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Abstract

Mangrove forests, which provide critical ecosystem services in tropical and subtropical coastal regions around the world, are increasingly threatened, with total mangrove area declining from 18.8 million hectares to 15.2 million hectares globally between 1980 and 2005. Focusing on the mangrove wetlands of the Cayman Islands, we use GIS spatial analysis to document past trends and project future trends of mangrove clearance, and a near-exhaustive series of 57 interviews with key business and political figures as well as leaders of environmental NGOs to identify the social forces driving these trends. Analysis of the satellite images shows that mangrove loss on Grand Cayman has been dramatic and that mangroves could be extinct by 2097, with potentially dire consequences for the island's inhabitants. The interviews indicate that the destruction of mangrove forests is primarily attributable to consumption generated by Grand Cayman's financial sector. The demand for real estate by financial professionals employed on the island along with international investors who come to 'visit their money' has resulted in the mangrove forest clearance. These dynamics have persisted due to the alignment of political forces that has emerged in their defense: a state structurally-dependent on development fees for revenues and dependent for political support on landowners. To explain our findings, a political economy approach is put forward, highlighting the shortcomings of both ecological modernization and neo-Marxist theories of social impacts on the environment.

Keywords: mangrove forests, new economy, offshore financial center (OFC), geographic information system (GIS), ecological modernization, dematerialization

Highlights

- We offer estimates of total loss of mangrove wetlands in Grand Cayman for the period 1964-2013.
- Using current rates of mangrove reclamation, we project that mangroves may disappear from the island before the end of the current century.
- Through a nearly exhaustive series of interviews with economic and political elites, we attribute these losses to luxury property development in response to demand from the offshore financial centre.
- Interviews further suggest a political alliance between the state, land owners and property developers.

1. Introduction

Mangrove forests provide vital services to ecosystems and human communities in tropical and subtropical coastlands around the world. Known to exist in 124 countries, their importance has been recognized by policymakers at least since The Ramsar Convention on Wetlands in 1971. Mangroves protect communities from coastal erosion as well as extreme weather events such as hurricanes and tidal waves (FAO, 2007). They may serve as a filter for pollutants, as a 'source and sink' for nutrients and sediments for other inshore habitats, and as a habitat for terrestrial, estuarine and marine species. Finally, with disproportionately large carbon stores, they play a critical role in carbon sequestration (Alongi, 2012; Polidoro et al., 2014).

Alarmingly, however, global mangrove area has declined from approximately 18.8 million hectares in 1980 to 15.2 million hectares in 2005 – a decline of nearly 20%, and a rate of 102,000 hectares annually (FAO 2007). Other estimates suggest that between a third and a half of the world's mangroves were lost over the latter half of the 20th century (Alongi, 2015; Polidoro et al., 2014). This dramatic decline implies a drastic loss to the ecosystem and the benefits mangroves provide to the local community. It also makes a sizeable contribution to global carbon emissions – deforestation contributes between 12-20% of anthropogenic CO2 emissions (IPCC 2007; van der Werf et al. 2009) and mangroves may account for up to 10% of emissions from deforestation (Donato et al. 2011).

As they do globally, mangrove wetlands provide various benefits for the residents of the Caribbean island of Grand Cayman. Indeed, their role is of critical importance to the long-term security of this low-lying island (only 18 m above sea level at its highest point), which lies in the path of the very active Atlantic Hurricane Belt. Between 1887 and 1987, on average, a tropical storm has passed directly over Grand Cayman every 12.5 years (Tompkins & Hurlstone, 2003). Between 1988 and 2008 alone, the Cayman Islands have been affected

by three Category 5 hurricanes, two of which were direct impacts. On September 11th 2004, the sixth strongest recorded hurricane to ever hit the Atlantic basin, Hurricane Ivan, passed directly over Grand Cayman, inundating the island with storm surge and causing an estimate US$3.4 billion in damage - about 183% of the gross domestic product for the preceding year (UNDP 2004). The loss of mangroves on Grand Cayman thus poses a clear and real threat to the island's population and tourism sector.

Mangroves also help maintain the health and biodiversity of the island's marine ecosystem, moderate local rainfall patterns and maintain fresh water lenses. Mangrove root systems filter run off rain and ground water and by doing so control sediment run off into the surrounding seas and sounds; 'the traditional clear seas surrounding the Island, where lateral visibilities of up to 60m were common, is no doubt due in some measure to the physical and biological filtration of land surface water through the mangrove areas' (Giglioli 1994: 511).

1.1 Social causes of mangrove wetland loss

Grand Cayman offers a case of particular interest in challenging existing understandings of the social causes of mangrove destruction and environmental destruction worldwide. While mangroves are vulnerable to natural factors such as rising sea levels (SLR) and storms (Nicholls et al 1999; Woodroffe 1990), anthropogenic impacts represent a far more significant threat (Ellison and Farnsworth 1996). Globally, the main anthropogenic causes of mangrove loss are often said to include overexploitation for fuelwood and timber (Valiela et al., 2001) and land conversion for tourism, agriculture and aquaculture (Alongi, 2002). Referring specifically to the loss of mangrove wetlands in the Caribbean, the FAO asserts that the 'rapid and often unsustainable development of tourism industries' – hotels, marinas and related infrastructure, is the main cause (FAO 2007: 33).

Here we challenge these claims by close examination of the Caribbean offshore financial centre (OFC) Grand Cayman. As with its competitors in the global economy - the British Virgin Islands, Bermuda, the Bahamas, and in Europe, Guernsey, Jersey and Gibraltar -- this micro-territory's economy is based largely on offshore finance. In this paper, we hypothesize that the loss of mangrove wetlands in Cayman is being caused primarily by the consumption generated as a spillover from the financial sector.

