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MAROONS AND LANDSCAPES

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Maroons, or runaway slaves, form a conspicuous group in the narrative and study of slave societies, being important exponents of the continuous rebellion against slavery. From a point of view of cultural theory they also form an especially interesting group in that they both isolated themselves from the slave society they escaped, but also constantly interacted with it. As such, Maroon sites can inform us on the cultural conditions of people who are at the same time both 'inside' and 'outside' established society, and their study will potentially provide insight of theoretical significance far beyond local history and environment in the Caribbean. A main archaeological problem is to identify such sites, as they are inherently located in the most remote and inaccessible places, difficult to access for the surveying archaeologist. In this paper a GIS-based predictive model is developed for the island of St. Croix to identify the most likely places for maroon settlements, thus making a more focussed field work effort possible. The presented model was made in preparation of a field trip in March 2007 as part of the Danish scientific Galathea 3 expedition, taking Danish scientists around the globe.

Any study on the period of Danish colonialism on the U.S. Virgin Islands will necessarily focus on plantations; their economy, organisation and populations. In a broader context, we have to consider the position of the plantation in systems of local and regional trade, the mercantilist thinking and organisation behind the entire colonial system, and the contacts with both Europe and Africa. The triangular trade of African slaves, American cash-crops and European manufacturers and markets was what made this world go around, and is in general the mindset from which we have to view these societies. But throughout the Americas, one group of people broke out of the system, more or less. Runaway slaves would take to the forests and mountains to establish an independent life away from plantation slavery. They were known as maroons, a name derived from the Spanish *Cimarron*, originally referring to cattle gone wild.

In the dominant planter society these people were a source of constant concern, because they destabilized the slave system, not only by running away, and thereby encouraging others to follow their example, but also and not least because the maroon societies were seen as centres for rebellion against slavery, and were in effect in a state of constant warfare against the slave owners. Maroons were fought vigorously, and they often demonstrated a remarkable ability to fight back. This happened everywhere where slaves were kept, and did so from the very start of the colonial period. Indeed one of the first Old World settlers in the Americas was an African slave who escaped his Spanish master in 1502 (Price 1979: 1), and thus *marronage* is as old as colonization itself.

Maroons form a conspicuous group in both the narrative and the study of slave societies. Maroons were rebels and freedom fighters in a cultural and economic system whose very structure was based on inequality of human beings. As such maroons are important symbols of resistance and rebellion against slavery, their significance in contemporary society extending far beyond a purely scientific interest (*cf*. Price (ed.) 1979; Agorsah (ed.) 1984; Orser 2001).

But even from the most dispassionate scientific view, maroons form significant cultural groupings to investigate and understand, their study potentially contributing insight of theoretical significance beyond their local history and environment in the Caribbean. On one hand these people did rebel against slave conditions, seeking the most remote and inaccessible places in order to avoid contact with the established planter society and hence recapture. On the other hand they did not stand in complete isolation from the societies towards which they rebelled (Orser & Funari 2001). Throughout the Americas these people were dependent on regular interaction with surrounding communities, not only in the form of the much dreaded raids on isolated plantations and settlements, but also as trade and exchange with people both inside and outside the established plantocracy (Vibæk 1966: 154f; Orser & Funari 2001). There are even contemporary accounts of maroons visiting the local markets to procure necessities, obviously doing this at great personal risk (Oldendorp 1777). It is this exact mix of isolation and interaction which makes Maroon societies and settlements so interesting. These people were in many ways both outside and inside the plantation economy system, part of it and secluded from it, and investigating the types of cultural response to this situation, and how such a system could work, is culturally significant by any scale.

The presence of maroons on St. Croix is widely documented in the historical sources, as has been discussed and presented in a recent paper in this journal (Norton & Espenshade 2007), but the memory of them also lives in the landscape itself, where the place names Maroon Ridge and Maroon Hole in the Northwestern quarter can be found on any modern map, marking the location of important sanctuaries for escaped slaves, and both supporting an interaction with a local oral tradition on maroon hideouts. According to Vibæk (1953: 153), a more organized existence for the maroons even developed at Maroon Ridge, then named Maroon Hill or “Maron Bierg”; at least the Moravian historian Oldendorp (1777) described how “*a large number of Negroes*” had established there, the approaches of the area protected not only by the dense vegetation, but even by small pointed stakes of poisoned wood. Oldendorp wrote his account on the basis of having lived on the Danish Virgin islands for 18 months in 1768-69, and must be considered a well informed writer.

That an island as small as St. Croix could sustain an organized and independent maroon population seems surprising, and the conditions here can hardly be compared to the large, independent and well known maroon communities in for instance Jamaica (Campbell 1988), Surinam (Price 1990) or Palmares in Brazil (Anderson 1996; Orser & Funari 2001). As shown by Hall (1985), this type of “interior” *grand marronage* became increasingly difficult on St. Croix during the second half of the 18th century, when the general intensification of the plantation economy meant that even the marginal areas to the North were settled by planters, reclaiming large tracts of the forested hills. Instead, Hall claimed that *grand marronage* had either to be maritime in nature, seeking means to get off the island, or benefit from the relative anonymity of the towns. Such types of *marronage* would not leave many recognizable archaeological remains. This interpretation leaves the question what became of the maroons in the Northern Quarters after 1750. Even today tracts of forest are preserved on St. Croix, where individuals and small groups could hide.

The early history of the maroons in the hills of St. Croix forms an intriguing story, not in spite of the relative small size of the island, but exactly because of it. While it may be immediately understandable, that relatively large communities of runaway slaves could escape and establish into the forested hills and mountains of Jamaica or Brazil, the confined space of St. Croix makes the question of their spatial and cultural organization even more pressing.

