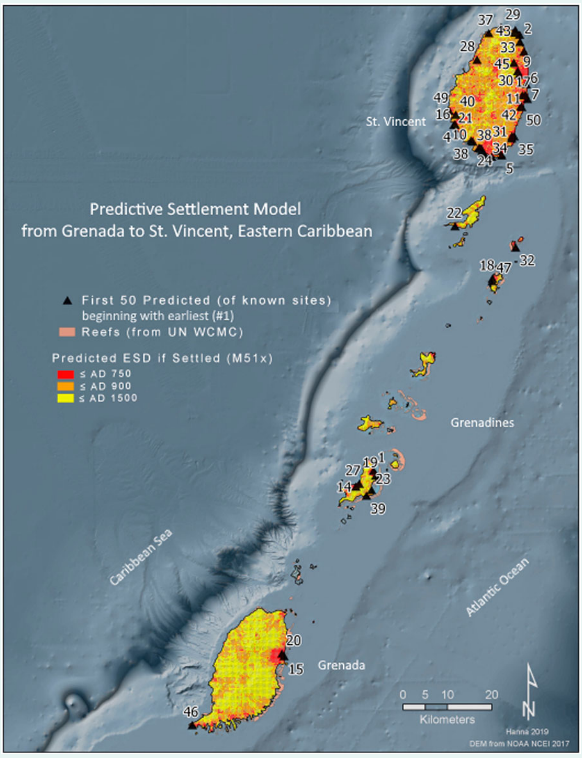
ENVIRONMENTAL ARCHAEOLOGY
https://doi.org/10.1080/14614103.2019.1689895

An Islandscape IFD: Using the Ideal Free Distribution to Predict Pre-Columbian Settlements from Grenada to St. Vincent, Eastern Caribbean

Jonathan A. Hanna [a] and Christina M. Giovas [b]

[a]Department of Anthropology, Pennsylvania State University, University Park, PA, USA; [b]Department of Archaeology, Simon Fraser University, Burnaby, Canada

ABSTRACT
This study employs an ideal free distribution (IFD) model to conduct a fine-grained analysis of environmental factors affecting the pre-Columbian colonisation sequence and settlement patterning in the southern Lesser Antilles of the Eastern Caribbean. We compiled a database of all known archaeological site locations and associated chronological data from St. Vincent, the Grenadines, and Grenada, and vetted this dataset for accuracy. We then performed multivariate statistical analysis of the vetted site data and 24 environmental variables hypothesised to influence settlement habitat quality, including soil attributes, proximity to freshwater/stream beds, structure and sizes of marine environments, and net primary productivity (NPP) layers. Iterative testing and refinement of the model allowed for the creation of a predictive map of pre-Columbian archaeological sites over time. Results indicate proximity to freshwater wetlands, NPP, and reef size were important variables influencing habitat choice. Additionally, latitude (distance from the equator) was also a significant variable, indicating support for a proposed colonisation of the southern Lesser Antilles that began in the northern Caribbean, rather than the south. Lastly, we provide a site inventory and map of predicted site locations that can aid in the management of threatened archaeological resources within the study region.



ARTICLE HISTORY
Received 21 June 2019
Revised 6 September 2019
Accepted 23 September 2019

KEYWORDS
Grenadines; human behavioral ecology; island colonisation; Lesser Antilles; migration; Windward Islands

Introduction

When analysing the settlement patterns of an island in an archipelago, is it more productive to consider the island as an isolated unit, or does it make more sense to account for the proximity of other nearby islands? If the latter, where is the cut-off: the nearest island, a

CONTACT Jonathan A. Hanna jah1147@psu.edu Department of Anthropology, Pennsylvania State University, 409 Carpenter Building, University Park, PA, 16802, USA
Supplemental data for this article can be accessed https://doi.org/10.1080/14614103.2019.1689895

microregion comprised of several islands, or some other grouping within the (is-)landscape?

Despite strong interest in prehistoric migration since the mid-twentieth century (e.g. Loven 2010; Rouse 1986; Steward 1947), Caribbean archaeologists continue to debate Amerindian colonisation routes and settlement processes. Recent studies involving computer voyaging simulations (Callaghan 1990; Callaghan 2001; Callaghan 2003), reassessment of early site distributions (Fitzpatrick 2006, 2013; Fitzpatrick, Kappers, and Giovas 2010), and neo-Darwinian theoretical applications (Giovas and Fitzpatrick 2014; Hanna 2018a) challenge orthodox models of 'stepping-stone' migrations through the islands (e.g. Rouse 1964, 499; Rouse 1986, 106). Building on these foundations, this paper analyses settlement patterns in the pre-Columbian southern Lesser Antilles, comprising the islands of Grenada, the Grenadines archipelago, and St. Vincent (Figure 1). These islands were selected because they constitute a distinct cluster, separated from other islands by large open water passages, and are the first 'steps' in the chain of oceanic islands leading northward from the South American coast. They therefore represent a possible migration gateway where early sites would be expected to be found. We use the ideal free distribution (IFD) to evaluate chronological and environmental characteristics of each pre-Columbian site known and attempt to fit these data into a settlement sequence for the region, as well as a predictive model for the discovery of previously unknown sites.

Below we review the relevant archaeological and theoretical background for this study, followed by a discussion of model construction and the set of archaeological and environmental variables employed to examine the settlement sequence of the study region. We discuss the results in terms of their adherence or departure to model expectations and consider their implications for future research. Overall, our findings indicate the most favourable environmental variables across time involved low slope, high net primary productivity (NPP), and close proximity to freshwater wetlands. Other, less intuitive (potentially cultural) factors also contributed to stronger predictions: e.g. distances to beaches decreased over time while nearest reef size rose (suggesting increased preference for nearshore resources), yet site elevations also increased on average, suggesting more cliff-like locations during the later (Late Ceramic) period. Meanwhile, latitude decreased such that northern islands were more likely to be settled first, and island size decreased in the Grenadines, such that smaller islands were likely settled later.

Environmental and Archaeological Background

The insular Caribbean is composed of four major island groups: the Greater Antilles and Lucayan Archipelago are located in the north, the Lesser Antilles form the eastern margin of the Caribbean Sea, and the Leeward Antilles/Southern Caribbean islands (including Trinidad, Tobago, Margarita, Aruba, Bonaire Curaçao, and the Los Roques archipelago) lie off the northern coast of South America (Figure 1). Although Trinidad and Tobago are sometimes included among the Lesser Antilles, they possess distinct geologic and biogeographic histories, and are excluded from consideration here. The study region forms the southern terminus of the Lesser Antilles and includes St. Vincent (352 km^2), Grenada (322 k^2), and the Grenadines, a micro-archipelago comprising ~40 islands and cays distributed

Figure 1. Map of the Caribbean with enlarged area showing the study region.

across 110 km between the two larger islands and belonging mostly to the nation of St. Vincent and the Grenadines (SVG).[1] Grenada and the Grenadines are part of the Grenada Bank, which ends in a deep trough just before St. Vincent (Beard 1949). All the Grenadines are less than 35 km^2, with the five largest consisting of (from south to north): Carriacou (32.4 km^2), Union (8.5 km^2), Canouan (9.0 km^2), Mustique (5.7 km^2), and Bequia (17.3 km^2). This study region derives from mostly Tertiary volcanism – with several active volcanoes remaining, including the semi-active Soufriere volcano on St. Vincent (Robertson 2005) and the active seamount, Kick 'em Jenny, 8 km north of Grenada (Lindsay and Shepherd 2005). These islands exhibit rolling to mountainous terrain and experience pronounced summer-wet and winter-dry seasons.

The Antilles were first colonised by humans beginning 3000–5000 BC, during the 'Archaic' period, when lithic blade producers reached the Greater Antilles. Belize and the Yucatán Peninsula are often cited as the origin for these initial populations (e.g. Roksandic and Roksandic 2018; Rouse 1992; Wilson, Iceland, and Hester 1998), but this is based on tool stylistic affinities that are debated and chronologically problematic (Keegan and Hofman 2017, 27). Another Archaic group producing groundstone tools may have moved from South America into the Lesser Antilles around this time as well, but there is little evidence of them south of Guadeloupe (Callaghan 2010; Fitzpatrick 2011). Cultivated plants and pottery appeared during the Archaic (Keegan 2006; Newsom and Wing 2004; Pagán Jiménez 2013) but become ubiquitous in the archaeological record during the Ceramic Age, which began around 500 BC with the arrival of the distinctive pottery and horticultural lifeways associated with the Cedrosan and Huecan Saladoid ceramic series. Archaeological distinction between the Archaic and Early Ceramic is based primarily on material culture, subsistence strategies, and settlement characteristics, underpinned by the assumption that these represent different cultural groups with separate migration histories. With some exceptions, the Archaic Age is typically associated with chipped or groundstone tools, a greater reliance on foraging, higher mobility, lower site density, and more ephemeral settlements. While we now know that the Archaic Age peoples made low-fired pottery in the late period and practiced limited forms of plant cultivation, the Ceramic-era communities are considered the first dedicated horticulturalists in the Caribbean, based on the ubiquitous presence of ceramic artifacts and shell tools, a mixed farming-foraging economy, sedentary or near-sedentary lifeways, long-term village settlements, and increasing social complexity. These are broad generalisations, however, and Caribbean archaeologists now question many details of these reconstructions and the mutual influence of Archaic and Early Ceramic groups where they overlap in time and space (e.g. Hofman and Antczak 2019; Keegan 2006).

Interestingly, despite proximity to northern South America, there is scant evidence for Archaic and Early Ceramic occupations in the southernmost islands of the Lesser Antilles. Instead, the majority of early sites occur in the northern Caribbean – essentially, the islands most distant from the South American homeland (Fitzpatrick 2006; Giovas and Fitzpatrick 2014). This pattern has led some archaeologists to argue for a 'Southward Route' (Fitzpatrick 2013; Fitzpatrick, Kappers, and Giovas 2010), in which the southernmost islands were bypassed during initial Ceramic Age colonisation, then eventually populated seven to nine centuries later.

Prehistoric temporal frameworks in the Caribbean are heavily influenced by ceramic-based cultural chronologies, to the extent that many sites, especially those investigated prior to the 1990s, are primarily dated via ceramic types, an issue to which we return later. In St. Vincent, the Grenadines, and Grenada, the earliest sites tend to be characterised by a later Saladoid ceramic variant known as Saladoid-Barrancoid, which emerged around AD 300–400 (Petersen, Hofman, and Curet 2004). By AD 750, Saladoid-Barrancoid wares transitioned to a new series, Troumassan Troumassoid, corresponding with population increases and shifts in settlement patterns, subsistence strategies, and burial practices (Giovas 2016; Hofman 2013; Hoogland and Hofman 2013). The Troumassan Troumassoid series – and its later expression, the Suazan Troumassoid (ca. AD 900–1400/1650) – were heavily influenced by mainland developments (Hanna 2018b), unsurprising given the substantial interaction between South America and the Antilles in this period (e.g. Hofman et al. 2011). A final, distinct ceramic tradition, Cayo, arrived around AD 1250, and may represent a new migratory wave from South America (Boomert 1986). Recent evidence indicates Cayo sites are associated with the historically identified 'Island Caribs' (Hofman and Hoogland 2012), but too little is currently known, as Cayo sites are rare and restricted almost entirely to the southernmost Lesser Antilles (Keegan and Hofman 2017, 231).

Caribbean Colonisation and the Ideal Free Distribution

At the most fundamental level, the human career is characterised by the global dispersal of our species, a phenomenon that mandates theoretical treatment in an evolutionary context. The ideal free distribution (IFD) provides this requisite theory. Grounded in neo-Darwinian, adaptationist principles and derived from population ecology (Fretwell 1972; Fretwell and Lucas 1969; Sutherland 1996), the IFD has been successfully used within behavioural ecology studies to explain human colonisation sequences and selection of settlement locations based on socio-environmental variables (e.g. Kennett, Anderson, and Winterhalder 2006; Winterhalder et al. 2010).

At its simplest, the IFD model states that humans (or any animal) will settle the most 'suitable' habitat first, where suitability is determined by optimisation of reproductive fitness. Over time, density-dependent effects will degrade habitat quality to a point where it no longer offers benefits over the next most suitable habitat (see Weitzel and Codding, this issue), at which point newly arrived individuals will begin settling the second most optimal habitat. This process continues down the resource gradient, effectively dividing population growth amongst all occupied habitats.[2]

The IFD provides a strong theoretical framework for predicting settlement sequences and locations (i.e. the 'best quality' habitats are settled first) that can be tested against the archaeological record. Additional mechanisms may also be incorporated to develop more nuanced models. For instance, habitat suitability may not initially decline with population growth, instead benefiting from social and ecological improvements that delay out-migration – a phenomenon known as the 'Allee effect' (Allee 1931; McClure, Jochim, and Barton 2006). Another model variant, the ideal despotic distribution (IDD), accounts for dominant individuals that may hoard or otherwise interfere with resource extraction, causing settlers to emigrate prematurely (Fretwell 1972). Interestingly, 'Allee effects' not only account for cultural niche construction, but also the rise of territorialism/IDD patterns (Codding, Parker, and Jones 2017). It might be argued that humans are always somewhat territorial/despotic, but our use of the IFD here accounts for moderately low-level community affiliation and some amount of settlement cost to switching settlements (Greene and Stamps 2001).

Archaeological applications of the IFD have largely focused on the Pacific Basin/Oceania and California, with observed patterns upholding theoretical predictions for fitness-maximizing behaviour (Allen and O'Connell 2008; Bird and O'Connell 2006; Codding and Jones 2013; Jazwa, Kennett, and Winterhalder 2013; Kennett 2005; Kennett and Winterhalder 2008; Kennett, Anderson, and Winterhalder 2006). Looking at the California Channel Islands, for example, Winterhalder et al. (2010; see also Kennett et al. 2009 and Jazwa, Kennett, and Winterhalder 2016) employed Bayesian modelling to demonstrate that the site settlement sequence correlated with expected habitat rankings based on a suite of environmental variables, including watershed size, the spatial extent of rocky intertidal patches and kelp forest, and availability of beach areas for canoe pull-outs.

In the Caribbean, aside from work by Keegan (e.g. Keegan 1985, 1995; Keegan et al. 2008; Keegan and Diamond 1987), explanation for the non-stepping-stone colonisation pattern has remained largely disconnected from broader, deductive theories of human behaviour. Giovas and Fitzpatrick (2014) initiated the first explicit application of the IFD across the Caribbean, demonstrating overall that larger, more resource-rich islands were settled first, based on correlations of settlement sequence between island size (km^2) and NPP (kg C m^2/day). At the island scale, Hanna (2018a) used the IFD as a predictive model for determining the timing and location of previously unknown sites on Grenada, using proximity to freshwater wetlands, forest-types (e.g. cactus, deciduous, evergreen, etc.), and a radiocarbon-backed ceramic chronology. This paper combines these past two efforts to apply the IFD at the regional level of Grenada, St. Vincent, and the Grenadines.

Methods

We used multivariate statistical analysis to run exploratory models in R, in combination with spatial analysis in ArcGIS to search for correlations between pre-Columbian site settlement dates and a set of 24 environmental variables for habitat quality (Table 1). These models were then used to make predictions on new data and construct a predictive map for the entire region. We review the methods of model construction below, followed by a discussion of results. Complete details of the methods used appear in the Supplemental Material.

Environmental Dataset and Site Inventory

Data for 24 environmental variables were compiled from high-resolution geospatial datasets to explore relationships with site settlement sequence and location. Table 1 details these variables and their expected direction over time, according to the logic of the IFD (i.e. significant variables should decline in quality over time with each new settlement). Environmental data come from the SVG Physical Planning Unit (CHARIM 2016), the Grenada Ministry of Agriculture (MOA GIS 2015), the Marine Resource Space-Use Information System (MarSIS) (Baldwin 2012), a 1-arc digital elevation model (DEM) by NOAA (NOAA NCEI 2017), the United Nations Environment World Conservation Monitoring Centre (UNEP-WCMC et al. 2018), and two USAID Country Environmental Profile reports (USAID 1991a; USAID 1991b). NPP, a measure of biomass, was incorporated from NASA's MODIS project (Zhao and Running 2010), slope and forest-type elevation from the 1-arc DEM, and rivers and temporary streams derived from the flow accumulation tool in ArcGIS Pro 2.3,

Table 1. Environmental variables explored.

Category	(Sub-)Variables	Description	Expectation	Reference
Island Size	Island_Area	Terrestrial area of the island	decrease over time (larger islands earlier)	Calculated in ArcGIS Pro 2.3
Latitude	Latitude_84	site latitude (degrees north of the equator)	decrease over time (northern sites earlier)	Calculated in ArcGIS Pro 2.3
Rivers	River_Dist	distance to nearest stream or river (including ephemeral streams)	increase over time (earlier sites closer)	Flow accumulation tool in ArcGIS
	RiverA_Dist	distance to nearest major river	increase over time (earlier sites closer)	
Beaches	BeachDist	distance to nearest beach	increase over time (earlier sites closer)	MOA 2015; CHARIM (2016); Baldwin (2012)
Elevation	Elevation	site elevation	increase over time (earlier sites lower)	NOAA NCEI (2017)
	Slope	site slope (in degrees)	increase over time (earlier sites flatter)	
	Forests	site forest class (via elevation)	increase over time (earlier sites lower)	
NPP	NPP_cell	NPP value of exact location	decrease over time (earlier sites highest)	MODIS (Zhao and Running 2010)
	NPP_mean	average NPP value of surrounding cells (between 30–60 m buffer)	decrease over time (earlier sites highest)	
Reefs	ReefDist	distance to nearest reef	increase over time (earlier sites closer)	UNEP-WCMC et al. (2018)
	ReefSize	size of nearest reef	decrease over time (earlier sites bigger)	
	ReefRatio	ratio of nearest reef size to distance (size/distance)	decrease over time (earlier sites bigger and closer)	
	ReefBuffTotal	size of nearest reef in 600 m buffer	decrease over time (earlier sites have more within buffer)	
	ReefBuffPercent	percent of nearest reef area within a 600 m buffer	decrease over time (earlier sites have more within buffer)	
Flat Bluespots	FlatBlueDist	distance to nearest flat bluespot	increase over time (earlier sites closer)	ESRI (2015)
	FlatBlueBuffTotal	sum of flat bluespot area within a 600 m buffer	decrease over time (earlier sites have more within buffer)	
	FlatBlueBuffPercent	percent of flat bluespot area within a 600 m buffer	decrease over time (earlier sites have more within buffer)	
	FlatBlue_mod_Dist	distance to nearest flat bluespot > 0.01 km^2	increase over time (earlier sites closer)	
	BlueBuff_modTotal	sum of flat bluespot areas > 0.01 km^2 within a 600 m buffer	decrease over time (earlier sites more within buffer)	
	BlueBuff_modPercent	percent of flat bluespot areas > 0.01 km^2 within a 600 m buffer	decrease over time (earlier sites more within buffer)	
	FlatBlue_red_Dist	distance to nearest flat bluespot > 0.02 km^2	increase over time (earlier sites closer)	
	BlueBuff_redTotal	sum of flat bluespot areas > 0.02 km^2 within a 600 m buffer	decrease over time (earlier sites have more within buffer)	
	BlueBuff_redPercent	percent of flat bluespot areas > 0.02 km^2 within a 600 m buffer	decrease over time (earlier sites have more within buffer)	

as was the calculation for island area (see Table 1 and Table S2 in the Supplemental Material for additional details). Because many of the variables are interdependent or co-vary based on the same underlying macro-variable, these are presented as sub-variables under broader categories. For example, 'Elevation', 'Slope' and 'Forest Type' are derived from the DEM and nested under 'Elevation'.

Non-parity in data format and availability across the study islands created an initial challenge to developing the ArcGIS environmental database. For example, the wetlands data for Grenada were derived from a 1959 soil survey (MOA GIS 2015; Vernon, Payne, and Spector 1959). A similar survey was conducted on St. Vincent (Watson, Spector, and Jones 1958), but the digitised version (CHARIM 2016) did not contain wetlands data. An alternative proxy was thus generated by combining low-slope areas (derived from the DEM) and 'bluespots' (ESRI 2015).[3] Bluespots are simply depressions or sinks in a DEM that are prone to flooding, particularly during heavy rainstorms. Floodplains were thus identified as any area where a bluespot and low (<2 degree) slope co-occurred (hereafter labelled 'flat bluespots'). The results were compared against the wetlands data available in Grenada, for which 77% of wetlands overlapped flat bluespots – the closest of any other proxy we tried. In addition to distance from flat bluespots, a 600 m buffer was also placed around each point and used to calculate the area of overlap within the buffer. This buffer was then also used for several other variables (e.g. reef sizes and average NPP).

For the site inventory, we used two major syntheses to compile data on site locations and settlement dates, based on radiocarbon assays and ceramic types: Bright's (2011) inventory for St. Vincent and the Grenadines, and Hanna's (2017) inventory for Grenada. To confirm and augment these data, we reviewed accessible published works, unpublished theses, and conference proceedings (e.g. Bradford 2001; Bullen

1964; Bullen and Bullen 1972; Callaghan 2007; Cody and Banks 1986; Cody Holdren 1998; Fewkes 1903; Fitzpatrick et al. 2009; Fitzpatrick et al. 2013; Giovas 2013; Giovas 2016; Hanna 2018a; Huckerby 1914; Huckerby 1921; Kaye 2003; Kaye, Fitzpatrick, and Kappers 2017; Petitjean Roget 1981; Sutty 1991a; Sutty 1991b), yielding a total of 297 archaeological sites for the region (hereafter called the Archaeological Site Inventory for Grenada, St. Vincent, and the Grenadines, or ASIG-SVG) (Figure 2 and Supplemental Material). The ASIG-SVG data were then vetted and culled to remove sites with insufficient chronological information or multiple loci associated with a larger settlement. Single-occupation Cayo sites were eliminated since there were too few to test ($n = 4$). This vetting procedure produced a set of 77 non-ambiguous pre-Columbian settlements dating from the Saladoid-Barrancoid through the Suazan Troumassoid cultural historical periods. This culled dataset was further refined to include only sites that were definitively residential (e.g. large and diverse middens), contain strong chronological data (e.g. diagnostic ceramics and/or radiocarbon dates), and have sufficient locational data (e.g. GPS coordinates), resulting in a subset of 50 settlements with locations and dates (SLD sites, or SLD-50). These SLD sites represent the strongest available data for all subregions and time periods.

