

Hazards of the Jamaican Coastline

THE PALISADOES: SAFE ACCESS TO THE AIRPORT?

PART TWO

This is another in a series of articles on Hazards of the Jamaican Coastline contributed by the Marine Geology Unit, Department of Geography and Geology, University of the West Indies.

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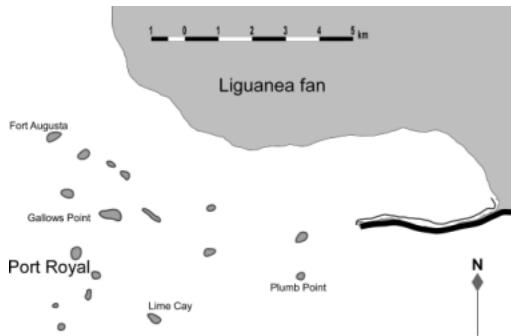
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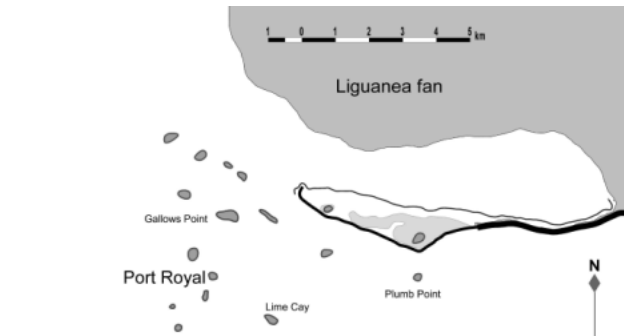
How did the Palisadoes form?

In the previous instalment of the *Hazards of the Jamaican Coastline Series* we mentioned that the Palisadoes has evolved a complex structure as a result of the way it has developed over the past 5000 years. Five thousand years ago was about the time that sea level reached more or less its present position, ending the spectacular rise from a point some 120 metres below today's level. (For a description of this rise read our previous article 'Will sea level rise and drown Jamaica?' The Gleaner November 25, 2005, pages E5-E6.). This rise and fall of sea level has occurred several times over the past million years, going up and down like a yo-yo, and it is quite likely that previous incarnations of Palisadoes-like formations existed during the high stands of the ocean through this period. However, we only know about the present one with any certainty. The model for the evolution of the Palisadoes we suggest here assumes that all the present complex has developed since sea level rose to its present position.

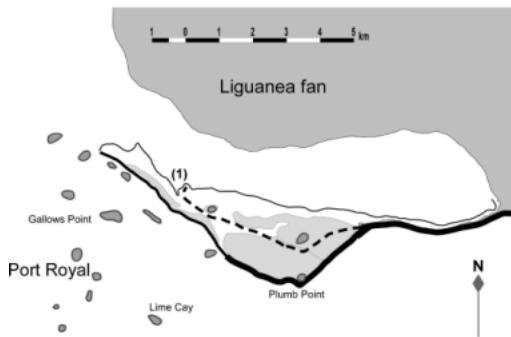
Five thousand years ago there was no Palisadoes as we know it, but the ingredients for its development existed in the form of ocean waves coming from the southeast and river sediment coming down the Hope and Cane Rivers. The accompanying diagrams illustrate the course of the growth of Palisadoes. Note that before growth started the shallow shelf south of the Liguanea Plain was probably dotted with small cays, similar to today's Lime Cay. The exact locations of these cays are not known.



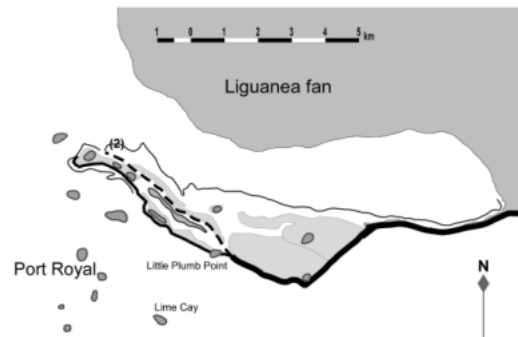
P1. Initial development of a spit westwards towards the various cays on the island shelf.



P2. Extension of spit as far as the site of the present airport, where, turning northwest at Plumb Point, it engulfed more cays.



