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Seascape corridors : modeling routes to connect communities across the Caribbean Sea

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Voyaging Over Longer Distances

Connecting the South American Mainland with the Windward Islands

Based on the ceramic evidence of vessel shapes and decorative motifs, scholars have established the existence of connections between Kaliña Koriabo communities from the mainland in Guyana, Suriname, and French Guiana and the Kalinago peoples with their Cayo ceramic complex in the islands of the southern Lesser Antilles between ca. AD 1250 – 1600 (see Allaire 1980; Boomert 1986, 2004; 2009; 2016; Bright 2011; Hofman and Hoogland 2012; Hofman *et al.* 2008b; Jacobson forthcoming; Keegan and Hofman 2017). Within the island group, there is also evidence of exchanged materials originating from the South American mainland such as pendants made from the teeth of tapir and peccary, and flutes made of deer bones (Hofman 2016; Hofman *et al.* forthcoming). The non-local provenance of these faunal tooth pendants is established by their isotopic signature and the fact that these animals did not live on the islands (Laffoon *et al.* 2016). The strong parallels in ceramic typology, alongside the presence of these exported pendants and flutes, attest to a recurrent exchange of trade objects between the mainland and the islands and suggest continued contact between the Windward Islands and the Guianas after Europeans entered the wider region. However, the specific mechanizations behind these ties are not entirely clear, as there are no solid arguments for directly linking mainland (Kaliña) settlement to island (Kalinago) settlement in the archaeological record.

By seeking to determine the cost of moving peoples and materials between these areas, least-cost pathway modeling provides an additional layer of analysis to existing information gathered through the archaeological analysis of ceramic styles (Bright 2011; Boomert 1989; Hofman and Hoogland 2012) or linguistic analysis comparing language used by South American and Windward Island peoples (Boomert 2008; Hoff 1994; Hofman 1993). The cost of movement, while not prohibitive in many cases, influenced whether and when Amerindian peoples would have moved between places (Callaghan 2001; Cooper 2010). The trajectories of these routes can indicate the location of stopover points and the outlines of the physical process of moving through the region. The models can be used to evaluate reciprocated movement and offer a valuable new way to explore the process behind human mobility patterns and the introduction of materials and ideas to island communities.

In this third case study, I applied least-cost pathways analysis onto the existing archaeological and environmental dataset and modeled canoe pathways between the Guianas and the Lesser Antilles to determine if route cost and route layout influenced the shape of mobility and exchange networks. The nodes or points of connection were selected for their shared pottery tradition. Knowledge of the full effort required for canoe voyages in the past underlines the importance of material and social links connecting Kaliña and Kalinago peoples. Generating least-cost routes across this geographic layout allows an evaluation of the model's effectiveness over larger distances. Unlike routes run in the Leeward Islands, or between that group and the Greater Antilles, there are fewer islands between the Guianas and the Windward Islands that could act as stopover points during voyages, which would have increased the level of danger and uncertainty for any crews that may have attempted these routes.

This is the first attempt to use computer modeling to study reciprocal movement from the Guianas to the Lesser Antilles. These least-cost pathways explore where interconnection between the mainland and the Windward Islands may have occurred. Determining the ability of canoers to make direct contact from the mainland to the islands without stopping at in-between islands such as Trinidad or Tobago or sections of mainland coast can influence our understanding of these networks. Hypothetical canoe travel corridors can shed light onto how people entered the islands, which is currently obscured. Plausible entrance and egress points may indicate who may have wanted to be in this network and where these pathways could have taken them when traveling back and forth from the mainland to the islands.

This lack of stopover potential and seasonal variation in routes suggest time costs may have been a greater factor in this region. The distance from Guyana to the Windward Islands (roughly 700 km) allows for a stronger variance in seasonal route times than observed in the other two case studies. The longer voyages have time costs of several days rather than hours. Because the currents moving between Tobago and Grenada fluctuate more than those in the northern half of the Caribbean Sea, route costs across this distance can better assess how seasons influence canoeing networks in the region when compared to the routes modeled for previous chapters.

In addition to these connections between the Guianas and the Lesser Antilles, there is also archaeological evidence that suggests connections between the Guianas and the coast of Venezuela, Tobago or Trinidad, and Grenada or St. Vincent (Boomert 2016; Hofman *et al.* 2008b). Modeling routes that pass Trinidad and Tobago could determine if the locations of assemblages on these islands were related to the layout of canoe pathways or social preferences. It is possible that some crews avoided parts of this region, in particular the coast of Trinidad, to avoid contact with Spanish forces or antagonistic Amerindian communities. These social factors are not present in the model, indicating the importance of including links with historic and archaeological sources. These factors present a way to evaluate the feasibility and functionality of this isochrone least-cost pathway model by allowing the hypothetical routes to be measured against possible social preferences to avoid certain areas.

This analysis relies on the understanding that seafaring communities would have built up extensive mental navigation maps over generations to allow the modeled routes to represent reality (*sensu* Terrell and Welsh 1998: 59; Terrell *et al.* 1997). The continual movement of peoples north and south in this region would have led to shared commu-

nity navigation maps (Basso 1996; Schlanger 1992; Tilley 1994). The 170-year span of this case study increases the likelihood that mental maps existed for movement between sites, due to the possibility of tighter links between the generations of navigators (*sensu* McNiven 2008; Terrell *et al.* 1997). Routes linking nodes, represented here as optimal least-cost pathways, can indicate where generations of canoers learned to travel to take advantage of current movement. Voyaging across such a large distance would have required knowledge of these currents, as movable environmental features and celestial bodies were the only visible navigation markers. Thus, the water's surface must have acted as a guide for these Amerindians. This case study allows for a better understanding of how that guidance would function over longer routes where visibility of coastlines was limited.

It is difficult to say which sites or areas played a role in disseminating the Koriabo style into the Lesser Antilles through archaeological evidence alone. Route modeling can bolster these conversations. Here, I have explored how difficult it would have been to travel between Guyana and the Windward Islands. As least-cost routes can indicate where travel corridors between the mainland and the Lesser Antilles might have been located, these first attempts can indicate broader situations that might have been faced by canoers.



Figure 87: Map of the case study region, including Guyana, Suriname, and the Windward Islands.

Not all routes generated by the model were able to complete, perhaps due to the difficulty with the reach of underlying environmental data, the completeness of data for cells near the extremity of the NOAA AmSeas3D data set, and the high route costs and tendency to loop for routes traveling long distances against stronger currents than found in the previous case studies. In addition, routes that exceeded seven days were discounted post-modeling due to the extensive time cost, and associated physical cost, that would have been placed on the canoers following these optimal routes. This has led to the inability of a full seasonal comparison between all points on the Windward Islands and Guyana points.