Exploratory and Predictive Analyses

Following data assembly, environmental attributes (in Table 1) were calculated in ArcGIS Pro for each site and the resulting measurements exported into Excel for organisation, then into R for multivariate statistical analysis. Basic descriptive statistics were then calculated for each subregion and associated time period (Figure 3). The data were transformed (cubed) for normalcy and fit to various multiple linear regression (MLR) models. MLR is well suited to the IFD because of its inherent presumption

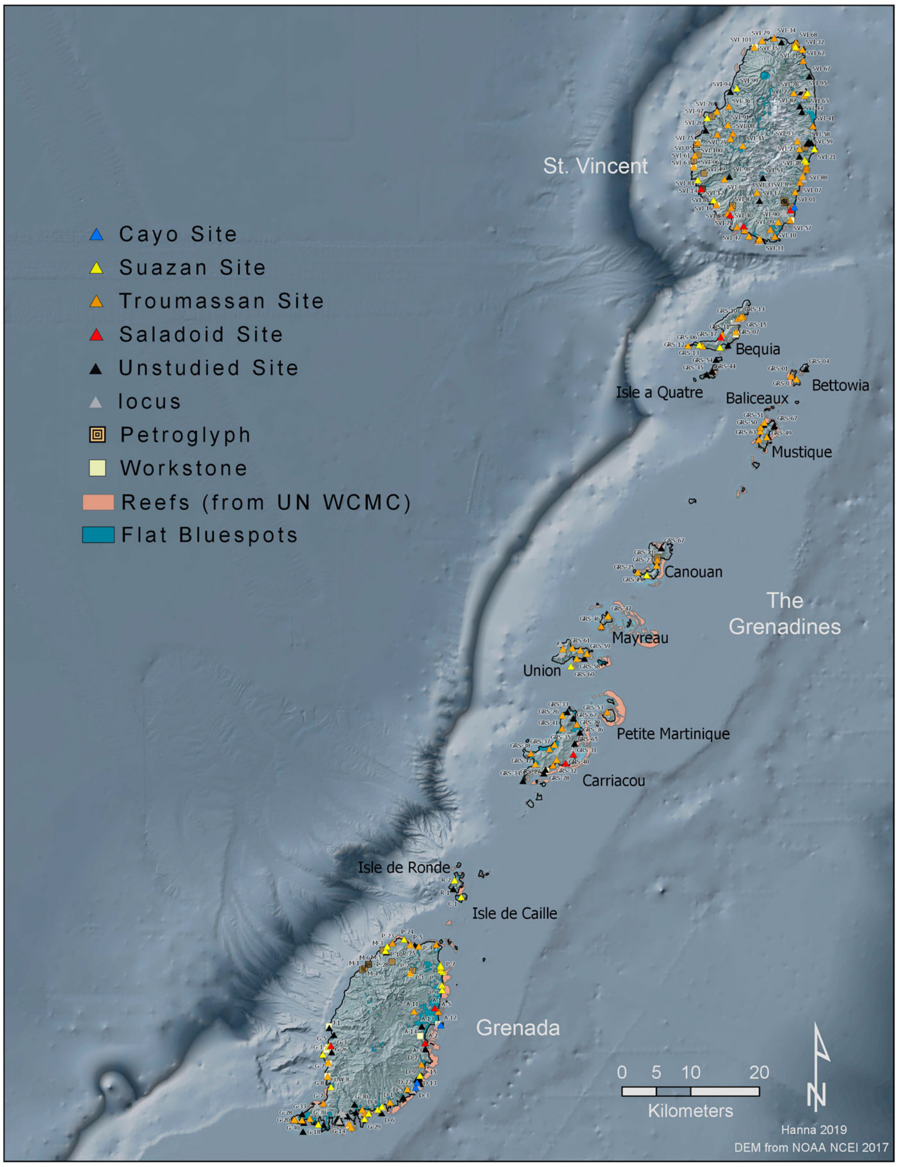


Figure 2. Map of Pre-Columbian Sites Inventoried for Grenada, St. Vincent, and the Grenadines (ASIG-SVG); interactive version: https://bit.ly/2ZIOz94.

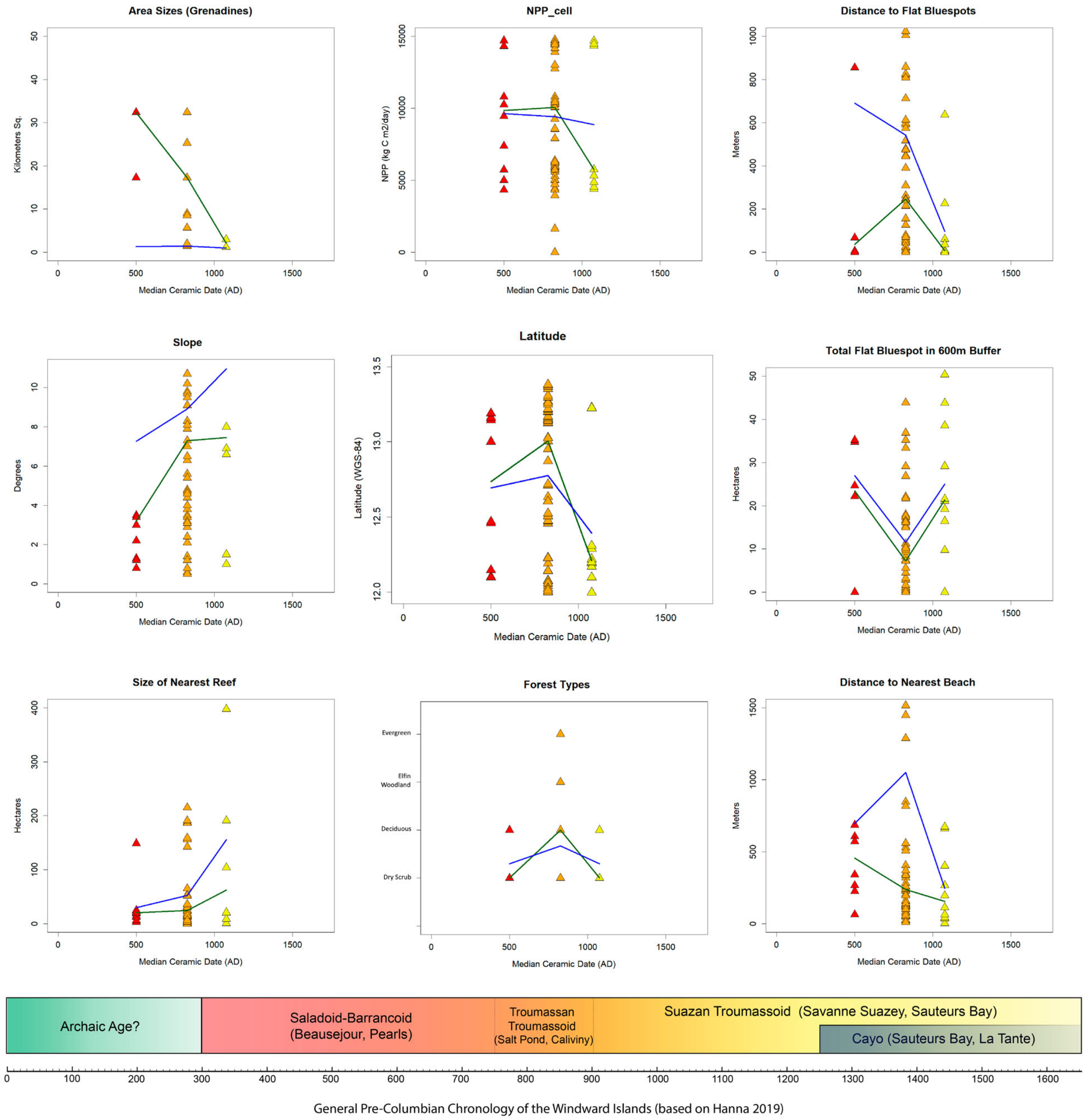


Figure 3. The Variables Selected in the Final Model (M51x) for All Known Settlements (plus Island Area for the Grenadines); green line represents median values, blue line represents mean values; see Supplemental Material for graphs of all 24 variables.

of linearity, i.e. a sequential progression of site settlements. The earliest ceramic date (i.e. median ceramic typology-based date) from each site was set as the MLR target.[4] Initially, large, exploratory models were built to examine variables for significant change consistent with declining quality over time. Following the logic of the IFD, those variables exhibiting decreasing quality through time should be the most important environmental factors for settlement suitability. For example, if rivers were an important factor for habitat suitability, newly settled sites should be increasingly farther from a river. Larger models were then pared down using backward stepwise linear regression to produce a 'minimal model'. Minimal models were produced for each subregion – Grenada (GREN), St. Vincent (SVI), and the Grenadines (GRS) – separately, as a whole, and with the refined SLD-50 dataset.

To gauge model performance, we used statistical values (e.g. R^2, p-values, F-statistic) and residuals (deviations from the target ceramic range). Models that performed well but contained potential redundancies (e.g. distance to beaches and distance to reefs) were remodelled with different, mutually-exclusive variables whenever possible. To guard against chance associations, favoured models, including the final selected model, were also applied to a randomised set of data and the results compared to the original model (see Results below and Supplemental Material). Randomised data provides a sobering check, as any model performing well on such data is likely based on fabricated patterns.

Predictive Mapping

Use of MLR allowed the models to be trialled on new data to check correspondence between predicted and known settlement dates. For instance, the models for each subregion (e.g. GREN, GRS, SVI) were applied to the entire ASIG-SVG dataset ($n = 297$) to predict that model's earliest settlement date (ESD) for every site.

Once we determined the best-fit model (M51x), we created a grid of points every 300 m across the entire region in ArcGIS.[5] Measurements of the variables used by the model were then taken for each point (e.g. distance to flat bluespots, nearest reef, etc.). These data were then exported to R and used as the new data for ESD predictions every 300 m across the entire region. Results were then re-imported into ArcGIS and joined to the 300 m gridpoints to create the final predictive map (Figure 4).

Results

Most variables did not show a consistent decline or increase over time (as would be expected from IFD predictions) – rather, most exhibited a departure in one direction from the Saladoid to the Troumassan period, followed by a reversal of this trend in the following Suazan period, i.e. a 'V' pattern (Figure 3). Forest-types became slightly more coastal for Grenada and St. Vincent, but went in the opposite direction for the Grenadines. Distance to reefs and wetlands as well as NPP values all generally went down over time, except in St. Vincent, where they went the opposite direction. Beaches, too, were highly variable, as were distance to rivers. Additionally, island area (km^2) worked well

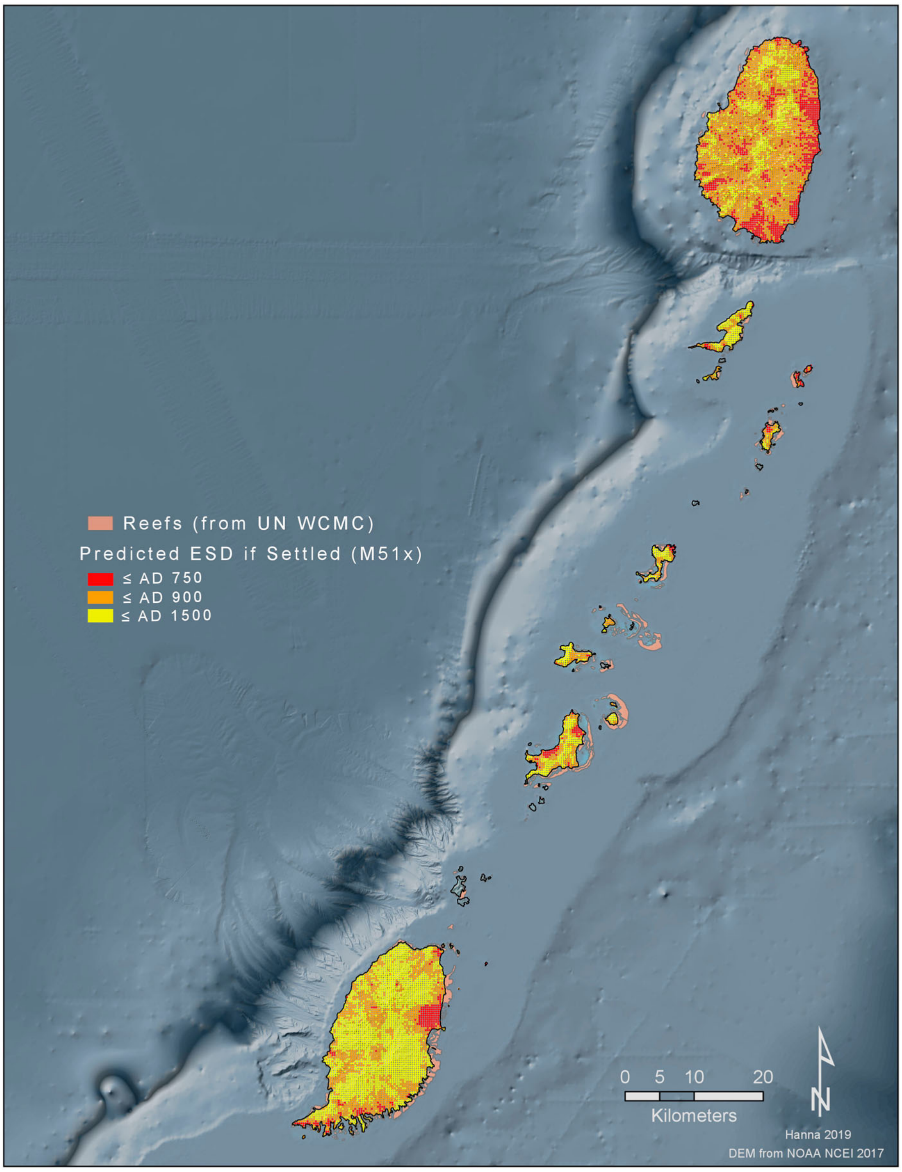


Figure 4. Visual representation of the final predictive model for the region (M51x).

within the Grenadines but could not be applied to the 80+ sites in Grenada or St. Vincent.

Differences in model performance among the subregions resulted in a unique combination of variables for each minimal model (e.g. flat bluespots for GREN, reef distances for GRS, and river distances for SVI). While models built from individual subregions could be combined for the entire region, they were not as strong as the ones based on SLD-50 sites (statistical information for each subregional model is provided in the Supplemental Material). The favoured model for the whole region (M51x) accurately predicted the earliest

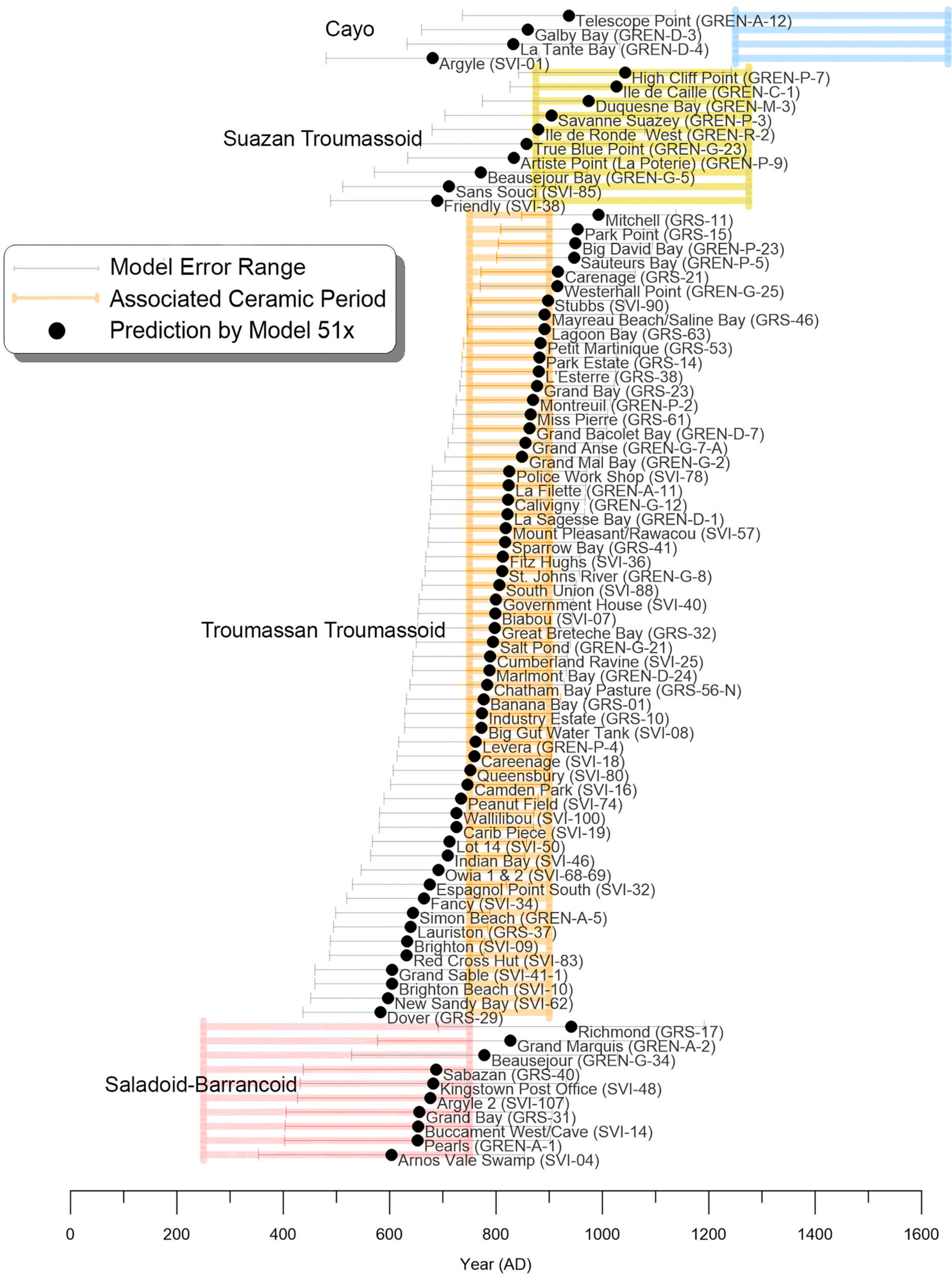


Figure 5. Predicted earliest settlement dates for all 77 known settlements (plus Cayo sites), with associated ceramic ranges.

Table 2. M51x variables for the minimal model on SLD-50 sites[8] (see also Figure 3).

Variable	Description	p-value	M51x coefficient
ReefSize	size of nearest reef	0.0102	32.95674
FlatBlueBuffTotal	amount of flat bluespot area within a 600 m buffer	0.0127	−39.66934
FlatBlueDist	distance to nearest flat bluespot	0.0251	−22.42500
Latitude_84	site latitude (degrees north of the equator)	0.0407	−1718.90462
NPP_cell	NPP value of site point's exact location	0.0674	−9.76365
Forests	site forest class (via elevation)	0.0893	308.06631
Slope	site slope (in degrees)	0.0927	66.93399
BeachDist	distance to nearest beach	0.1265	−10.32980

ceramic phase for 59 of 77 sites (76%) in the inventory (Figure 5). Generally, NPP and some variation of flat bluespots were the best predictors of settlement period (based on the statistics described above). Using the SLD-50 dataset, these two variables were strengthened slightly by adding several others to the model (Table 2). As described in the Methods section, the final model was also tested using a set of randomised data. Its poor performance confirmed that the patterns identified in the final model were real and not random.[6]

Attempt to Build Another Model from Outliers

When M51x was applied to all 77 settlements in the ASIG-SVG, 18 sites were predicted with high residual error, outside of their assigned ceramic range. These outliers were subsequently separated from the dataset and run in a new exploratory model in the hopes of identifying another, alternative model for site suitability. However, the only variable that was identified as having any potential explanatory value was slope, which was already in the M51x model. This suggests that either these sites were settled using a different logic with variables not included here (or perhaps not quantifiable at all), or their assigned settlement dates are erroneous. We think the latter is quite likely since most are not SLD sites (little is known about them), and nine of these 18 sites were predicted less than 50 years from their ceramic range (and 14 were less than 100 years). All except three are also Troumassan or Suazan sites, periods with considerable ceramic overlap. However, of the three Saladoid outliers, two are supported by radiocarbon dates. We return to these in the Discussion.

Performance of 2018 Grenada Model

As mentioned above, it was problematic to compare the new M51x model with Hanna's (2018) model for Grenada because of incongruity between the wetlands datasets. Both forest types and wetland buffers (total area within a 600 m buffer) – the sole variables used in 2018 – were integral to M51x, but were weak when applied regionally on their own. Even the GREN model (built and applied only from Grenada

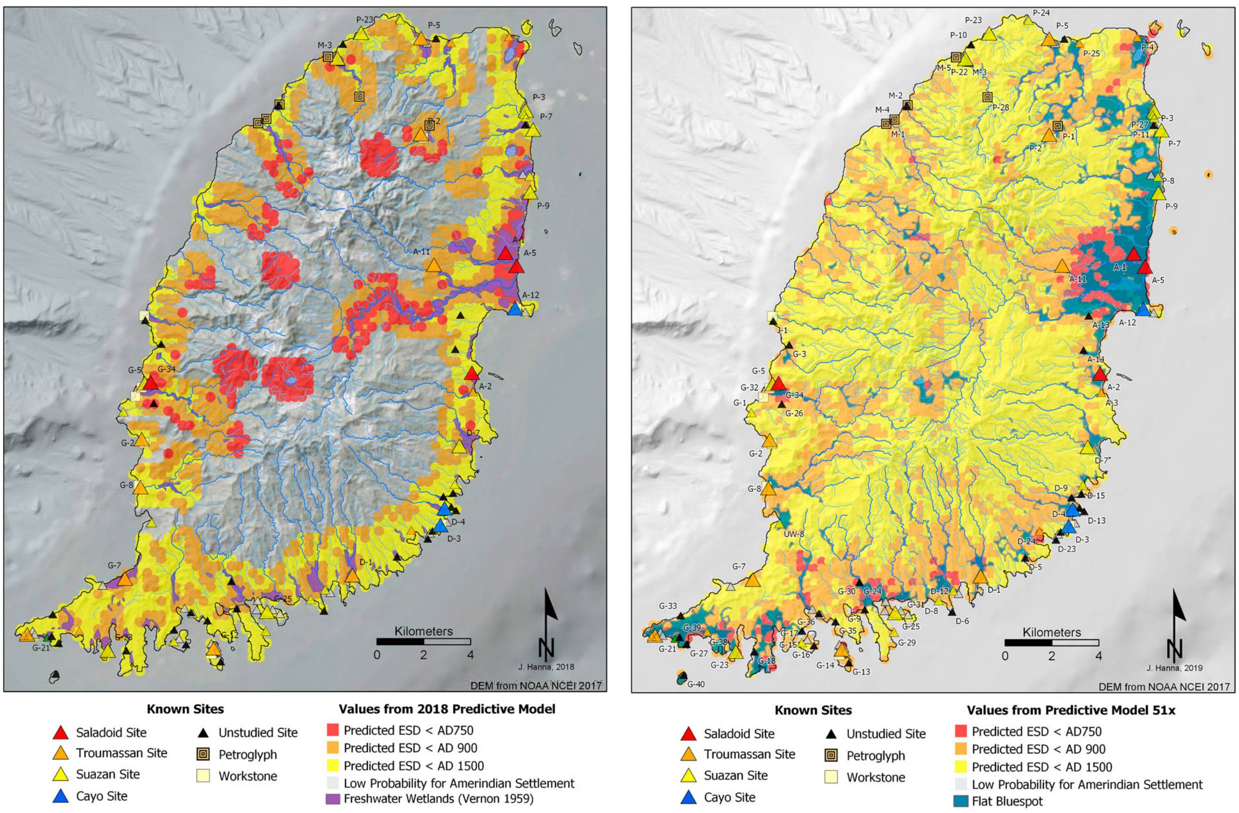


Figure 6. Comparison of predictive maps for Grenada from 2018 (left) and present paper (right).

sites) was weakened by the substitution of freshwater wetlands for flat bluespots, suggesting that the former might have performed better had they been available (see Figure 6 for comparison). The use of flat bluespots here, then, offers an alternative for situations where high-resolution soils data are not available.

Discussion

The major trend observed from this modelling exercise is that the earliest (Saladoid-Barrancoid) settlements in the southern Lesser Antilles preferred slightly inland locations – a few hundred metres from the coast – compared to later settlements (notwithstanding the aberrant Troumassan sites even farther inland). The three Saladoid residual sites (outliers that the model predicted much later, see Figure 5) – Beausejour (G-34) and Grand Marquis (A-2) on Grenada, and Richmond (GRS-17) on Bequia – bear this out. Beausejour and Grand Marquis appear to be single-component occupations with adjacent Troumassoid sites (G-5 and A-3, respectively) several hundred metres away and closer to the shore. Thus, these areas remained highly ranked over time with settlements simply migrating closer to the coast. Richmond, which lacks the data and radiocarbon dates of the other two outliers, may follow the same pattern, although it could have been founded later, as the model suggests.[7]

Similar patterns between Saladoid and Troumassan sites can be seen throughout the region: Pearls and Simon, Indian Bay and Arnos Vale, Argyle/Escape and Mt. Pleasant, etc. On St. Vincent, however, the earliest sites (e.g. Kingstown PO and Arnos Vale) are not spread out but situated in adjacent bays, just 3 km away from each other. This is likely due to the superior reefs in the area, compared to otherwise sparse reefs around St. Vincent (USAID 1991a, 95). This also confirms the continued importance of reefs over time.