The history of maroons is mostly told through the written accounts of their oppressors, or through the traditions of oral history and ethnography. Archaeology plays an important role in voicing out the history of the Maroons, as the material culture of these people is the only contemporary reflection of central aspects of their society, made by themselves. Maroon settlements can be expected to answer questions of subsistence, structure and external contact, and are thus fundamental in understanding Maroon societies. An obvious and very practical problem to archaeology is to locate Maroon settlements. This reflects the double problem that not only were these settlements inherently placed in the most remote and difficult areas, but also that, at least in the case of St. Croix, the settlements would reflect relatively small bands of people, possibly moving between places, and thus leaving few traces at each individual site, and such settlements are always difficult to find in the field. But although difficult, other periods and cultural settings have proven it possible to find even such elusive settlements. One telling example - among many similar in archaeology- is Late Palaeolithic settlements in Denmark. Having been known in Northern Germany since the 1930s, only stray finds of the so-called Hamburgean Culture were known in Denmark, although settlements had been found almost right up to the Danish-German border. The lack of settlements in Denmark was for many years explained in various ways as being a result of solifluction or of the proximity of the ice sheet during the last glaciation. But in 1981 the first settlement was found (Holm & Rieck 1983). As is so often the case in archaeology, when the first discovery was made, several followed. The settlements turned out to be small camp sites, reflecting a few days of stay by family-sized groups. The finds are simply small scatters of flint and occasionally a tent-ring of large stone slabs. Such sites are inherently difficult to locate, and seen as archaeological entities, the maroon sites in the Caribbean must be rather parallel to the equally small and elusive Danish Palaeolithic sites, the latter demonstrating that with a concerted effort -and some luck- it is possible to locate them in the field.

Maroon settlements have yet to be found on St. Croix. Therefore the first important step in an archaeological study of the maroons on St. Croix is to locate where they lived. This can only be done in the field, but due to the practical problems of surveying for such settlements, it would be useful to guide surveys by producing an informed guess about where in the landscape surveying might be most profitable. The purpose of this paper is therefore to develop and present a preliminary spatial model for guiding future field work.

Methods and Data

Informed - and uninformed - guessing has always been a part of archaeological field work. But formal methods have developed since the 1970s in the form of predictive modelling. A recent and comprehensive overview of predictive modelling is given by van Leusen *et al*. (2005), but in brief a predictive model is a computer generated map showing areas of "high" and "low" probabilities of archaeological sites being present. They can be based on statistical analysis of the spatial properties of already known archaeological sites (inductive or data-driven models), or on hypothetical assumptions on the "best" places to live (deductive or theory-driven models). Some methods, such as the one used here, allow for the combination of empirical analysis with hypothetical modelling, but due to the lack of known Maroon settlements on St. Croix, the model will have to be deductive and hypothetical.

A vast array of methods has been used in producing such models, and the map outcome of "highs" and "lows" given in an equally diverse number of scales. In this case a technique called Dempster-Shafer theory is used. Dempster-Shafer based modelling has increasingly been used for this purpose by archaeologists around the world, replacing older -mostly regression based- methods (Ejstrud 2003; 2005b; Canning 2006; Hernandéz 2006; Ducke 2007). The method is an extension of Bayesian probability theory, and is based on statistical rules of combination for handling an array of individual parameters, which can support one or more hypotheses. There are several different versions of the mathematical 'belief function' by which the actual calculation is done (Smets 1994), but the implementation of Dempster-Shafer theory in the GIS system IDRISI (Eastman 2003) seems to be based on what Smets labelled the Transferable Belief Model (1994). Although the actual -and fairly complicated- mathematics behind the IDRSI module is something of a black-box, this has the advantage that the interface is very easy to use in an analysis, even for the non-statistically minded archaeologist. What is important to know are the more general workings, assumptions and conditions of the method, rather than the actual equations.

Dempster-Shafer theory provides a flexible and theoretically valid framework for modelling past human behaviour. Unlike many other methods in probability theory it allows for the assumption that ignorance is built into of our knowledge of a field. To archaeology this seems an important assumption to make, as some degree of ignorance about a specific field is inherent in most archaeological work. The method is based on determining a decision space of possible outcomes. In this case, that would be [presence] or [absence] of a maroon settlement. The degree to which we cannot decide between the two is our ignorance, and can be described mathematically through inference using the Dempster-Shafer statistical rules of combination on the variables. In distinguishing between variables that support presence, variables that support absence, and recognizing the fact that our body of knowledge is not complete, Dempster-Shafer modelling is a strong tool for archaeological predictive modelling (Ejstrud 2003; 2005b).

The method works within the [0;1] range of probabilities, although the result should not be interpreted as a formal probability of finding a site. At best it can be seen as reflecting the *suitability* of a certain location for settlement, given a chosen set of variables and on a gradient from 0 to 1: whether people actually settled there is a different story. For this reason the resulting models are probably better regarded as *indicative* rather than *predictive*: in a strict sense they do not predict sites, but do give a general indication of the most likely spots to find them.

Two main datasets are used in the analysis. The first is a Digital Elevation Model (DEM) derived from contours on the standard topographical maps in 1/24,000, which has been digitized by USGS, and is freely available for download for instance through http://www.geocomm.com. The contours are interpolated into a raster model, and the unit converted to meter. This gives a highly detailed model, and probably the best available for the area (Figure 1). The DEM is a basis for developing many other important variables in the landscape, as shall be shown below.