7.1 Kaliña and Kalinago

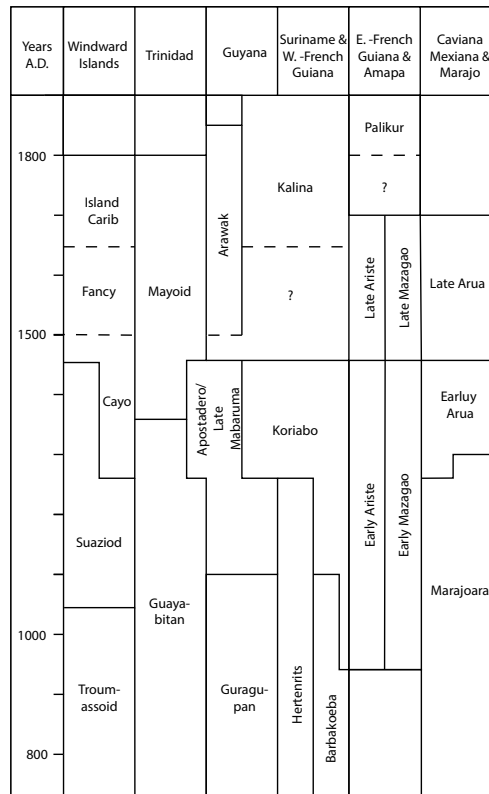
This case study evaluates reciprocal movement between the South American mainland and the islands of Grenada and St. Vincent during the period just before and after European arrival in the region, with radiocarbon dates between AD 1430 and 1600 from the site of Argyle on St. Vincent and La Poterie on Grenada (Hofman *et al.* forthcoming). Other researchers (Boomert 1986) have suggested that the exchange of Koriabo stylistic elements may have begun as early as AD 1250, corresponding with the advent of the mainland ceramic style. Origin points for this chapter will be based on sites occupied after AD 1400 with evidence of Cayo ceramics. It is possible that pathways shown here were used in earlier periods as well, expanding the possible temporal applicability of this research.

Sites selected for analysis come from the Guyana coast, Grenada, and St. Vincent. These have enough material links to justify modeling canoe routes connecting the Kaliña and the Kalinago communities. Evidence of this movement can be tracked through multiple avenues: archaeology, linguistics, and the historic record. This case study also draws on ethnohistorical accounts to tie the spread of language to island and mainland connections, particularly in the split of Mainland and Island Carib as defined by Allaire (2013) and Boomert (1995, 2002). Finally, historic accounts also add information on how Amerindians canoed through the region and suggest the location of stopover areas.

7.1.1 Ceramic Styles

Archaeological assemblages from the Windward Islands show several macro-regional influences that pre- and postdate the case study period. Those on the Windward Islands likely enjoyed access to the wider circum-Caribbean regional exchange that took off during the Late Ceramic Age/early colonial period (see Allaire 1990; Boomert 2000, 2016; Hofman and Hoogland 2011; Hofman *et al.* 2007, 2011; Keegan and Hofman 2017). Sites within Grenada and St. Vincent draw from stylistic motifs from both the north and the south. Materials from the southern Lesser Antilles indicate several possible population demographics and interaction spheres on the same island or group of islands (Allaire 1990; Hofman and Hoogland 2011; Keegan and Hofman 2017). Ceramic stylistic evidence from both the Greater Antilles and the South American mainland can be seen in these assemblages (see Boomert 1995; Davis *et al.* 1990; Hofman 2013; Hofman and Hoogland 2012; Hofman *et al.* 2015). A large portion of the archaeological evidence used to evaluate these connections lies in the comparison of different Koriabo and Cayo

Figure 88: Chronological chart showing the cultural sequences in the Windward Islands and the Guianas (modified from Boomert 1986: Figure 15). These Cultural sequences can be linked to the ceramic styles from this region before and after the dates of this case study.



ceramic assemblages from the Windward Islands and mainland South America. Both culturally and in their stylistic motifs, the so-called Island Carib are regarded as a cultural entity separate but connected to mainland populations (Davis *et al.* 1990).

Ceramic evidence supports the existence of these relationships. Even before the period discussed here, ceramics were being moved between the islands and the mainland (Boomert 1986; Table 16). The movement of mainland influences north can be partially traced through ceramic stylistic elements. According to Bright (2011: 144), the evaluation of different ceramic series found in the southern Lesser Antilles during the Late Ceramic Age/early colonial period relies on the comparison of ten traits: “Caliviny Polychrome, lugs, legs, legged griddles, support rings, anthropomorphic adornos, loom weights, finger-indented rims, scratching and statue(tte)s”. These elements help to identify one ceramic group from another (Bright 2011:144). Sites on Grenada and St. Vincent often include ceramic objects with elements from multiple groups (Boomert 1995; Bright 2011; Hofman *et al.* forthcoming).

7.1.1.1 Troumassoid Ceramics

The archaeological materials suggest that routes between these areas existed in earlier periods (Boomert 2016; Bright 2011). Materials from the Saladoid period (300 BC – AD 650/800) indicate that peoples had already developed travel corridors around the region (Boomert 2016: 16). The Troumassoid style of adornos is linked to rim decorations of the earlier Saladoid ceramic series. The anthropomorphic motifs

on these adornos share stylistic affiliations with the Valencoid series from the South American coast, where the component is placed on the upper portion of the vessel (Antczak and Antczak 2006). Some examples of Suazoid (AD 1000 – 1500) ceramics found in the southern Lesser Antilles have rim incision (Bright 2011), a trend also seen in Koriabo ceramics from the mainland. Rim indentations are found in assemblages throughout Late Ceramic Age/early colonial period sites, including Guadeloupe and Tobago (Boomert 1995; Bright 2011; Petersen *et al.* 2004). Other Suazoid traits include “thick coarse and soft pottery, with scratched or scraped surfaces, inward thickened rims, legged, pedestals or annular bases, legged griddles and triangular rims” (Hofman *et al.* 2008b; Petersen *et al.* 2004:28). Many of these aspects relate to choices made by the potter, rather than technological limitations, including rim indentations that were made using the potter’s finger (Bright 2011). Possibly as a result, specific techniques and implementations varied widely throughout the islands.

These characteristics and other Troumassoid stylistic elements are largely known from the Grenadines and St. Lucia, and, though present, are less common on St. Vincent (Bright 2011). The scarcity of these traits on St. Vincent is puzzling, because there is petrographic evidence that ceramics were exported from this island into Grenada (Bright 2011; Degryse personal communication 2017; Hofman *et al.* 2008b). This could indicate that route layouts between the South American mainland and individual Windward Islands differed enough for communities to possess their own travel corridors. These separate corridors could have allowed for exchange and the spread of ideas between these three locations to follow different patterns.

