean journey about 3500 years ago, people first reached the Mariana Islands (Northwest Pacific) from the Philippines (Hung et al., 2011); their descendants are still there. Around the same time, people set out from the islands of Papua New Guinea to colonize most Southwest Pacific island groups, where their descendants remain (Carson et al., 2013). Outside the Pacific, one of the earliest occupations of oceanic islands was the Canary Islands; 125 km from Africa, Lanzarote was reached around 2900 years ago (Atoche, 2008).

[12] Physical adaptations include the use of rainwater-optimization techniques, like terracing and irrigation, for agricultural production (Bayliss-Smith & Hviding, 2015; Earle, 1980) and the use of food preservation and 'cyclone foods' for surviving disasters (Johnston, 2014). Societal adaptations on some islands involved "infanticide, abortion, and other methods of population control" (McNeill, 1994: 310). It is possible that the roots of modern islander spirituality found in some places may lie in long-held numinous beliefs about islanders' relations with Nature (Nunn et al., 2016a), beliefs that evolved during times of food shortage or adversity. The food crisis around AD 1300 on many Pacific islands that led to an enduring shift from coastal to upland settlement may have seen the start of cannibalism and headhunting (Nunn, 2007: 157).

[13] Among tropical Pacific island groups, "interdependent networks of kin, political allies and economic partners could be called upon by participants finding themselves in times of hardship facing food stress following extreme events" (Campbell, 2015: 1318). Similarly, exchanges dating from 4000 BC in the Caribbean between island communities and continental coastal ones led to the "circulation of commodities, plants, animals, ideas, technologies and peoples" (Rodríguez Ramos, 2013: 156).

[14] In the Pacific, coping ranged from precursor identification (Lefale, 2010) to ensuring sufficient food post-disaster (McNamara & Prasad, 2014). Culturally embedded knowledge in the Philippines helped one island community withstand Typhoon Haiyan better than most (Hilvano et al., 2016). Reciprocity binding together cooperative groups in the Nicobar group (Indian Ocean) made these more resilient to disaster than kin groups, a nuance that is proving useful for future planning (Chandi et al., 2015).

[15] A good example comes from Mota Lava island in Vanuatu. After a 1910 hurricane, people were able to survive by processing and consuming sago – a long-established adaptation to disaster impact – but after a similar event in 1980, most people had lost this knowledge and there was a food crisis (Campbell, 1990).

[16] In western Pacific island groups about 2570 years ago, a (climate-driven) shift of sea level below reef-surface level is thought to have caused a food crisis for marine foragers that led to their relocation and pursuit of different strategies for food acquisition (Nunn & Carson, 2015); a comparable event around AD 1300 led to widespread conflict, even societal collapse (Nunn, 2007). Yet there are a few 'mystery' islands in the tropical Pacific that people apparently abandoned *en masse* when living became too difficult (Nunn, 2007; Weisler, 1996); a similar scenario is applicable to islands off the Australian coast (Bowdler, 1995; Draper, 2015).

[17] There are several reviews of this for islands everywhere (Lane et al., 2013; McNamara, 2013; Nunn, 2009a).

[18] (Hay, 2013a)

[19] (Donner, 2007)

[20] Documented examples of island oral traditions, many intended to ensure survival, come from the Haida Gwaii or Queen Charlotte Islands in western Canada (Bringhurst, 1999) and from the Pacific island groups of Samoa and Solomon Islands where traditions focus on volcanic hazards (Németh & Cronin, 2009; Petterson et al., 2003).

[21] The effectiveness of traditional tsunami early warning systems are exemplified by Simuelue Island in Indonesia (McAdoo et al., 2006) and by Pentecost Island in Vanuatu (Walshe & Nunn, 2012) while that of post-hurricane survival on remote Tikopia Island in Solomon Islands demonstrates the depth of local coping strategies in such places (Yates & Anderson-Berry, 2004).

[22] See for example Mercer et al. (2010). I take issue with Pete Hay's characterization of some island cultures as fundamentally despairing and stagnant – I can't think of any – but do agree that the psychology of most "is enabling, conducive to resilience, resourcefulness, cultural dynamism and a can-do economics" (Hay, 2013b: 209).

[23] This ranges from wetland taro systems on Yap (Nunn et al., 2016b) to the establishment/restoration of marine protected areas (Johannes, 2002).

[24] Examples include the island of El Hierro (Canary Islands) that has become the world's first in modern times to meet the energy demands of its 11,000 residents entirely through renewables (wind, solar, hydro) offsetting 18,200 tons of CO_2 annually from imported fuels (Hallam et al., 2012). At the COP-21 meeting in Paris (2015), the island nations of Samoa and Vanuatu committed to total conversion to fossil fuels by 2025 and 2030 respectively.