The second dataset is the Cronenberg/Jægersberg map from 1750 (Figure 2). This map, which was drawn in *c*. 1/30,000, is an excellent and highly detailed source for the land use and land cover of the island, based on an original survey. The map was largely prepared by the competent Lieutenant Johann Cronenberg, who started his work in 1747, and had completed main parts of the work by March 1750 when he was arrested and expelled from St. Croix due to an amorous affair with a married woman. A Lieutenant Johann Jægersberg, who had previously been dismissed from his job as surveyor on St. Croix

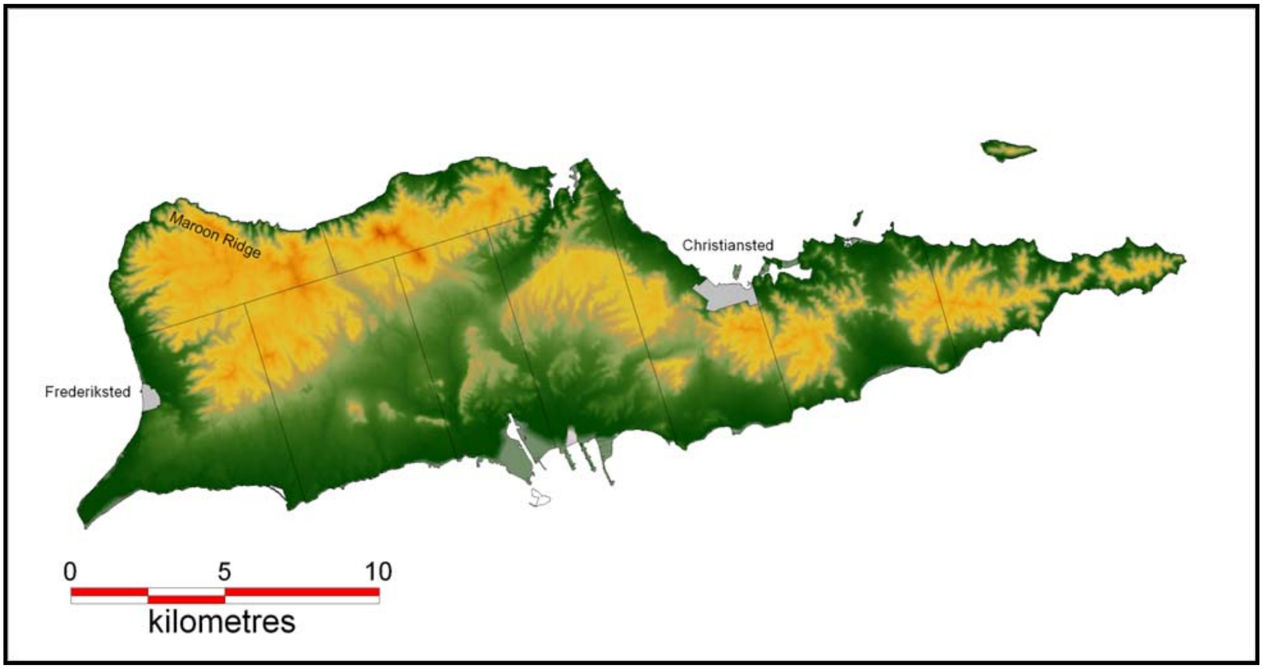

Figure 1. The DEM used in this analysis. Overlain are the island's two towns, the administrative division in "quarters", and Maroon Ridge.

Figure 2. The Cronenberg/Jægersberg map. Here scanned in two sections.

due to laziness, was called back to complete the survey and the map, which was shipped back to Copenhagen in 1750.

The result was marvellous. The map shows the settlement in much detail, with every field surveyed and their crop type given. Plantation main buildings, locally known as "greathouses", are marked precisely on the map, while the slave villages are shown in signature format. In all 201 houses are marked on the map. In some instances, especially on the sugar plantations, more than one building is marked on a single plantation, so the number of buildings reflects somewhat less than 200 plantations. The completeness and quality of this map is outstanding for it's time, and gives us a very complete picture of the colonial settlement (Hopkins 1989).

The original map has been scanned, georeferenced and digitized for use in a Geographical Information System (GIS), and has proven to be very precise, except in the northern quarters, where the maroons would have been located. But in this case the map is used to locate the plantations and infrastructure of the European settlers, so the imprecision in the northern quarters is not be a problem for the analysis. Using this map, the model will show potential areas of Maroon settlements in the period around the mid 18th century.

The data are analysed in a 50 m resolution giving the final map a nominal precision of 1/50,000.

The Geography of Grand Marronage

As most any writer on the subject of maroons has noted, the success of *grand marronage* is dependent on topography and environment. But unlike many other situations where one might use predictive modelling, the model for maroon settlements will describe a balance between two partly opposite considerations: while finding suitable places to live, the maroons also had to keep out of sight of the existing settlement of towns and plantations.

Visibility from plantations

Modelling areas out of sight from the plantation is a relatively straightforward task using cumulative viewshed analysis (van Leusen 1999). Viewshed analyses show which parts of a landscape can be seen from a given location. The analysis uses the DEM (Figure 1) to model visible and invisible areas from that location (Figure 3). Visible areas are normally coded with the value 1, invisible with a 0. In a cumulative viewshed analysis one simply adds up the result from several analyses.

The basis is the plantation main buildings on the 1750 map, and using the DEM it is possible to calculate how many houses can be seen from any point on the map - or how many houses can see each part of the map (Figure 4). The variable is not considered to reflect directly where runaway slaves could hide. Although the calculation of a viewshed is relatively straightforward, the reality behind the model is slightly more complicated. First of all, using the DEM, vegetation is not taken into consideration. Secondly the algorithms behind viewsheds do not take into account the increasing difficulties of seeing an object or a person at increasing distances. Rather than modelling direct visibility of a runaway slave, this variable is thought to reflect a cognitive variable. Areas of the island that are visible from the plantations would also be the ones that a slave planning to escape would try to get past. The visible land is that controlled by the planters, and intuitively it seems a valid goal for an escapee to take to the areas beyond that.