7.1.1.2 Cayo Complex

Allaire (1980, 1984) and Boomert (1986, 1995) have both argued that Island Carib, or Kalinago, peoples did not only produce wares assigned to the Suazoid ceramic series. Instead, they have suggested that these people were more likely to be associated with the Cayo complex of St. Vincent. Kirby (1974) was the first to classify this ceramic complex when excavating on the northeastern coast of St. Vincent at the site of New Sandy Bay. Boomert (1986) later studied the assemblage excavated by Kirby and confirmed a relationship to the Koriabo ceramics of the Guianas. He hypothesized that the genesis of the Cayo complex occurred after the beginning of the Suazoid series, around AD 1250 (Boomert 1986, 1995).

Cayo ceramic pieces are typically part of assemblages that contain multiple ceramic styles (Boomert 1986). For example, Cayo material can be found in assemblages that contain ceramics of the Suazoid series (Bright 2011; Bullen and Bullen 1972). The Cayo complex is indicative of converging stylistic influences as it bears elements from the mainland but also from the Greater Antilles (Chicoid and Meillacoid series) (Hofman and Hoogland 2012). Cayo ceramics often denote relationships to the Koriabo style from mainland South America (Boomert 1986, 2004; Bright 2011; Hofman 2013; Hofman *et al.* 2015; Keegan and Hofman 2017; Rostain 2009). This trend reflects the broad cultural milieu of peoples who were traveling through the area (Hofman 2013; Hofman and Hoogland 2012; Keegan and Hofman 2017).

Examples of Cayo ceramics are likely the result of local level production within macro-regional interaction networks (Bright 2011; Hofman 2013). Results from recent XRF studies suggest that it was the communities with potters that moved from

the mainland to the islands and not only the ceramic vessels, as the clays used to make these objects all have local island provenances (Scott *et al.* in press).

Boomert (1986) has defined several decorative techniques that distinguish Cayo pottery. These decorative elements include “painted or slipped designs, incised and grooved motifs, punctuation, lobed rims and outward bossed wall sections” (Boomert 1986: 7). Examples of these decorative elements include leaving dark smudges on the exterior of the items, or Cayo ceramics being “tempered with caraipé, *i.e.* the ash of the siliceous bark of a small tree, *Licania apetala*” to color the vessel (Boomert 1995: 7). These trends have been observed on vessels found in St. Vincent. As the *Licania apetala* species only grows on the mainland, the use of this temper affirms the mainland-island Cayo connection (Boomert 1995).

The inspiration behind Cayo designs was probably the continued exchange between the Guianas and the Windward Islands that allowed for the sharing of ideas and aesthetic preferences (Davis *et al.* 1990). The Koriabo style is contemporaneous with the rise of Cayo ceramics in the Windward Islands (Evans and Meggers 1960). In fact, Cayo pottery has been considered a simplified version of the Koriabo ceramic style (Boomert 1986). The Koriabo style is commonly found in coastal areas or along large riverbanks, from the banks of the Maroni River on the border of Suriname and French Guiana, and the interior of the Guianas to Brazilian Amazonia (Groene 1976; van den Bel 2015).

Aspects of Cayo ware were likely inspired by mainland Kalíña peoples leading raids against those in the southern Lesser Antilles and exchanging marriage partners between the islands and the mainland, or simply by individuals coming to live on the islands (Boomert 1995; Davis 1990; Morsink 2013). The adaptations in style observed in some Cayo ceramics suggests that the displacement of refugees from Taíno expansion in the Greater Antilles also influenced the genesis of Cayo ware (Bright 2011; Farr 1995; Hofman 2013). Kalíña communities that may have interacted with the settlements of the relocated Taíno incorporated some stylistic trends from the Greater Antilles (Allaire 1987; Bright 2011; Hofman *et. al.* 2008), adding to the cross-cultural nature of the Cayo complex. These cross-cultural connections led to the blending of styles that can identify sites as Cayo.

To this date there are around 20 sites known to possess Cayo material within the Lesser Antilles, with the majority of these located on St. Vincent and Grenada (Hofman and Hoogland 2012). For this reason, sites on these two islands were used as the base for the modeled routes. Analysis of pathways to these points from the mainland will explore routes between mainland and island communities to discern any variation in and difficulty of contact between Kalíña and Kalinago groups.

7.1.2 Language

Another bridge between communities in this region is the historic and ethnographic record of the languages of the Kalíña and Kalinago peoples. The use of language among these groups has generally been categorized as a split between Mainland and Island Carib as well as between genders (Hoff 1995). Men predominately used the Island Carib language, which has an Arawakan base lexicon with Kalíña loan words (Hoff 1994; Hofman 1993; Boomert 2008). The women used a pure mainland Arawakan lexicon (Boomert 2008). It is possible that this split in male and female language use was related to the Kalinago origin myth that modern day Island Carib communities are descendants of male Kalíña warriors who immigrated into the Windward Islands

from the area around the Guianas, specifically Suriname and French Guiana (Boomert 1986, 2008; Breton 1665; de Rochefort 1665).

There are enough similarities between the languages to suggest direct interaction and communication between mainland and island peoples. Taylor and Hoff (1980) have suggested that the Island Carib men's language grew out of a form of pidgin Mainland Carib dialect, specifically the Kaliña pidgin used for trade in the Guianas coastal zone (Boomert 1986; de Gomberville 1682). It is possible this subset of the language grew from a need to understand either Kaliña or Island Carib trading partners, if it did not evolve from a Kaliña invasion into the islands (Davis *et al.* 1990). Like the use of the pidgin language itself, specific words reaffirm the importance of exchange in these communities. In the Island Carib dialect, the word for 'friend' can also mean 'him with whom is being negotiated' (Boomert 2002: 89; Breton 1978: 55; Roth 1924). Mobility can even be represented in the language itself. The relationship between settlement and canoe use is indicated through the term *hueitinocou*, which means both villager and member of a canoe crew (Hofman and Hoogland 2012). The position of men as the main speakers of this language (Allaire 1980) could relate to the prestige of speaking languages during interactions with members of the other community (Taylor and Hoff 1980).

Differences in language between Kaliña and Kalinago peoples also related to the use of specific words associated with their ceramics. Some have postulated that the association of men and pottery means the production of ceramics was a male field, as in mainland communities (Allaire 1980; Boomert 1995). Boomert (2008) mentions that ceramic vessels linked with male-controlled activities or environments typically held names in the Caribbean linguistic affiliation, such as *chamacous* or "well-finished, more or less ceremonial ceramics" related to the preparation and consumption of cassava beer for communal meals or feasts (Boomert 1986, 1995, 2008; Breton 1665: 94). This contrasted with activities or environments associated with the female sphere that held names in Maipuran Arawakan or European languages (Boomert 2008). Female-related vessels were often linked with earthenware used for domestic purposes, such as griddles (Boomert 2008).