Indeed, reefs were an increasingly important variable, as supported by the model's positive coefficient for reef size, which indicates larger reefs were more likely to be chosen as time progressed. This can clearly be seen on Carriacou, where the earliest sites occur near reefs on the island's windward side, rather than the leeward-located wetlands. In general then, areas with both freshwater wetlands and good reefs likely have an early Amerindian site in the vicinity, but once these prime areas were claimed, an apparent calculus was made towards one or the other variable. This highlights a limitation of the MLR method used here, which applies the same coefficients to every point, assuming each site represents the same balance of factors. A future IFD analysis might be strengthened by including multiple models focused on different resources (e.g. splitting or alternating wetlands and reefs) (see Plekhov and Levine, this issue, for a similar example).

Interestingly, for the few Cayo sites in the dataset, the model predicted much earlier settlement, within Troumassan (even Saladoid) dates (see Figure 5). This might indicate a completely different suitability criteria than the Saladoid to Suazan progression used for building the model, just as one would expect from a different cultural system. However, the Cayo phenomenon is not well understood, and more research is needed for clarification.

Hygiene Protocols

Given the potential for dramatic change over the last 1500 years, caution is warranted in using modern environmental data to inform models of past human ecology. For this reason, NPP is potentially the most problematic among the variables considered here. As a measure of biomass, NPP appears to be an appropriate proxy for habitat suitability, as others have shown (e.g. Codding and Jones 2013). However, it is derived from present-day amounts of atmospheric carbon fixed by oxygen producing plants. Modern disturbances (urbanism, agriculture, deforestation, etc.) could thus undermine the applicability of contemporary NPP for that of the past. Yet, most of the major towns in the region today are coastal, and all coastal areas tend to have low NPP regardless of how much modern disturbance is in the area. Even so, to reduce potentially erroneous values, we took a second measurement for NPP by averaging the values within a 600 m buffer around each point, which was then compared against singular NPP values during exploratory analysis. Ultimately, though, the results were similar and the MLR favoured the singular NPP over these averages.

Another potential drain on model strength is the poor chronological information available for the Grenadines and St. Vincent. The model presented here was based on an initial inventory of 297 sites that, following removal of subsidiary loci, single-use areas, and understudied sites (including Cayo), left a dataset of 77 pre-Columbian settlements. Of these, only 50 had robust chronological data (i.e. radiocarbon dates and/or diagnostic ceramics) for model construction. Scrutiny of original reports in relation to larger, published inventories revealed big dating discrepancies. For instance, while Bright's (2011) compilation of sites is an impressive effort, only three of the 25 Saladoid-Barrancoid sites he assigns in St. Vincent are convincingly from the period. This problem is not solely with Bright, but with how ceramic typologies are often assigned in the Caribbean in general (see Hanna 2019 for a similar example from Grenada). The rare occurrence of an 'early' ceramic type amongst hundreds of 'later' sherds should not be taken as conclusive evidence of 'early' settlement. We want to renew and emphasise the call made by others for improved chronological hygiene applications in the Caribbean (e.g. Fitzpatrick 2006; Giovas 2017), not just for radiocarbon dates and contexts but also in the details for ceramic artifact reporting. Lack of such standards is precisely why so many still believe the southern Lesser Antilles were settled hundreds of years earlier than the evidence allows. Such data harmonisation would be a critical step toward improving understanding of Caribbean prehistory.

To prevent these mistakes in our inventory, we did not designate a site as Saladoid-Barrancoid unless numerous diagnostic adornos, white-on-red (WOR), and zone-incised-crosshatching (ZIC) pottery were all reported, preferably also with radiocarbon dates. Otherwise, the site was assigned to the Troumassan period. Admittedly, one effect of this is that there are probably too many Troumassan sites. In particular, the apparent over-abundance of Troumassan-era sites in St. Vincent, especially, may be biasing its suitability in the model. There is good reason to believe St. Vincent's distribution of sites (by period) would be similar to Grenada's, in which case, several of those labelled Troumassan may actually fit more comfortably in a later (Suazan) category. However, without better data – or radiocarbon dates – we have retained their Troumassan designation.

That said, while these errors affect the comparative abundance of Troumassan sites in our inventory, it does not affect the obvious population rise during the Late Ceramic, generally – only the exact timing. Present evidence suggests population expansion occurred during the early Late Ceramic (Troumassan) period, corresponding to the settlement of new environments (e.g. islets, arid scrubland, and inland locations), probably in conjunction with diet-breadth expansion and decreased regional precipitation (Hanna 2018b). This is also evident in the variability of settled environments and disrupted suitability rankings shown above (e.g. Figure 3). By the Suazan period, new site locations appear to have returned to the earlier trajectory, but additional research is needed to clarify this pattern of consolidation.

Given the above, we propose several hygiene protocols for predictive modelling, inspired by the 'chronometric hygiene' principles advocated for Oceania and the Caribbean (Fitzpatrick 2006; Spriggs 1989):

(1) Locational and chronological data for the sites used to inform the model parameters must be as accurate as possible (ideally based on GPS points and radiocarbon dates).
(2) If diagnostic ceramics are used to establish chronology in the absence of radiocarbon dates, period assignments for a site must be based on a sufficient sample of diagnostic sherds (i.e. not simply a surface collection).
(3) Chronological associations should be the earliest settlement date (ESD), when the site location was first deemed suitable for settlement, although it is worth noting which areas remained occupied during each period and which were abandoned.
(4) For sites represented by multiple associated loci, just one location should be used to represent the main settlement (multiple loci of the same area will impede the model's accuracy). Generally, only residential/settlement sites should be chosen (e.g. sites with large and diverse middens, rather than sherd scatters or special-use areas like petroglyphs or shell heaps).
(5) Strong statistics are important – particularly, *p*-value, R^2, and F-statistic; qualitative/subjective analyses should be limited to interpreting rather than determining the final model.
(6) Lastly, predictive modelling is a form of hypothesis testing, which should be grounded in theoretically-informed, deductive reasoning, such as that offered by behavioural ecology. Cultural historical approaches are a necessary complement to this work since they provide the archaeological data for interpretation. Without a theoretical foundation to guide interpretation, however, such inductive analyses merely produce historical narratives rather than contribute a broader understanding and explanation of human behaviour.

Insights from the IFD

For this region of the Caribbean, the longevity of the earliest sites shows potential for positive density dependent factors, or an Allee effect, consistent with the expectations of cultural niche construction theory, in which people 'enhance' the environment in advantageous ways (Codding and Bird 2015). Many of Grenada's earliest Amerindian sites were still occupied at French colonisation in 1649 (Hofman et al. 2019), suggesting that rather than degradation, a critical level of habitat quality was maintained. This pattern aligns well with the logic of the IFD and suggests Amerindian suitability criteria did not change drastically over time.

Finer-grained chronological data are needed to determine whether trends seen at the macro-scale show a consistent, successive settlement of less optimal habitats, which might have implications for migration patterns. For example, when new/incoming individuals are *known*, they should immediately integrate with existing settlements and new sites should fission in the ranked IFD order; but when newcomers are not known, a potential IDD situation could form, whereby the original population itself (rather than an individual) is the 'despot'. As mentioned, this is expected in situations of strong Allee effects (Codding, Parker, and Jones 2017). From what we know about the nature of migration in the Eastern Caribbean, there is rarely evidence of a singular, monolithic migration of unknown foreigners, but rather migrations that began with interaction, alliance, exchange, and then a diffusion of ideas, sometimes eventually culminating in the merger of disparate groups. An IFD scenario is thus expected; but again, better chronological data would contribute to stronger IFD-based models in which such patterns, if present, could be better understood.

It should be noted, too, that the model's predicted ESDs are not comparable to precise chronometric dates but more akin to ceramic typology dates, since there is substantial error for each ESD (approximately ± 200 years; see Supplemental Material). Thus, the model's ESDs are more useful as a metric for ranking the suitability of each site than reliably dating individual settlements. Nonetheless, what this suggests is that the environmental variables selected by model M51x are significantly correlated to the relative timing of each area's settlement. Generally, a higher ranked area should be chosen over a lower ranked one, and sites that are predicted to be earlier than previously suggested may actually have an earlier, undiscovered component (i.e. these are sites worth investigating further). However, where there are no earlier components, or where an early

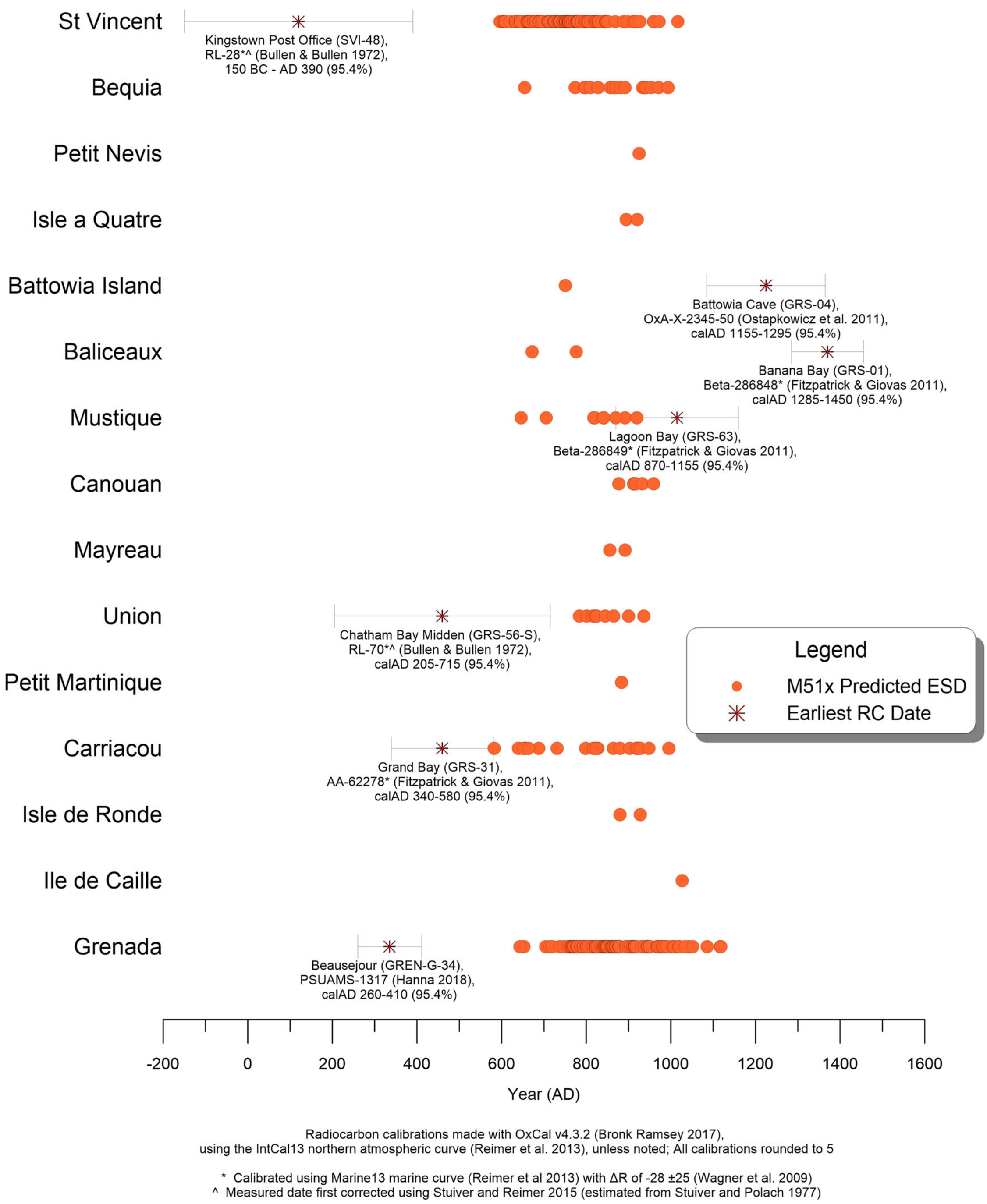


Figure 7. Sequence of earliest settlement dates (ESDs) from model M51x in geographical order.

site is predicted much later than evidence indicates, other (e.g. cultural) factors may be at work. This was the basis for the (unsuccessful) residual model described in the Results.

The analysis here also makes clear that freshwater wetlands are not an exclusively Grenadian phenomenon with respect to environmental suitability, but an overlooked factor in the suitability of Ceramic Age settlement locations in general, at least in the southern Lesser Antilles. Both the coefficient for distance to flat bluespots and the total size of flat bluespots within a 600 m buffer decreased over time, indicating settlements were closer to increasingly smaller wetlands, presumably because larger wetlands were more desirable and thus already occupied.

Archipelagic or Micro-Regional? Implications for Colonisation Patterns

What does the model developed here imply for colonisation of the southern Lesser Antilles? First, given the differences in the subregional models, especially the smaller Grenadines versus larger Grenada and St. Vincent, each subregion may have had particular characteristics that influenced their relative suitability. Yet overall, when considering colonisation processes, the region is best viewed as one archipelagic islandscape (Watters 1997).

Second, latitude was conserved in each model variation, always with a low p-value, high R^2, and negative coefficient; essentially, latitude decreased over time, indicating more southerly sites were more likely to be settled later (Figure 7). This lends support to the 'Southward Route Hypothesis' (Fitzpatrick 2013; Fitzpatrick, Kappers, and Giovas 2010) and the growing consensus that the Caribbean was indeed colonised 'backwards' (from north to south), but additional radiocarbon dates are needed throughout the region to mitigate the recognised problems of chronometric hygiene (Fitzpatrick 2006).

A scan of locations in the northern Lesser Antilles chosen during the earliest Ceramic Age migrations suggest different criteria for the Early Ceramic Age. Those selections were likely influenced, at least in part, by the presence of Archaic groups nearby, but more detailed analysis (e.g. proximity to freshwater wetlands) is needed. If those earliest settlements in the northeast Caribbean are not correlated to wetlands (as they are in the south), this might suggest that the groups who eventually settled the southern Lesser Antilles were guided less by suitability criteria from the northern sites than by mainland preferences (where, for example, floodplain agriculture was well known) (Denevan 2001). This might also explain the apparent drifting of the study region's earliest sites towards marine resources over time (e.g. the Beausejour and Grand Marquis sites above).

Conclusion

In this paper, we employed environmental data, site locations, and multiple linear regression to show how an ideal free distribution might work in the southernmost part of the Eastern Caribbean, offering an alternative lens through which to view pre-Columbian colonisation dynamics. Our model builds on those employed by Hanna (2018) and Giovas and Fitzpatrick (2014) and confirms the importance of freshwater wetlands and high-resource areas (indicated by NPP) in pre-Columbian colonisation noted in those studies. This research also suggests latitude and reef size were important variables conditioning settlement over time.

Notably, our results provide geostatistical confirmation of the southerly progression of new settlements within the microregion of Grenada, St Vincent, and the Grenadines, lending support to the 'Southward Route Hypothesis' that the Lesser Antilles were colonised from north to south. More broadly, they offer support for an IFD settlement pattern, but as discussed above, conclusive assessment requires more robust chronometric and site data. Other modelling tools might prove insightful, such as principal components analysis or the overlapping of multiple suitability criteria. Finally, the model highlights areas where potentially undiscovered sites may be found. As sea levels rise over the next several decades, threatening destruction of many (perhaps most) archaeological sites in the region, the predictive maps presented here provide a valuable tool for heritage managers and local communities for prioritising archaeological assessments and site impact mitigation efforts (de Waal et al. 2019). Salvaging the Caribbean's heritage in the face of climate change is this century's greatest challenge for the region's heritage community, and we hope this study can be employed as a contribution towards those efforts.

Notes

1. Sometime in the early 16th century, the Spanish named Grenada after the recently conquered Andalusian city of 'Granada', and the Grenadines 'Los Granadillos' (little Granadas). These islands remained a political unit through French and British rule. In 1783 (inspired by the temporary French re-capture of Grenada in 1779), the British decided to annex most of the Grenadines to St. Vincent's oversight (from Bequia to Union) (Martin 2013, 305). After independence in 1969, the country included them in its official name, St. Vincent and the Grenadines (SVG). However, for the purposes of this paper, we mostly treat the Grenadines and St. Vincent as separate entities.
2. It is worth noting that the logic of the IFD suggests the most suitable areas should be settled first and remain occupied until a change in suitability occurs, but permanent occupation is not a requirement — only that the same area continues to be occupied whenever

the population returns, and/or that sites are not abandoned once their suitability matches the next ranked habitat (partly due to settlement costs and Allee effects). It remains debatable whether pre-Columbian settlements were permanently settled or periodically abandoned. While some archaeological sites contain deep and broad midden deposits suggestive of permanent settlement (e.g., Pearls and Sauteurs Bay in Grenada, or Sabazan and Grand Bay in Carriacou), others indicate more short-lived occupations (especially during the Troumassan period). Nonetheless, the IFD requires only some level of territorial affiliation that would deter new settlers from occupying someone else's village. The spacing of sites (declining over time) implies different individuals inhabited contemporaneous settlements. Given the size of the areas in our analysis (see the Supplemental Material for comparison between the buffers used and observed site clusters), there is also ample accommodation for occasional abandonment, reconstruction, and even settlement drift.

3. As is made clear in the Discussion, however, no proxy could duplicate the value of the soils data itself.
4. These targets were: Saladoid (AD 500 ± 250), Troumassan (AD 825 ± 75), and Suazan (1075 ± 200). Assigned ceramic phases were informed by radiocarbon dates, where available.
5. Specifically, the island outlines were converted to a raster with a 300 m cell-size; then the raster-to-point tool was used to place a point at the center of each cell. Note that computing power is the limiting factor for grid size — a 300 m grid created 8,792 points and took only a few minutes to compute the measurements (this was also the size used in the 2018 model); a 100 m cell size, on the other hand, would have created 79,055 points and required ∼60 h to process.
6. Randomized M51x: $p = 0.490$; adjusted $R^2 = 0.006$; F-test = 0.941 (F-critical = 2.1).
7. Indeed, a Troumassan-period site, Mitchell, is <500 m away from Richmond (not unlike Grand Marquis or Beausejour). Bright (2011, Apx I:25) mentions a local collection with both sites mixed together, supposedly exhibiting Saladoid through Suazan ceramics.
8. M51x overall: $p = 0.007$, adj. $R^2 = 0.262$ (multiple R^2 = 0.383), 146.9 on 41 DF, F-test = 3.176 (F-critical = 2.2).

Acknowledgements

Many thanks to the guest editors, Elic Weitzel and Brian Codding, for arranging this special issue and inviting us to participate in the original SAA session. The authors also thank Ms. Dornet Hull of the St. Vincent Physical Planning Unit, Messrs. Michael Mason and Kenton Fletcher of the Grenada MOA GIS Office, and Mr. Michael Jessamy, Heritage Officer in Grenada's Ministry of Tourism. We also thank two anonymous reviewers for comments on an earlier draft of this paper.

Disclosure Statement

No potential conflict of interest was reported by the authors.

Notes on Contributors

Jonathan A. Hanna is an Instructor in Anthropology at the Pennsylvania State University. His research interests include environmental anthropology, geoarchaeology, and human behavioural ecology in the Eastern Caribbean.

Christina M. Giovas is an Assistant Professor of Archaeology at Simon Fraser University. Her research focuses on prehistoric fisheries, animal translocations, and the human paleoecology of island and coastal settings, particularly the Caribbean and Oceania. She is Associate Editor for the Journal of Island and Coastal Archaeology and serves on the Board of the International Association for Caribbean Archaeology.

ORCID

Jonathan A. Hanna http://orcid.org/0000-0002-9386-4013
Christina M. Giovas http://orcid.org/0000-0002-4626-113X

References

Allee, W. C. 1931. *Animal Aggregations, a Study in General Sociology*. Chicago: Chicago University Press.

Allen, Jim, and James F. O'Connell. 2008. "Getting from Sunda to Sahul." In *Islands of Inquiry: Colonisation, Seafaring and the Archaeology of Maritime Landscapes*, edited by Geoffrey A. Clark, Foss Leach, and Sue O'Connor, 31–46. Canberra: Australian National University Press.

Baldwin, Kimberly. 2012. "A Participatory Marine Resource and Space-Use Information System for the Grenadine Islands: An Ecosystem Approach to Collaborative Planning and Management of Transboundary Marine Resources." PhD diss., Barbados: University of the West Indies.

Beard, John Stewart. 1949. *The Natural Vegetation of the Windward & Leeward Islands*. Oxford, UK: Clarendon Press. Oxford Forestry Memoirs, no. 21.

Bird, Douglas W., and James F. O'Connell. 2006. "Behavioral Ecology and Archaeology." *Journal of Archaeological Research* 14 (2): 143–188.

Boomert, Arie. 1986. "The Cayo Complex of St. Vincent: Ethnohistorical and Archaeological Aspects of the Island Carib Problem." *Antropológica* 66: 3–86.

Bradford, Margaret Ann Cassity. 2001. "Caribbean Perspectives on Settlement Patterns: The Windward Island Study." PhD. diss., Iowa City: The University of Iowa.

Bright, Alistair J. 2011. *Blood is Thicker Than Water Amerindian Intra- and Inter-Insular Relationships and Social Organization in the Pre-Colonial Windward Islands*. Leiden: Sidestone Press.

Bullen, Ripley P. 1964. *The Archaeology of Grenada, West Indies*. Contributions of the Florida State Museum: Social Sciences, n. 11. Gainesville, FL: University of Florida.

Bullen, Ripley P., and Adelaide K. Bullen. 1972. *Archaeological Investigations on St. Vincent and the Grenadines, West Indies*. Orlando: Bryant Foundation.

Callaghan, Richard T. 1990. "Mainland Origins of the Preceramic Cultures of the Greater Antilles." PhD. diss., Calgary, Canada: University of Calgary.

Callaghan, Richard T. 2001. "Ceramic Age Seafaring and Interaction Potential in the Antilles: A Computer Simulation." *Current Anthropology* 42 (2): 308–313. doi:10.1086/320012.