Distance

Another way to describe a good hiding place is to maximize the distance to the planta-

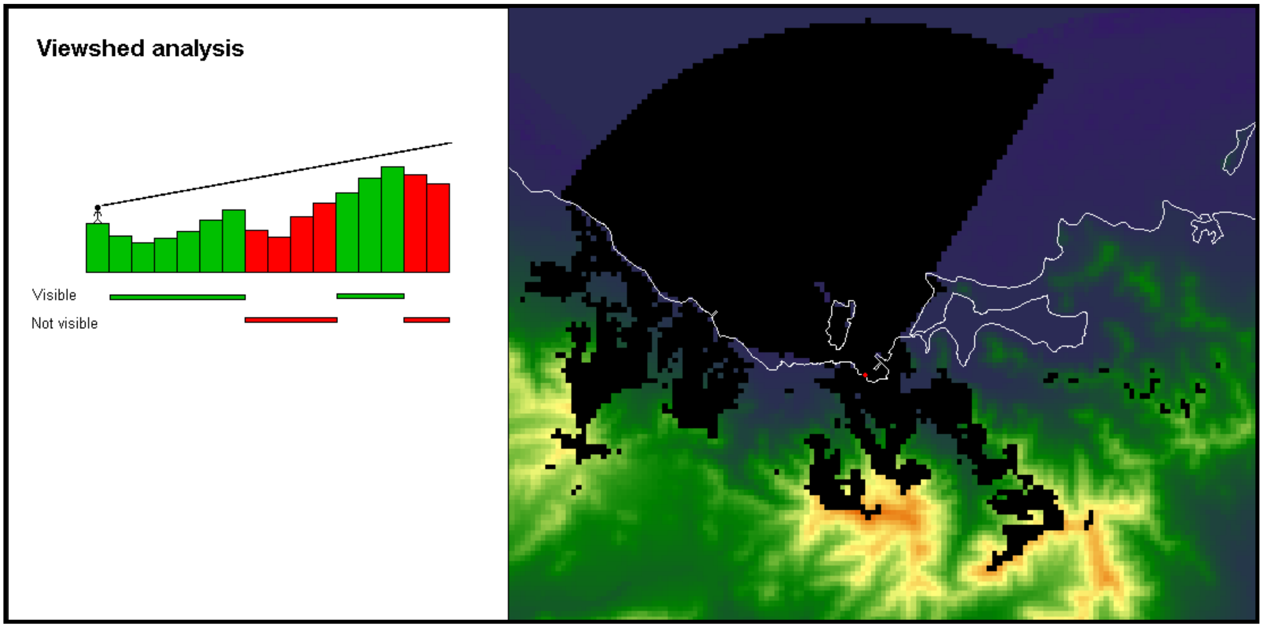

Figure 3. Left: The principle of viewshed analysis in a GIS, where visibility is determined from a given location across the DEM. Right: As an example, a viewshed (black areas) is calculated from the a location on waterfront at Christiansted, St. Croix, and overlain the DEM. For this example viewing distance is set to 3500 m, and town buildings are not taken into account.

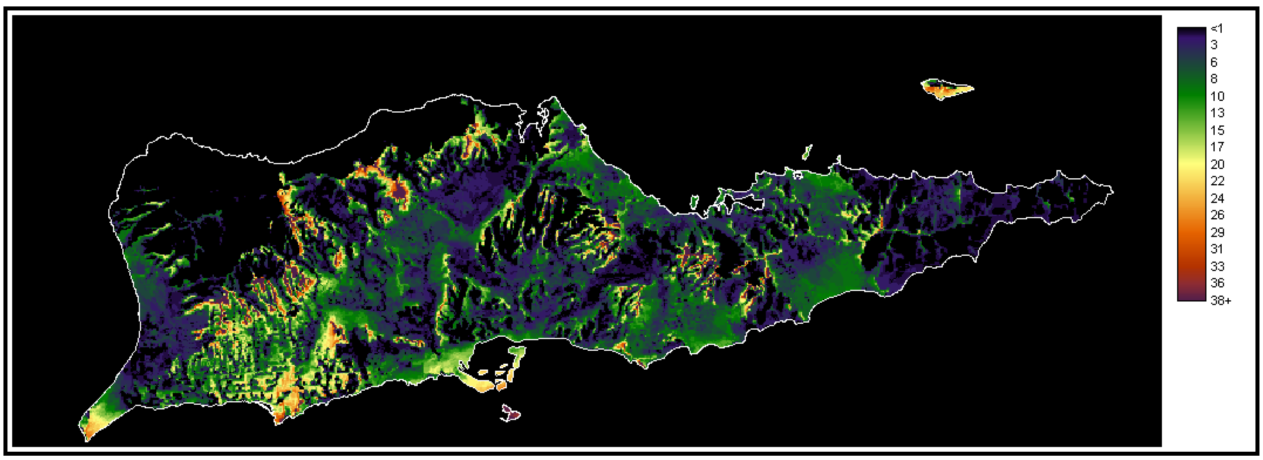

Figure 4. Viewshed analysis showing the number of main houses in 1750 that could be seen from any part of the island. The unit is number of houses visible.

tions, again represented by the main buildings in 1750. But Euclidian distance is not necessarily describing the actual effort of going across the landscape, especially in a hilly area, so in stead a Cost Surface Analysis (CSA) was used. CSA is a type of analysis which can describe the cumulative difficulties of moving through the landscape by using the DEM (van Leusen 1998; Ejstrud 2005a). The analysis works from two maps. The first map gives the 'cost' of moving through any given cell, using time or energy as the unit. The second holds one or more starting points from which the cost of movement is calculated cumulatively. Cost is typically a function of the topography of the landscape, as a flat surface would be faster to move through than a sloping one. Walking speed through each cell is here calculated using the formula derived by Garenflo & Gale (1990):

$$V = 6\, e^{-3.5\,|\,TAN(s)+0.05\,|}$$

Where V is the velocity in km/h, s is the slope of the landscape in degrees, and *e* is the base for natural logarithms. Having calculated the speed by which one can move through every 50x50 m cell in the GIS system, it is easy to calculate the time it would take to pass through the cells, and this is the ‘cost’ used in the analysis.