These language trends, both on a direct and added-meaning level, align with the ceramic assemblages recovered from both the mainland and the Windward Islands (see Allaire 1977, 1984; Boomert 2008; Hofman 2013; Hofman and Hoogland 2012; Keegan and Hofman 2017; Kirby 1974). Allaire (1977, 1984) suggested that similarities in names for ceramic objects could indicate that the styles of these vessels were identical. This is unlikely, as archaeological evidence suggests difference in stylistic elements between island and mainland vessels (Boomert 1986). While there are several vessel types with similar names in the Guianas and the Windward Islands, for example the cassava-beer brewing vessel called *chamacou* (Kalinago) or *samaku* (Kaliña), there are many words that exist in the Guianas that were not recorded in the Windward Islands (Boomert 1986). Additionally, ceramics may have been referred to in terms of their function and not their stylistic characteristics (Boomert 1986). Although vessel types were not the same, a similarity in language for ceramic style and use indicates that there was communication about these objects across Kaliña and Kalinago communities.

These lines of evidence confirm that a similarity between these language groups, particularly in the sixteenth and seventeenth centuries, justifies generating least-cost canoe routes based on the existence of language exchange. As the exchange of language

was linked to the moving of peoples and broader interaction networks, modeling the physical layout of canoe routes can speak for how this similarity in language between Kaliña and Kalinago peoples was transmitted.

7.1.3 Ethnohistoric Accounts

The Island Carib were also documented by French ethnographers Charles de Rochefort (1665), Raymond Breton (1665-1666), and Baptiste du Tertre (1667-71) (see also Whitehead 1995; Petersen *et al.* 2004). Historic accounts also leave room for the Island Carib to describe their own social network. Raymond Breton, while on his stay in Dominica (1635), recorded that:

“They are descended from the people of the mainland closest to the island... The friendship they maintain with them and their commerce with them are signs of it. [Breton and la Paix 1926: 45-46]” (Davis and Goodwin 1990: 39).

Breton later adds to this description by recounting that the South American Kaliña had branched out from their coasts to colonize the islands (Breton 1665; Davis 1990). He states that the Carib peoples were a result of this migration and the incorporation of other island-based communities (Breton 1665; Davis 1990). In contrast, de Rochefort (1658) intimates that Island Carib peoples on St. Vincent were merely associates of the Kaliña (Davis 1990). These records suggest that both groups were linked, culturally and/or genetically. Breton and Rochefort’s acknowledgment of this interaction supplements the archaeological and linguistic evidence linking the two groups.

Ethnohistoric accounts also point towards the connection between Trinidad, Tobago, mainland South America, and the Windward Islands. As mentioned above, early myths of Island Carib origins mention groups from the Guianas traveling north to the Windward Islands. Ethnohistoric accounts of this myth also mention movement through Tobago (*e.g.*, Boomert 2002; Borde 1886; Menkman 1939; Rochefort 1665b: 384). Tobago would have been a primary stopping point for communities looking to engage in all forms of interaction due to its location between the mainland and the islands (see Boomert 2002; Young 1795: 5). Historical accounts mention Kalinago crews using the island to rest and resupply on their way to raid Arawak communities on the mainland (*e.g.*, Boomert 2002; Brett 1868: 485; Halliday 1837: 238; Reeves 1749: 24; Rochefort 1665a: 67).

There was likely a high level of traffic along the corridor between the Guianas and the Windward Islands. In the late 1620’s, the governor of St. Kitts thought it was too dangerous to settle Tobago due to the large number of Carib vessels passing the island (Anderson 1956; Boomert 2002; Williamson 1923). The Dutch governor of Tobago also noted the frequent passage of Carib crews past the island in 1654 (Boomert 2002). He noted that many Amerindians from St. Vincent stopped on Tobago before moving to the mainland and vice versa (Boomert 2002; Mattiesen 1940). Some accounts suggest that Island Caribs would have made the journey from the Lesser Antilles to the Guianas on an annual basis (Boomert 2002; Laet 1931). Travel past Tobago could have been organized on a seasonal basis as a result. Crews leaving from the mainland during one time of year could have returned months later when the currents were more favorable for traveling in the opposite direction.

The practice of stopping at Tobago was probably adhered to for generations before contact with Europeans. This practice is demonstrated by Saladoid and Troumassoid ceramic evidence on the island that links communities to the neighboring islands and the mainland (Boomert 2016), signifying Tobago's possible inclusion in any regional mental map of navigators. Stopovers on Tobago continued well after the Spanish moved into the area (Boomert 2002; Mattiesen 1940). Some beaches on Tobago are even named for their role as landing points, for example Canoe Bay (Boomert 2002, 2010), which is first mentioned on a seventeenth century Dutch map of Tobago where it is called Kano Baeij (Anonymous 1677; Boomert 2000, 2002; Keulen 1688). The bay served as a landing point for canoes and Spanish vessels in the early historic period (Boomert 2002), and probably did so in earlier periods as well. Place names like Canoe Bay show the continued role of these beaches within inter-island canoe networks.

Connections between communities on Trinidad and in the Lesser Antilles likely became more antagonistic after the arrival of the Spanish in the region (Boomert 2008). Though Spanish influence was relegated to the west portion of the island, the Spanish arrival incentivized Amerindian peoples to settle in different areas. The Arawak peoples from the north mainland who began to exchange with the Spanish pushed Carib or Kalinago peoples living on Trinidad and Tobago into the Windward Islands to avoid meeting hostile forces (Boomert 2008). For example, some of the Amerindian groups that at first allied with the Spanish became powerful through this alliance and came to Trinidad to usurp local populations "that were natural of the place" (Boomert 2002; Raleigh 1848: 8). Spanish influence can also explain the split in connections outward from Trinidad and Tobago. Some Amerindian peoples from Trinidad allied with the Spanish in the sixteenth century (Boomert 2008). This alliance lasted for more than fifty years (Boomert 2008) and would have increased connection between communities on the mainland and the east coast of Trinidad. Conversely, to avoid members of that alliance, peoples from Tobago became more connected to communities on the Windward Islands and in the Guianas (Boomert 2002, 2009, 2010).

7.1.4 Mainland and island locations

Based on these lines of evidence, the current case study will focus on modeling routes between a small number of sites on St. Vincent, Grenada and points off the coast of Guyana. Despite being outside the geographic scope of this case study, it is possible that peoples from the northeastern coast of the mainland, or around the Guianas, were familiar with communities on these islands and mainland areas further to the west. These include Isla de Margarita, the Los Roques archipelago, and the trinity of Aruba, Bonaire, and Curaçao. Routes linking these other islands and the mainland have been evaluated in other works (Hofman *et al.* 2017; Slayton *et al.* 2015). Tested previously (Slayton 2013), modeling routes between the Windward Islands and the northern Lesser Antilles based on the archaeological record of interaction (see Bright 2011; Hofman and Hoogland 2012; Hofman 2013; Knippenberg 2007) will also need to be explored in future works.