Callaghan, Richard T. 2003. “Comments on the Mainland Origins of the Preceramic Cultures of the Greater Antilles.” *Latin American Antiquity* 14 (3): 323–338.
Callaghan, Richard T. 2007. “Prehistoric Settlement Patterns on St. Vincent, West Indies.” *Caribbean Journal of Science* 43 (1): 11–22.
Callaghan, Richard T. 2010. “Crossing the Guadeloupe Passage in the Archaic Age.” In *Island Shores, Distant Pasts: Archaeological and Biological Approaches to the Pre-Columbian Settlement of the Caribbean*, edited by Scott M. Fitzpatrick, and Ann H. Ross, 127–147. Bioarchaeological Interpretations of the Human Past. Gainesville: University Press of Florida.
CHARIM. 2016. “Geonode: Saint Vincent and the Grenadines.” *Caribbean Handbook on Risk Information Management (CHARIM)*. Accessed May 31, 2019. http://www.charim-geonode.net/people/profile/svg/.
Codding, Brian F., and Douglas W. Bird. 2015. “Behavioral Ecology and the Future of Archaeological Science.” *Journal of Archaeological Science* 56 (April): 9–20. doi:10.1016/j.jas.2015.02.027.
Codding, Brian F., and Terry L. Jones. 2013. “Environmental Productivity Predicts Migration, Demographic, and Linguistic Patterns in Prehistoric California.” *Proceedings of the National Academy of Sciences* 110 (36): 14569–14573. doi:10.1073/pnas.1302008110.
Codding, Brian F., Ashley K. Parker, and Terry L. Jones. 2017. “Territorial Behavior Among Western North American Foragers: Allee Effects, Within Group Cooperation, and Between Group Conflict.” *Quaternary International*. doi:10.1016/j.quaint.2017.10.045.
Cody, Ann K., and Thomas J. Banks. 1986. *Archaeological Survey of Grenada*. Project Reports of Research Funded by the Foundation for Field Research on Grenada. St. George’s, Grenada: Foundation for Field Research.
Cody Holdren, Ann K. 1998. “Raiders and Traders: Caraïbe Social and Political Networks at the Time of European Contact and Colonization in the Eastern Caribbean.” PhD. diss., University of California, Los Angeles.
Denevan, William M. 2001. *Cultivated Landscapes of Native Amazonia and the Andes: Triumph Over the Soil*. New York: Oxford University Press.
de Waal, Maaike S., Jochem Lesparre, Ryan Espersen, and Ruud Stelten. 2019. “The Effectiveness of Archaeological Predictive Maps.” *Journal of Cultural Heritage Management and Sustainable Development* 9: 149–164. doi:10.1108/JCHMSD-02-2018-0014.
ESRI. 2015. “Bluespot Models.” *Find Areas at Risk of Flooding in a Cloudburst*. Accessed May 20, 2019. https://learn.arcgis.com/en/projects/find-areas-at-risk-of-flooding-in-a-cloudburst/.
Fewkes, Jesse Walter. 1903. “Preliminary Report on an Archaeological Trip to the West Indies.” In *Smithsonian Miscellaneous Collections*, XLV, Report no. 1429:112–133. Washington, D.C. https://library.si.edu/digital-library/book/smithsonianmisce451903smit.
Fitzpatrick, Scott M. 2006. “A Critical Approach to 14C Dating in the Caribbean: Using Chronometric Hygiene to Evaluate Chronological Control and Prehistoric Settlement.” *Latin American Antiquity* 17 (4): 389–418.
Fitzpatrick, Scott M. 2011. “Verification of an Archaic Age Occupation on Barbados, Southern Lesser Antilles.” *Radiocarbon* 53 (4): 595–604.
Fitzpatrick, Scott M. 2013. “The Southward Route Hypothesis.” In *The Oxford Handbook of Caribbean Archaeology*, edited by William F. Keegan, Corinne Lisette Hofman, and Reniel Rodríguez Ramos, 198–204. Oxford; New York: Oxford University Press.
Fitzpatrick, Scott M., Michiel Kappers, Meagan Clark, and Jessica Stone. 2013. “Preliminary Investigation of Pre-Columbian Sites on the Islands of Mustique and Union in the Grenadines, West Indies.” *Caribbean Journal of Science* 47 (2–3): 260–272.
Fitzpatrick, Scott M., Michiel Kappers, and Christina M. Giovas. 2010. “The Southward Route Hypothesis: Examining Carriacou’s Chronological Position in Antillean Prehistory.” In *Island Shores, Distant Pasts: Archaeological and Biological Approaches to the Pre-Columbian Settlement of the Caribbean*, edited by Scott M. Fitzpatrick, and Ann H. Ross, 163–176. Gainesville: University Press of Florida.
Fitzpatrick, Scott M., Michiel Kappers, Quetta Kaye, Christina M. Giovas, Michelle J. LeFebvre, Mary Hill Harris, Scott Burnett, Jennifer A. Pavia, Kathleen Marsaglia, and James Feathers. 2009. “Precolumbian Settlements on Carriacou, West Indies.” *Journal of Field Archaeology* 34 (3): 247–266.
Fretwell, Stephen D. 1972. *Populations in a Seasonal Environment*. Princeton, NJ: Princeton University Press.
Fretwell, Stephen Dewitt, and Henry L. Lucas Jr. 1969. “On Territorial Behavior and Other Factors Influencing Habitat Distribution in Birds.” *Acta Biotheoretica* 19 (1): 16–36. doi:10.1007/BF01601953.
Giovas, Christina M. 2013. “Foraging Variability in the Prehistoric Caribbean: Multiple Foraging Optima, Resource Use, and Anthropogenic Impacts on Carriacou, Grenada.” Ph.D., Seattle: University of Washington.
Giovas, Christina M. 2016. “Pre-Columbian Amerindian Lifeways at the Sabazan Site, Carriacou, West Indies.” *The Journal of Island and Coastal Archaeology* (September): 1–30. doi:10.1080/15564894.2016.1229702.
Giovas, Christina M. 2017. “The Beasts at Large – Perennial Questions and New Paradigms for Caribbean Translocation Research. Part I: Ethnozoogeography of Mammals.” *Environmental Archaeology* (April): 1–17. doi:10.1080/14614103.2017.1315208.
Giovas, Christina M., and Scott M. Fitzpatrick. 2014. “Prehistoric Migration in the Caribbean: Past Perspectives, New Models and the Ideal Free Distribution of West Indian Colonization.” *World Archaeology* 46 (4): 569–589. doi:10.1080/00438243.2014.933123.
Greene, Correigh M., and Judy A. Stamps. 2001. “Habitat Selection at Low Population Densities.” *Ecology* 82 (8): 2091–2100. doi:10.2307/2680218.
Hanna, Jonathan A. 2017. *The Status of Grenada’s Prehistoric Sites: Report on the 2016 Survey and an Inventory of Known Sites*. Botanical Gardens, Grenada: Ministry of Tourism. doi:10.18113/S1QG64.
Hanna, Jonathan A. 2018a. “Ancient Human Behavioral Ecology and Colonization in Grenada, West Indies.” PhD. diss., University Park, PA: Pennsylvania State University.
Hanna, Jonathan A. 2018b. “Grenada and the Guianas: Mainland Connections and Cultural Resilience During the Caribbean Late Ceramic Age.” *World Archaeology* 50 (4): 651–675. doi:10.1080/00438243.2019.1607544.
Hanna, Jonathan A. 2019. “Camáhogne’s Chronology: The Radiocarbon Settlement Sequence on Grenada, West Indies.” *Journal of Anthropological Archaeology* 55: 101075. doi:10.1016/j.jaa.2019.101075.

Hofman, Corinne L. 2013. “The Post-Saladoid in the Lesser Antilles (AD 600/800-1492).” In *The Oxford Handbook of Caribbean Archaeology*, edited by William F. Keegan, Corinne L. Hofman, and Reniel Rodríguez Ramos, 205–220. Oxford: Oxford University Press.

Hofman, Corinne L., and Andrzej T. Antczak, eds. 2019. *Early Settlers of the Insular Caribbean. Dearchaizing the Archaic*. Leiden: Sidestone Press.

Hofman, Corinne L., Arie Boomert, Alistair J. Bright, Menno L.P. Hoogland, Sebastiaan Knippenberg, and Alice VM Samson. 2011. “Ties with the Homelands: Archipelagic Interaction and the Enduring Role of the South and Central American Mainlands in the Pre-Columbian Lesser Antilles.” In *Islands at the Crossroads: Migration, Seafaring, and Interaction in the Caribbean*, edited by L. Antonio Curet, and Mark W Hauser, 73–86. Tuscaloosa: University of Alabama Press.

Hofman, Corinne L., and Menno L. P. Hoogland. 2012. “Caribbean Encounters: Rescue Operations at the Early Colonial Carib Site of Argyle, St. Vincent.” In *Analecta Praehistorica Leidensia: The End of Our Fifth Decade*, edited by Corrie Bakels, and Hans Kamermans, 63–76. 43/44. Leiden, Netherlands: Leiden University, Faculty of Archaeology.

Hofman, Corinne L., Menno L. P. Hoogland, Arie Boomert, and John Angus Martin. 2019. “Colonial Encounters in the Southern Lesser Antilles: Indigenous Resistance, Material Transformations, and Diversity in an Ever-Globalizing World.” In *Material Encounters and Indigenous Transformations in the Early Colonial Americas*, edited by Corinne Hofman, and Floris Keehnen, 9:359–384. The Early Americas: History and Culture. Leiden, Netherlands: Brill. doi:10.1163/9789004273689_017.

Hoogland, M. L. P., and C. L. Hofman. 2013. “From Corpse Taphonomy to Mortuary Behavior in the Caribbean: A Case Study from the Lesser Antilles.” In *The Oxford Handbook of Caribbean Archaeology*, edited by William F. Keegan, Corinne Lisette Hofman, and Reniel Rodríguez Ramos, 452–468. Oxford; New York: Oxford University Press.

Huckerby, Thomas. 1914. “Petroglyphs of St Vincent, British West Indies.” *American Anthropologist* 16 (2): 238–244. doi:10.1525/aa.1914.16.2.02a00040.

Huckerby, Thomas. 1921. *Petroglyphs of Grenada and a Recently Discovered Petroglyph in St. Vincent*. Edited by F.W. Hodge. Indian Notes and Monographs, v. 1(3). Museum of the American Indian. New York: Heye Foundation.

Jazwa, Christopher S., Douglas J. Kennett, and Bruce Winterhalder. 2013. “The Ideal Free Distribution and Settlement History at Old Ranch Canyon, Santa Rosa Island, California.” In *California’s Channel Islands: The Archaeology of Human-Environment Interactions*, edited by Christopher S. Jazwa and Jennifer E. Perry, 75–96. Salt Lake: University of Utah Press.

Jazwa, Christopher S., Douglas J. Kennett, and Bruce Winterhalder. 2016. “A Test of Ideal Free Distribution Predictions Using Targeted Survey and Excavation on California’s Northern Channel Islands.” *Journal of Archaeological Method and Theory* 23 (4): 1242–1284. doi:10.1007/s10816-015-9267-6.

Kaye, Quetta. 2003. “A Field Survey of the Island of Carriacou, West Indies, March 2003.” *Papers from the Institute of Archaeology* 14 (March): 129–135. doi:10.5334/pia.197.

Kaye, Quetta, Scott M. Fitzpatrick, and Michiel Kappers. 2017. “*An Overview of Ten Years of Archaeological Research on Carriacou, W.I. (2003–2014)*.” Proceedings of the XXVI Congress of the International Association for Caribbean Archaeology (2015 IACA), St. Maarten.

Keegan, William F. 1985. “Dynamic Horticulturalists: Population Expansion in the Prehistoric Bahamas.” PhD. diss., University of California, Los Angeles.

Keegan, William F. 1995. “Modeling Dispersal in the Prehistoric West Indies.” *World Archaeology* 26 (3): 400–420.

Keegan, William F. 2006. “Archaic Influences in the Origins and Development of Taino Societies.” *Caribbean Journal of Science* 42 (1): 1.

Keegan, William F., and Jared M. Diamond. 1987. “Colonization of Islands by Humans: A Biogeographical Perspective.” *Advances in Archaeological Method and Theory* 10: 49–92.

Keegan, William F., Scott M. Fitzpatrick, Kathleen Sullivan Sealey, Michelle J. LeFebvre, and Peter T. Sinelli. 2008. “The Role of Small Islands in Marine Subsistence Strategies: Case Studies from the Caribbean.” *Human Ecology* 36 (5): 635–654. doi:10.1007/s10745-008-9188-z.

Keegan, William F, and Corinne Lisette Hofman. 2017. *The Caribbean Before Columbus*. New York: Oxford University Press.

Kennett, Douglas J. 2005. *The Island Chumash: Behavioral Ecology of a Maritime Society*. Berkeley: University of California Press.

Kennett, Douglas J., Atholl Anderson, and Bruce Winterhalder. 2006. “The Ideal Free Distribution, Food Production, and the Colonization of Oceania.” In *Behavioral Ecology and the Transition to Agriculture*, edited by Douglas J. Kennett and Bruce Winterhalder, 265–288. Berkeley, CA: University of California Press.

Kennett, Douglas J., and Bruce Winterhalder. 2008. “Demographic Expansion, Despotism and the Colonization of East and South Polynesia.” In *Islands of Inquiry: Colonisation, Seafaring and the Archaeology of Maritime Landscapes*, edited by Geoffrey Clark, Foss Leach, and Sue O’Connor, 87–96. Canberra: ANU E Press.

Kennett, Douglas J., Bruce Winterhalder, Jacob Bartruff, and Jon M. Erlandson. 2009. “An Ecological Model for the Emergence of Institutionalized Social Hierarchies on California’s Northern Channel Islands.” In *Pattern and Process in Cultural Evolution*, edited by Stephen Shennan, 297–314. Berkeley: University of California Press.

Lindsay, Jan M., and John B. Shepherd. 2005. “Kick ‘em Jenny & Ile de Caille.” In *Volcanic Hazard Atlas of the Lesser Antilles*, edited by Jan M. Lindsay, Richard E. A. Robertson, John B. Shepherd, and Shahiba Ali, 107–126. Trinidad and Tobago: University of the West Indies Seismic Research Unit.

Loven, Sven. 2010. *Origins of the Tainan Culture, West Indies*. Tuscaloosa: University of Alabama Press.

Martin, John Angus. 2013. *Island Caribs and French Settlers in Grenada: 1498-1763*. St George’s, Grenada: Grenada National Museum Press.

McClure, Sarah B., Michael A. Jochim, and Michael C. Barton. 2006. “Human Behavioral Ecology, Domestic Animals, and Land Use During the Transition to Agriculture in Valencia, Eastern Spain.” In *Behavioral Ecology and the Transition to Agriculture*, edited by Douglas J. Kennett and Bruce Winterhalder, 197–216. Berkeley, CA: University of California Press. Accessed February 25, 2015. http://www.public.asu.edu/~cmbarton/files/reprints/McClure%20et%20al.%20-%

202006%20-%20Behavioral%20ecology,%20domestic%20animals,%20and%20land%20use.pdf.

MOA GIS. 2015. *Grenada- Soils Shapefile* (version Proprietary Digital Data of the State of Grenada). Botanical Gardens, Tanteen, Grenada: GIS Unit of the Ministry of Agriculture, Government of Grenada. Accessed May 31, 2019. http://charim-geonode.net/people/profile/grenada/.

Newsom, Lee A., and Elizabeth S. Wing. 2004. *On Land and Sea: Native American Uses of Biological Resources in the West Indies*. Tuscaloosa: The University of Alabama Press.

NOAA NCEI. 2017. *Grenada Digital Elevation Model - 1 Arc-Second*. University of Colorado at Boulder. https://catalog.data.gov/dataset/grenada-digital-elevation-model-1-arc-second. Accessed December 12, 2017: NOAA National Centers for Environmental Information (NCEI). https://data.noaa.gov/dataset/dataset/grenada-1-arc-second-digital-elevation-model.

Pagán Jiménez, J. R. 2013. "Human-Plant Dynamics in the Precolonial Antilles." In *The Oxford Handbook of Caribbean Archaeology*, edited by William F. Keegan, Corinne L. Hofman, and Reniel Rodríguez-Ramos, 391–406. Oxford: Oxford University Press.

Petersen, James B., Corinne L. Hofman, and Antonio L. Curet. 2004. "Time and Culture: Chronology and Taxonomy in the Eastern Caribbean and the Guianas." In *Late Ceramic Age Societies in the Eastern Caribbean*, edited by Andre Delpuech and Corinne L. Hofman, 17–32. Oxford: Archaeopress. BAR International Series, v. 1273(14).

Petitjean Roget, Henry. 1981. *Archaeology in Grenada*. Barbados: Caribbean Conservation Association.

Robertson, Richard. 2005. "St. Vincent." In *Volcanic Hazard Atlas of the Lesser Antilles*, edited by Jan M. Lindsay, Richard E. A. Robertson, John B. Shepherd, and Shahiba Ali, 240–261. Trinidad and Tobago: University of the West Indies Seismic Research Unit.

Roksandic, Ivan, and Mirjana Roksandic. 2018. "Peopling of the Caribbean." In *New Perspectives on the Peopling of the Americas*, edited by Katerina Harvati, Gerhard Jäger, and Hugo Reyes-Centeno, 199–223. Tübingen: Kerns Verlag. Words, Bones, Genes, Tools: DFG Center for Advanced Studies Series.

Rouse, Irving. 1964. "Prehistory of the West Indies." *Science* 144 (3618): 499–513.

Rouse, Irving. 1986. *Migrations in Prehistory: Inferring Population Movement from Cultural Remains*. New Haven: Yale University Press.

Rouse, Irving. 1992. *The Tainos: Rise & Decline of the People Who Greeted Columbus*. New Haven: Yale University Press.

Spriggs, Matthew. 1989. "The Dating of the Island Southeast Asian Neolithic: An Attempt at Chronometric Hygiene and Linguistic Correlation." *Antiquity* 63 (240): 587–613. doi:10.1017/S0003598X00076560.

Steward, Julian H. 1947. "American Culture History in the Light of South America." *Southwestern Journal of Anthropology* 3 (2): 85–107. doi:10.1086/soutjanth.3.2.3628725.

Sutherland, William J. 1996. *From Individual Behaviour to Population Ecology*. Oxford; New York: Oxford University Press.

Sutty, Lesley. 1991a. "*A Preliminary Inventory And Short Essay On Ceramic And Stone Artifacts from Recent Excavations On Grenada And In The Southern Grenadines*." In Proceedings of the XII Congress of the International Association for Caribbean Archaeology (IACA,1987), 73–86, French Guiana.

Sutty, Lesley. 1991b. "*Paleoecological Formations in the Grenadines of Grenada and Their Relationship to Preceramic and Ceramic Settlements: Carriacou*." In Proceedings of the XIII Congress of the International Association for Caribbean Archaeology (IACA, 1989), 127–147, Curacao.

UNEP-WCMC, WorldFish Centre, WRI, and TNC. 2018. Global Distribution of Warm-Water Coral Reefs, Compiled from Multiple Sources Including the Millennium Coral Reef Mapping Project (v.4). Cambridge, UK: UNEP World Conservation Monitoring Centre. http://data.unep-wcmc.org/datasets/1. [accessed: March 16, 2019].

USAID. 1991a. *St. Vincent and the Grenadines: Country Environmental Profile*. Bridgetown, Barbados: Regional Development Office/Caribbean.

USAID. 1991b. *Grenada: Country Environmental Profile*. Bridgetown, Barbados: Regional Development Office/Caribbean.

Vernon, K. C., Hugh Payne, and J. Spector. 1959. *Grenada*. Soil and Land-Use Surveys, no. 9. Trinidad and Tobago: Soils Research and Survey Section, Regional Research Centre, Imperial College of Tropical Agriculture.

Watson, J. P., J. Spector, T. A. Jones, and Imperial College of Tropical Agriculture (Trinidad and Tobago). 1958. *St. Vincent*. Soil and Land-Use Surveys, no. 3. Trinidad: Regional Research Centre, Imperial College of Tropical Agriculture.

Watters, David R. 1997. "Maritime Trade in the Prehistoric Eastern Caribbean." In *The Indigenous People of the Caribbean*, edited by Samuel M. Wilson, 88–99. The Ripley P. Bullen Series. Gainesville: University Press of Florida.

Wilson, Samuel M., Harry B. Iceland, and Thomas R. Hester. 1998. "Preceramic Connections between Yucatan and the Caribbean." *Latin American Antiquity* 9 (4): 342–352. doi:10.2307/3537032.

Winterhalder, Bruce, Douglas J. Kennett, Mark N. Grote, and Jacob Bartruff. 2010. "Ideal Free Settlement of California's Northern Channel Islands." *Journal of Anthropological Archaeology* 29 (4): 469–490. doi:10.1016/j.jaa.2010.07.001.

Zhao, Maosheng, and Steven W. Running. 2010. "Drought-Induced Reduction in Global Terrestrial Net Primary Production from 2000 through 2009." *Science* 329 (5994): 940–943. MOD17 dataset. Accessed August 18, 2019. http://www.ntsg.umt.edu/project/modis/mod17.php.

Supplemental Material for

An Islandscape IFD: Using the Ideal Free Distribution to Predict Pre-Columbian Settlements from Grenada to St. Vincent, Eastern Caribbean

Jonathan A. Hanna*
Christina M. Giovas

*Corresponding email: jah1147@psu.edu

Methods (Expanded)

Step 1: Assemble environmental data

A major obstacle to building a settlement model across national boundaries is the difficulty in securing comparable cultural and environmental data that can be analyzed in ArcGIS. Data available in one country may not be available in another, or it may be in a totally different format. For example, the wetlands data used in Hanna's (2018) predictive model for Grenada was derived by analyzing and parsing a georeferenced version of a 1959 soil survey of Grenada (MOA GIS 2015; Vernon et al. 1959). A similar survey was conducted on St. Vincent (Watson et al. 1958), which was digitized (CHARIM 2016), but different methods in the digitization process created too much variation to permit meaningful data comparisons.

Since one goal of this paper is to test Hanna's (2018) model elsewhere, other methods were explored as potential proxies for freshwater wetlands. Net Primary Productivity (see below), use of satellite-derived wetlands by CIFOR (Gumbricht et al. 2017), and complex flood modelling with the ArcHydro toolset (Scopel 2014) were all explored. Ultimately, a combination of low-slope areas (derived from the DEM) and ESRI's "bluespot" toolset (2015) were found to be an adequate replacement. Bluespots are simply depressions or sinks in a DEM that are prone to flooding, particularly during extreme rainstorms such as cloudbursts. The ESRI tool can incorporate structural barriers with an additional shapefile, but the tool cannot generate the data offered by more complex toolsets like ArcHydro, which account for past water levels and any number of hydrological diversions. Ironically, these limitations are exactly what makes the bluespot tool so ideal when the only data available is a DEM.

For our purposes, floodplains were identified as any area where a bluespot and low (under 2 degrees) slope co-occurred — henceforth labelled "flat bluespots." The results were compared against the wetlands data available in Grenada, for which 77% of wetlands overlapped with a flat bluespot — the closest any other proxy had come by far. The number of flat bluespots far exceeded the number of wetlands, however, such that 80% did not overlap with a wetland. Since most of these were under 0.03 km^2 and could be easily culled, a reduced shapefile was made for further comparison. This brought the percent of flat bluespots that do not intersect with a wetland from 80% to 13% (although it also lowered the number of wetlands that overlapped with a flat bluespot from 77% to 71%). Since it is possible the larger dataset would be more useful in predictions, both the original and reduced datasets were retained for statistical comparisons. [A third variation was later added that includes all flat bluespots above 0.01 km^2. Compared to the original data, this retained all 77% of previous wetlands overlapped, with 68% of the flat bluespots not containing any wetlands.]

In addition to distance from flat bluespots, a 600 m buffer was also placed around each point and used to calculate the area of overlap within the buffer. This buffer was then also used for several other variables (e.g., reef sizes and average NPP). The buffer radius of 600 m was initially chosen as the maximum distance of any workstone or petroglyph (in Grenada) from its associated residential area (Hanna 2018). For this paper, several clusters of sites and loci across the region were re-examined to get a potentially different "site catchment" area. For example, the distance between the center and associated loci of the Westerhall sites in Grenada are 500 m. The Industry-

Park-Spring sites on Bequia are about 350 m apart. Arnos Vale and Indian Bay in St. Vincent average 650 m, as do the Lot 14 sites (with Orange Hill and Dandrades considered loci). The distance between settlements on Carriacou is (quite intriguingly) around 800 m consistently, indicating loci/site-catchments should be less than that. The average of those loci considered was 450 m, but 600 m was retained, since it ensures only the most extreme outliers would be left out.

Reefs data was acquired from MarSIS, the United Nations Environment World Conservation Monitoring Centre (UN WCMC), and two USAID Country Environmental Profile reports (USAID 1991a; USAID 1991b). The latter confirmed the relatively depauperate situation of reefs in St. Vincent (see below). Net Primary Productivity (NPP) was incorporated from the MODIS project (Zhao and Running 2010), slope and forest-type elevation from the 1-arc DEM (NOAA NCEI 2017), and rivers and temporary streams (for the Grenadines) derived from the flow accumulation tool in ArcGIS Pro 2.3; as was the calculation for island area.

Step 2: Assemble site inventory

The next step is to make the site inventory— with the express goal of acquiring site locations and ceramic types/periods to be plotted on a map. Alistair Bright's (2011) inventory was digitized and georeferenced for St. Vincent's and the Grenadines, while Hanna's (2017) inventory of Grenada's pre-Columbian sites was used for Grenada. We then further researched all reports available to confirm site chronologies and characterizations. A total of 297 archaeological sites were inventoried for the region, hereafter called the Archaeological Site Inventory for Grenada, St. Vincent, and the Grenadines (or, ASIG-SVG) (Figure 2 in the article, Table S2 below). These 297 sites in the ASIG-SVG were then subjected to a process of vetting and culling. Sites with unknown chronologies or those merely labelled "post-Saladoid" were removed, as were all loci associated with a larger settlement, all conch middens, sherd scatters, workstones, and petroglyphs. Cayo sites were also removed, since they are a more recent discovery with very few samples. They are also coeval with Suazan sites and not aligned with the earliest sequence of ceramics (though Suazan sites with Cayo reported were retained). This might be expected given the difference in cultural lifeways, but the sample is too small to confirm. In total, 77 pre-Columbian settlements remained in the main dataset (all non-ambiguous settlements dating between Saladoid and Suazan ceramic periods). These 77 sites were further refined into 50 sites with locations and dates (SLD sites, or SLD-50); i.e., sites with the strongest data available, spanning all subregions and time periods.