The model could be refined by combining landform with information of vegetation. A dense forest is more difficult to pass than an open plain. But even without using this refinement, the model seems to give a reasonable description: it is noteworthy that Maroon Ridge is part of a narrow area which is furthest away from any plantations, measured in walking distance (Figure 5). This is a good indication that maroons actually did seek to maximize distance away from their former owners, and by inference that formal modelling of this kind can actually give valid results.

Settlement density

But the visibility of and distance to individual houses cannot in itself describe the state of being “away” from the planter society. One may be hiding in a local hollow between two houses, and still be in the middle of the settled area. To supplement the variable above, the number of main houses on the 1750 map was added within a radius of 2000 m across the entire island. This map gives the density of the settlement, and thus the general areas to avoid (Figure 6).

Roads

Settled areas are not only defined by houses. The roads on the Cronenberg/ Jægersberg map were digitized and a simple distance function was fitted, to mark the immediate corridors (500 m) around the roads. There are only few roads on the 1750 map, and probably only the main road network has been mapped. This variable may therefore be underestimated in this model. It is assumed that proximity to roads will discourage maroon settlements.

Elevation

The maroons lived in the hills. Or at least the maroons at Maroon Ridge did, and there is historical evidence of maroons hiding everywhere possible on the island (George Tyson, personal communication March 2007). As this model will focus on the communities in the mountains mentioned by Oldendorp (1777), elevation has been considered, higher values

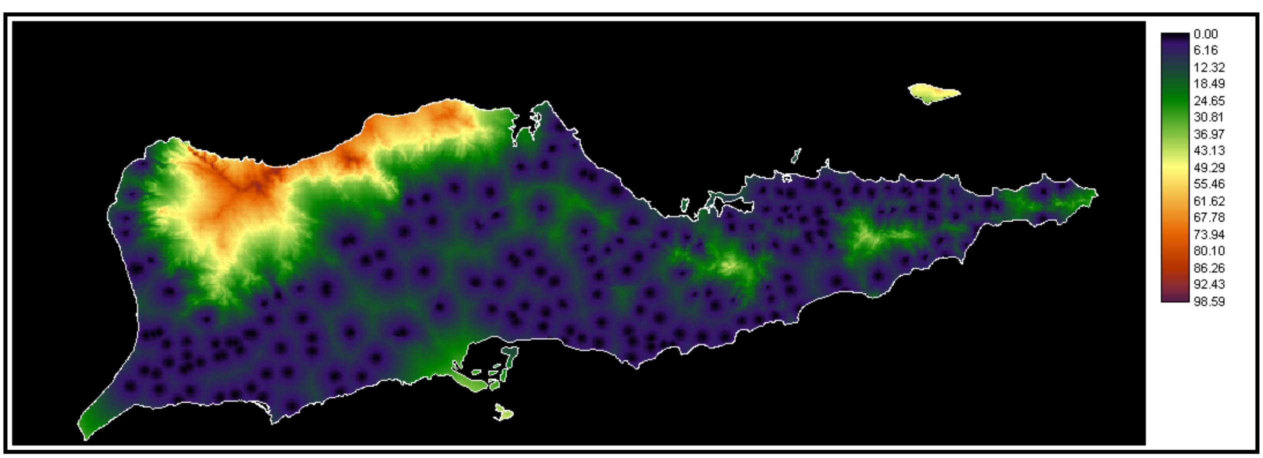

Figure 5. Cost surface analysis using the main houses as basis and moving over the DEM. The unit is minutes.

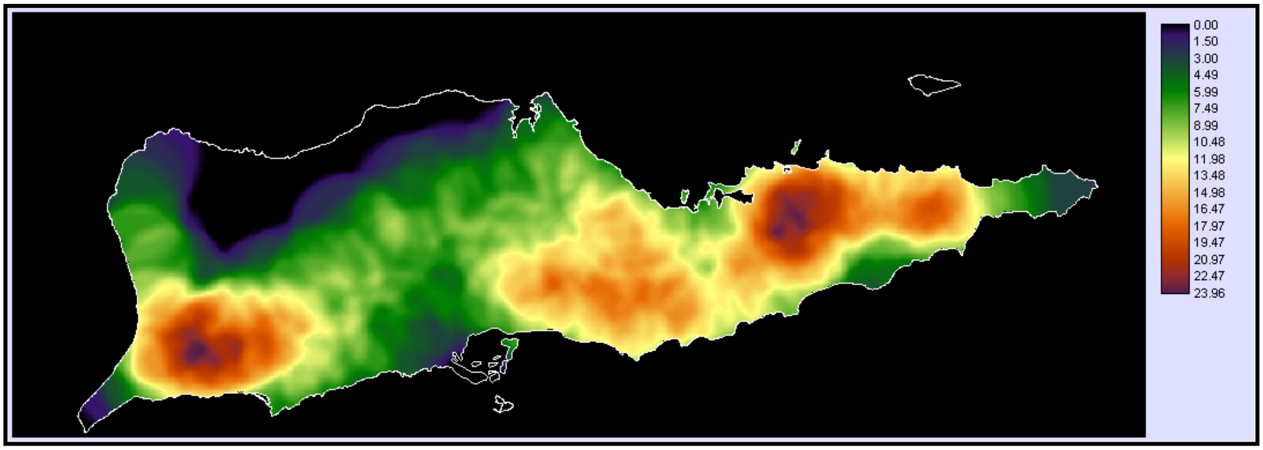

Figure 6. Density of main buildings on the 1750 map. The unit is number of houses.

being better for settlement. The relation was expressed as an S-shaped increase between 75 and 200 m, and a similar decrease between 300 and 350 m (Figure 7). The highest point on the Island is Mount Eagle at 355 m. The values are decreased here, as it is assumed that no one would settle on the highest peaks of the mountains.