This possibility makes Grand Cayman relevant to broader debates about the links between capitalist economic growth and environmental damage. While there are numerous studies on the environmental impacts of a wide range of economic activities, we are aware of no social scientific studies that have focused specifically on the environmental impacts of finance, usually regarded as a clean, 'dematerialized', service industry. A typical understanding is that 'financial markets are the vanguard of weightless economics. They exist in cyberspace' (Coyle 1998; see also Drucker, 1969; Leadbeater, 2000; OECD, 1996; and Quah, 1998, for similar conceptualizations). Grand Cayman provides a direct test of such arguments. Further, although consumption has also been problematized and addressed on some levels (Spaargaren and Mol, 2008; Spaargaren, 2003), production-side activities are typically given more weight in attempts to explain environmental damage. The case of Grand Cayman, by contrast, leads us to focus on the role played by patterns of elite consumption.

Leading existing theories of social-environmental links also tend to favor economic processes, to the relative neglect of political processes. Treating economic patterns of development as given, or even inevitable, the role of political action – or inaction – in *permitting, enabling and directing economic processes* has received less attention. Ecological modernization theory, for example, originally posited a natural greening of economic growth over time, largely through technological progress (Mol and Spaargaren, 1992). Conversely, Neo-Marxists argued that the requirements of capitalist accumulation essentially doom the

environment to a process of steady destruction (Magdoff and Foster, 2011). Although both schools have acknowledged the importance of social reform movements (Foster, 2012; Mol, Spaargaren and Sonnenfeld, 2014), neither school places sufficient emphasis on the political alignments and conflicts that determine whether environmentally-damaging development will occur in any given instance. Here, we argue that economic process and the political alignments that make them possible *must be understood together*. A better understanding of how political alignments of power enable economic patterns of development is essential for helping societies navigate towards more environmentally sustainable futures. In this paper, we thus seek to partially redress this imbalance, by identifying key actors in the political coalition that has supported real estate and property development – with its accompanying reclamation of mangrove wetlands – in Grand Cayman.

Grand Cayman is, in many ways, an ideal subject for a case study of the socio-environmental relations that develop around a financial sector. Its offshore financial centre (OFC) dominates the economy of the island, with relatively few "confounding effects" from other economic sectors. It was one of the first OFCs to develop and is one of the most successful and widely recognised. In addition to being the fifth largest banking centre in the world (CIMA, 2016), it is also the second largest jurisdiction in captive insurance and 75% of hedge funds worldwide are domiciled there (IMF, 2009; CIMA, 2015). Amongst offshore financial centres, it displays the purest characteristics, with zero as opposed to low direct taxation, and low levels of general economic regulation. Further, as a micro-jurisdiction of 76 square miles, Grand Cayman has extremely tight spatial and ecological limits and as such is a laboratory for understanding less tangible global ecological limits. As a high income, primarily service economy, Grand Cayman is also suitable for testing more general theories in the social sciences formulated for post-industrial economies, premised on their evolution towards dematerialized service economies.

To this end, we test the following hypotheses:

H1: Unsustainable environmental degradation of mangrove wetlands is occurring in Grand Cayman.

H2: The offshore financial centre via a spillover into real estate development is causing environmental degradation of mangrove wetlands in the OFC Grand Cayman

2. Methodology: A case-study approach

In the case study method 'each case is examined as a whole, as a total situation resulting from a combination of conditions' (Ragin, 1987: 49). A good case study demands a combination of a 'strong macro causal analytic with compelling thick descriptions' allowing single cases to stand on their own as reliable explanatory accounts of particular mechanisms at work in a given context. A 'thick case' is one that provides both an in depth understanding of a historical case and that has multiple measures of mechanisms (King and Sznajder, 2006: 766-767).

This study of Grand Cayman will first attempt to quantitatively determine the extent of mangrove wetland loss and then to qualitatively establish the relationship between offshore finance (and the related consumption and investment habits of elites) and environmental degradation and to elucidate the causal mechanisms involved.

2.1 Using GIS to calculate wetland loss

Our first goal was to establish estimates of wetland area for the years 1976, 2006 and 2013. These years were chosen based on the availability of either maps or satellite images from which wetland area estimates could be made. The starting point for the analysis was a 1965 estimate for wetland area of 107 km^2 or 26,934 acres made by Dr. Marco Giglioli, founder and head of the Mosquito Research and Control Unit in Grand Cayman in 1965 and

co-creator of the 1976 Swamps and Shallow Marine Substrates map (hereafter, Giglioli 1994). Giglioli estimated the percent of the island covered by mangroves; based on this estimate, we calculated how many acres this would represent. After consulting with the Cayman Islands Department of Environment (DOE), it was felt that Giglioli's estimate may have been slightly high, so to avoid overstating the loss, this was reduced by 10 percent, yielding an estimate of 24,241 acres (hereafter, Revised Giglioli 1994). This was used as the starting point for the simulation.

The total area of wetlands in Grand Cayman in 1976 and 2006 was established using Arc View v9.2 and digital images of:

1) 1976 Swamps and Shallow Marine Substrates map (Brunt & Giglioli, 1980), with specific wetland habitats demarcated but areas not calculated.
2) 2005/2006 high resolution satellite imagery ('2006') – with no demarcation or area calculation.

The 1976 swamp map of Grand Cayman had wetland habitats indicated. Using ArcView, we began by digitizing polygons around all 1976 wetland areas using a scale of 1:5000. Next, areas for each polygon were determined with ArcView. The attributes table showing all polygon areas was opened in Excel where a gross total 1976 wetland area was established.

This 1976 wetland map was then compared with the 2005/2006 satellite image to determine the 2006 area by digitizing areas of loss between the two images. Using the 2005/2006 imagery as a base map, the 1976 wetland polygon shapefile was overlaid so that only the boundaries of these wetlands and the underlying 2005/2006 imagery were visible. Visual interpretations of habitat loss within the 1976 polygons were made and digitized to form the 2005/2006 cleared wetland area polygon. A scale of 1:5000 was again used (although scale was modified as needed for areas difficult to view due to resolution, cloud cover, etc.).