Step 3: Take measurements of chosen variables for each site

After these data were assembled, environmental attributes were calculated in ArcGIS Pro for each site (e.g., distance to rivers, distance to reefs, NPP value, elevation, etc.). In sum, 24 environmental variables for each site were explored, as listed in Table 1 of the article. Figure S1 below provides R-plots of each of these for the SLD-50 dataset.

Step 4: Statistical analysis

Once all the measurements were made, the data were exported from ArcGIS Pro into Excel, organized and input into R for exploratory and multivariable statistical analyses. Basic descriptive statistics were then calculated for each region and associated time period, depicted in the graphs shown in Figure 3 of the article. The data were then transformed (cubed) for normalcy and fit to various multi-linear regression (MLR) models.

MLR is well-suited to the IFD because of the IFD's inherent assumption of linearity (i.e., settlements following in a sequence, one after the other). The earliest (median) ceramic date from each site was set as the MLR target. Large, exploratory models were built initially, through which we looked for variables that declined in quality with each new settlement over time. Following the logic of the IFD, these should be the most important environmental factors for settlement suitability. For example, if rivers were important, distances should increase as closer areas became occupied. Larger models were then pared down using backward stepwise linear regression to produce a "minimal model" (i.e., a model with strongest R^2 and *p*-value with least number of variables— this is how it pinpoints certain variables to use). We marked the minimal models with an "x"— hence 51x was the minimal model of M51. Minimal models were produced for Grenada (GREN), St. Vincent's (SVI), and the Grenadines (GRS) separately, as a whole, and using the refined SLD-50 dataset.

The target date for each MLR model was the median date of the earliest ceramic typology found at each site (hereafter "ceramic date"). These were assigned as follows (derived from the trapezoidal models in Hanna 2019):

- Saladoid = 500 ± 250
- Troumassan = 825 ± 75*
    - *Since Troumassan error was lower than M51x error, the model's error (± 147) was used instead
- Suazan = 1075 ± 200
- Post-Saladoid = 1275 ± 375 (not used)
- Unstudied = 1275 ± 375 (not used)
- Cayo = 1450 ± 200 (not used in model but shown in Figure 5 of the article)

Statistical values (e.g., R^2, *p*-values, f-statistic) and residuals (deviations from the target ceramic range) were used to gauge model performance. Models that performed well but contained potentially mutually-inclusive data (e.g., distance to beaches and distance to reefs, which could be measuring the same thing) were scrutinized and remodelled with different, mutually-exclusive variables.

Lastly, to guard against chance associations, favored models were applied to a randomized set of data and the results compared to the original model. The randomized dataset was completely dissociated between sites and measurements (in Excel, each column was separately re-sorted using a new sequence of random numbers each time, generated via random.org). Randomized data provides a sobering check, as any model performing well on such data is likely based on fabricated patterns.

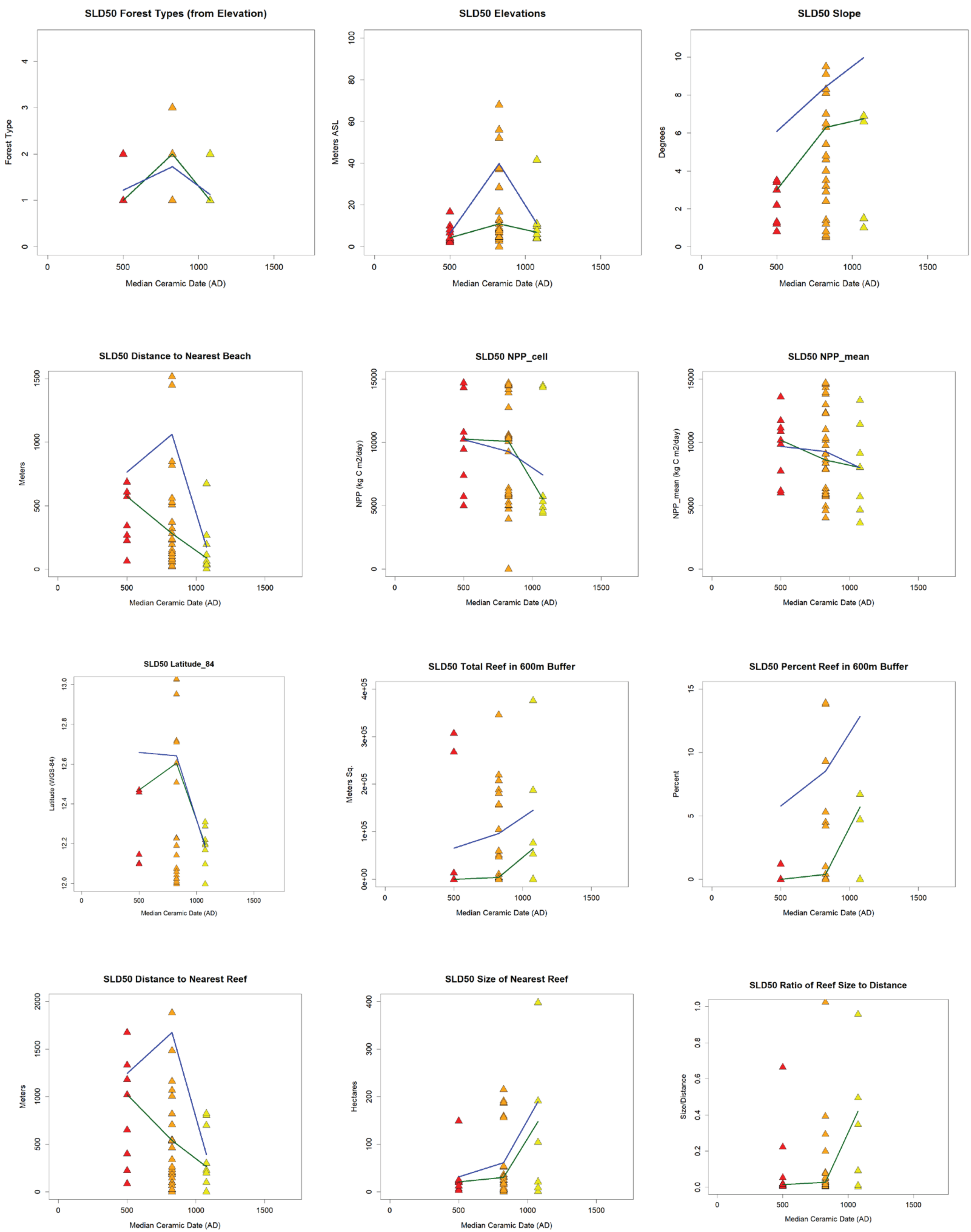
Step 5: Use model to make predictions with new data
Since the models are linear regressions, predictions can be made on new data, so long as the selected variables are present. For instance, a model built from the ceramic dates on GREN sites using distance to rivers can therefore predict the ceramic date of new data as long as it knows the

river distances. Predictions were also evaluated qualitatively, by reviewing the model's predictions for the earliest sites. For instance, models with a stronger coefficient for elevation tended to predict the inland sites in Grenada and St. Vincent to be unrealistically earlier than those on the coast. Current evidence suggests inland sites were settled during the middle (Troumassan) period, after the Saladoid-era sites on the coast. That said, such qualitative analysis could be misleading, as was made clear with the randomization trial (M62z, described in article), so this analysis was mostly left for interpreting — rather than deciding — the final model. Table S1 below offers statistics for each of these models, and Figures S2 and S3 offer further details on model M51x.

Step 6: Make a predictive map by applying the model to the entire region

Once the final model (M51x) was decided, we went back to ArcGIS and created a grid of points every 300 m across the entire islandscape. Measurements were then taken of the final model's variables for each point (e.g., distance to flat bluespots, nearest reef, etc.) and exported to a .csv file. That was then imported into R and used as the new data for M51x to make predictions (i.e., an ESD for each point). These were then imported back to ArcGIS and joined to the 300 m gridpoints to create the predictive map in Figure 4 of the article. Figure S4 below provides an alternative version of this figure, with the earliest 50 sites labelled in their predicted order.

Figure S1. All 24 variables measured, shown here for the SLD-50 dataset



(Figure S1 continued)

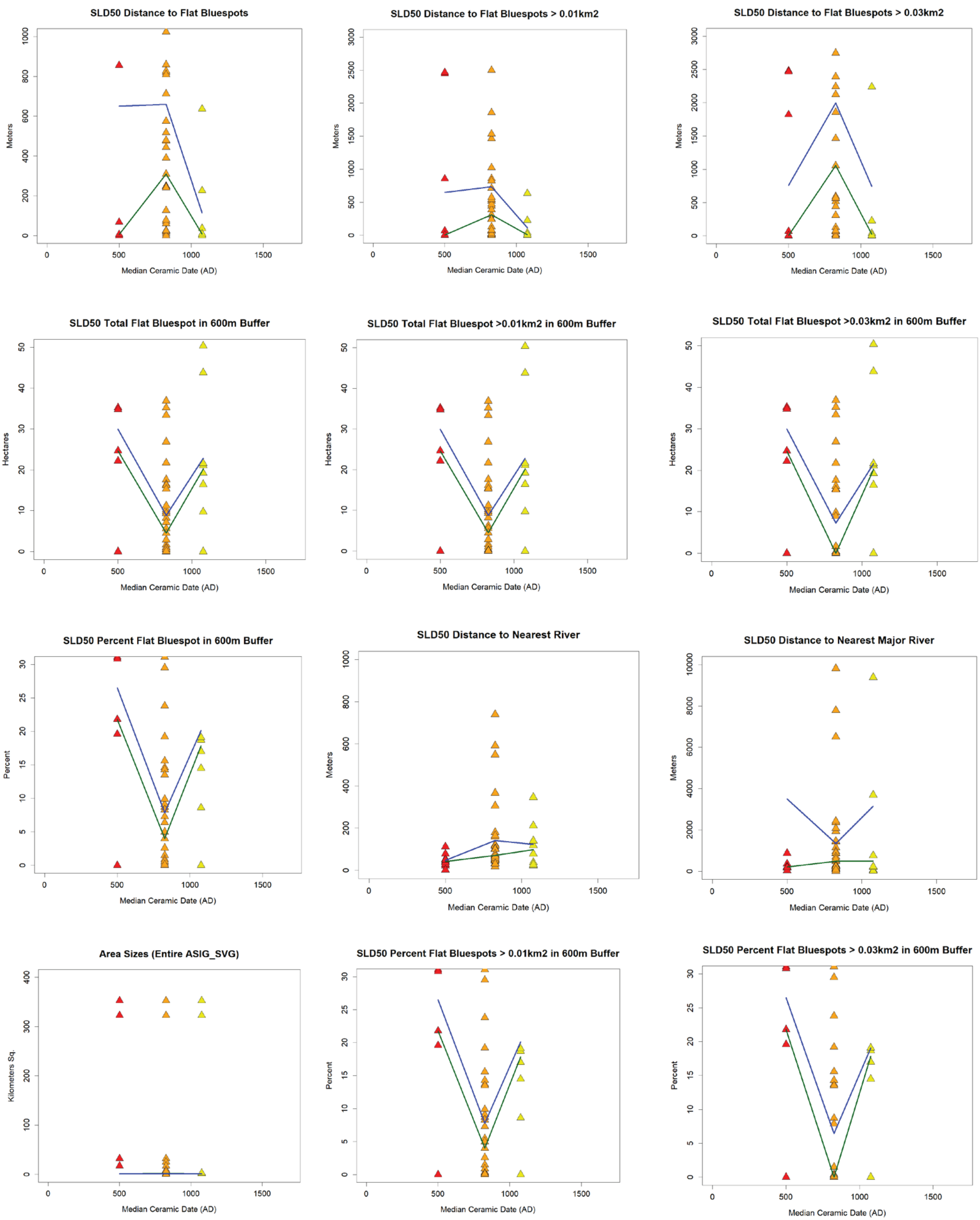


Table S1. Statistics for Relevant Models

Model	p-value	Adj r-sq	error
M47 (fixed data, exploratory on GREN), all variables	0.019	0.9785	25.22 on 2 DF
M47x (GREN min model) F-stat: 75.03 (f-critical is over 8.7)	0.002175	0.9847	21.27 on 3 DF

Min model variables
Island_Area, p= 0.000396 ***
FlatBlueDist, p= 0.019448 *
FlatBlue_red_Dist, p= 0.569029
River_Dist, p= 0.000279 ***
RiverA_Dist, p= 0.002263 **
BeachDist, p= 0.002754 **
ReefDist, p= 0.000634 ***
Latitude_84, p= 0.106412
ReefSize, p= 0.000292 ***
ReefBuffTotalM, p= 0.000706 ***
Elevation, p= 0.001154 **
Slope, p= 0.003519 **
Forests, p= 0.004660 **
NPP_cell, p= 0.004666 **
NPP_mean, p= 0.604661
FlatBlueBuffTotalM, p= 0.000231 ***
BlueBuff_modTotalM, p= 0.000302 ***
BlueBuff_redTotalM, p= 0.518013
FlatBlueBuffPercent, p= 0.000215 ***
ReefRatio, p= 0.000584 ***

Model	p-value	Adj r-sq	error
M48 (GRS exploratory)	0.2392	0.9005	45.22 on 1 DF
M48x (GRS min) F-stat: 21.74 (f-critical is over 19.4)	0.04484	0.9494	32.24 on 2 DF

Min model variables
Island_Area, p= 0.0139 *
FlatBlueDist, p= 0.1095
FlatBlue_red_Dist, p= 0.1024
River_Dist, p= 0.0774 .
BeachDist, p= 0.0938 .
ReefDist, p= 0.0445 *
Latitude_84, p= 0.0213 *
ReefSize, p= 0.0247 *
ReefBuffTotalM, p= 0.1167
Elevation, p= 0.0456 *
Slope, p= 0.0460 *
Forests, p= 0.0227 *
NPP_cell, p= 0.1563
NPP_mean, p= 0.0314 *
FlatBlueBuffTotalM, p= 0.0257 *
BlueBuff_redTotalM, p= 0.0688 .
ReefBuffPercent, p= 0.1115
BlueBuff_redPercent, p= 0.0687 .
ReefRatio, p= 0.0429 *

Model	p-value	Adj r-sq	error
M49 (SVI exploratory)	0.6987	-0.2045	145.4 on 7 DF
M49x (SVI min) F-stat: 2.78 (f-critical is over 2.34)	0.02424	0.3954	103 on 19 DF

Min model variables
FlatBlueDist, p= 0.15945
FlatBlue_mod_Dist, p= 0.08599 .
ReefDist, p= 0.05287 .
Latitude_84, p= 0.13006
Slope, p= 0.00424 **
NPP_mean, p= 0.08100 .
FlatBlueBuffTotalM, p= 0.02340 *
BlueBuff_modTotalM, p= 0.02245 *
BlueBuff_redTotalM, p= 0.01673 *
BlueBuff_redPercent, p= 0.01634 *
ReefRatio, p= 0.07160 .

Model	p-value	Adj r-sq	error
2018_ESD21 (Grenada only_SLD25) F-stat: 4.34 (f-critical is over 3.4)	0.02575	0.2178	286.4 on 22 DF

Min model variables
Forests, p= 0.0342*
WetBuffer, p= 0.0769

Model	p-value	Adj r-sq	error
M50 (ALL exploratory)	0.7071	-0.06346	153 on 52 DF
M50x (All min) F-stat: 3.162 (f-critical is over 2.2)	0.008397	0.1458	137.2 on 70 DF

Min model variables
FlatBlueDist, p= 0.0199 *
River_Dist, p= 0.0858 .
Latitude_84, p= 0.1787
ReefSize, p= 0.0158 *
Slope, p= 0.0414 *
FlatBlueBuffTotalM, p= 0.0941 .

Model	p-value	Adj r-sq	error
M51 (SLD50 exploratory)	0.5378	-0.01952	172.7 on 25 DF
M51x (SLD50 min) F-stat: 3.176 (f-critical is over 2.2)	0.006807	0.2621	146.9 on 41 DF

Min model variables
FlatBlueDist, p= 0.0251 *
BeachDist, p= 0.1265
Latitude_84, p= 0.0407 *
ReefSize, p= 0.0102 *
Slope, p= 0.0927 .
Forests, p= 0.0893 .
NPP_cell, p= 0.0674 .
FlatBlueBuffTotalM, p= 0.0127 *

Model	p-value	Adj r-sq	error
M56 (2018_ESD21 with bluespots in place of wetlands) F-stat: 0.23 (f-critical is over 3.5)	0.8001	-0.07222	178.1 on 21 DF

no variables retained

Model	p-value	Adj r-sq	error
M62z-- randomized M51x F-stat: 0.495 (f-critical is over 2.2)	0.8526	-0.08985	178.6 on 41 DF

no variables retained

Figure S2. R print-out for model M51x

```
Call:
lm(formula = CeramicDate ~ FlatBlueDist + BeachDist + Latitude_84 +
    ReefSize + Slope + Forests + NPP_cell + FlatBlueBuffTotalHa,
    data = SLD50_n.cube)

Residuals:
    Min      1Q  Median      3Q     Max
-326.55  -91.46    7.38   70.79  302.95

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)          4769.567   1859.173   2.565   0.0141 *
FlatBlueDist          -22.425      9.644  -2.325   0.0251 *
BeachDist             -10.330      6.623  -1.560   0.1265
Latitude_84         -1718.905    813.535  -2.113   0.0407 *
ReefSize               32.957     12.243   2.692   0.0102 *
Slope                  66.934     38.880   1.722   0.0927 .
Forests               308.066    177.039   1.740   0.0893 .
NPP_cell               -9.764      5.196  -1.879   0.0674 .
FlatBlueBuffTotalHa   -85.465     32.789  -2.606   0.0127 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 146.9 on 41 degrees of freedom
Multiple R-squared:  0.3826,    Adjusted R-squared:  0.2621
F-statistic: 3.176 on 8 and 41 DF,  p-value: 0.006807
```

Figure S3. Plot of the M51x coefficients
(from ‘coefplot’ package in R)

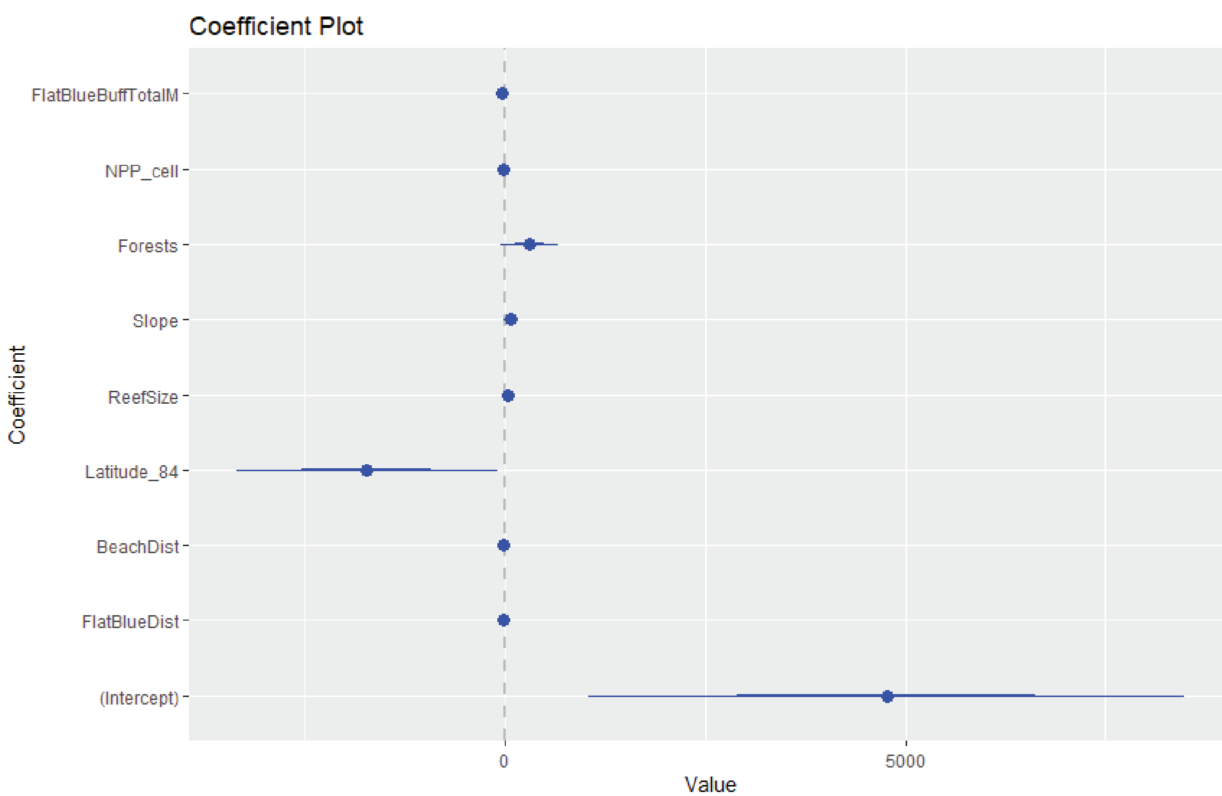


Figure S4. An alternate view of Figure 4 (in the main text), depicting the progression of the first 50 settlements predicted by M51x