Slope

Living in the hills, the Maroons also settled in the most sloping areas. But to establish a settlement proper, there has to be at least some level ground to settle on. This is also noted in the historical sources. Quoting a source from 1803 Jamaica, Price describes settlement placed "*on a ground which compared to those precipices, might be called a plain*" (Price 1979a: 6), noting similar conditions for Maroon settlements in Surinam.

Calculating slope from a DEM is a standard component of any raster GIS system, and this variable has been used in almost every archaeological predictive modelling effort. A seemingly universal trend is that settlements can be found on slopes up to 6-7°, while they are rare in more sloping areas. In the current area and situation, settlements may be expected at slightly higher slopes. To model this, an S-shaped function is used to convert the map of slopes with probabilities decreasing in the range between 5 and 10° slope.

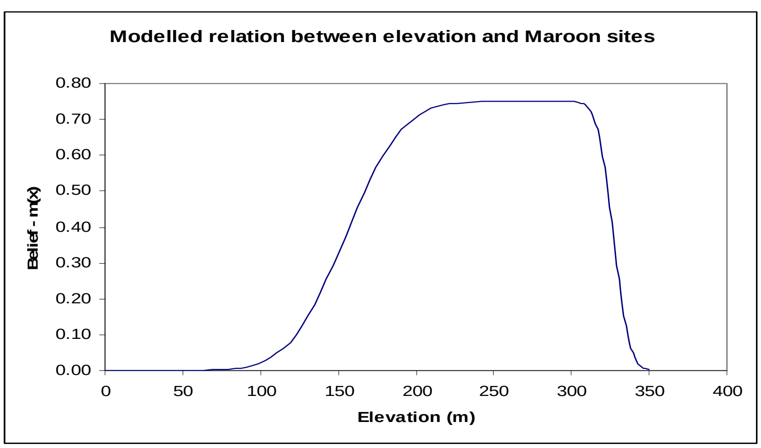

Figure 7. The modelled relation between elevation and maroon sites. To S-shaped functions are fitted; One increasing between 75 and 200 m and another decreasing between 300 and 350 m elevation. Areas between 200 and 300 m are considered equally good for hiding.

This variable can be misleading in karst areas, where caves can be used for settlement. In such cases the relation between settlement and slope may be reversed, letting the most sloping areas be the ones with the most cave entrances at the surface. In all likelihood such a use would render the relation between surface slope and human settlement very, if not too, complicated to model. Coastal caves were used for Maroon settlement on St. Thomas (Hall 1986), and the place name Maroon Hole on St. Croix may indicate a similar use here.

Gill *et al*. (2002) mentions some tendency for karsting in the northern area, but the phenomenon does not seem to extend beyond the immediate coastline. The historical record indicates that these caves, on the slopes just North of Maroon Ridge, were inhabited by maroons, and this means that for this specific area the predictive model does not show the correct locations of maroon settlement. On the other hand, that would mean that caves would be a focal point for surveys, being geographically as precise as any predictive model.

Topography

Slope in itself does not describe much on the properties of the landscape. Again using the DEM, the landscape can be classified into eleven different features: peak, ridge, saddle, flat, ravine, pit, convex hillside, saddle hillside, slope hillside, concave hillside, and inflection hillside. Any pixels not assigned to these classes are "unclassified". Estimating that relatively flat areas are preferred, the classification has been deductively assigned values as shown in Table 1.

Using this classification the model will point out the ridges, saddles and flat areas. It must be added that the use of this variable is entirely speculative at this stage. For Danish prehistory, where the variable has been tested against actual sites, it cannot explain settlement location (Ejstrud 2003). But for hills such as the ones on St. Croix, a classification of landform seems more meaningful than in the flat Danish area.

Class	Value
Peak	0.4
Ridge, saddle, flat	0.6
Ravine, pit	0.2
Hillsides (all)	0.3
Unclassified	0.5

Table 1. Values assigned to the topographic classification.

Water

Water is an indispensable part of human life, and must be considered essential for site location in any part of the world. A drainage network was generated from the DEM, as the modern streams shown on the topographical maps are visibly affected by modern activities. By using the DEM the original network of streams can be reconstructed. The next step was to analyze distance from the streams. Again cost surface analysis was used rather than Euclidian distance. This analysis revealed that only very few areas on St. Croix are actually more than 15 minute walk from a stream. Given that the choice of settlement locations for maroons must have been a balanced trade off between convenience and security, this cannot be considered a long distance. Important as this variable generally is, it carries little significance on this island. An S-shaped function was fitted for areas between 15 and 30 minutes walking distance from a stream, the final map showing places that were avoided.

The Model

The resulting model is made using the Dempster-Shafer based module build into IDRISI (Eastman 2003), using the variables listed above. The resulting model expresses the minimum conditional probability that any given area is suitable for maroon settlement. What is seen on the model is that a larger area than Maroon Ridge itself is covered by the model. Large tracts of land could have been used for hiding places, at least around 1750. Nonetheless the model does point to certain locations where the suitability is particularly high for maroon settlements, and given the variables chosen here (Figure 8).

For Maroon Ridge itself, the areas with the highest probabilities are distributed in three locations. In the westernmost part at an area around 64°51'56.2"W / 17°45'58.8"N, at the centre of the ridge at 64°52’05.8”W / 17° 45’52.5”N, and to the east in a area around 64° 51’33.2 W / 17°45’46.1N, all positions given in WGS84. Altogether these areas cover 2-2½ hectares (5-6 acres).

For ease of use, the model has been converted from a cell-based to a vector based GIS format, so that it can be layered on top of other maps. This map could be brought into the field on any portable computer to guide a concerted effort to locate actual sites (Figure 9).