Finally, a 2013 mangrove area was calculated by the Cayman Islands Department of Environment allowing for a determination of the rate of loss from 1965 to 2013. This resulted in estimates for 1965 (Revised Giglioli 1994), 1976, 2006 and 2013, from which total loss, average loss rates, and predictions of future loss could be calculated.

Two estimates of projected future losses were made. The first was a low estimate, using only the rate of loss between 1965 and 2013 and not including future losses due to sea level rise (SLR). For the second, high estimate, the same rate of loss from reclamation was combined with an expected rate of loss of mangroves due to SLR of 12.5% of the 2013 area by 2085. Actual loss due to sea level rise will depend on a variety of factors and is difficult to estimate. Nicholls et al. (1999) estimate that 6% to 22% of coastal wetlands globally could be lost; Gilman et al. (2008) offer a global estimate of between 10-20%. Given that the Caymans, small islands with small tidal ranges, are highly vulnerable to SLR, 12.5% would appear to be a conservative estimate.

The GIS software, ESRI's ArcView v9.2, and the Cayman Islands Lands and Survey's Cadastral Package Standard of 2008 which contains updated, detailed information on all land parcels in Grand Cayman was used to assist with all calculations, cross referenced with local knowledge of mangrove areas and developments. All results were checked against local informants with knowledge of the development of the island and observations during field work. In Table 2, we include these area estimates, along with additional estimates from other sources for 1980, 1990, 2000 and 2005, for comparison.

2.2 Interviews

The second stage of our research consisted of interviews conducted between April and July 2008. In total, 57 semi-structured in-person interviews were conducted with key economic, political and civil society leaders. These included: (a) 18 real estate agents and property developers, including the head of firms of almost 80 percent of all real estate and property development companies in Grand Cayman; (b) seven representatives of financial institutions, including the head of a major bank, two CFOs of financial institutions, and the former head of a trust company; (c) 14 government officials and politicians, including a former Financial Secretary and heads of The National Trust, The Botanical Gardens and all other significant environmental agencies; and (d) 18 local environmentalists. Titles of the interviewees are provided in Table 1. Note that four of the environmentalists, marked with asterisks, were working for government environmental organizations. Average interview length was approximately one hour, with minimum length of 45 minutes and some lasting two to three hours. Handwritten notes were taken during the interview. These were reviewed and typed up within 24 hours of the interview. These interviews were supplemented with an analysis of related written documents (e.g., national budget documents, real estate newsletters and magazines, development plans, a proposed conservation bill, and policy documents).

Table 1
List of interviewees.

Real Estate & Property Development Sector (REPD) REPD 1-15: Agents and property developers REPD 16-18: Architects working with REPD firms Financial Sector (FNC) FNC 1 - Partner, Law Firm FNC 2 - Partner, Law Firm FNC 3 - CFO, Offshore Bank FNC 4 - Partner, Offshore Finance Co. FNC 5 - Former CEO, Trust Co. FNC 6 - CFO, Offshore Finance Co. FNC 7 - CEO equivalent, Bank Government Officials and Politicians (G/P) G/P 1 - Politician & former Cabinet member G/P 2 - Politician & former Cabinet member G/P 3 - Politician & former Cabinet member G/P 4 - Former Policy Advisor to Gov't. on Financial Industry G/P 5 - Leader of Government Business G/P 6 - Leader of the Opposition G/P 7 - Member of Cabinet G/P 8 - MD, Cayman Islands Monetary Authority G/P 9 - Chief Officer, Ministry of Planning G/P 10 - Director, Planning Department G/P 11 - Director, Department of the Environment G/P 12 - Officer, Planning Department G/P 13 - Director, Department of Tourism G/P 14 - Former Financial Secretary	Environment - Organizers, Activists, Organisations ENV 1 - Director of Environmental Project, Activist ENV 2 - Officer, Environmental Organisation ENV 3 - Coordinator, John Gray High School Recyclers ENV 4 - Director, Global Green Caribbean ENV 5 - President, Cayman Orchid Society ENV 6 - Environmental Activist ENV 7 - Concerned Citizen/Environmental Activist ENV 8 - Environmental Activist/ Artist ENV 9 - Environmental Activist ENV 10 - Environmental Activist ENV 11 - Projector Manager, Cayman Wildlife Rescue ENV 12 - Senior DoE Officer* ENV 13 - Senior DoE Officer* ENV 14 - Senior DoE Officer* ENV 15 - Director of Blue Iguana Recovery Program ENV 16 - Manager, The National Trust, Cayman Islands* ENV 17 - Officer, Environmental Organisation ENV 18 - Environmental Science Professor

3. Results

3.1. Loss of Grand Cayman's mangrove wetlands

Figure 1 and Table 2 summarize the losses as of 2013 and projected future losses to 2099. In 2013, total remaining mangrove area in Grand Cayman was approximately 16,238 acres, meaning that 8,003 acres had been lost since 1965 when wetland area was estimated at

24,241 acres (Revised Giglioli 1994). The Central Mangrove Wetlands (CMW) area is 8,700 acres, making the remaining area outside of the CMW less than 8,000 acres.

The average rate of clearing over the last 48 years (1965-2013) was 167 acres per annum. Using this average rate of clearing (1965-2013) and taking account of predicted future losses from sea level rise (SLR) in addition to losses from clearing, and in the absence of further conservation measures, all mangrove wetlands in Grand Cayman could be lost by 2099 (High Estimate). The more conservative estimate, which only takes account of wetland clearing and ignores losses to SLR, leaves a mere 1,896 acres of mangroves on Grand Cayman at the end of the century.

At this point, we note that The Marine Parks Regulations offers some level of protection to around 1,707 acres of coastal tidally inundated mangrove wetlands that are protected as a marine Environmental Zone. Another 1,573 acres are protected by the Development Plan (1977) as a designated ‘Mangrove Buffer’ (originally named ‘Storm Belt’). In principle, these protections would prevent mangroves from disappearing entirely. However protected mangrove buffers are occasionally cleared via ‘exceptional’ permission given by the cabinet to developers wishing to remove their mangrove ‘buffer’ to build canals through or to be able to have unobstructed views of the ocean.