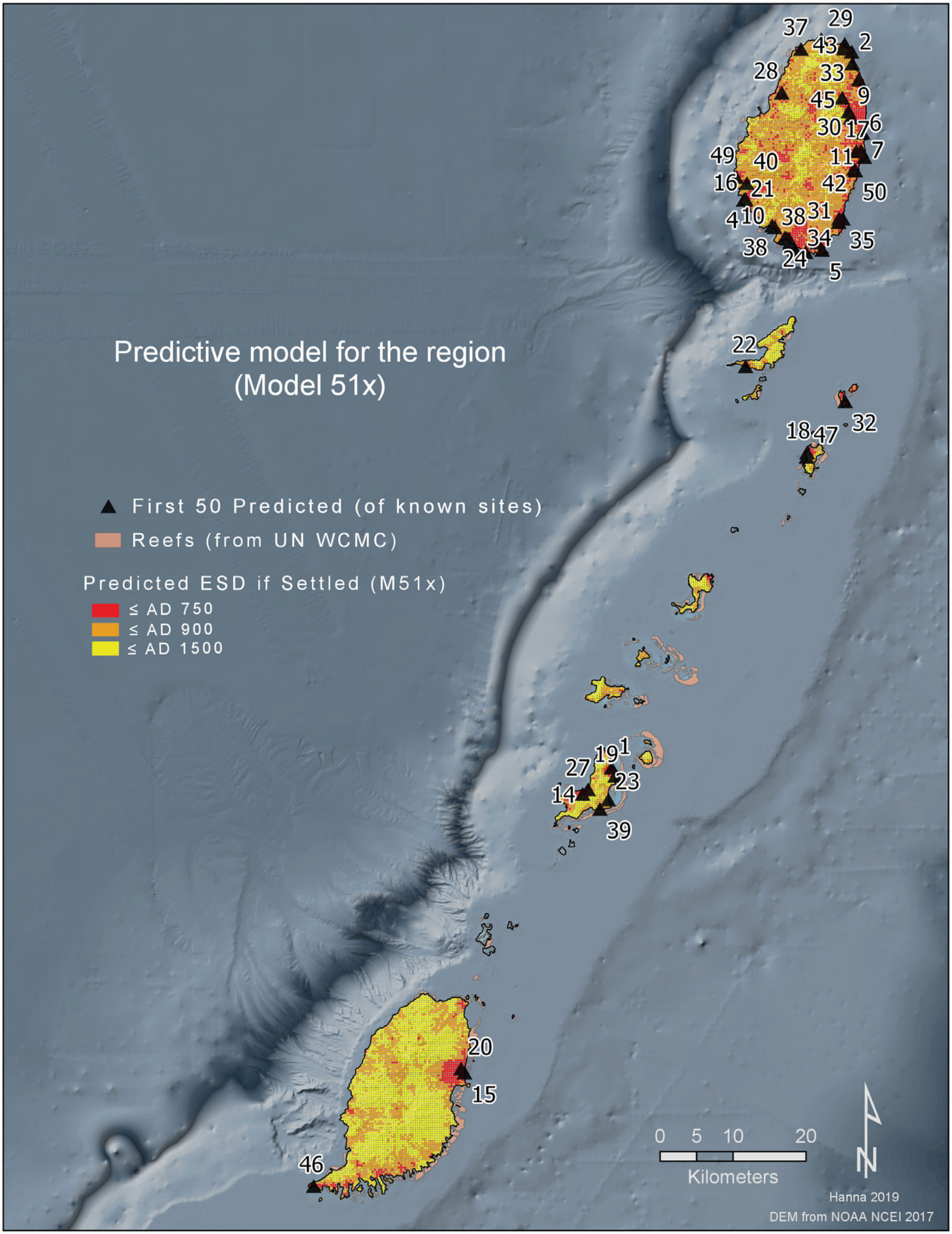


Table S2. Inventory of Pre-Columbian Sites from Grenada through St. Vincent

Island	Site Name	Site No	Site Type	SLD?	Earliest Ceramic Type	Ceramic Diagnostics	Earliest Site RC (calAD)	lab # (and orig ref)	Latitude (WGS 84)	Island Area (km2)	Beach Dist (M)	ReefSize (Ha)	Slope (degree)	Forests	NPP cell	FlatBlue Dist (M)	FlatBlue BuffTotal (ha)	M51x ESD (AD)	M51x error (±)
Baliceaux	Banana Bay	GRS-01	Small Settlement	X	Troumassan	Finger-Indented, GriddleFeet, Polychrome, Scratched	1285-1450	Beta-286848 (Fitzpatrick & Giovas 2011)	12.951779	1.4	528.9	159	20.1	Deciduous	6382	7579.5	0	776	145
Baliceaux	North Bay	GRS-03	Sherd Scatter		Troumassan	Groundstone Axe			12.947917	1.4	0	13.4	16.9	Cactus Scrub	6382	7471.6	0	672	145
Battowia Island	Battowia Cave	GRS-04	Unknown		General Post-Saladoid		1155-1295	OxA-X-2345-50 (Ostapkowicz et al. 2011)	12.961434	0.7	652.9	47.1	32.5	Deciduous	2805	9483.8	0	751	375
Bequia	Friendship Point	GRS-05	Sherd Scatter		Suazan				12.9883298	17.3	195.7	14.3	13.7	Deciduous		1661.5	0	856	200
Bequia	Gelizeau	GRS-06	Sherd Scatter		Suazan				12.9915509	17.3	2180.8	14.3	20.6	Deciduous	2455	359.2	6.6	795	200
Bequia	Hope Estate	GRS-07	Sherd Scatter		Troumassan				13.0079885	17.3	113.4	187.5	18.6	Deciduous	7991	203.1	3.8	971	145
Bequia	Hope Rocks	GRS-08	Workstone		General Post-Saladoid				13.004869	17.3	67.4	187.5	6.9	Cactus Scrub	7991	5.1	4.1	939	375
Bequia	Industry East	GRS-09	loci		Troumassan				13.0249898	17.3	94.4	8.7	9.5	Deciduous	5873	258	6.4	798	145
Bequia	Industry Estate	GRS-10	Small Settlement	X	Troumassan	Adornos, Caliviny Unique Adorned, Finger-Indented, GriddleFeet, Polychrome, Scratched			13.0252595	17.3	152.5	8.7	5.4	Deciduous	14541	8.8	10.3	773	145
Bequia	Mitchell	GRS-11	Small Settlement		Troumassan				13.0050173	17.3	49	187.5	2.1	Deciduous	4337	597	0	993	145
Bequia	Moon Hole	GRS-12	Sherd Scatter		Troumassan				12.9906941	17.3	3825.6	18.4	20.2	Deciduous	2455	2013.2	0	810	145
Bequia	Paget Farm	GRS-13	Sherd Scatter		Troumassan				12.9898624	17.3	1779.5	14.3	1.4	Cactus Scrub	5815	0	21	655	145
Bequia	Park Estate	GRS-14	Large Settlement		Troumassan				13.0274089	17.3	124.4	8.7	7.9	Deciduous	5873	44.4	3.2	881	145
Bequia	Park Point	GRS-15	Small Settlement	X	Troumassan	Scratched			13.0274578	17.3	75.3	187.5	8.1	Deciduous	5873	248.5	2.9	954	145
Bequia	Ravine Bay	GRS-16	Sherd Scatter		General Post-Saladoid				12.9914508	17.3	256.1	187.5	14.7	Deciduous	8550	1755.5	0	934	375
Bequia	Richmond	GRS-17	Small Settlement		Saladoid				13.0013243	17.3	63.8	14.3	17.9	Deciduous	4337	1062.4	0	942	250
Bequia	Spring Beach	GRS-18	Small Settlement		Unknown				13.0206046	17.3	92.6	187.5	3.3	Cactus Scrub	5873	6.9	11.3	864	375
Bequia	Spring Estate	GRS-19	loci		Unknown				13.0216098	17.3	162.3	187.5	2.3	Deciduous	5873	18.6	14	892	375
Bequia	Spring Rocks	GRS-20	Workstone		Unknown				13.0191493	17.3	15.4	187.5	7.6	Cactus Scrub	5873	75.7	10.5	871	375
Bequia	Spring-Industry Point	GRS-64	loci		Troumassan	Finger-Indented			13.0223755	17.3	76.7	187.5	13.8	Cactus Scrub	5873	243.4	11.8	828	145
Calivigny Island	Calivigny North (Area 1)	GREN-G-12-1	loci		Troumassan				11.999494	0.4	0	6.4	3.2	Cactus Scrub	3954	1669.4	0	878	145
Calivigny Island	Calivigny North (Area 2)	GREN-G-12-2	loci		Troumassan				11.9980758	0.4	76.4	3.5	0.6	Cactus Scrub	3954	1854.9	0	776	145
Calivigny Island	Calivigny North (Area 3), MAIN	GREN-G-12	Large Settlement	X	Troumassan	Caliviny Unique Adorned, Finger-Indented, Groundstone Axe, Polychrome, Scratched			11.9975248	0.4	52.2	3.5	3.2	Cactus Scrub	3954	1859.7	0	823	145
Calivigny Island	Calivigny North (Area 5)	GREN-G-12-5	loci		Troumassan				11.9980665	0.4	15.1	3.5	2.2	Cactus Scrub	3954	1867.4	0	823	145
Calivigny Island	Calivigny Island Workstone	GREN-G-14	Workstone		General Post-Saladoid				11.9953428	0.4	108.5	3.5	3.5	Deciduous	3954	1888.9	0	894	375

(Table S2 continued)

Island	Site Name	Site No	Site Type	SLD?	Earliest Ceramic Type	Ceramic Diagnostics	Earliest Site RC (calAD)	lab # (and orig ref)	Latitude (WGS 84)	Island Area (km2)	Beach Dist (M)	ReefSize (Ha)	Slope (degree)	Forests	NPP cell	FlatBlue Dist (M)	FlatBlue BuffTotal (ha)	M51x ESD (AD)	M51x error (±)
Calivigny Island	Calivigny South (Area 4)	GREN-G-13-4	Sherd Scatter		Troumassan				11.9926242	0.4	182	26.5	4.8	Cactus Scrub	3954	2377.2	0	842	145
Canouan	Carenage	GRS-21	Small Settlement	X	Troumassan	Finger-Indented, Saline Wide-Handle, Scratched			12.7174225	9	229.3	156.3	6.3	Cactus Scrub	10516	0	8.2	917	145
Canouan	Carenage Petroglyph	GRS-22	Petroglyph		Troumassan				12.7207298	9	292.5	33.9	5.7	Deciduous	10516	0	8.8	913	145
Canouan	Grand Bay	GRS-23	Large Settlement	X	Troumassan	Adornos, Finger-Indented, Polychrome, Saline Wide-Handle, Scratched			12.7102941	9	320.2	0.2	13.9	Deciduous	6015	712.7	0	877	145
Canouan	Mahault Bay	GRS-67	Conch Midden		Unknown				12.733051	9	88.9	44.7	8.9	Deciduous	4075	1199.4	0	959	375
Canouan	Rumereng	GRS-24	Sherd Scatter		Suazan				12.6981827	9	214.8	26.2	14.9	Deciduous	1964	236	6	932	200
Canouan	Taffie	GRS-25	Sherd Scatter		Troumassan				12.701807	9	0	75.1	5.6	Cactus Scrub	1964	54.7	13.7	913	145
Carriacou	Anse la Roche	GRS-26	Sherd Scatter		Troumassan				12.519145	32.4	1410.9	4.2	14.8	Deciduous	4911	1200	0	864	145
Carriacou	Belvue South	GRS-27	Conch Midden		General Post-Saladoid				12.4457987	32.4	696.9	156.4	11	Cactus Scrub	4532	1305.4	0	922	375
Carriacou	Black Bay	GRS-28	Unknown		Unknown				12.4504701	32.4	1011.8	156.4	11.9	Deciduous	5938	1056.6	0	995	375
Carriacou	Dover	GRS-29	Small Settlement	X	Troumassan	Finger-Indented, Polychrome, Scratched, WOR			12.5076399	32.4	1956.2	4.3	4.8	Cactus Scrub	5771	60.1	35.2	582	145
Carriacou	Dumfries	GRS-30	Sherd Scatter		Troumassan				12.4624628	32.4	2254.5	156.4	19.3	Deciduous	9907	1173.5	0	948	145
Carriacou	Grand Bay	GRS-31	Large Settlement	X	Saladoid	Caliviny Unique Adorned, Finger-Indented, GriddleFeet, Polychrome, Scratched, WOR	340-580	AA-62278 (Fitzpatrick & Giovas 2011)	12.4694534	32.4	607.3	3	3	Cactus Scrub	7389	2448.8	0	655	250
Carriacou	Great Breteche Bay	GRS-32	Small Settlement		Troumassan				12.4554157	32.4	2251	156.4	9.8	Cactus Scrub	10258	1715.1	0	798	145
Carriacou	Gun Point/Belpha	GRS-33	Sherd Scatter		General Post-Saladoid				12.5240269	32.4	508.9	4.2	28.5	Deciduous	7734	304.6	8.5	823	375
Carriacou	Hermitage/Pegus Pt.	GRS-34	Conch Midden		General Post-Saladoid				12.4361509	32.4	385.6	28.4	13	Deciduous	2419	2606.8	0	918	375
Carriacou	Hillsborough	GRS-35	Sherd Scatter		Troumassan				12.4817746	32.4	217.7	8.8	1.6	Cactus Scrub	8520	0	48.7	664	145
Carriacou	Jew Bay	GRS-36	Sherd Scatter		Unknown				12.4979381	32.4	1777.2	90.6	4.4	Cactus Scrub	11121	365.9	11.1	652	375
Carriacou	L'Esterre	GRS-38	Small Settlement		Troumassan				12.4707948	32.4	59.1	13.4	16.2	Deciduous	4430	448.6	7.5	880	145
Carriacou	Lauriston	GRS-37	Small Settlement		Troumassan				12.4761681	32.4	406.2	8.8	3.2	Cactus Scrub	6317	0	75.3	639	145
Carriacou	Mt. Pleasant	GRS-39	loci		Suazan				12.4751718	32.4	95.5	90.6	6.1	Deciduous	7389	1869.6	0	928	200
Carriacou	Point Bay	GRS-65	Small Settlement		General Post-Saladoid		1410-1450	UCIAMS-111933 (Giovas 2013)	12.4838536	32.4	74.9	90.6	1.5	Cactus Scrub	7389	1450.2	0	827	375
Carriacou	Sabazan	GRS-40	Large Settlement	X	Saladoid		400-550	AA-67535 (Fitzpatrick & Giovas 2011)	12.4581938	32.4	2221.6	19.4	12.7	Cactus Scrub	10258	2468.1	0	688	250
Carriacou	Sparrow Bay	GRS-41	Small Settlement		Troumassan				12.5024864	32.4	196.8	1.2	7.3	Deciduous	10058	262.8	1.6	817	145
Carriacou	Tyrrel Bay/Harvey Vale	GRS-42	Sherd Scatter		Troumassan		1060-1280	AA-62284 (Fitzpatrick & Giovas 2011)	12.4570711	32.4	980.1	156.4	0.3	Cactus Scrub	7787	0	38.9	731	145
Carriacou	Windward	GRS-62	Sherd Scatter		General Post-Saladoid				12.5158782	32.4	961	27.4	13.4	Deciduous	5575	557.5	0.4	903	375

(Table S2 continued)

Island	Site Name	Site No	Site Type	SLD?	Earliest Ceramic Type	Ceramic Diagnostics	Earliest Site RC (calAD)	lab # (and orig ref)	Latitude (WGS 84)	Island Area (km2)	Beach Dist (M)	ReefSize (Ha)	Slope (degree)	Forests	NPP cell	FlatBlue Dist (M)	FlatBlue BuffTotal (ha)	M51x ESD (AD)	M51x error (±)
Glover's Island	Glovers Island	GREN-G-40	Unknown		Unknown				11.9879941	0.1	1295.3	7.7	1.8	Cactus Scrub	5853	0	13.1	800	375
Grenada	Artiste Point (La Poterie)	GREN-P-9	Large Settlement	X	Suazan	Caliviny Unique Adorned, Scratched			12.168456	322.7	196.2	397.9	6.9	Cactus Scrub	14347	9	50.4	834	200
Grenada	Bagadi Bay	GREN-G-38	Sherd Scatter		Troumassan	Adornos, Caliviny Unique Adorned, WOR			12.0039866	322.7	173.1	14.6	0.6	Deciduous	5876	0	46.6	819	145
Grenada	Beausejour	GREN-G-34	Small Settlement	X	Saladoid	Adornos, WOR, ZIC	260-410	PSUAMS-1317 (Hanna 2019)	12.0971615	322.7	266.5	21	26.6	Cactus Scrub	14326	68.1	24.7	778	250
Grenada	Beausejour Bay	GREN-G-5	Small Settlement	X	Suazan	Scratched			12.0968347	322.7	64.8	21	1	Cactus Scrub	14483	0	21.6	771	200
Grenada	Beausejour Bay Workstones	GREN-G-5	Workstone		Suazan				12.0951706	322.7	56.6	2.1	17.2	Cactus Scrub	14483	33	21.4	760	200
Grenada	Beausejour Estate	GREN-G-26	Unknown		Unknown	Groundstone Axe			12.0894354	322.7	847.1	2.1	13.2	Deciduous	14364	321.2	14.7	715	375
Grenada	Big David Bay	GREN-P-23	Small Settlement	X	Troumassan	Polychrome, Scratched			12.228227	322.7	26.7	191.1	3.2	Cactus Scrub	5783	390	1	950	145
Grenada	Black Bay Cave	GREN-J-1	Sherd Scatter		General Post-Saladoid	ZIC			12.1206025	322.7	161.9	21	10.5	Deciduous	3795	1333.4	0	991	375
Grenada	Black Bay Workstones	GREN-J-1	Workstone		General Post-Saladoid				12.1221246	322.7	68.4	21	10.4	Cactus Scrub	3795	1508.9	0	914	375
Grenada	Black Point	GREN-G-20	Sherd Scatter		Troumassan	Adornos, Polychrome, Saline Wide-Handle, Scratched, ZIC			12.002309	322.7	37.7	14.9	3.1	Cactus Scrub	5740	0	31.7	840	145
Grenada	Bonne Gaye 1	GREN-D-23-1	loci		Unknown				12.0408665	322.7	45	89.7	6.9	Cactus Scrub	11669	800.8	0	946	375
Grenada	Bonne Gaye 2	GREN-D-23-2	Sherd Scatter		Unknown				12.0387156	322.7	237.7	89.7	11.8	Deciduous	11669	869.9	0	1018	375
Grenada	Calabasse River	GREN-P-11	Sherd Scatter		Suazan	Finger-Indented, Scratched			12.1938963	322.7	93.8	397.9	14.4	Deciduous	5750	30.1	41.1	1020	200
Grenada	Carbia Beach	GREN-D-10	Sherd Scatter		Unknown				12.0558818	322.7	43.6	215.1	4.4	Cactus Scrub	14279	0	13	970	375
Grenada	Cato Beach Rocks	GREN-G-28	Sherd Scatter		Troumassan		715-890	PSUAMS-3021 (Hanna 2019)	12.0021998	322.7	15.7	14.9	3.9	Cactus Scrub	5740	32.3	38.1	769	145
Grenada	Chemin Bay	GREN-G-29	Sherd Scatter		Suazan	Scratched			12.0038799	322.7	46.1	25.7	2.4	Cactus Scrub	9140	1010.5	0	863	200
Grenada	Chemin River	GREN-G-30	Sherd Scatter		Unknown				12.0227998	322.7	1508.7	22.1	7.2	Deciduous	13780	0	24.7	840	375
Grenada	Crochu Harbor	GREN-D-9	Sherd Scatter		Unknown				12.0545458	322.7	85	215.1	1.5	Cactus Scrub	14279	0	25.3	878	375
Grenada	Degra Bay	GREN-G-27	Conch Midden		Unknown				11.9995528	322.7	65.5	5.8	1	Cactus Scrub	5853	0	32.9	778	375
Grenada	Dragon Bay	GREN-G-1	Sherd Scatter		Suazan	Scratched			12.086062	322.7	32.6	4.6	3.1	Cactus Scrub	3271	1097.1	0	876	200
Grenada	Duquesne Bay	GREN-M-3	Small Settlement	X	Suazan	Groundstone Axe, Scratched	775-1035	Beta-98365 (Cody 1998)	12.2186791	322.7	266.7	191.1	1.5	Cactus Scrub	4527	0	9.8	974	200
Grenada	Duquesne Petroglyphs	GREN-M-5	Workstone		General Post-Saladoid				12.2193125	322.7	3.7	191.1	11.7	Cactus Scrub	4527	200.3	7.7	983	375
Grenada	Duquesne Petroglyphs	GREN-M-5	Petroglyph		General Post-Saladoid				12.2191721	322.7	21.2	191.1	11.7	Cactus Scrub	4527	197.3	7.9	969	375
Grenada	Egmont Harbor	GREN-G-9	Sherd Scatter		General Post-Saladoid				12.0125295	322.7	321.5	22.1	3.8	Cactus Scrub	10801	16.5	19	766	375
Grenada	Flamingo Bay Workstone	GREN-G-32	Workstone		General Post-Saladoid				12.0918228	322.7	23.7	2.1	16.4	Cactus Scrub	14483	271	7	768	375
Grenada	Fort Annunciation	GREN-UW-8	Sherd Scatter		Suazan	Finger-Indented, Scratched			12.0446159	322.7	132.1	186.7	1.5	Cactus Scrub	5000	0	34.2	905	200
Grenada	Galby Bay East Loci	GREN-D-3-B	loci		Cayo				12.0450437	322.7	39.8	89.7	14.3	Deciduous	11669	71	8.1	1007	200
Grenada	Galby Bay (West)	GREN-D-3	Small Settlement		Cayo				12.0437232	322.7	21	89.7	4	Cactus Scrub	11669	262.4	4.2	860	200

(Table S2 continued)

Island	Site Name	Site No	Site Type	SLD?	Earliest Ceramic Type	Ceramic Diagnostics	Earliest Site RC (calAD)	lab # (and orig ref)	Latitude (WGS 84)	Island Area (km2)	Beach Dist (M)	ReefSize (Ha)	Slope (degree)	Forests	NPP cell	FlatBlue Dist (M)	FlatBlue BuffTotal (ha)	M51x ESD (AD)	M51x error (±)
Grenada	Galby Bay Workstone	GREN-D-3	Workstone		Cayo				12.0438185	322.7	5.1	89.7	4.3	Cactus Scrub	11669	229.5	4.4	877	200
Grenada	Grand Anse	GREN-G-7-A	Small Settlement	X	Troumassan	Adornos, Polychrome, WOR, ZIC	685-1020	[UNK-G7-1] (Banks 1988)	12.0236515	322.7	196.2	186.7	0.5	Cactus Scrub	10084	1465.3	0	855	145
Grenada	Grand Anse (Locus B)	GREN-G-7-B	loci		Troumassan				12.0212652	322.7	38.8	186.7	9.1	Deciduous	6081	919.8	0	1117	145
Grenada	Grand Bacolet Bay	GREN-D-7	Small Settlement	X	Troumassan	Scratched			12.0733686	322.7	507.1	215.1	4	Cactus Scrub	5942	18.8	26.9	863	145
Grenada	Grand Bay	GREN-G-39	Sherd Scatter		Troumassan	Saline Wide-Handle			12.0021815	322.7	173.9	7.7	2.7	Deciduous	5853	0	66.5	801	145
Grenada	Grand Bay Beach	GREN-G-22	Conch Midden		Archaic?		760-530 BC	PSUAMS-3017 (Hanna 2019)	12.0016315	322.7	20.8	7.7	1.4	Cactus Scrub	5853	0	58.8	746	375
Grenada	Grand Bras	GREN-A-13	Sherd Scatter		Unknown				12.1225309	322.7	952.1	98.1	4.6	Deciduous	14744	18.4	44.7	769	375
Grenada	Grand Mal Bay	GREN-G-2	Large Settlement	X	Troumassan	GriddleFeet, Scratched, ZIC			12.0759381	322.7	20.9	5	4.6	Cactus Scrub	5277	1464.9	0	849	145
Grenada	Grand Mal Workstone	GREN-G-2	Workstone		Troumassan				12.0744954	322.7	8.7	5	11.1	Cactus Scrub	5140	1304.6	0	905	145
Grenada	Grand Marquis	GREN-A-2	Small Settlement	X	Saladoid	WOR, ZIC			12.1007436	322.7	226.4	148.9	3.4	Cactus Scrub	14306	0	35.2	827	250
Grenada	Halifax North	GREN-G-3	Sherd Scatter		General Post-Saladoid				12.1116502	322.7	46.8	21	10.2	Cactus Scrub	15013	231.7	6.1	794	375
Grenada	High Bluff	GREN-P-21	Sherd Scatter		Suazan	Scratched			12.1964253	322.7	12.2	397.9	12.7	Cactus Scrub	5750	30.5	46.2	944	200
Grenada	High Cliff Point	GREN-P-7	Small Settlement	X	Suazan	Scratched	1445-1630	PSUAMS-3945 (Hanna 2019)	12.1919437	322.7	113.5	397.9	18.6	Deciduous	5750	226	16.5	1042	200
Grenada	Irvins Bay	GREN-P-25	Sherd Scatter		Troumassan	ZIC			12.2244407	322.7	92.9	191.1	0.8	Cactus Scrub	11264	0	25.8	851	145
Grenada	La Filette	GREN-A-11	Large Settlement	X	Troumassan	Polychrome, Scratched	720-885	PSUAMS-1565 (Hanna 2019)	12.141257	322.7	3095.9	4.6	8.1	Elfin Woodland	13915	517.7	0.4	824	145
Grenada	La Sagesse Bay	GREN-D-1	Large Settlement	X	Troumassan	Adornos, Finger-Indented, Polychrome, Scratched			12.0249154	322.7	141.1	35.7	1.2	Cactus Scrub	9251	0	21.7	821	145
Grenada	La Tante Bay A	GREN-D-4	Small Settlement		Cayo		1050-1390	Beta-85939 (Cody 1998)	12.0500045	322.7	52	35.6	4.4	Cactus Scrub	11669	0	28.9	833	200
Grenada	La Tante Bay B	GREN-D-4-B	loci		Cayo				12.0489721	322.7	29.1	35.6	10.9	Cactus Scrub	11669	10.4	26.8	836	200
Grenada	La Tante Point	GREN-D-13	Sherd Scatter		Unknown				12.0493548	322.7	52.6	35.6	2.3	Deciduous	11669	33.4	7	918	375
Grenada	Laurant Point	GREN-P-24-A	Sherd Scatter		Suazan	Scratched			12.2330951	322.7	143.3	191.1	11.3	Cactus Scrub	14144	979.3	0	944	200
Grenada	Laurant Point (chert)	GREN-P-24-B	Sherd Scatter		Suazan				12.2337407	322.7	202	191.1	10.6	Cactus Scrub	10769	1048.8	0	950	200
Grenada	Le Petite Trou	GREN-D-5	Sherd Scatter		Unknown				12.0319455	322.7	50.6	146.5	1.9	Cactus Scrub	11556	0.8	17.4	895	375
Grenada	Leapers Hill	GREN-P-26	Sherd Scatter		Unknown				12.2262263	322.7	136.4	191.1	12.3	Deciduous	1954	157.7	21.4	1008	375
Grenada	Levera	GREN-P-4	Small Settlement	X	Troumassan	Adornos, ZIC			12.2266821	322.7	83.9	51.9	0.6	Cactus Scrub	10605	0	33.4	762	145
Grenada	Little Bacolet Bay	GREN-D-12	Sherd Scatter		Suazan				12.0194686	322.7	108.1	15.1	5.3	Cactus Scrub	15172	10.3	20.7	764	200
Grenada	Little Bacolet Bay (Locus 2)	GREN-D-12-B	loci		Suazan				12.0185807	322.7	93.3	15.1	2.2	Cactus Scrub	15172	59.1	8.9	756	200
Grenada	Little Bacolet Point	GREN-D-6	Sherd Scatter		Unknown				12.0116731	322.7	375	33.7	8.4	Deciduous	9251	744.5	0	981	375
Grenada	Little David Pt	GREN-P-10	Sherd Scatter		Suazan	Scratched			12.2241581	322.7	343.6	191.1	30.5	Deciduous	4527	518.9	1.5	1086	200
Grenada	Lower La Tante	GREN-D-11	Sherd Scatter		Unknown				12.0506936	322.7	0.1	35.6	8.9	Cactus Scrub	14279	66.2	21.7	812	375
Grenada	Lower Woburn Shellmidden	GREN-G-36-1	Conch Midden		Unknown				12.0110838	322.7	1086.4	6.4	15.1	Cactus Scrub	7489	378.4	2.5	792	375