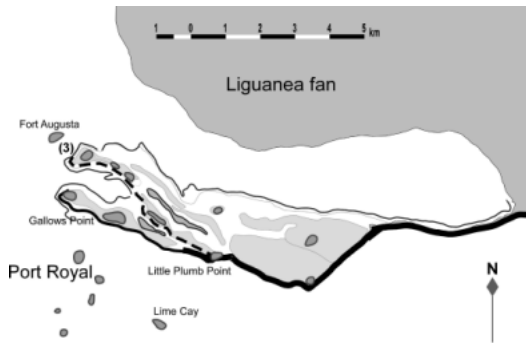
P3. Spit growth in a new direction, more to the west of the previously formed spit (1)



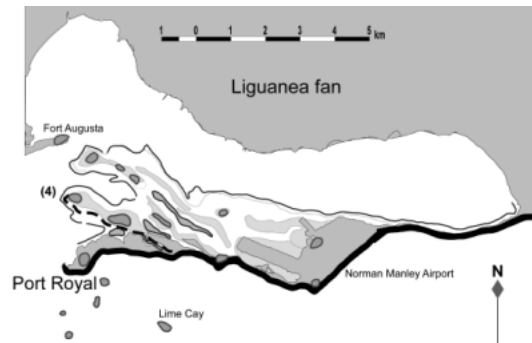
P4. Westward shift in spit formation direction and starvation of former spit (2).

Initially the sediment supply and wave action started to form a spit that gradually extended itself westwards towards the various cays on the island shelf (**P1**). Eventually this spit had grown as far as the site of the present airport, where it engulfed one or more cays. These probably acted as an anchor for the subsequent extension to the northwest (**P2**). At some moment in time the currents swirling about this anchor-point initiated spit growth in a new direction, more to the west of the previously formed spit. As this new growth developed, it cut off the supplies of sediment to the former spit, which became inactive, eventually to exist only as a set of shallow banks (**P3**). A miniature version of an event of this kind can actually be seen today if one drives out to Rocky Point where the old fort is (a party spot today). Here a small, curved spit has thrust itself seawards where no spit existed six months ago. The conditions are not favourable for it to develop much further, but it shows how conditions for spit development can arise quite suddenly.

The rest of the story of the development of Palisadoes basically consists of several repetitions of this process of capture of sediment supply through the initiation of spit growth in a new direction, leading to the starvation of the sediment supply and cessation of growth of each former spit in turn (diagrams **P4** to **P5**). The most recent phase in the evolution of Palisadoes appears to have taken place in the last 500 years (**P6**). When the Spanish first came to Jamaica at the end of the 15th Century Port Royal was still an island. Since then it has become more or less firmly joined to the rest of the Palisadoes.



P5. Initiation of new spit direction and abandonment of spit (3).



P6. Abandonment of spit (4) and extension of new spit to its present location at what was once the island of Port Royal.

What of the future?

Most of the public concern about the integrity of the Norman Manley Airport and its access road has had to do with two developments that will occur over the next hundred years and more. Firstly are fears of the effects of future storms like Ivan blocking or even cutting the road and thus preventing access. Secondly, of equal concern, is the prospect of flooding and submergence following current reports in the media about the prospect of rising sea level. Here we add our own penny's worth of predictions for the near future.

Because of global warming, well-documented for the past hundred years, many of the smaller glaciers and parts of the larger ice caps are melting at an accelerating rate. The melt-water from the ice caps plus the thermal expansion of the seawater itself, due to warming, is generating the rise in sea level. The rate of rise is accelerating.

The envelope of predictions of sea level rise, from many scientists, range from a low of about 10 centimetres to a high of about 85 centimetres over the next hundred years. Recent studies of the Arctic region, as well as the discovery that the Greenland ice sheet is melting at nearly three times the rate of a few years ago, suggest that the high estimate is quite likely. The Intergovernmental Panel on Climate Change published these findings in 2001. The Panel is scheduled to publish revised figures this year. Other scientists have suggested that a sea level rise of as much as 4 metres over the next three to four hundred years is also a strong possibility.