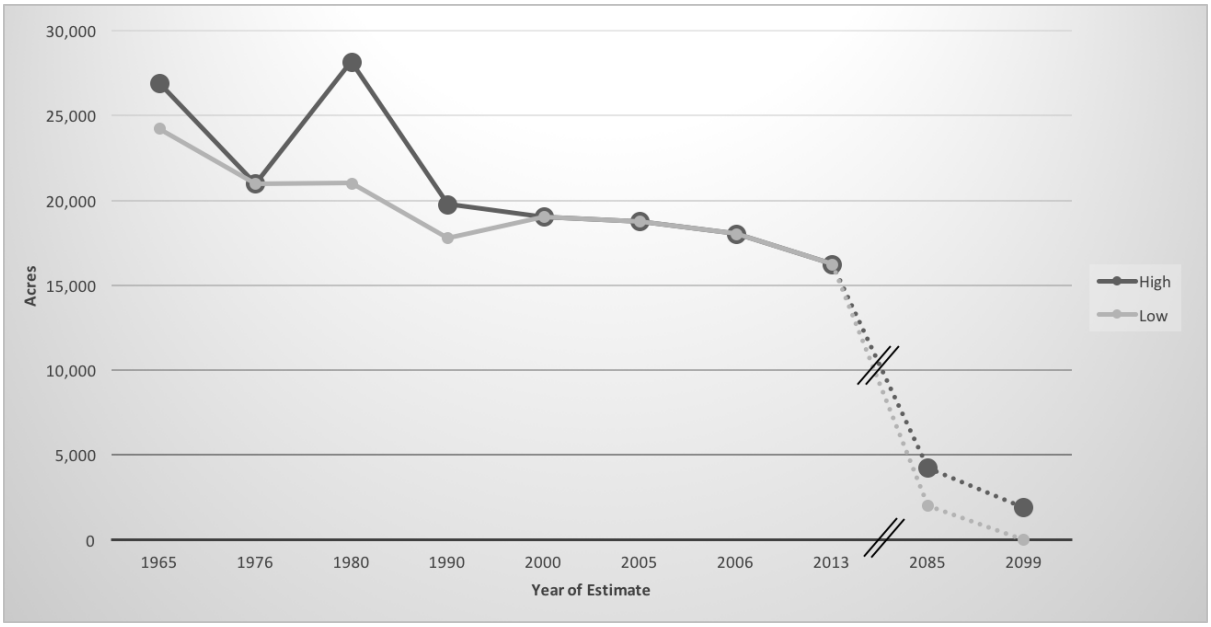

Fig. 1. Estimates and future projections of mangrove wetlands in Grand Cayman, 1965 to 2099. Note that the horizontal axis shows estimates of actual and projected losses, and not time. Line breaks are added between 2013-2085 to remind the viewer that the distance does not represent time.

Table 2
Mangrove wetland in Grand Cayman, 1965 to 2013, and projected future losses.

1965	1976	1980	1990	2000	2005	2006	2013	2085	2099
26,934[1]	20,987[3]	28,170[4]	19,768[5]	19,027[5]	18,780[5]	18,024[6]	16,238[7]	4,234[6]	1,896[6]
24,241[2]	20,987[3]	21,004[5]	17,792[4]	19,027[5]	18,780[5]	18,024[6]	16,238[7]	1,981[6]	0[6]

Sources: [1]Giglioli, 1994. [2]Revised Giglioli 1994 (see Section 2.1). [3]Brunt & Davies, 1978. [4]Ellison, 1996. [5]FAO, 2007. [6]Estimates reported in this paper (see Section 2.1). [7]Cayman Islands Department of Environment (personal communication).

A further estimate was made of the wetland area lost specifically to luxury canal residential developments between 1976 and 2006, using comparisons of high resolution maps with wetland areas indicated along with the GIS software ESRI ArcView v9.2 software, and the Lands and Survey Department's online program Cadastral Package Standard which allows areas to be identified and measured accurately (see Figures 2-5). This analysis found that approximately 54% of all wetlands cleared since 1976 were cleared specifically for high end property developments. Thus, the loss of mangrove wetlands since 1976 was primarily due to conversion of wetlands to luxury canal residential property developments.

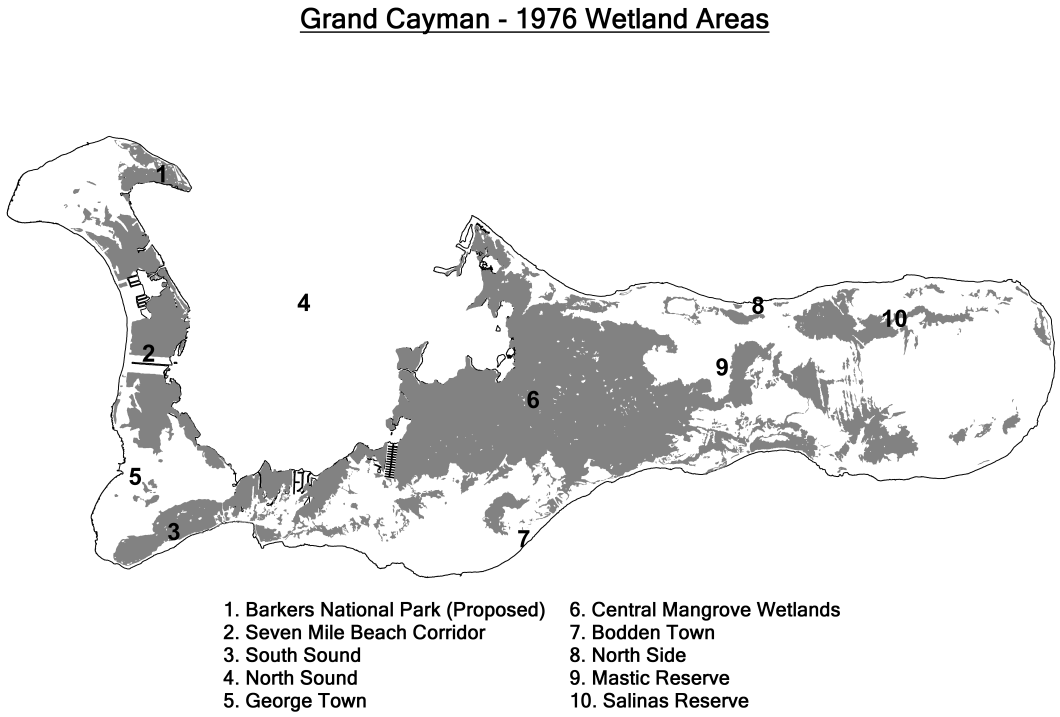

Fig. 2. Grand Cayman 1976 Mangrove Wetland Area. 20,987 acres.