(Table S2 continued)

Island	Site Name	Site No	Site Type	SLD?	Earliest Ceramic Type	Ceramic Diagnostics	Earliest Site RC (calAD)	lab # (and orig ref)	Latitude (WGS 84)	Island Area (km2)	Beach Dist (M)	ReefSize (Ha)	Slope (degree)	Forests	NPP cell	FlatBlue Dist (M)	FlatBlue BuffTotal (ha)	M51x ESD (AD)	M51x error (±)
Grenada	Lower Woburn Shellmidden 2	GREN-G-36-2	loci		General Post-Saladoid				12.0127021	322.7	1168	6.4	10.5	Cactus Scrub	7489	70	6.8	794	375
Grenada	Lower Woburn Shellmidden 3	GREN-G-36-3	loci		General Post-Saladoid				12.0106144	322.7	1080.2	6.4	7.2	Cactus Scrub	7489	472.5	1.1	772	375
Grenada	Magazin Beach	GREN-G-33	Unknown		Unknown				12.0103206	322.7	45.3	186.7	10.9	Cactus Scrub	5853	152	36.6	862	375
Grenada	Mahot Bay	GREN-D-15	Sherd Scatter		Suazan	Scratched			12.0590551	322.7	176.9	215.1	8.2	Cactus Scrub	14424	47.7	15.5	878	200
Grenada	Marlmont Bay	GREN-D-24	Large Settlement	X	Troumassan	Groundstone Axe			12.0417746	322.7	124.4	3.6	9.5	Deciduous	14170	309.5	9.8	788	145
Grenada	Marquis River	GREN-A-3	Sherd Scatter		General Post-Saladoid				12.0935413	322.7	100.2	257.2	0.9	Cactus Scrub	14092	0	15.1	911	375
Grenada	Montreuil	GREN-P-2	Large Settlement	X	Troumassan	Adornos, GriddleFeet, Scratched	720-795	PSUAMS-3946 (Hanna 2019)	12.1902174	322.7	3982.7	191.1	4	Elfin Woodland	14175	25.7	16.5	870	145
Grenada	Montreuil Workstone	GREN-P-2	Workstone		Troumassan				12.1887532	322.7	4141	191.1	4.5	Elfin Woodland	14175	45.8	14	870	145
Grenada	Mt. Hartman	GREN-G-17	Sherd Scatter		Unknown				12.0045553	322.7	305.1	26.8	2.3	Cactus Scrub	5501	9.3	8.4	866	375
Grenada	Mt. Rich Petroglyphs	GREN-P-1	Workstone		General Post-Saladoid				12.1935117	322.7	3590.1	191.1	23.1	Elfin Woodland	14518	0	32.9	968	375
Grenada	Mt. Rich Petroglyphs	GREN-P-1	Petroglyph		General Post-Saladoid				12.1934112	322.7	3601.5	191.1	23.1	Elfin Woodland	14518	0	32.1	970	375
Grenada	Mt. William	GREN-P-22	Sherd Scatter		General Post-Saladoid	Scratched			12.2172795	322.7	477	191.1	2.9	Deciduous	4527	0	11	1051	375
Grenada	Pearls	GREN-A-1	Large Settlement	X	Saladoid	Adornos, Caliviny Unique Adorned, Finger-Indented, Groundstone Axe, Scratched, WOR, ZIC	370-645	UGa [A1-B2] (Cody 1991)	12.14573	322.7	571.5	5.9	1.2	Deciduous	9459	0	97.5	652	250
Grenada	Petite Anse	GREN-D-22	Unknown		Unknown				12.0416867	322.7	49.2	89.7	3.2	Cactus Scrub	14170	655.3	0	915	375
Grenada	Petite Bacaye Bay	GREN-D-8	Sherd Scatter		Suazan	Caliviny Unique Adorned, Groundstone Axe, Scratched			12.0157682	322.7	13.6	33.7	6.7	Cactus Scrub	9251	280.9	16.6	778	200
Grenada	Petite Calivigny	GREN-G-35	Sherd Scatter		General Post-Saladoid				12.0080329	322.7	735.4	6.4	6.6	Cactus Scrub	3954	1164.4	0	844	375
Grenada	Prickly Point	GREN-G-18	Sherd Scatter		General Post-Saladoid				11.9967788	322.7	240.9	1	14.2	Deciduous	4389	28.1	28.7	864	375
Grenada	River Antoine	GREN-P-8	Sherd Scatter		Suazan	Scratched			12.1744608	322.7	184	397.9	0.3	Cactus Scrub	14347	0	58.7	780	200
Grenada	River Antoine loci 2	GREN-P-8-B	loci		Suazan				12.1752954	322.7	463.5	397.9	0.2	Cactus Scrub	14400	0	68.1	736	200
Grenada	River Sallee	GREN-P-27	Sherd Scatter		Suazan	Scratched			12.1976189	322.7	65.1	397.9	1.3	Deciduous	5750	0	52.8	979	200
Grenada	Salt Pond 1	GREN-G-21	loci		Troumassan	Caliviny Unique Adorned, Saline Wide-Handle, Scratched			12.0041643	322.7	245.2	9.5	0.2	Cactus Scrub	5740	0	47.1	705	145
Grenada	Salt Pond 2	GREN-G-21-2	Large Settlement	X	Troumassan		770-945	PSUAMS-1320 (Hanna 2019)	12.0027433	322.7	75.2	14.9	1.4	Cactus Scrub	5740	0	36.9	795	145
Grenada	Salt Pond 3	GREN-G-21-3	loci		Troumassan				12.002894	322.7	108.5	14.9	5.4	Cactus Scrub	5740	0	47.8	806	145
Grenada	Sauteurs Bay (Locus 1)	GREN-P-5-1	Large Settlement	X	Troumassan	Finger-Indented, GriddleFeet, Scratched	660-880	Beta-85941 (Hanna 2019)	12.2262157	322.7	60.6	191.1	0.8	Cactus Scrub	5021	0	16.2	946	145
Grenada	Sauteurs Bay (Locus 2)	GREN-P-5-2	loci		Troumassan		1295-1485	Beta-98367 (Cody 1998)	12.2249836	322.7	123	191.1	0.2	Cactus Scrub	11312	0	20.6	844	145

(Table S2 continued)

Island	Site Name	Site No	Site Type	SLD?	Earliest Ceramic Type	Ceramic Diagnostics	Earliest Site RC (calAD)	lab # (and orig ref)	Latitude (WGS 84)	Island Area (km2)	Beach Dist (M)	ReefSize (Ha)	Slope (degree)	Forests	NPP cell	FlatBlue Dist (M)	FlatBlue BuffTotal (ha)	M51x ESD (AD)	M51x error (±)
Grenada	Sauteurs Bay (Locus 3)	GREN-P-5-3	loci		Troumassan		660-880	Beta-85941 (Cody 1998)	12.224541	322.7	103.1	191.1	0.4	Cactus Scrub	11312	0	22.6	849	145
Grenada	Savanne Suazey 1 (South)	GREN-P-3-1	Large Settlement	X	Suazan	Finger-Indented, GriddleFeet, Polychrome, Scratched	775-1020	Beta-85935 (Cody 1998)	12.1991613	322.7	34.7	397.9	6.6	Cactus Scrub	5750	36.8	43.8	904	200
Grenada	Savanne Suazey 2 (Center)	GREN-P-3-2	Sherd Scatter		Suazan				12.2002821	322.7	25.3	397.9	6.5	Cactus Scrub	5750	0	40.8	988	200
Grenada	Savanne Suazey 3 (North)	GREN-P-3-3	loci		Suazan				12.2012588	322.7	14.6	397.9	11.5	Deciduous	5750	0	33.7	1118	200
Grenada	Simon Beach	GREN-A-5	Small Settlement		Troumassan	Adornos, GriddleFeet, Scratched			12.1408215	322.7	53.4	8.9	3.4	Cactus Scrub	14453	7.8	58.4	643	145
Grenada	Soubise Workstones	GREN-A-14	workstone		Unknown				12.1096774	322.7	683.4	148.9	4.2	Deciduous	9430	69	11	914	375
Grenada	South Victoria Petroglyphs	GREN-M-1	Petroglyph		General Post-Saladoid				12.1942887	322.7	15.7	6.3	23	Deciduous	4084	1178.2	0	1034	375
Grenada	St. Johns River	GREN-G-8	Large Settlement	X	Troumassan	Adornos, Caliviny Unique Adorned, Finger-Indented, GriddleFeet, Polychrome, Saline Wide-Handle, Scratched, ZIC	905-1060	UCIAMS-179806 (Hanna 2019)	12.0579753	322.7	52.1	0.1	3.5	Deciduous	5000	70.2	17.6	812	145
Grenada	St. John's River (Greenbridge)	GREN-G-8	Workstone		Troumassan				12.0585588	322.7	19.7	0.1	6.1	Cactus Scrub	5639	53.2	17.3	766	145
Grenada	Telescope Point A	GREN-A-12-A	Small Settlement		Cayo				12.123663	322.7	264.9	98.1	24.7	Deciduous	11510	276.6	10.3	937	200
Grenada	Telescope Point B	GREN-A-12-B	loci		Cayo				12.1249775	322.7	27.2	98.1	9	Deciduous	11510	4.5	43.7	911	200
Grenada	Telescope Workstone	GREN-A-12-C	Workstone		Cayo				12.1247083	322.7	18.3	98.1	8.5	Cactus Scrub	11510	66.7	39.5	788	200
Grenada	True Blue Point	GREN-G-23	Small Settlement	X	Suazan	Scratched			11.9966864	322.7	3.3	1	6.6	Cactus Scrub	4389	5.4	19.2	858	200
Grenada	Union Petroglyph	GREN-P-28	Petroglyph		General Post-Saladoid				12.2042849	322.7	2153.3	191.1	3.2	Deciduous	9930	582.2	0	930	375
Grenada	Victoria Petroglyph	GREN-M-4	Petroglyph		General Post-Saladoid				12.195904	322.7	21.5	6.3	1.5	Cactus Scrub	7178	1033.4	0	816	375
Grenada	Waltham Beach Petroglyph	GREN-M-6	Petroglyph		General Post-Saladoid				12.2012792	322.7	535.8	3.6	7.4	Cactus Scrub	2364	478.8	0.5	845	375
Grenada	Waltham Petroglyphs	GREN-M-2	Petroglyph		General Post-Saladoid				12.201254	322.7	559.1	3.6	8.5	Cactus Scrub	2364	439.7	0.7	847	375
Grenada	Waltham-b	GREN-M-2	Petroglyph		General Post-Saladoid				12.2012576	322.7	574.5	3.6	12.2	Deciduous	2364	419	0.7	945	375
Grenada	Westerhall Bay	GREN-G-11	loci		Troumassan				12.0121616	322.7	666.6	6.5	3.7	Cactus Scrub	4742	403.1	7.4	720	145
Grenada	Westerhall Point 1	GREN-G-24	Sherd Scatter		Troumassan	Scratched			12.0155761	322.7	1023	13.8	1.8	Deciduous	4742	0	23.2	869	145
Grenada	Westerhall Point 2 (Main)	GREN-G-25	Small Settlement	X	Troumassan	Caliviny Unique Adorned, Polychrome, Scratched			12.0111506	322.7	818.2	6.5	15.4	Deciduous	4742	444.3	1.7	915	145
Grenada	Westerhall Point 3	GREN-G-31	Sherd Scatter		Suazan				12.0106578	322.7	323	6.5	10.3	Deciduous	4742	609.2	0	1003	200
Grenada	Westerhall Pt Old Harbor	GREN-G-10	loci		Troumassan				12.0121556	322.7	788.1	13.8	1.9	Cactus Scrub	4742	0	10.4	857	145

(Table S2 continued)

Island	Site Name	Site No	Site Type	SLD?	Earliest Ceramic Type	Ceramic Diagnostics	Earliest Site RC (calAD)	lab # (and orig ref)	Latitude (WGS 84)	Island Area (km2)	Beach Dist (M)	ReefSize (Ha)	Slope (degree)	Forests	NPP cell	FlatBlue Dist (M)	FlatBlue BuffTotal (ha)	M51x ESD (AD)	M51x error (±)
Hog Island	Hog Island East	GREN-G-16	Sherd Scatter		Unknown				11.9990758	0.4	103	5.9	7.1	Cactus Scrub	5501	799	0	901	375
Hog Island	Hog Island West (Locus A)	GREN-G-15	Conch Midden		Suazan				12.000022	0.4	78.4	26.8	2.7	Cactus Scrub	5501	370.5	2	849	200
Hog Island	Hog Island West (Locus B)	GREN-G-15-B	loci		Suazan				12.0012864	0.4	70.7	26.8	6.9	Cactus Scrub	5501	426.8	2.4	870	200
Ile de Caille	Ile de Caille	GREN-C-1	Small Settlement	X	Suazan	Finger-Indented			12.2874278	1.2	41.9	104.1	25.7	Cactus Scrub	4866	0	21.1	1026	200
Isle a Quatre	Grand Bay	GRS-44	Unknown		Unknown				12.9579413	1.7	125.6	42.5	12.3	Deciduous	5216	1835	0	894	375
Isle a Quatre	Isle a Quatre	GRS-45	Sherd Scatter		General Post-Saladoid				12.9543893	1.7	170.2	17.7	12.7	Deciduous	5188	899.2	0	920	375
Isle de Ronde	Ile de Ronde South	GREN-R-1	Sherd Scatter		Unknown				12.2980727	3	737.7	12.1	19.2	Deciduous	4866	88.9	6.3	928	375
Isle de Ronde	Ile de Ronde West	GREN-R-2	Small Settlement	X	Suazan	Caliviny Unique Adorned, Polychrome			12.3086261	3	673.4	8.6	12.9	Cactus Scrub	5313	636.6	0	880	200
Mayreau	Mayreau Beach/Saline Bay	GRS-46	Small Settlement		Troumassan				12.6329272	1.7	76.1	16.4	12.5	Cactus Scrub	5596	591.6	0	892	145
Mayreau	Windward Carenage	GRS-47	Sherd Scatter		Troumassan				12.6458886	1.7	22	17.3	6.4	Cactus Scrub	5596	24.3	6.5	856	145
Mustique	Desalination Plant	GRS-66	Sherd Scatter		Unknown				12.8904401	5.7	254.1	110.4	1.5	Deciduous	6191	0	41.8	821	375
Mustique	Lagoon Bay	GRS-63	Small Settlement		Troumassan		870-1155	Beta-286849 (Fitzpatrick & Giovas 2011)	12.8708385	5.7	11.4	65.4	3.1	Cactus Scrub	6259	0	10.2	892	145
Mustique	Lamb Bay	GRS-48	Sherd Scatter		Troumassan				12.8815096	5.7	35.9	4.1	9.9	Cactus Scrub	10935	179.2	6.9	705	145
Mustique	Paster/Pasture Point	GRS-49	Sherd Scatter		Unknown				12.8748923	5.7	136.3	26.5	10.4	Deciduous	8278	556	0.5	870	375
Mustique	Plantain Bay	GRS-50	Sherd Scatter		Troumassan				12.8866738	5.7	540.3	12.9	7.8	Cactus Scrub	6191	120.6	21.4	646	145
Mustique	Rosemary/LAnsecoy Bay	GRS-51	Sherd Scatter		Troumassan				12.8925598	5.7	6	110.4	5.8	Cactus Scrub	8108	0	31.4	841	145
Mustique	Rosemary/L'Ansecoy Bay	GRS-51-B	loci		Unknown				12.8933503	5.7	143.8	110.4	4.3	Cactus Scrub	6191	0	21.9	841	375
Mustique	Rutland Bay	GRS-67	Small Settlement		Unknown				12.8885502	5.7	78.9	120.2	3.4	Cactus Scrub	2982	14.2	5.6	920	375
Mustique	Windmill Tower	GRS-52	Sherd Scatter		Troumassan				12.8740606	5.7	152.8	26.5	5.3	Deciduous	8278	347.2	2.5	818	145
Petit Martinique	Petit Martinique	GRS-53	Small Settlement		Troumassan				12.5234146	2	60	142.6	5.6	Cactus Scrub	8542	1438.2	0	884	145
Petit Nevis	Petit Nevis	GRS-54	Sherd Scatter		General Post-Saladoid				12.9731951	0.4	253.3	6.5	35.4	Deciduous	2393	1924.9	0	925	375
St Vincent	Argyle	SVI-01	Large Settlement	X	Cayo				13.1670828	352.7	82.8	12.7	12.2	Cactus Scrub	13523	0	39.5	681	200
St Vincent	Argyle 1	SVI-02	loci		Saladoid				13.1592516	352.7	1360.4	12.7	11.7	Deciduous	10808	466.2	1	738	250
St Vincent	Argyle 2	SVI-107	Large Settlement	X	Saladoid				13.1631222	352.7	686.5	12.7	2.2	Deciduous	10808	0	34.8	677	250
St Vincent	Arnos Vale Field	SVI-03	loci		Saladoid				13.1437072	352.7	302.1	23.3	0.7	Cactus Scrub	5733	0	52.2	610	250
St Vincent	Arnos Vale Swamp	SVI-04	Large Settlement	X	Saladoid		250-675	RL-75 (Bullen and Bullen 1972)	13.1429792	352.7	341.1	23.3	0.8	Cactus Scrub	5733	0	55.4	604	250
St Vincent	Barrouallie	SVI-05	Sherd Scatter		Troumassan				13.2325095	352.7	111.8	24.5	33.7	Deciduous	4047	1212.4	0	959	145
St Vincent	Barrouallie Petroglyph	SVI-06	Petroglyph		Troumassan				13.2332458	352.7	535.6	24.5	28.2	Elfin Woodland	4047	1167.9	0	972	145

Island	Site Name	Site No	Site Type	SLD?	Earliest Ceramic Type	Ceramic Diagnostics	Earliest Site RC (calAD)	lab # (and orig ref)	Latitude (WGS 84)	Island Area (km2)	Beach Dist (M)	ReefSize (Ha)	Slope (degree)	Forests	NPP cell	FlatBlue Dist (M)	FlatBlue BuffTotal (ha)	M51x ESD (AD)	M51x error (±)
St Vincent	Biabou	SVI-07	Small Settlement		Troumassan				13.1984844	352.7	205.4	53.9	18.9	Deciduous	8595	156.2	16.7	798	145
St Vincent	Big Gut Water Tank	SVI-08	Small Settlement		Troumassan				13.260663	352.7	3994.3	24.5	17.2	Evergreen	14432	79.7	10.6	773	145
St Vincent	Brighton	SVI-09	Small Settlement		Troumassan				13.1383894	352.7	1288.3	17	19.3	Deciduous	14575	263	21.7	633	145
St Vincent	Brighton Beach 1	SVI-10	Small Settlement		Troumassan				13.1296067	352.7	347.7	17	4.4	Cactus Scrub	14535	0	43.9	604	145
St Vincent	Brighton Salt Pond	SVI-11	Sherd Scatter		Unknown				13.124498	352.7	45	15.9	5	Cactus Scrub	6199	81.1	9	729	375
St Vincent	Buccament East	SVI-13	Petroglyph		Saladoid				13.1900697	352.7	177.7	24.8	14.2	Cactus Scrub	14710	40.3	27	644	250
St Vincent	Buccament Petroglyphs/Shelter	SVI-12	Petroglyph		Saladoid				13.1905992	352.7	260.7	24.8	5.1	Cactus Scrub	14710	11.1	31	604	250
St Vincent	Buccament West/Cave	SVI-14	Small Settlement	X	Saladoid		5-660	RL-73 (Bullen & Bullen 1972)	13.1898239	352.7	64	24.8	3.5	Cactus Scrub	14710	5.7	22.2	653	250
St Vincent	Byera Valley	SVI-15	loci		Saladoid				13.2556527	352.7	2435.9	19.8	15.2	Elfin Woodland	14714	236.3	5	738	250
St Vincent	Camden Park	SVI-16	Small Settlement	X	Troumassan	Polychrome, Scratched, WOR, ZIC			13.1698503	352.7	370.1	24.8	2.9	Cactus Scrub	6165	818.9	0	747	145
St Vincent	Carapan	SVI-17	Sherd Scatter		Unknown				13.1755256	352.7	4715.6	1	21.6	Evergreen	4549	461.6	0.4	849	375
St Vincent	Careenage	SVI-18	Small Settlement		Troumassan				13.1246621	352.7	161.2	15.9	4.7	Cactus Scrub	6199	0	18	759	145
St Vincent	Carib Piece, North Union	SVI-19	Small Settlement	X	Troumassan	Caliviny Unique Adorned, Scratched, ZIC			13.2173657	352.7	237.8	53.9	8.3	Deciduous	14699	127	15.3	725	145
St Vincent	Coconut Oil Factory	SVI-20	loci		Saladoid				13.1446075	352.7	404.4	23.3	2	Cactus Scrub	5733	0	38.1	660	250
St Vincent	Colonarie	SVI-21	Sherd Scatter		Suazan	Scratched			13.2408765	352.7	271.5	19.8	4.1	Cactus Scrub	14355	60.6	14	609	200
St Vincent	Colonarie Petroglyph	SVI-22	Petroglyph		Suazan				13.2422886	352.7	1361	19.8	16.6	Deciduous	14556	9.9	5	803	200
St Vincent	Colonarie River	SVI-23	Sherd Scatter		Troumassan				13.2410091	352.7	1928.6	19.8	8.9	Elfin Woodland	3852	421.7	6.3	768	145
St Vincent	Copeland	SVI-24	Sherd Scatter		Troumassan				13.2539942	352.7	3866.4	24.5	36.7	Evergreen	14697	76	4.7	869	145
St Vincent	Cumberland Ravine	SVI-25	Small Settlement	X	Troumassan	Finger-Indented, GriddleFeet, Polychrome, Scratched			13.2596065	352.7	1815.8	24.5	34.1	Elfin Woodland	14442	245.8	7.2	789	145
St Vincent	Cumberland West	SVI-26	Sherd Scatter		General Post-Saladoid				13.2650205	352.7	46.2	24.5	1.8	Cactus Scrub	4811	794.2	0	777	375
St Vincent	Dandrade 1	SVI-27	Sherd Scatter		Troumassan				13.3121518	352.7	3007.1	30.5	3.4	Evergreen	14304	67.1	15.5	698	145
St Vincent	Dandrade 2	SVI-28	Sherd Scatter		Unknown				13.3139508	352.7	1918.1	19.8	11.2	Elfin Woodland	13606	182.1	6.2	733	375
St Vincent	Dandrade 3	SVI-29	Sherd Scatter		Unknown				13.3146784	352.7	1618.3	19.8	7.1	Elfin Woodland	10257	105.3	4.2	781	375
St Vincent	Escape 1,2 & 3	SVI-30	loci		Saladoid	WOR			13.1614447	352.7	1672.7	12.7	32	Deciduous	10808	178.7	1	837	250
St Vincent	Espagnol Point North	SVI-31	loci		Suazan	GriddleFeet			13.369641	352.7	5416.7	30.4	32.6	Deciduous	6355	536.5	1.3	756	200
St Vincent	Espagnol Point South	SVI-32	Large Settlement	X	Troumassan	Caliviny Unique Adorned, Finger-Indented, Polychrome, Scratched			13.3673528	352.7	5116.2	30.4	9.1	Deciduous		241.2	5.6	675	145
St Vincent	Evesham School	SVI-33	Sherd Scatter		Troumassan				13.1855793	352.7	5590.4	53.9	19.8	Evergreen	8935	555.7	0.1	888	145
St Vincent	Fancy	SVI-34	Small Settlement		Troumassan				13.3821612	352.7	8752.7	30.4	9.7	Deciduous	7920	1397.3	0	664	145