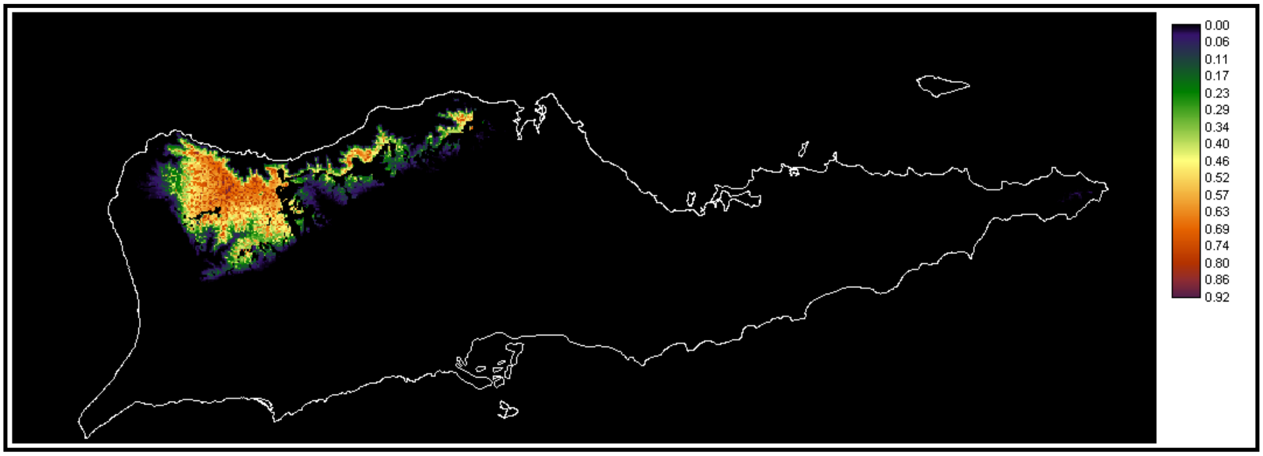

Figure 8. The predictive model, showing the relative suitability of the landscape for Maroon settlements.

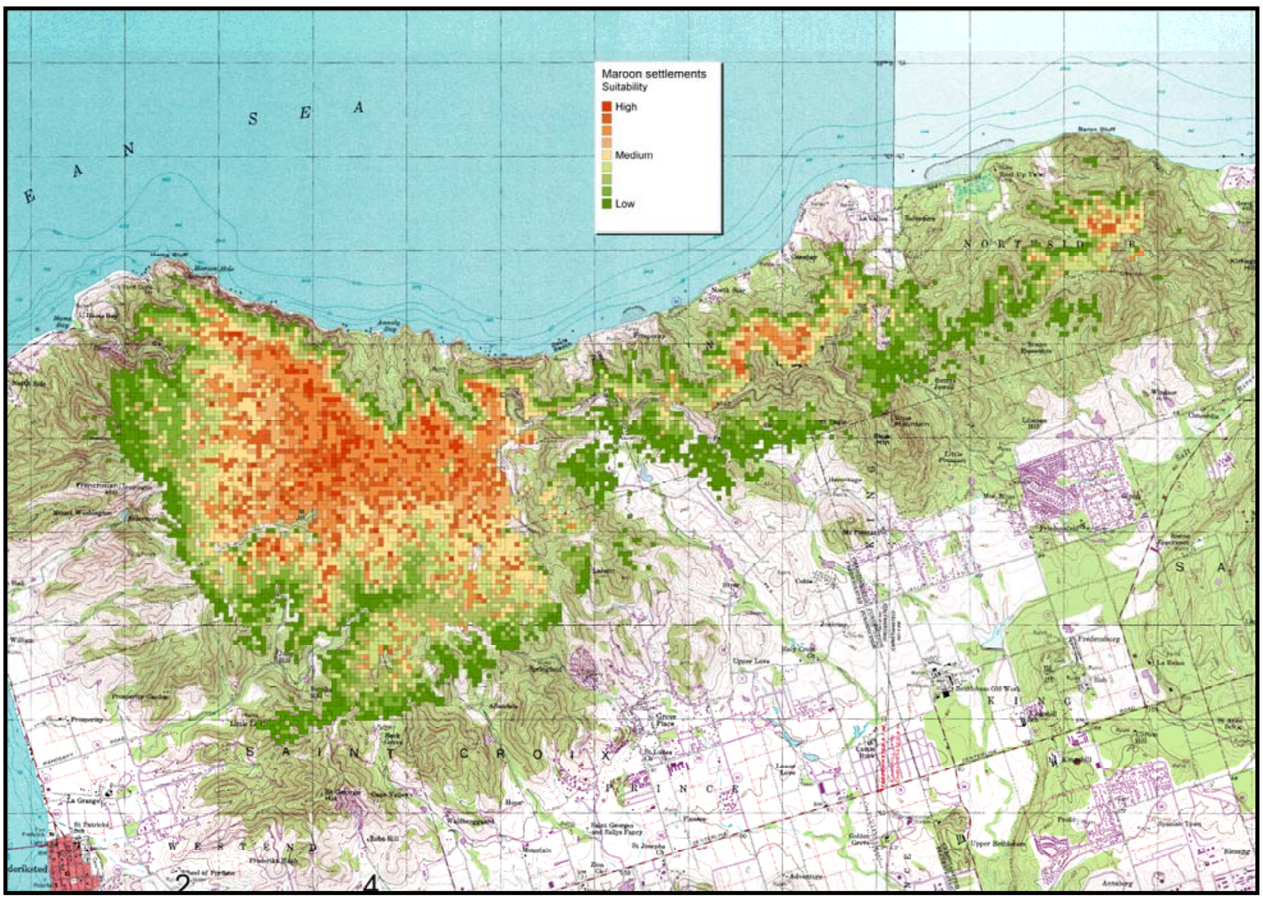

Figure 9. The model converted to vector format and drawn on top of a modern topographical map. From USGS (1958, with corrections 1978).

To validate the model itself, it is important also to look in areas where lower degrees of suitability are indicated. Otherwise these models could potentially end up as self-fulfilling prophesies. Still, to locate the first sites it would not bias the data to focus on the most suitable areas.