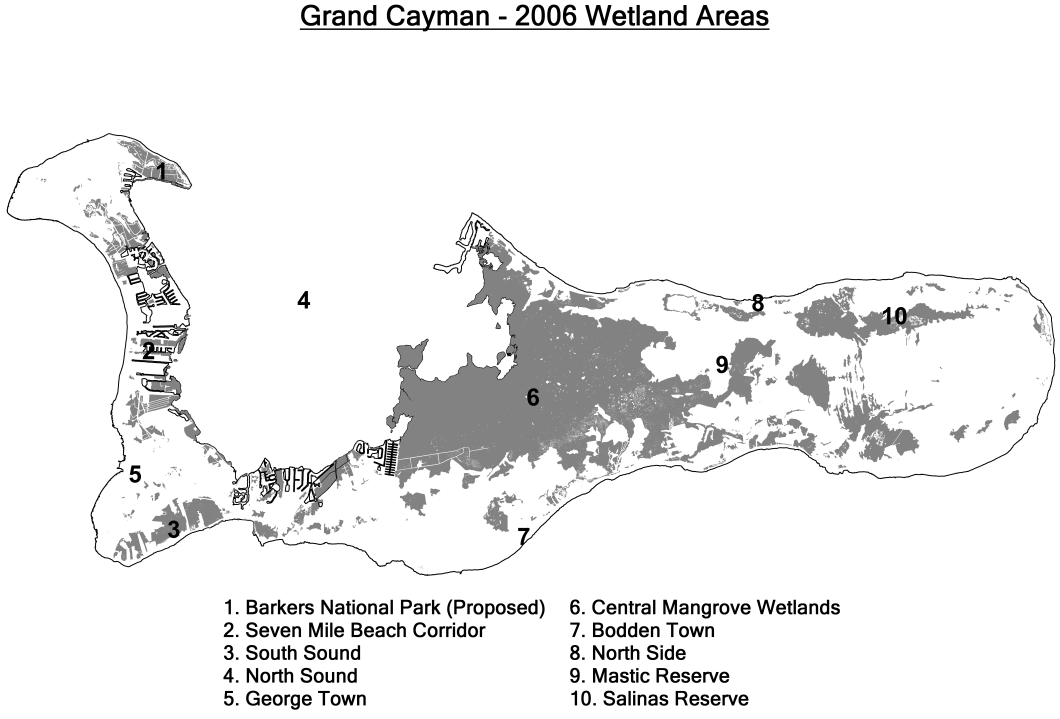

Fig. 3. Grand Cayman 2006 Mangrove Wetland Area. 16,447 acres.

Fig. 4. West Side Grand Cayman 1976.

Fig. 5. West Side Grand Cayman 2006. 61% Loss of 1976 Mangrove Wetland Area.

3.2 Social causes: The Role of the OFC in environmental destruction

Turning to our interview data, we now ask: *what are the social processes driving this destruction?* Traditionally, little value was placed on low lying wetland areas by residents, who preferred the more secure elevated inland properties. Beginning in the 1960s, condominiums on the island's Seven Mile Beach were built to accommodate tourists, as well as newly arriving financial professionals. As the island's limited 'beach front' and 'ocean front' property became increasingly expensive, luxury and usually canal property developments, built on reclaimed mangrove wetlands, have become the favoured residence of these international financial professionals (REPD 6; FNC 7).

3.2.1. Finance industry professionals

All real estate agents and property developers interviewed agreed that the high-income employees of Grand Cayman's offshore finance industry create significant demand for real estate. As one put it: "Cayman as an OFC attracts…very high level people…and they all need somewhere to stay. That is a big driver of property markets and the reason why developments such as Crystal Harbour, Governors Harbour and Canal Point (luxury developments built on reclaimed wetlands) were developed" (REPD 10). Moreover, most (9 out of 13) identified this group as the *prime driver* of the entire real estate market (or as their main customers), and particularly the high-end market. One real estate head of firm explained that while in the past most demand for real estate came from international investors (for speculation or vacation residences), local demand by offshore finance professionals was now most significant. One of the main luxury property developers in Cayman disclosed that approximately 70% of his property developments are purchased specifically by European employees in offshore finance. Most of his property developments are on reclaimed mangrove wetlands.

This group primarily buys luxury residences either in the numerous luxury canal developments along the Seven Mile Beach corridor or in South Sound. Almost all of these developments have been built (and are being built) by reclaiming mangrove wetlands. One real estate agent interviewed explained that canal properties allow highly paid expatriate professionals to have the lifestyle they expect – a luxurious home and neighbourhood, on the water and with convenient access to the recreational activities associated with boating and the North Sound. The websites of two real estate and property development firms similarly explain:

> ‘If you're looking for the glamour and excitement of John Grisham's Cayman, then Seven Mile Beach is the spot. Here you will discover a fine cocktail of executives blended with visitors and residents enjoying the area's lifestyle. In addition to its shiny characters, the mellow charms of a powdery white beach and shimmering emerald blue sea, the whole area vibrates with life both on land and underwater. Traditionally a North American playground, this is a great investment for the global crème de la crème. (Cayman Islands Sotheby’s International Realty 2)