7.1.4.1 Mainland South America

For many ceramic series found on the islands there is currently no way to determine where the styles originated. Direct one-to-one links cannot be made between settlements on the South American mainland and island settlements' ceramic series (Bright

2011). As the material styles are dispersed through many island sites, it is not clear what material, ideas, or even peoples traveled directly or by way of another community. Modeling canoe routes between potentially connected locations can begin to determine what types of links existed. Origin and termination points for the model are based on the identification of specific sites that share archaeological, linguistic, and ethnographic elements. Points selected for this region stand as through areas for canoe travel along the Guianas coastal stretch and on towards the islands (see Figure 89).

The proximity of Trinidad and Tobago to the mainland places them in the region of this case study. These islands allow for juxtaposition of route placement for voyages heading north into the Windward Islands from Galleons Passage, the channel between Trinidad and Tobago, and the Atlantic. It is possible that Tobago played a mediating role as a stopover area for rest and resupply between Trinidad, the Windward Islands, and the mainland, as evidenced by techniques observed in ceramics from Tobago and to a large extent in the southern Lesser Antilles (Boomert 2002, 2016). Trinidad and/or the nearby mainland coastline may have acted as a break area before heading toward the islands to the north. Boomert (2016) suggests that during the shift from the Saladoid to Troumassoid period island communities on Trinidad played a role in disseminating the simplification of ceramic designs found within the islands of the southern Lesser Antilles. Trinidad may also have acted as a diffusion or dissemination point for stylistic elements from the mainland. Routes passing these islands can be weighed against pathways traveling directly from the Guianas. Focusing on direct and indirect travel can allow for a reevaluation of relationships between mainland and island peoples in this region. Although it is not possible to determine if these were actual connections, it is possible to model canoe routes and suggest what role these islands played within the regional exchange network.

7.1.4.2 St. Vincent and Grenada

The Windward Islands themselves contain a microcosm of interaction. As gateway points for Koriabo materials into the Lesser Antilles, Grenada and St. Vincent are a key area for study. Previous work using a different model has shown that routes between St. Vincent and islands to the north are crucial to movement past Barbados (Slayton 2013). Focusing on direct connections between the Guianas and the Windward Islands will allow for an evaluation of the relationship between communities that traded Koriabo and Cayo ceramic styles. It is possible that connections with the South American mainland were run largely through one island. This could have led to the islands having an unequal position within the network. Routes from off the Guyana coast to both islands suggest this could be a possibility.

Grenada and St. Vincent possess sites whose assemblages suggest that each could have acted as a hub for inter-island connectivity. The presence of these sites suggests there was canoe activity through the islands during this period. St. Vincent has 12 recorded Late Ceramic Age/early colonial period sites, which is the largest quantity of Cayo ceramics on all the Windward Islands (Bright 2011: 84). Cayo sites on St. Vincent include Mount Pleasant/Rawcou, New Sandy Bay, Owia 2, Spring Friendly, Fancy, Camden Park, Lot 14, Argyle 1, Sans Souci, Grand Sable, and Brighton (Bright 2011; Hofman and Hoogland 2012). These sites are all candidates for termination points of the modeled routes. The sites of Argyle and Brighton have been selected to represent landing points within the mobility network.

Argyle lies on the southeastern coast of the island and is an Island Carib, or Kalinago, site. The site (AD 1540 – 1620) possessed artifacts with possible origins in, or at least affiliations with, the Guianas and to a lesser extent with the Greater Antilles (Hofman and Hoogland 2012, 2016; Hofman *et al.* 2014, 2015; Keegan and Hofman 2017). All of the ceramic evidence belongs to the Cayo complex. This supports the multi-ceramic aspect of these Cayo sites mentioned by Boomert (2008). Materials from Brighton on the southeastern coast of the island are very comparable to those of Argyle, and thus suggest that the site was integrated in the interaction network (Boomert *et al.* 2015; Bright 2011).

Grenada has five recorded Cayo sites, including Sauteurs Bay (Bright 2011: 140, Figure 5.44), Galby Bay (Holdren 1998), La Poterie, Artist Pointe, and Telescope Point (Hofman 2016; Hofman *et al.* forthcoming). All of these sites have been selected to represent landing points within the mobility network. These sites provide an interesting contrast with sites located in St. Vincent, as they are closer to Trinidad and Tobago.

Unlike the earlier case studies, it may be that geographical distance played less of a role in deciding which sites should be visited within this exchange sphere. The long distances between sites may have encouraged canoers to travel over shorter distances, which can be seen in the model as routes passing closely by coastlines, thus facilitating stopovers. The knowledge of stopovers or friendly sites (*sensu* Terrell and Welsch 1998; Terrell *et al.* 1997) may have aided crews in resting during a journey.

These lines of evidence all point to a sustained and systematic connection between the Amerindian peoples from the Windward Islands and those of the Guianas. Though not all sites cover the entire period, they do relate sections of coastlines with occupation and canoeports. These sites stand as nodes within the seafaring network and as possible locations of cultural activity within the generational and individual navigation associations of Amerindian canoers (*e.g.*, Terrell and Welsch 1998: 59; Terrell *et al.* 1997). While individuals at these sites reacted to the influx of materials differently, being a part of this network was a central aspect of life on these islands. These implications of interconnect-edness will be explored and evaluated through modeling connections below.

7.2 Route Modeling

To add a new line of evidence to the existing archaeological, linguistic and ethnohistorical data, I applied the least-cost route isochrone tool to map both direct and indirect pathways between the Guianas and the Lesser Antilles. Modeled pathways could help to identify the possible cost of traveling north. The cost and layout of routes could then point to the interplay of inter-island networks. Possible stopover points could indicate the location of a social cost to interaction, either negative, like antagonistic relationships between local and foreign communities (Boomert 2002; Keegan and Hofman 2017), or positive, like places to rest. An evaluation of both direct and indirect routes can identify which travel corridors influenced indirect connections.

The distance that canoers would have been required to paddle to match the length of routes modeled from origin to termination points sets this case study apart. For example, canoers would have had to paddle roughly 700 km to cross to Grenada from the north coast of Guyana, the farthest point possible using the AmSeas3D data. This is 460 km more than what is required to cross between the Leeward Islands and Puerto Rico. Traveling directly from the Suriname and French Guiana border to Grenada would result in crews

paddling over 1,000 km. If crews had favorable currents and paddled at a speed of three knots, it could take around 181 hours, or seven and one-half days, to make this voyage.