[25] Well-aligned strategies of interaction with (sub-) Arctic islands were followed by Inuit but ignored by Norse settlers although they eventually developed diverse community-grounded subsistence strategies that helped them survive on the Faroe Islands and Iceland (Dugmore et al., 2012).
[26] These include the recognition of the special adaptive needs of Outermost European Regions (OERs), which are mostly islands, by the European Union and the various initiatives periodically coordinated on behalf of island countries by the Alliance of Small Island States (aosis.org).
[27] (Nurse et al., 2014)
[28] In this context, it is germane to note that "trying to attribute SIDS' development problems solely to a new and external climate change hazard shifts the focus away from the wider context of SIDS' vulnerabilities to numerous hazards" (Kelman, 2014: 123).
[29] (Becker et al., 2012)
[30] (Nunn, 2013)
[31] Examples of collapsed seawalls in the Pacific islands were documented by Nunn and Mimura (1997). Comments on their global inefficacy in island contexts were made by Betzold (2015).
[32] An empirically grounded study of this was presented by Dickinson (2009). Other studies that show atoll shorelines to be prograding (Testut et al., 2016; Webb & Kench, 2010) have been popularly misinterpreted as meaning that they are not (and perhaps will not in the foreseeable future) be affected by sea-level rise (Nunn, 2013).
[33] See example of Nadi Town in Fiji (Nunn, 2010, 2013).
[34] There are several examples of this. Perhaps the most severe are those from atoll islands where spreading groundwater salinization can progressively reduce the area for cropping or even cause this to be temporarily rendered impossible, perhaps as a result of an extreme wave event (Chui & Terry, 2015; Kench et al., 2006).
[35] Examples include health impacts, exemplified by Réunion Island (Vilain et al., 2015), and more general livelihood impacts, exemplified by the Andaman Islands (Yuvaraj et al., 2015) and Pacific islands (d'Aubert & Nunn, 2012).
[36] A good example is around awareness of volcanic hazards (Cronin & Cashman, 2008).
[37] Around Prince Edward Island (Canada), a 30% increase in mussel production is predicted for the year 2050 "driven by more efficient utilization of the phytoplankton spring bloom" (Guyondet et al., 2015: 1593).
[38] While much of the published literature focuses, somewhat perversely, on the aesthetic value of coral reefs and the ways in which this will be impacted by climate change, the more pressing practical concern for many tropical island dwellers is around the reduction in reef-associated food supply linked to rising sea-surface temperatures and increasing ocean acidification (Nunn, 2009a; Toth et al., 2015; Valmonte-Santos et al., 2016).
[39] Airborne dust is known to have had effects, mostly negative, on peri-continental and oceanic islands. From East Asia, "atmospheric aerosols … are significantly emitted from the highly populated and rapidly developing industrial regions and are transported to the North Pacific" (Kunwar et al., 2016: 243-244) where they are directly linked to diminished human health. Conversely, the fertility of nutrient-poor soils on La Palma Island (Canary Islands) has long been enhanced by regular deposition of Saharan dust (von Suchodoletz et al., 2013). Long-range ocean swells have recently been recognized as a major influence on (ocean) island shoreline erosion (Hoeke et al., 2013).
[40] A rapid and massive decline in sea urchin (*Diadema antillarum*) during the 1980s in the Caribbean and Bahamas had knock-on effects on coral-reef ecosystems and may have been facilitated by warmer seawater temperatures (Idjadi et al., 2010). The mobility and concentration of ciguatoxins in surface waters are thought to become elevated with increasing sea-surface temperatures; examples come from Madeira and the South Pacific (Llewellyn, 2010; Otero et al., 2010).
[41] Inaccurate because many other environments on Earth are equally if not more exposed to climate change; one thinks of the densely-populated mega-deltas of south and east Asia, for example, and communities in many places that depend on agriculture from rivers that flow only seasonally when melting occurs of nearby mountain ice caps, which are decreasing in size.
[42] For example, on islands, "food security is reduced by the use of less resistant crops such as cassava, by the declining production and consumption of famine foods, by infrequent use of food preservation and by increased monocropping" (Hay, 2013a: 323).
[43] Examples come from the Pacific and Caribbean (FAO, 2008; Pulwarty et al., 2010).
[44] (Bell et al., 2009; Campbell, 2015; Fletcher & Richmond, 2010; McGregor et al., 2009)
[45] Examples come from Pacific Island Countries and specifically from Solomon Islands (Albert et al., 2015; Barnett, 2007)

[46] A point made explicitly by Nurse et al. (2014). Specifically, it is clear that climate change adaptation and disaster risk reduction in island contexts can clearly be planned for together (Kelman, 2014; Kelman & Gaillard, 2010).

[47] On the drier islands in the eastern Canary group (Atlantic Ocean), there is growing interest in the water-efficient agricultural systems that sustained people here for millennia before the era of globalization (García-Rodríguez et al., 2016).

[48] It is becoming clear that many Pacific island peoples once eschewed the most vulnerable locations for potential settlement because of their periodic exposure to extremes. A good example comes from the Torres Islands in Vanuatu (Siméoni & Ballu, 2012). With colonization and later increasing globalization of many islands, occupation and infrastructural development along the coast became essential to islands' participation in regional and global networks, from the spread of Christianity to trade. Yet history had taught many islanders that less-exposed locations were invariably more sustainable, a lesson some are learning anew (McNamara & Des Combes, 2015; Walshe & Nunn, 2012).

[49] Given that many disasters (like extreme waves) have highly variable impacts within large island groups, mutual support might extend to supplying relief (food and material) to affected communities, helping them rebuild. Similarly, as is currently happening in the Pacific, high-island nations might offer land to low-island nations, allowing their most vulnerable populations to migrate with dignity to familiar climatic-cultural contexts.

[50] See Rudiak-Gould (2014) for an account from the Marshall Islands.

[51] The issue of balancing economic development, quality of life and ecological integrity is key (Baldacchino & Niles, 2011).

[52] Examples come from Singapore, French Polynesia and Pacific islands more generally (Andrefouet et al., 2013; Guest et al., 2008; Johannes, 1978). For a discussion of climate-change impacts on marine wild capture fisheries, see Perry (2011).

[53] This was reinforced at the COP-21 meeting in Paris (December 2015) which recognized that Small Island developing States have 'special circumstances' (http://newsroom.unfccc.int/unfccc-newsroom/finale-cop21/ accessed in August 2016).