> ‘Every home site offers sweeping water views, a private dock, and navigable access to the North Sound and the crystal clear Caribbean sea. .... Sunrise Landing offers all the luxuries expected of a first class community. Strict covenants insure the exclusive nature of Sunrise Landing – a community which promises to be one of Grand Cayman’s premier residences’ (NCB Development)

3.2.2. ‘People like to visit their money’

Clients of the island’s OFC also buy property in Cayman, because, as the head of one Cayman bank put it, ‘people like to visit their money.’ Two particularly illustrative examples were mentioned by interviewees. The sole investor in Camana Bay, a billion-dollar property development being built on over 500 acres of mangrove wetlands, originally set up financial offices in Cayman to perform offshore back office operations to support his investment portfolio, before eventually diversifying into property investment. Another property developer interviewed shared that the joint investor in their new luxury canal development (again built on mangrove wetlands) used the island’s financial services before investing in property (REPD 9). While these are prominent cases, our interviewers reported many such cases on a smaller scale of individuals who use Cayman’s financial services and subsequently choose to invest in a property for a vacation home, thus further driving demand for waterfront property.

3.2.3. Global investors and real estate speculation

The final significant spillover from finance to real estate is speculative property investment. Global Mutual Funds, Hedge Funds, Real Estate Investment Trusts (REITs) and individual investors buy property in Cayman for their investment portfolios. Moreover, they often buy in large quantities, such as one or a few commercial buildings, 90 apartments or dozens of parcels of land in a pre-construction development (REPD 6, 10). One interviewee had recently received a call from one such REIT, but he was unable to assist as he did not have a sufficient volume of properties to sell them.

Some of the best investments are in the luxury developments built on reclaimed wetlands, as these can often be purchased ‘pre-construction’ Two interviewees stated that investment funds will buy dozens of ‘pre-construction’ lots in these developments at below

market prices. They then wait until development has been completed to 'flip' the properties, making very favourable returns for their shareholders (or themselves in the case of individual investors) (REPD 6, 10). This trend of speculative investment in canal properties is also evidenced in data from the Cayman Planning Department which shows that only 41% of total canal lots in Grand Cayman have been built on (Cayman Islands Planning Department, 2007).

While this speculative investment in property is now secondary to consumption by the financial elite, in the past, purely speculative investments by both overseas and local investors was said to have been the most significant driver of the property market (REPD 6).

3.2.4. 'What's beautiful is the model'

While these international investors may or may not have had existing connections with the financial industry in Cayman, their decision to buy property is often influenced by the presence of Cayman's OFC services. In the words of one real estate agency CEO, 'Cayman is not the most beautiful island in the Caribbean – what's beautiful is the socio-economic model. … Investors come…because of the convenience of being so close to a sophisticated OFC which looks after their money through its various financial services' (REPD 5).

More broadly, the Cayman 'model' is characterized by its low regulatory, low-tax environment (no income tax and no property tax apart from a one-time stamp duty on property sales of 5-7% of purchase price). The model also includes relaxed residency requirements and no effective limit on the number of properties foreigners can buy (limitations exist on commercial properties but these can be legally circumvented under the Local Companies (Control) Law (Revision 2007)). Investments are 'safe' because of the political stability inherent in Cayman's association with the UK and, as Cayman's currency is

tied to the US dollar, 'currency risk' is also low (Chen and Mills, 2004). Furthermore, professional assistance from sophisticated attorneys is readily available to help investors minimize taxes on their investments through various OFC products such as the creation of Cayman companies and trusts to hold property (REPD 1). Citizens of some countries can use their Cayman permanent residency to minimize income taxes in their country of origin, although the UK and other EU states, following the 2008 financial crisis, are attempting to close the "loopholes" in their own laws which permit these practices.

3.2.5. Impact of a shifting regulatory landscape

Interviewees, in discussing links between the financial and the real estate development sectors, also mentioned recent changes in international and local financial regulation requiring offshore companies to have a greater physical presence on the island, as the practice of simply having the company's 'brass plate' on the wall of another financial institution has become insufficient (REPD 5). In addition to actual growth in the island's financial industry, these stricter requirements have contributed to significant expansion in the market for commercial properties, including for non-financial companies seeking to benefit from Grand Cayman offshore legal status. In fact, Grand Cayman now has the largest 'Class A' commercial office space market in the Caribbean. Some of this development is occurring on reclaimed mangrove areas, such as Camana Bay. One firm, opening a 70-acre site on reclaimed wetlands, for instance, offers the following on its website:

> The Cayman Enterprise City Special Economic Zone doesn't provide your typical 'virtual' or 'shell brass plate' offshore company. Instead we enable you to have **a genuine staffed office in a stable offshore**

> **jurisdiction**, where you can legitimately generate an income which is 100% exempt from corporate tax. (CEC 2016).

3.2.6. Ruling out tourism as an alternate explanation

Both tourism and financial industries emerged in the mid-1960s and have been referred to as the 'twin pillars' of the island's economy. Indeed, earlier studies have claimed that tourism-related development is the main cause of mangrove loss in Cayman (Ellison & Farnsworth 1996; FAO 2007). Here we argue that this claim cannot be sustained.

First, in terms of the demand for real estate for employees of the two industries, the offshore financial industry is far more significant than tourism in creating the type of wealth and high salaries needed to create demand for the luxury developments in question (Ridley 2008).

As for demand generated by the tourists themselves, some of the tourism is itself a spillover from the island's OFC activities. Indeed, as much as 40% of Cayman's early tourism was estimated to be a direct spillover from banking (Johnson, 2001), although no source was given for this figure and The Departments of Tourism and Immigration were unable to verify it. The Immigration Department, whose data starts in 1992, confirmed that in 1992, 9% of people entering the island declared business as the purpose of their trip. An interview with the head of a local bank confirmed that the earlier practice of bankers traveling to Grand Cayman with their families and a 'suitcase of cash' declined significantly through the 1990's and Johnson's figure might be relatively accurate for the 1970s and 1980s.