This does not mean that direct voyages were not possible. Direct crossings could account for the similarity in archaeological deposits from the Guianas and the southern Lesser Antilles (Bright 2011). Richard Callaghan (2001) used a different model to establish that connections between the north coast of South America and the Greater Antilles could realistically take five days. The distance between the coast of Venezuela and the Dominican Republic, or roughly 950 km, is almost equal to the distance between the Maroni River mouth and Grenada. Even though currents in these regions are different, the similarity in distance indicate that Amerindian crews could cover comparable distances successfully. However, taking longer voyages may not have been preferred due to the distance between communities, the physical strain on the body, and the capacity of a canoe to carry supplies.

This work relies on the use of modern current and wind data to interpolate surfaces on which least-cost routes are modeled. The lack of environmental data from NOAA for the area around the mouth of the Maroni River, at the border between Suriname and French Guiana, limited the process of modeling between the mainland Koriabo settlements and the Lesser Antilles. The eastern extent of AmSeas3D data falls at 57.00 degrees latitude. This posed a challenge for modeling canoe routes directly from this point, as the latitude of the mouth of the Maroni River is 53.9391477. It is possible that routes would have followed the coastline of Suriname before heading out into the open sea if crews followed the trajectory of modern real-world sailing preferences and the previous examples of route layouts. Based on that and modern sources, navigators could very likely have chosen to travel close to the coastlines in order to take advantage of subsistence resources and the safety associated in being near landing points. It is worth running the route model using the farthest extent possible to replicate the legs of a voyage between the area around Suriname and the coastline of South America, thus further reducing the limitations posed by the lack of NOAA data for this area.

As an additional complicating factor, the data from the AmSeas3D project in this area was at times incomplete, as it was not collected for all months of all years. The lack of data sometimes limited the number of possible locations to place nodes. For example, data was not available from NOAA for the months of January to March between 2014 and 2015 for Guyana Point A (see Appendix D). However, the absence of specific information at one point does not prohibit the use of the route tool, as the entirety of the pathway relies on the interpolation of data over many points to create a route.

Accounting for all the above-mentioned factors, I approached modeling routes between Guyana, Grenada, and St. Vincent from different locations. As I wanted to evaluate movement from as far south as possible, I chose to model from the geographic extent of the environmental data rather than any of several Koriabo sites that could have acted as origin points. Instead I ran routes from three separate origin points, one further away from the coastline (Guyana Point A) and two closer to the coast (Guyana Point B and Guyana Point C) (see Figure 89). Though these points are not tied to specific sites, they represent areas along the travel corridor between the Guianas and the Windward Islands. As the environmental data did not allow for direct sampling from the Maroni River mouth, these points stand in as possible points in likely travel corridors. Guyana Points A, B, and C act as if there was a continuous journey from the

Maroni River mouth. These points are therefore suggestions based on the available data of possible origin points at the furthest extent of the underlying environmental data.

Choosing origin points near and away from the coast allows the modeled routes to represent possible different options open to Amerindian mariners. Guyana Point A's position off the coastline stands in for canoe routes that were placed away from land. Points B and C are meant to represent routes for canoers who chose to stay close to the coastline. Guyana Point B is further east than Point C and is positioned below Guyana Point A, or as close to the edge of the environmental data as possible. It lies just east of the Guyana/Venezuela border. Guyana Point C is located north of the Guyana coast. These two points near the coastline allow an assessment of whether starting further west would have affected the placement of canoe routes through the Galleons Passage, or the channel between Trinidad or Tobago (see Figure 89).

Termination points on the islands were also approached in two ways. First, routes from Guyana Point A to the site of La Poterie and Argyle were modeled (see Figure 89) to evaluate the basic connection between a mid-route position from Guyana and Cayo sites on Grenada and St. Vincent. These modeled routes showed that connections were possible



Figure 89: Map of the study area with origin and termination points used for least-cost route modeling.

despite the high associated time cost. Second, Points B and C were added when generating runs from nearer the coast of Guyana to determine if there was any change in moving through Galleons Passage for sites closer to the coast of St. Vincent and Grenada. These sites include Brighton Beach and Telescope Point as well as Galby Bay. Sauteurs Bay northwest of La Poterie was added as an additional point to see if there was any difference in approach when moving towards the north of Grenada versus the south of St. Vincent. All of the island points are associated with sites where Cayo materials have been found. This will allow an evaluation of direct connections between mainland and island communities.

7.2.1 Failed Routes and Navigation Challenges

As with the canoe pathways modeled earlier, there were some routes generated that should not be considered actual optimal connections between island and mainland points. Reasons to discount these routes include the inability of routes to be completed in certain periods of the year, routes with exaggerated time costs, the presence of loops within pathways, and pathways that show extreme deviations in route trajectory from others modeled in the same period

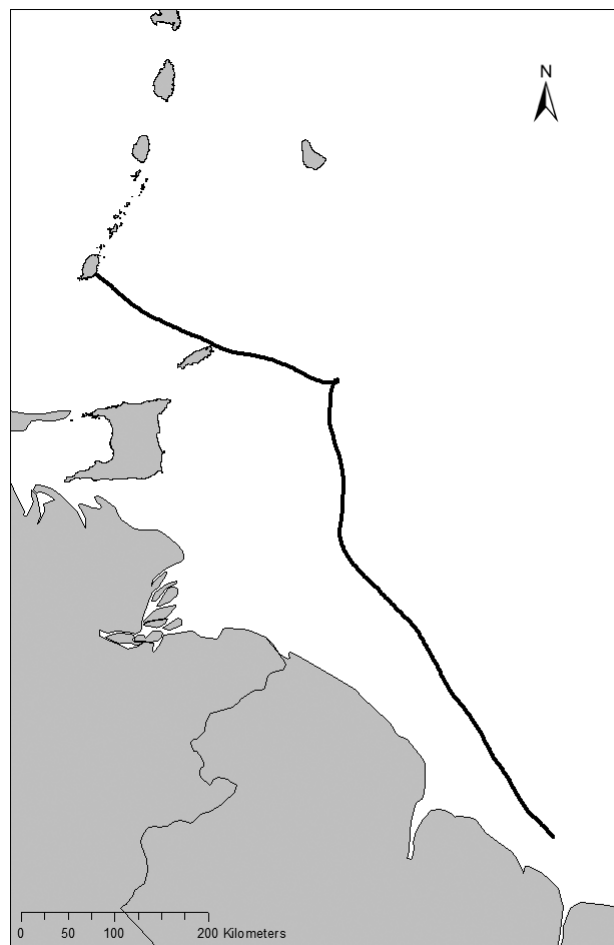


Figure 90: Modeled route from Guyana Point A to Grenada showing a loop in the Atlantic. Route launched at 3pm on the 16th of November 2013, Route: 4-1_2013-11-16T15.