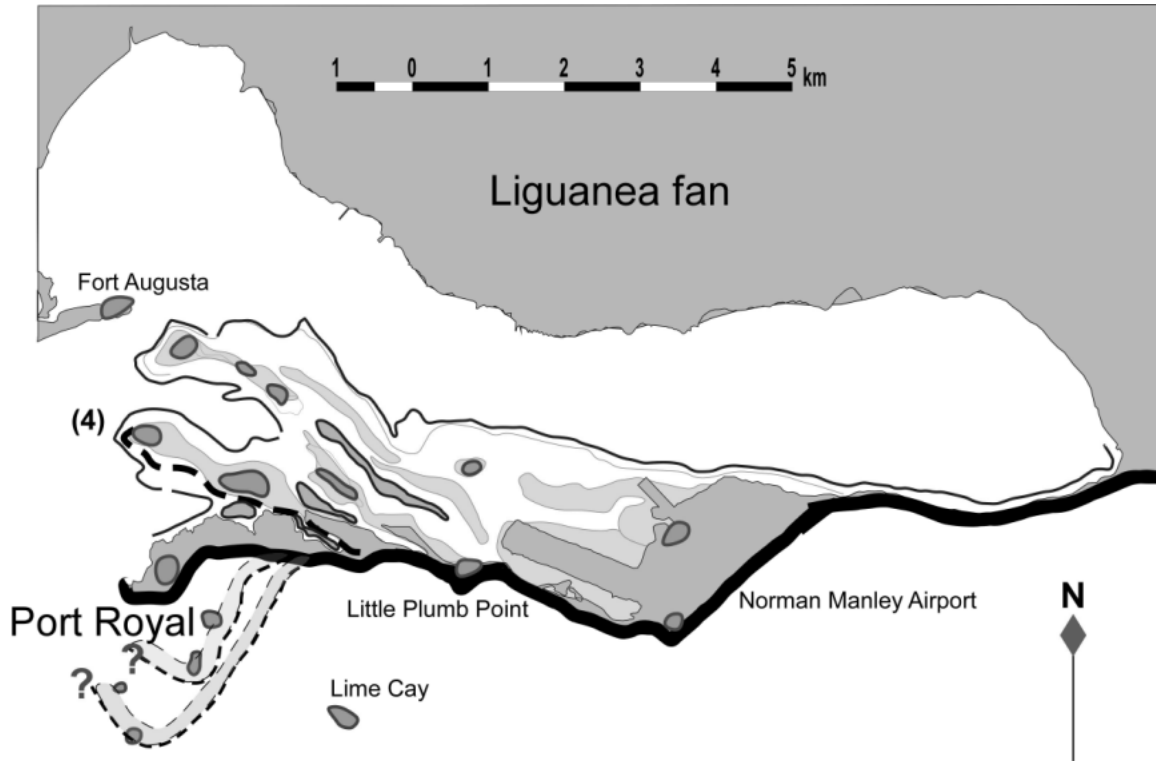
The active beaches along the south side of Palisadoes will probably cope with rising sea level because they are being supplied with new sediment from the rivers to the east. However, excessive sand and gravel extraction from the river beds could rob the beaches of part of their source of sediment so there is the possibility that such supplies will not be available in sufficient quantities to maintain the integrity of the Palisadoes in the future. Well-designed protective measures, applied to the Palisadoes on the ocean side will certainly diminish or even prevent overwash events and erosion from hurricanes, with the accompanying deposition of junk on the airport highway although they probably would not be able to cope with a significant tsunami event. Such protective measures are already at an advanced stage of planning at Government level.

The same cannot be said for man-made structures, such as the highway surface itself. No amount of protection of the shoreline will stop flooding of the highway by rising sea level, or even temporarily by storm surge. It is important to distinguish between washover events and erosion, induced by large vigorous STORM WAVES, when protection is possible, and flooding, caused by STORM SURGE, and, more gradually, by SEA LEVEL RISE when protection is not possible. In New Orleans last year the storm surge that overtopped the levees was thought to be 25 feet (seven and a half metres) above normal sea level. Such a surge would temporarily flood both the highway and the airport runway and one cannot build protective levees for open-ended roads and runways.

The surface of the Palisadoes road in some places is already at sea level during times of spring tides. With future sea level rise, flooding will become more frequent. A rise of ten centimeters in twenty years may not seem much, but it will leave the existing road permanently flooded in some places. Without raising the present level of the road surface the frequency of flooding of the road to the airport cannot but increase. The same argument applies to man-made structures on the harbour side of Palisadoes. Here structures, such as the airport runway and approach road will eventually be submerged unless they are raised. The main runway is high enough that it will not be affected in the near future, except by storm surge, but the approach road is lower and is already subject to flooding. Of course, the remedy is to raise these structures. The engineering solutions are available and, presumably, will be implemented as and when necessary.

Therefore we can say, with some confidence, that the access road to the Norman Manley airport, as well as the airport itself, will not be in any danger of permanent isolation provided the necessary mitigation steps are taken. However, there is always the possibility of severe hurricanes temporarily flooding the highway due to storm surge. While storm waves and storm surge may cut the access road to the airport they create only a temporary situation, and the remedial measures of clearance and road repair will be a whole lot cheaper than building a bridge across the harbour. A backup airport however is important if NM becomes isolated. It may also be crucial, if for example, there were to be severe, island-wide damage, and emergency medical supplies are needed urgently by air-lift.

Turning back to the future development of Palisadoes, if supplies are maintained, sand and gravel will continue to migrate westwards (P7). Eventually there may be enough continuous supply that the end of the spit at Port Royal will become extended beyond the town to the point where sand supplies will encroach on Gun Cay, perhaps joining it to the Palisadoes. However this will almost certainly not happen in our lifetimes. Westward extension across the mouth of the harbour to Fort Augusta and Portmore is unlikely to happen because of the strong outward flow of water from the Rio Cobre.



P7. A model of what the Palisadoes may look like in the future.

The Marine Geology Unit welcomes commentary on our articles. Please e-mail us at mgu@uwimona.edu.jm. You are also welcome to view our website at: <http://www.mona.uwi.edu/geoggeol/MGU/>.