Turning to our interviews, although some did suggest that tourism is a significant factor, this segment of the market is mostly restricted to condominiums on Seven Mile Beach

and other 'ocean front' (i.e., *not canal*) vacation home properties (REPD 1, 2), which did not require the clearing of wetlands. The exceptions to this are the Ritz Carlton and the former Hyatt hotel, but both also had a very significant residential property component in addition to tourism facilities. While the island's golf courses are built on reclaimed wetlands, they were built for and are used by wealthy residents as well as tourists.

In contrast, the luxury canal developments or luxury subdivisions built on reclaimed wetlands are purchased primarily by high income, year-round residents who tend to work in finance (REPD 5, 10). The estimate mentioned above in 3.1, showed that a minimum of 54% of all wetlands cleared between 1976 and 2006 were reclaimed specifically for these luxury residential property developments. Of the remaining areas of cleared mangrove wetlands, significant areas were cleared for government roads, quarries (over 100 acres), an industrial park (100 acres), and other developments – quantitatively showing tourism to be a less significant contributor.

Thus, while it is not possible to say with certainty how the development of the island would have unfolded in the absence of the finance sector, our findings do rule out tourism and identify the demand for property generated from the presence of the financial sector as the primary driver of mangrove wetland loss. We thus find strong support for hypothesis 2.

3.3. The pro-development political alliance in Grand Cayman

3.3.1 Structural dependence of the state on real estate development

One of the reasons that the destruction of mangrove wetlands continues unabated is because the OFC is built on very low levels of taxation and minimal regulations. As a result of this low-tax regime, the state has become structurally dependent on fees from real-estate and property development and thus is not predisposed to check these processes. In 2005 to 2006, revenues from property sales and construction fees (building permit fees, planning fees,

land registry fees and total 'Levies on Property' - but excluding duties on construction material, which is also significant) was 8% of the Government's total revenue at CI $24,819,000 (2006/7 Budget, Annual Plans and Estimates for the Government of the Cayman Islands). Additionally, of course, to the extent that political support for the government is predicated on the health of the economy, it has an additional reason to be cautious about regulations on this sector: The total value of the real estate sector in 2006 was US $410 million, approximately 17% of the total GDP of approximately US$2.4 billion for the year, according to the Cayman Islands Economics and Statistics Office.

The Government admits their environmentally problematic reliance on this revenue, but claims to have no choice but to allow it to continue because of a lack of economic diversification options and the need to maintain the Government's revenue. The Leader of Government Business (G/P 5), at the time, explained that 'Land transfer is central to the wellbeing of the economy… For us to consciously slow development down – we absolutely have to have more diversification of the economy… But, because of the lay of the land and the way that the economy has grown, with no direct taxation, no oil, or other natural resources, little prospect for agriculture, high cost of labour, high costs of living – it is difficult to diversify'. Sir Vassel Johnson, financial secretary from 1965 to 1983, similarly recounts numerous failed attempts at diversification of the economy in the 1970 and 1980s (Johnson, 2001).

3.3.2. Vested interests: the role of land owners and the real estate industry

Interviewees also pointed to the role of Caymanian land owners and the real estate and property development industries in opposing environmental conservation legislation.

The real estate and development industries were said to exert significant pressure on the Government to not enact 'restrictive' environmental policies. One example involves the

2007 Conservation Bill, which was being actively debated while the fieldwork was being conducted. One real estate agency's newsletter (Coldwell Bankers 2007) voiced opposition to the bill and one of the local architects interviewed stated that he would 'absolutely object to it'. Both contended that the proposed bill could 'stop development in Cayman.' Almost all environmental activists and representatives of environmental organisations identified these industries when asked who they thought benefited from the lack of environmental protection legislation and/or who had the power to influence these.

For Caymanians who lack the qualifications and experience to succeed in the finance sector, land has been a major source of wealth, and for others who have not yet sold their land, it is seen as a source of potential wealth. Many Caymanians are, according to a local saying, 'money poor, but land rich'. Until recently, the real estate boom had been restricted to George Town and West Bay and landowners in these areas benefited tremendously from the sale of their land. Consequently, land owners in the relatively less developed eastern districts (Bodden Town and North Side) expect that as development spreads across the island, they will also profit from the sale of their land, and this expectation has fueled their opposition to all attempts at conservation measures in the past (Cranton, 2003: 403; Member of Cabinet; Planning Official; National Trust). A more general antagonism amongst Caymanians towards environmental protection legislation was described by numerous officials who were interviewed. 'Caymanians have tremendous difficulty being told what to do with their land' (G/P 5). 'Uninformed Caymanians are the strongest opponents of environmental conservation. They associate indiscriminate development with prosperity' (ENV 7).

These tendencies are well-illustrated in the example of conflicts over attempts to conserve the Central Mangrove Wetlands (CMW). The consensus amongst environmentalists has always been that the CMW, the largest remaining inland mangrove forest in the Caribbean (FAO 2007: 29), should be protected in its entirety (National Trust of the Cayman

Islands; Gangaware & Bowen 1990; Giglioli 1994). The National Trust of the Cayman Islands, consider the long-term protection of the CMW 'to be one of the fundamental requirements for the well-being of future generations in the Cayman Islands' (NTCI 1). However, the CMW extends through Bodden Town and North Side and consequently any proposed conservation of this area affects land owners in the eastern districts. Most of the Development Plans which have 'not made it past the political process' in the past have proposed the protection of all of or significant areas of the CMW. The head of the National Trust described the area as 'the next gold mine'. While some of the developers who have been speculatively buying and selling land in the CMW are not Caymanian and do not have a vote, the Caymanian land owners certainly do. In the late 1990s, a proposal to extend the existing Environmental Zone further into the CMW was met by angry campaigning, public meetings and marches by North Siders and Bodden Towners (predominantly) led by their political representatives. 'Landowners from the unfashionable two-thirds of Grand Cayman, it was claimed, were being denied opportunities for profit by controls that were ignored on the richer third of the island.' (Cranton 2003: 403). Of course, to elected politicians and policy makers, the support of landowners equals votes; as one Government Minister observed, 'Comprehensive environmental legislation would require a fatalism that most politicians do not have' (G/P-7).