Figure 91 (continued on opposite page): Modeled routes from Guyana Point A to Grenada showing loops. (A): Route launched at 9am on the 18th of November 2013. Route: 4-1_2013-11-18T09, and (B): Route launched at 3am on the 26th of April 2014, Route: 1-3_2014-04-26T03.

Routes for this case study contained fewer loops than those created for the other studies. Loops occurred most often in routes heading south towards Guyana from Grenada. Loops like these may have been related to the need for vessels to redirect rather than being caught in currents. For example, route 4-1_2013-11-16T15 shows a loop east of Tobago's longitude (see Figure 90). There is no reason for this loop to exist.

These pathways suggest routes may have continued on a straighter or curved path south rather than choosing to turn around so far from land. Route 4-1_2013-11-18T09 shows a loop in the center of the channel between Grenada and Tobago (see Figure 91 A). This loop might have been avoided by real-world crews fighting the current or picking a different time to leave. Another example of a loop route is route 1-3_2014-04-26T03 between Grenada and Guyana (see Figure 91 B). It shows a loop both to the north and south of Grenada. The disadvantages associated with loops in modeled routes may suggest that canoers perhaps planned routes over long distances based on currents at the starting point. In some cases, crews may have known that they would face adverse conditions if they did not read the currents accurately. I assumed that other modeled least-cost pathways would have been selected over these options.

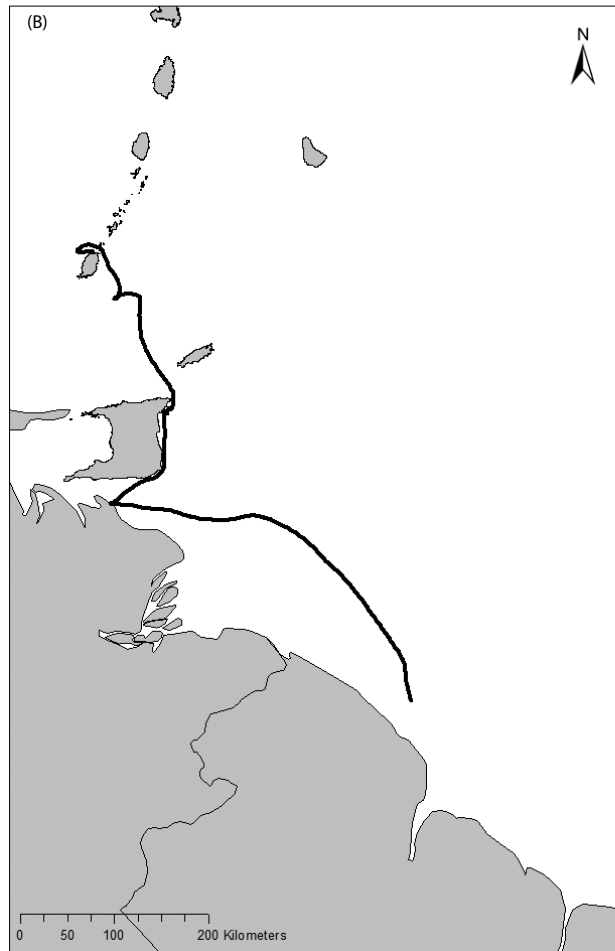


Figure 91 (continued).

Navigators would have needed to have a working knowledge of the area so that they could adjust the canoe's heading if the crew became endangered. This is especially true in this case study, where there are larger changes in the currents' position and the distances covered by the routes. Some of the modeled voyages suggest that real-world canoers following close to the least-cost route trajectories would have had to paddle for more than six days. Looking at the returns from the current tool and the route tool, these voyages were subject to change. Voyages of greater lengths may have required crews to readjust route plans at multiple points to take advantage of or work around dangerous currents. Trips over these distances would have required an experienced navigator to be a part of the crew.

There are some situations where loops may have been a technique used by seafarers. For example, route 1-3_2013-11-07T09 has a loop that shows a crew making a 90° turn and redirecting their vessel from heading west to going north toward Grenada as a direct connection route (see Appendix D). However, even in these situations it is more likely that if canoers were actually paddling somewhere close to the route trajectory suggested by this modeling, they may have chosen to make landfall either on Trinidad or Venezuela if they were caught in a current pushing them father east than intended.

Navigators would also have needed to reorient routes when they were blown off course. One example of this phenomenon was observed in a route between Guyana and the Orinoco River Mouth (route 1-8_2013-04-12T18; see Appendix D). The route runs past its target and meets the northeast coast of Trinidad. On this route, a navigator could have chosen to fight the current and move closer to the coast or chosen another time to canoe towards the Orinoco River mouth. Route 1-8_2013-11-24T21 and route 1-8_2013-11-29T00 also show the crew being ‘blown off’ course, running as far north as Trinidad but not connecting with the island (see Appendix D). These routes also removed the crew from the goal of the Orinoco region by taking them out to open sea.

Comparing routes in this case study was difficult, as no month had a 100 percent success rate for modeling pathways at all time intervals. This indicates that not all voyages leaving from the Lesser Antilles or the Guianas would have been successful. Callaghan (2001) also commented on the return rates of failed voyages in his efforts modeling colonization voyages from the mainland to the Greater Antilles, suggesting that unsuccessful canoe trips were a semi-regular occurrence in this region for routes of this length. This also indicates the increased level of difficulty found on least-cost routes crossing from the mainland to the Windward Islands over costs for crossing the Anegada Passage. The trend has also been observed in modeled routes from Venezuela to the Windward Islands (Slayton *et al.* 2016). In the future, more work should be done to model longer voyages with multiple time-steps to see if this issue can be avoided.

7.2.2 Current tool

AI first used the current tool (see Chapter 4), to evaluate currents at several points along the coast of South America as well as between the mainland and Grenada. I was able to assess which months might be appropriate to model in these areas. These points were checked for current velocity and direction to determine periods of high and low variance in current. This case study area has the largest difference between high and low current strength throughout the year of any evaluated. This is a result of the strong current that flows through the channel between Grenada and Trinidad and Tobago. Currents between the Lesser Antilles and the mainland often reach one knot, which is about twice the average for currents observed in the Anegada Passage (see Figure 92, 104, and 106). When looking at the averages in current strength across the channel between the mainland and the Windward Islands, current average falls around 0.5 knots for the entire year (see Figure 93) This speed is equivalent to current strength through the Anegada Passage.