Discussion

The model should present the potential of using predictive modelling for directing the archaeological field work necessary to understand the maroons of St. Croix. A map showing only areas with the highest values demonstrates this (Figure 10). Selected here are areas with a model value of more than 0.85. The value of 0.85 is somewhat arbitrarily chosen, but as an experience from earlier studies (Ejstrud 2003; 2005b) would reflect a very high “relative suitability”.

When comparing to the topographical map, not all of these areas seems likely to actually have been settled. This is an expected outcome of a purely statistical modelling method: archaeology is still a discipline involving human assessment. But there are areas which do look promising, both on Maroon Ridge itself, but even in other parts of the area.

The next step in developing a more thorough study would be to go through existing field reports on other Maroons sites. Unfortunately such reports would mostly be unpublished or published as *grey* literature in local reports, which are very difficult to access. Internationally available literature is mostly in the form of outlines of field work, or interpretations of field work, but rarely presents the

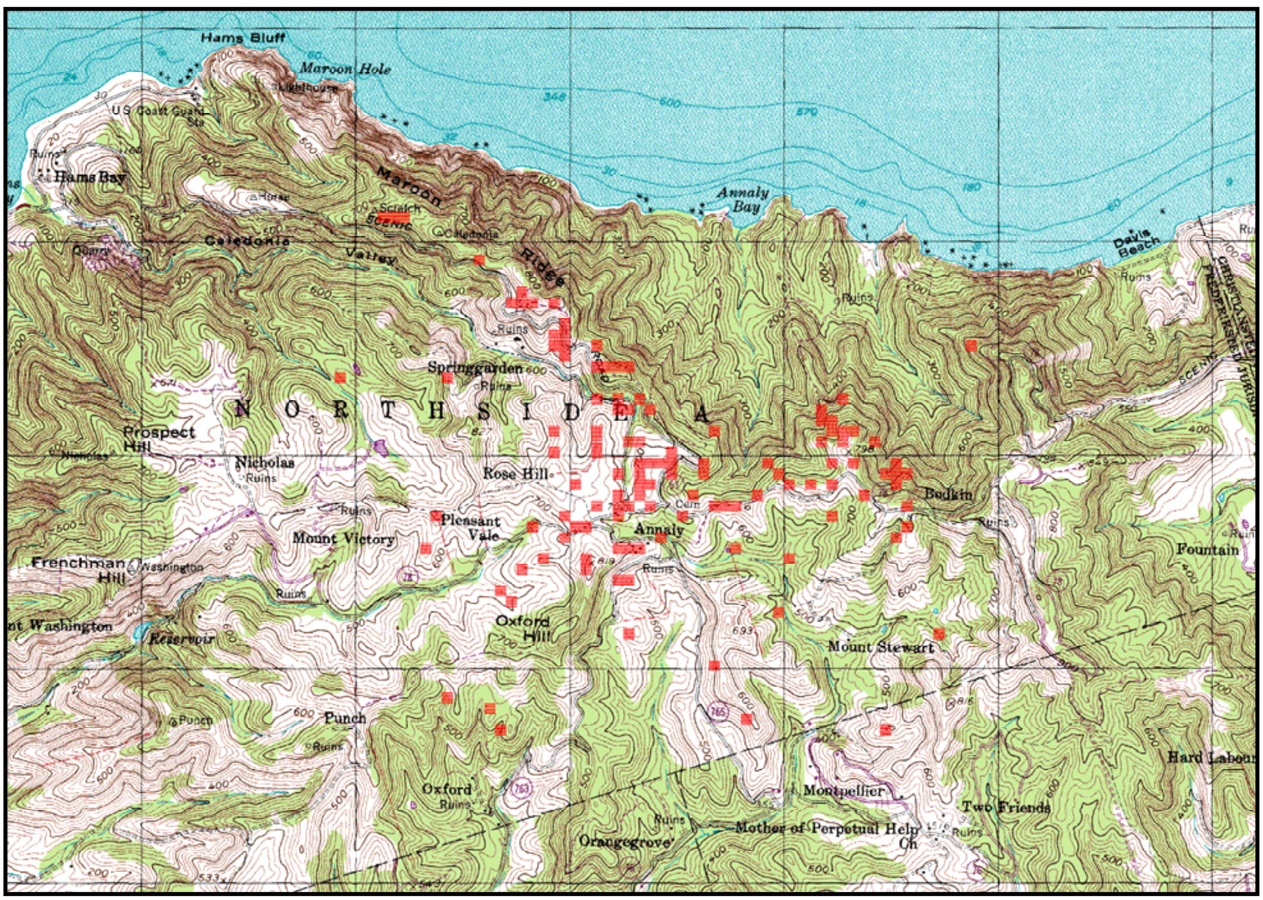

Figure 10. The highest values of the model (red areas) drawn on top of a modern topographical map.

field work itself, so it is difficult to get an impression of what to expect, and hence what to look for in the field.

Further work would include coupling the presence and disappearance of maroons on St. Croix with the development of land use during the 18th and 19th centuries, trying to understand the conditions from a dynamic perspective, rather than a single static picture. Hall's hypothesis that maroons disappeared from the area during the second half of the 18th century is worth investigating further.

During fieldwork done in March 2007, the focus was on the plantation remains, and only limited time was available to go into the field of Maroon sites. The area around Maroon Ridge was visited to get an overall impression of the landscape and vegetation, but no systematic survey was possible. The most striking result was the importance of the very dense vegetation, which should have bearings not only on the modelling effort, but will certainly effect field work to an extent that could not have been foreseen from a desk-based study done in Denmark. Nonetheless, the strong relation between *marronage* and geography makes GIS a strong tool in getting closer to the structure, organization and lives of these people of the hills, and hopefully this paper has demonstrated some of the potential.

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