4. Discussion and Conclusion

This study sought to determine both the extent of mangrove forest destruction on Grand Cayman and to illuminate the social causes of this destruction. Using high resolution satellite images and existing wetlands maps, we first established that environmentally unsustainable mangrove destruction is indeed occurring and that, between 1978 and 2006, most of this clearing was driven by the development of luxury canal residential property.

Next, through nearly exhaustive elite interviews, we showed that this destruction is essentially a "spillover" effect from the offshore financial industry into the real estate sector. High income OFC employees and international investors engage in both direct consumption and speculative investing by purchasing water-front property. Finally, from the same interviews, we identified the major political forces supporting this development and opposing attempts at conservation. Grand Cayman, as an OFC, relies on a strategy of hyper-low taxation and regulation. Because of this low-tax regime, the state has become structurally dependent on fees from property development, and this predisposes the government to tolerate the environmental destruction. Furthermore, local landowners have an interest in allowing unchecked real estate development: they hope to eventually sell their land for a large gain. In alliance with the real estate industry, they apply further political pressure on the state to hinder any legislation that might restrict property development.

Approximately 16,447 acres of Grand Cayman's mangrove wetlands still remain despite losses of 32% overall since 1965 and 61% on the western half of the island. The remaining mangroves still provide considerable protection and the exact extent of damage to the island if they were cleared is impossible to predict, but potentially disastrous. In the words of local environmental expert and Director of the Blue Iguana Recovery Program in Grand Cayman, Fred Burton:

> '[The mangrove wetlands] influence in buffering dry land from the sea and protecting both natural and human assets from hurricane storm surges, is hard to overstate …. A category 4 or 5 hurricane passing along the north coast of Grand Cayman in absence of mangrove protection, for example, would allow the full force of storm surge and wave action to devastate North Sound coastlines and interior areas which are currently secure.'

As Grand Cayman continues to convert its mangrove wetlands, the health of its marine ecosystem and the clarity of its waters is also likely to deteriorate and the island's tourism industry, facing strong competition from other pristine Caribbean islands, will be undermined.

How does this case study help us understand such destruction in other parts of the world?

4.1 New economy, old problems: 'Dematerialization' and the role of consumption.

Previous accounts of mangrove loss focused on overexploitation and land conversion for agriculture, aquaculture and tourism. Broader theories relating economic development to environmental destruction have put the blame largely on industrial manufacturing and have often praised 'dematerialized' service industries such as finance and de-emphasized the role of consumption. We hope to have clearly demonstrated that outcomes generated by the finance sector in particular, and the 'new economy' more broadly can have devastating consequences for the environment. Our work here supports earlier research critical of these tendencies (e.g., Trainer, 2001) and we hope that future work will continue to critically investigate the environmental consequences of service sector and consumption-related activities.

4.2 Consumption versus *conspicuous* consumption

If consumption practices directly threaten the environment, then understanding how to change consumption practices is of vital importance. A number of theories have posited a sociological element to consumption preferences. Veblen (1899) claimed that high status groups engaged in conspicuous consumption to distinguish themselves from subordinated groups. In a comment that seems directly relevant to the Cayman's case, he explained that

"the proximate ground of expenditure in excess of what is required for physical comfort is not a conscious effort to excel in the expensiveness of their visible consumption, so much as…a desire to live up to the conventional standard of decency in the amount or grade of goods consumed' (Veblen 1899, 103). Bourdieu (1984) has similarly highlighted the importance of consumption practices in creating *distinctions* between different social strata. Finally, recent years have seen an explosion of experimental research in the field of behavioral economics that has extensively documented the fundamentally malleable nature of consumption preferences (for reviews, see Camerer and Loewenstein 2004; Lichtenstein and Slovic, 2006; Thaler, 2016). In short, there is much to suggest that consumer preferences are socially shaped and influenced, implying that more environmentally sustainable patterns of consumption are feasible. This is clearly a critical topic for future research.

4.3 Political Alignments and the Future of the Mangrove Wetlands in Grand Cayman

One limitation of our study was that we only attempted to sketch the main features of the political coalition *supporting* property development, without investigating more thoroughly differences within constituencies and potentials for alternative alignments. In particular, one question left unanswered is why some – but only some - *vested interests* have been successfully mobilized to engage in political activity.

Continued property development and loss of mangrove wetlands will clearly be detrimental for a number of groups in Grand Cayman. Many residents of Grand Cayman – including low waged Jamaican, Filipino and other migrant workers and low waged Caymanians not employed in the OFC – are generally less able to afford land and are being forced to live in marginal flood prone areas. Without the protection of the mangroves, it is primarily this population which will become more vulnerable to storm threats and who will be unable to evacuate when a hurricane hit is likely. Finance firms and other large

corporations charter planes and move their entire staff (and families) to nearby affiliated offices in the US or other Caribbean islands when a strong hurricane hit is possible.

Further, Cayman's tourism industry relies on the health and biodiversity of marine ecosystems and water clarity to maintain its role as a top diving destination with white sandy beaches, crystal clear waters and abundant sea life. At some point, loss of mangrove habitat may impair the quality of Grand Cayman as a tourist destination, negatively impacting tourism revenues, given this industry a direct interest in mangrove preservation.

Future research should directly explore attitudes towards mangrove destruction in these groups. The coming years are likely to be critical in determining the fate of Grand Cayman's mangrove wetlands. After several failed attempts, proponents of conservation were able to pass a conservation law in 2013, with most sections enacted as of April 22, 2015. However, the mechanisms required to put the law into effect are still largely unused or under development. Implementation of the law remains a contested political issue. One vital area for further research – with clear implications for similar political struggles around the world – is to better understand when those most negatively affected by environmental damage do and do not mobilize to defend their way of life.

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