(Table S2 continued)

Island	Site Name	Site No	Site Type	SLD?	Earliest Ceramic Type	Ceramic Diagnostics	Earliest Site RC (calAD)	lab # (and orig ref)	Latitude (WGS 84)	Island Area (km2)	Beach Dist (M)	ReefSize (Ha)	Slope (degree)	Forests	NPP cell	FlatBlue Dist (M)	FlatBlue BuffTotal (ha)	M51x ESD (AD)	M51x error (±)
St Vincent	Fancy Fields	SVI-35	Sherd Scatter		General Post-Saladoid				13.3772148	352.7	7631.6	30.4	26.1	Elfin Woodland	7837	270.8	2.3	779	375
St Vincent	Fitz Hughs	SVI-36	Small Settlement	X	Troumassan	Finger-Indented, GriddleFeet, Polychrome, Scratched	885-1280	RL-74 (Bullen and Bullen 1972)	13.2952972	352.7	559.3	32.1	12.9	Deciduous	14593	826.5	0	813	145
St Vincent	Flour Mill	SVI-37	loci		Troumassan				13.1671368	352.7	183.2	24.8	12.1	Deciduous	6165	675.4	0	914	145
St Vincent	Friendly	SVI-38	Small Settlement		Suazan				13.2268543	352.7	662	19.8	21.7	Deciduous	14484	60.8	29.2	689	200
St Vincent	Golf Course	SVI-39	loci		Suazan				13.1232779	352.7	76.6	15.9	2.5	Deciduous	6199	121.7	17	723	200
St Vincent	Government House	SVI-40	Small Settlement		Troumassan				13.166277	352.7	2110.1	24.8	12.8	Deciduous	12757	612.5	0	800	145
St Vincent	Grand Sable 2	SVI-41-1	Small Settlement		Troumassan				13.2701818	352.7	258	19.8	12.4	Cactus Scrub	14677	44.8	29.1	605	145
St Vincent	Grand Sable 2	SVI-41-2	loci		Troumassan				13.2643036	352.7	1377.7	19.8	29.7	Deciduous	10152	370	3.7	766	145
St Vincent	Grant's Bay North	SVI-42	loci		Troumassan				13.2082426	352.7	280.9	53.9	10.2	Deciduous	14741	46	5.8	823	145
St Vincent	Grant's Bay South	SVI-43	Sherd Scatter		Troumassan				13.2059708	352.7	216.5	53.9	8.4	Deciduous	14741	201.4	8.8	746	145
St Vincent	Happy Hill	SVI-44	Sherd Scatter		Unknown				13.2885677	352.7	2388.4	19.8	23.1	Deciduous	14480	147.2	25.5	620	375
St Vincent	Hermitage	SVI-45	Sherd Scatter		Troumassan	Polychrome, Scratched			13.2450194	352.7	5908.1	24.5	33.3	Evergreen	14673	185	7.9	779	145
St Vincent	Indian Bay	SVI-46	Small Settlement		Troumassan				13.1373756	352.7	116.1	1	10.2	Cactus Scrub	1636	212.7	11.2	709	145
St Vincent	Indian Bay Point Petroglyph	SVI-47	Petroglyph		Unknown				13.1363809	352.7	32.9	1	11.8	Cactus Scrub	1636	316.7	6.7	745	375
St Vincent	Kingstown Post Office	SVI-48	Large Settlement	X	Saladoid		150 BC - AD 390	RL-28 (Bullen and Bullen 1972)	13.1568125	352.7	1904.7	24.8	1.3	Cactus Scrub	5000	855.7	0	682	250
St Vincent	Layou River	SVI-49	Petroglyph		Unknown				13.2097117	352.7	1430.4	24.5	5.3	Deciduous	14727	1607.5	0	688	375
St Vincent	Lot 14	SVI-50	Large Settlement	X	Troumassan				13.3088577	352.7	1449.4	19.8	7	Elfin Woodland	10257	475.3	4.5	712	145
St Vincent	Lowman's Bay	SVI-51	Workstone		Unknown				13.1688542	352.7	344.9	24.8	3.8	Deciduous	6165	715.9	0	847	375
St Vincent	Macariacaw Point	SVI-52	loci		Troumassan				13.2029796	352.7	113.5	53.9	10	Deciduous	14741	91	9	796	145
St Vincent	McDowall	SVI-53	Sherd Scatter		Troumassan				13.1270251	352.7	418.1	15.9	1.7	Cactus Scrub	14746	0	19.5	639	145
St Vincent	McMillan	SVI-54	Sherd Scatter		Unknown				13.2046164	352.7	5404.7	53.9	7.5	Evergreen	14754	0	30.9	762	375
St Vincent	Mount Pleasant/Rawacou	SVI-57	Small Settlement		Troumassan				13.1503614	352.7	131.8	12.7	8.1	Deciduous	10808	1004.6	0	819	145
St Vincent	Mount Pleasant/Rawacou	SVI-57	Workstone		Troumassan				13.1502184	352.7	78.7	12.7	3.8	Cactus Scrub	10808	1018.3	0	716	145
St Vincent	Mount William 1	SVI-58	Sherd Scatter		Unknown				13.2504923	352.7	924.7	19.8	22.4	Deciduous	14384	14.4	18.1	751	375
St Vincent	Mount William 2	SVI-59	Unknown		Unknown				13.2487942	352.7	574.8	19.8	7.5	Deciduous	14610	255.4	15	633	375
St Vincent	Mount William 3	SVI-60	Unknown		Unknown				13.248309	352.7	1213.1	19.8	12.4	Deciduous	14556	266.3	12.1	645	375
St Vincent	Mount Wynne	SVI-61	Petroglyph		Unknown				13.2259712	352.7	44.4	24.5	31.5	Deciduous	4047	1971.9	0	926	375
St Vincent	New Sandy Bay	SVI-62	Small Settlement		Troumassan				13.3532184	352.7	3583.9	30.4	3.8	Cactus Scrub	13004	215.3	1.1	597	145
St Vincent	North Mt. Wynn Bay	SVI-63	Sherd Scatter		Troumassan				13.2182646	352.7	41.9	24.5	19.4	Deciduous	5013	2846.2	0	848	145
St Vincent	North Mt. Wynn Bay	SVI-63	Workstone		Troumassan				13.2171669	352.7	8.4	24.5	3.9	Cactus Scrub	5013	2832.9	0	710	145
St Vincent	Orange Hill 1	SVI-64	loci		Unknown				13.3112613	352.7	1486.3	19.8	6.3	Elfin Woodland	10257	281.5	5.6	724	375

Island	Site Name	Site No	Site Type	SLD?	Earliest Ceramic Type	Ceramic Diagnostics	Earliest Site RC (calAD)	lab # (and orig ref)	Latitude (WGS 84)	Island Area (km2)	Beach Dist (M)	ReefSize (Ha)	Slope (degree)	Forests	NPP cell	FlatBlue Dist (M)	FlatBlue BuffTotal (ha)	M51x ESD (AD)	M51x error (±)
St Vincent	Orange Hill 2	SVI-65	Sherd Scatter		Suazan				13.3119844	352.7	1029.2	19.8	5.2	Deciduous	10257	596.1	0	772	200
St Vincent	Orange Hill 3	SVI-66	loci		Suazan				13.3134215	352.7	534.5	19.8	4.5	Deciduous	14835	266.3	0.8	737	200
St Vincent	Overland Old Road	SVI-67	Sherd Scatter		General Post-Saladoid				13.3337942	352.7	1214.3	30.4	4.2	Deciduous	6472	184.1	10	689	375
St Vincent	Owia 1 & 2	SVI-68-69	Small Settlement	X	Troumassan	Finger-Indented, GriddleFeet, Polychrome, Scratched			13.3767103	352.7	6467.3	30.4	6.5	Deciduous	10331	807.7	0	691	145
St Vincent	Owia Bay 1	SVI-70	Sherd Scatter		Suazan				13.3711527	352.7	5916.8	30.4	6.3	Deciduous	10331	484.4	0.4	663	200
St Vincent	Owia Bay 2	SVI-71	Sherd Scatter		Troumassan				13.3698183	352.7	5680.4	30.4	14.5	Deciduous	6355	724.3	0	778	145
St Vincent	Owia Bay 3	SVI-72	Sherd Scatter		Troumassan				13.3737427	352.7	6241.3	30.4	14.6	Deciduous	10331	439.2	0.7	695	145
St Vincent	Park Hill	SVI-73	Sherd Scatter		Unknown				13.2319897	352.7	1507.2	19.8	19.1	Elfin Woodland	14010	145.4	10.1	760	375
St Vincent	Peanut Field, North Union	SVI-74	Small Settlement		Troumassan				13.2189976	352.7	242.9	53.9	10.7	Deciduous	14699	58.8	22.1	734	145
St Vincent	Peter's Hope Bay Petroglyph	SVI-75	Petroglyph		Unknown				13.2463391	352.7	56.6	24.5	13	Deciduous	14767	0	15.6	851	375
St Vincent	Petit Bordel	SVI-76	Sherd Scatter		Troumassan				13.2888181	352.7	412.8	32.1	25	Deciduous	14605	1019.6	0	845	145
St Vincent	Petit Bordel	SVI-77	Petroglyph		Troumassan				13.282005	352.7	629.1	32.1	33.5	Elfin Woodland	14635	923.9	0	918	145
St Vincent	Police Work Shop	SVI-78	Small Settlement		Troumassan				13.1417051	352.7	337.4	23.3	19.6	Deciduous	5733	50.6	17.3	825	145
St Vincent	Quashie Point	SVI-79	Sherd Scatter		Troumassan				13.3788679	352.7	8580.7	30.4	35.5	Deciduous	4518	775.4	0	821	145
St Vincent	Queensbury	SVI-80	Large Settlement	X	Troumassan	Adornos, GriddleFeet, Groundstone Axe, Saline Wide-Handle, WOR, ZIC			13.2024327	352.7	3648.6	24.8	11.6	Elfin Woodland	14505	478.8	0.7	752	145
St Vincent	Questelles School	SVI-81	Sherd Scatter		Suazan				13.1759174	352.7	557.4	24.8	13.7	Elfin Woodland	14721	1526.2	0	828	200
St Vincent	Rabacca River	SVI-82	Sherd Scatter		Unknown				13.2958442	352.7	2508	19.8	20.7	Elfin Woodland	14100	275.4	18.6	666	375
St Vincent	Red Cross Hut	SVI-83	Small Settlement	X	Troumassan	Caliviny Unique Adorned, Finger-Indented, GriddleFeet, Polychrome, Saline Wide-Handle			13.1589966	352.7	1515.9	24.8	2.4	Cactus Scrub	12757	1023.7	0	632	145
St Vincent	Rutland Vale	SVI-84	Sherd Scatter		Suazan				13.2014431	352.7	147.6	24.8	3.2	Cactus Scrub	6660	946.1	0	751	200
St Vincent	Sans Souci	SVI-85	Small Settlement		Suazan				13.2249824	352.7	401.8	19.8	8	Deciduous	14699	0	38.6	712	200
St Vincent	Sharpe's Bay	SVI-86	loci		Suazan				13.1239757	352.7	45.8	15.9	4.5	Deciduous	6199	84.3	18	758	200
St Vincent	Sharpes Stream Petroglyph	SVI-87	Petroglyph		Unknown				13.1687037	352.7	2353.3	24.8	10.1	Elfin Woodland	15100	297.9	1.1	780	375
St Vincent	South Union	SVI-88	Small Settlement	X	Troumassan	GriddleFeet, Polychrome			13.2147189	352.7	281.6	53.9	16.5	Deciduous	14699	78.6	9.3	806	145
St Vincent	Spring	SVI-89	Sherd Scatter		Troumassan				13.1861972	352.7	279.4	53.9	11.3	Deciduous	14408	121.3	13.8	750	145
St Vincent	Stubbs	SVI-90	Large Settlement	X	Troumassan	Finger-Indented, GriddleFeet, Groundstone Axe, Polychrome, Saline Wide-Handle, Scratched			13.1480312	352.7	846.3	17	33.3	Elfin Woodland	14538	574.6	0.1	897	145
St Vincent	Swatt	SVI-91	Sherd Scatter		Troumassan				13.2715754	352.7	2554.3	32.1	10.5	Evergreen	14596	566.3	0.2	829	145
St Vincent	Texaco Tank	SVI-92	loci		Troumassan				13.1397622	352.7	134.1	1	0.3	Cactus Scrub	1636	0	31.7	662	145
St Vincent	Three Rivers	SVI-93	Sherd Scatter		Troumassan				13.2507349	352.7	2563.4	19.8	9.8	Elfin Woodland	14714	190.3	1.9	762	145
St Vincent	Top Hill	SVI-94	Sherd Scatter		Unknown				13.3142292	352.7	229.7	30.5	26.3	Deciduous	5426	628.1	0	959	375

(Table S2 continued)

Island	Site Name	Site No	Site Type	SLD?	Earliest Ceramic Type	Ceramic Diagnostics	Earliest Site RC (calAD)	lab # (and orig ref)	Latitude (WGS 84)	Island Area (km2)	Beach Dist (M)	ReefSize (Ha)	Slope (degree)	Forests	NPP cell	FlatBlue Dist (M)	FlatBlue BuffTotal (ha)	M51x ESD (AD)	M51x error (±)
St Vincent	Tourama 1	SVI-95	Sherd Scatter		General Post-Saladoid				13.3155655	352.7	1273.6	19.8	3.6	Elfin Woodland	10257	390.4	1	759	375
St Vincent	Tourama 2	SVI-96	loci		General Post-Saladoid				13.3186676	352.7	1707.2	19.8	13.8	Elfin Woodland	14268	526.9	1.4	752	375
St Vincent	Troumaka Bay	SVI-97	Sherd Scatter		Suazan				13.2804642	352.7	229.4	32.1	15.3	Elfin Woodland	14635	722.1	0	911	200
St Vincent	Vermont	SVI-98	Sherd Scatter		Unknown	Groundstone Axe			13.2060722	352.7	4474.3	24.8	12.9	Elfin Woodland	14730	121.3	3.4	755	375
St Vincent	Wallibou	SVI-99	Sherd Scatter		Suazan				13.3181924	352.7	1074.5	30.5	15.9	Deciduous	14373	100.3	23.1	664	200
St Vincent	Wallilibou	SVI-100	Small Settlement		Troumassan				13.2490212	352.7	139.1	24.5	6.3	Cactus Scrub	14767	0	15	726	145
St Vincent	Wallilibou	SVI-100	Workstone		Troumassan				13.2489188	352.7	108.5	24.5	6.3	Cactus Scrub	14767	0	15.1	730	145
St Vincent	Windsor Forest	SVI-101	Workstone		Troumassan				13.3705178	352.7	7217.8	30.4	29.2	Cactus Scrub	5065	497.2	0.8	681	145
St Vincent	Windsor Forest	SVI-101	Sherd Scatter		Troumassan				13.3703531	352.7	7151.9	30.4	29.6	Deciduous	5065	563.3	0.2	788	145
St Vincent	Yambou Petroglyphs	SVI-102	Petroglyph		Unknown				13.1674519	352.7	596.2	12.7	25.8	Deciduous	13523	87.2	37.3	669	375
St Vincent	Yambou Petroglyphs	SVI-103	Petroglyph		Unknown				13.1754984	352.7	1662.6	53.9	36.7	Elfin Woodland	14531	0	3.1	1016	375
St Vincent	Yambou Petroglyphs	SVI-104	Petroglyph		Unknown				13.1720808	352.7	1538.6	12.7	22.5	Elfin Woodland	14622	180.5	3.7	804	375
St Vincent	Yambou Petroglyphs	SVI-105	Petroglyph		Unknown				13.1731157	352.7	1348.8	53.9	18.6	Deciduous	14622	90.1	4	811	375
St Vincent	Young's Island	SVI-106	Sherd Scatter		Troumassan				13.1298836	352.7	391.5	7.9	3.1	Cactus Scrub	5685	416.5	1	681	145
Union	Belmont Pond	GRS-55	Sherd Scatter		Troumassan				12.6025961	8.5	223.2	36.4	3	Cactus Scrub	8512	0	17	801	145
Union	Chatham Bay Midden	GRS-56-S	loci		Troumassan		205-715	RL-70 (Bullen & Bullen 1972)	12.5979141	8.5	28.6	36.4	24.4	Cactus Scrub	5694	1220.4	0	936	145
Union	Chatham Bay Pasture	GRS-56-N	Large Settlement	X	Troumassan	Finger-Indented, Polychrome, Saline Wide-Handle, Scratched			12.6039165	8.5	100.8	36.4	1.2	Cactus Scrub	10434	858.6	0	783	145
Union	Chatham-Bloody Head	GRS-56-X	loci		Unknown				12.6109127	8.5	101.9	5.5	16.7	Deciduous	6516	1474	0	900	375
Union	Clifton Swamp	GRS-57	Sherd Scatter		Unknown				12.5922457	8.5	356.8	73	14	Cactus Scrub	5693	323.3	5.7	824	375
Union	Durham	GRS-58	Sherd Scatter		Troumassan				12.5915696	0.1	11.9	73	2.7	Cactus Scrub	7610	24.2	15.5	816	145
Union	Fort Hill	GRS-59	Sherd Scatter		Troumassan				12.5979166	8.5	0	1.4	7.7	Cactus Scrub	5740	0	18.9	844	145
Union	Frigate Island	GRS-60	Sherd Scatter		Suazan				12.5816972	16.9	1001.2	73	6.1	Cactus Scrub	7610	939	0	825	200
Union	Miss Pierre	GRS-61	Large Settlement	X	Troumassan				12.6051388	25.3	124.1	36.4	14.5	Cactus Scrub	5929	24.4	11.2	865	145

References

Banks, Thomas J. 1988. Archaeological Excavation at the Grand Anse Beach Site, Grenada, W.I. St. George's, Grenada: Foundation for Field Research.

Bright, Alistair J. 2011. Blood is thicker than water Amerindian intra- and inter-insular relationships and social organization in the pre-colonial Windward Islands. Leiden: Sidestone Press.

Bullen, Ripley P., and Adelaide K. Bullen. 1972. Archaeological Investigations on St. Vincent and the Grenadines, West Indies. Orlando: Bryant Foundation.

CHARIM. 2016. "Geonode: Saint Vincent and the Grenadines." Caribbean Handbook on Risk Information Management (CHARIM). http://www.charim-geonode.net/people/profile/svg/. [accessed: May 31, 2019].

Cody, Ann K. 1991. "From the Site of Pearls, Grenada: Exotic Lithics & Radiocarbon Dates." In Proceedings of the XIII Congress of the International Association for Caribbean Archaeology (IACA, 1989), 589–684. Curacao.

Cody Holdren, Ann K. 1998. "Raiders and Traders: Caraïbe Social and Political Networks at the Time of European Contact and Colonization in the Eastern Caribbean." PhD. Dissertation, University of California, Los Angeles.

ESRI. 2015. "Bluespot Models." Find Areas at Risk of Flooding in a Cloudburst. https://learn.arcgis.com/en/projects/find-areas-at-risk-of-flooding-in-a-cloudburst/. [accessed: May 20, 2019].

Fitzpatrick, Scott M., and Christina M. Giovas. 2011. "New Radiocarbon Dates for the Grenadine Islands (West Indies)." Radiocarbon 53 (3): 451.

Gumbricht, T., R. M. Román-Cuesta, L. V. Verchot, M. Herold, F. Wittmann, E. Householder, N. Herold, and D. Murdiyarso. 2017. "Tropical and Subtropical Wetlands Distribution Version 2." doi:10.17528/CIFOR/DATA.00058.

Hanna, Jonathan A. 2017. The Status of Grenada's Prehistoric Sites: Report on the 2016 Survey and an Inventory of Known Sites. Botanical Gardens, Grenada: Ministry of Tourism. doi:10.18113/S1QG64.

Hanna, Jonathan A. 2018. "Ancient Human Behavioral Ecology and Colonization in Grenada, West Indies." PhD. Dissertation, University Park, PA: Pennsylvania State University.

Hanna, Jonathan A. 2019. "Camáhogne's Chronology: The Radiocarbon Settlement Sequence on Grenada, West Indies." Journal of Anthropological Archaeology 55: 101075. doi:10.1016/j.jaa.2019.101075.

MOA GIS. 2015. Grenada- Soils Shapefile (version Proprietary Digital Data of the State of Grenada). Botanical Gardens, Tanteen, Grenada: GIS Unit of the Ministry of Agriculture, Government of Grenada. Available at: http://charim-geonode.net/people/profile/grenada/ [accessed 5-31-2019]. [accessed: May 31, 2019].

NOAA NCEI. 2017. Grenada Digital Elevation Model - 1 Arc-Second. University of Colorado at Boulder. https://catalog.data.gov/dataset/grenada-digital-elevation-model-1-arc-second [accessed 12/9/2017]: NOAA National Centers for Environmental Information (NCEI). https://data.noaa.gov/dataset/dataset/grenada-1-arc-second-digital-elevation-model.

Ostapkowicz, Joanna, Christopher Bronk Ramsey, Alex C. Wiedenhoeft, Fiona Brock, Tom Higham, and Samuel M. Wilson. 2011. "'This Relic of Antiquity': Fifth to Fifteenth Century Wood Carvings from the Southern Lesser Antilles." In Communities in Contact. Essays in Archaeology, Ethnohistory and Ethnography of the Amerindian Circum-Caribbean, edited by Corinne L. Hofman, 137–170. Leiden: Sidestone Press.

Scopel, Caitlin. 2014. "Floodplain Delineation Using Only Arc Hydro Models." ArcGIS Blog. https://www.esri.com/arcgis-blog/products/product/analytics/floodplain-delineation-using-only-arc-hydro-models/. [accessed: June 12, 2019].

USAID. 1991a. Grenada: Country Environmental Profile. Bridgetown, Barbados: Regional Development Office/Caribbean.

USAID. 1991b. St. Vincent and the Grenadines: Country Environmental Profile. Bridgetown, Barbados: Regional Development Office/Caribbean.

Vernon, K. C., Hugh Payne, and J. Spector. 1959. Grenada. Soil and Land-Use Surveys, no. 9. Trinidad and Tobago: Soils Research and Survey Section, Regional Research Centre, Imperial College of Tropical Agriculture.

Watson, J. P, J Spector, T. A Jones, and Imperial College of Tropical Agriculture (Trinidad and Tobago). 1958. St. Vincent. Soil and Land-Use Surveys, no. 3. Trinidad: Regional Research Centre, Imperial College of Tropical Agriculture.

Zhao, Maosheng, and Steven W. Running. 2010. "Drought-Induced Reduction in Global Terrestrial Net Primary Production from 2000 through 2009." Science 329 (5994): 940–943.