These changes in average current velocity are better observed in the table showing the 15-day average of current velocity at Point 1 (11.167624, 61.5344424). Here, spikes in current velocity can be seen between February and March, March and April, June and July, September and October, and in November (see Figure 93). This differs from the current averages observed in the table displaying 30-day averages, where currents spike in March, April, and June (see Figure 93). These changes provide the opportunity to evaluate movement when currents spiked, as in April, when they fell, as in July, and when they remain relatively stable, as in January. These environmental factors allow for a better assessment of changing time values over seasons than the two previous case studies, as these fluctuations in current velocity are greater.

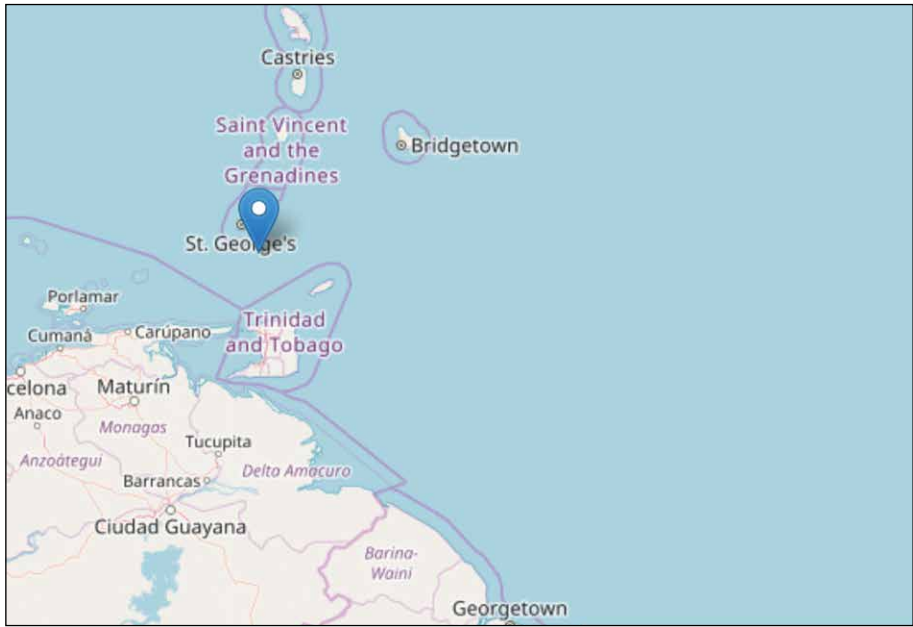


Figure 92: Map showing location of Point 1 (11.67624, -61.534424) evaluated using the current tool.

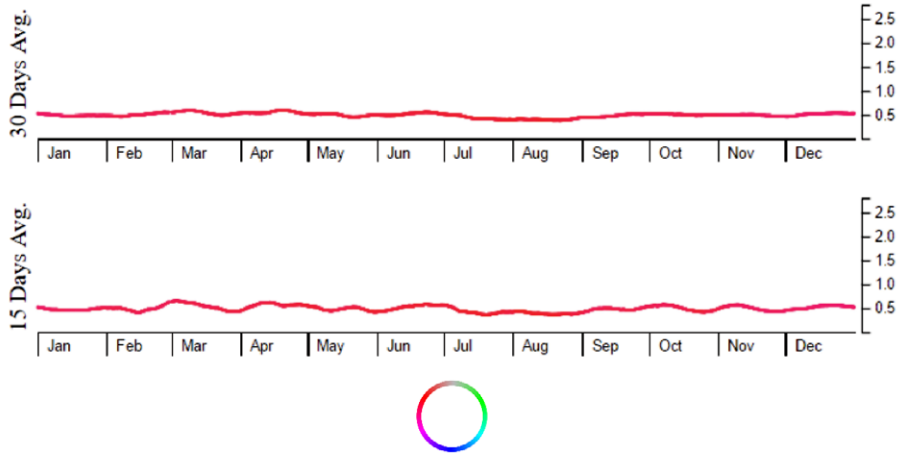


Figure 93: Graph showing the 15- and 30-day average values for direction and velocity of current at Point 1.

The fluctuations in these values also demonstrate the difference in strength and direction of current velocity over different years. While most months have similar peaks of current strength and direction, these happen at different times. For example, the current in August that generally trends to the northwest (see Figure 93; Appendix D) has also been recorded as moving to the east and the south at different times in August between 2010 and 2016.

Currents also peak at over one knot in all years tested except 2010 and 2012. However, these current peaks shift through the month. For example, in 2014 the peak

sits towards the middle of the August, while in 2015 the peak is at the beginning of the month. It is possible that Amerindian canoers noticed and/or included these fluctuations in their mental maps and yearly variations in current velocity may have affected when crews travelled. The seasonal averages of current velocity peaks indicate that specific times of year could have represented optimal travel months that were used as canoeing seasons by Amerindian crews. Though the day crews set off could have varied, it is likely the period of year during which they left did not.

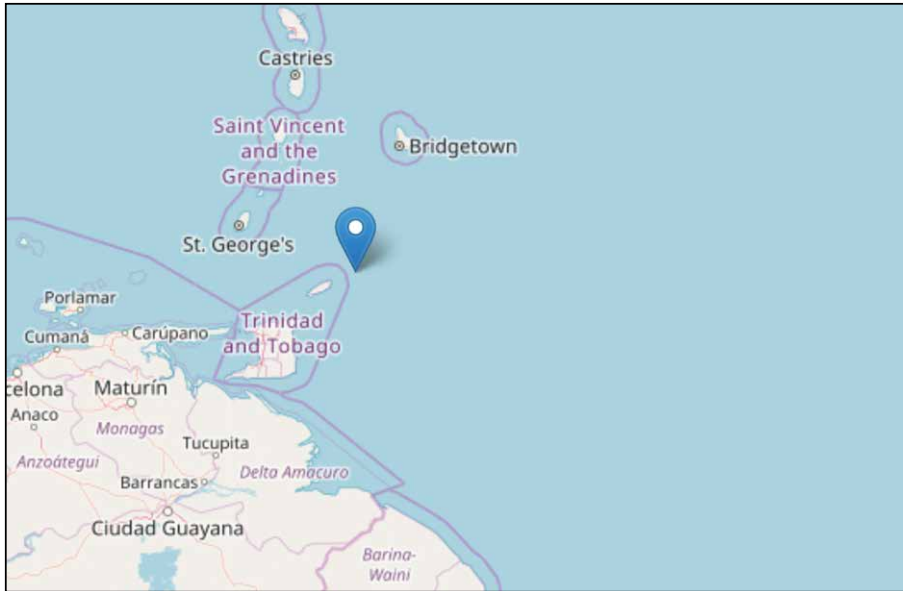


Figure 94: Map showing location of Point 2 (11.432648, -60.205078) that was evaluated using the current tool.

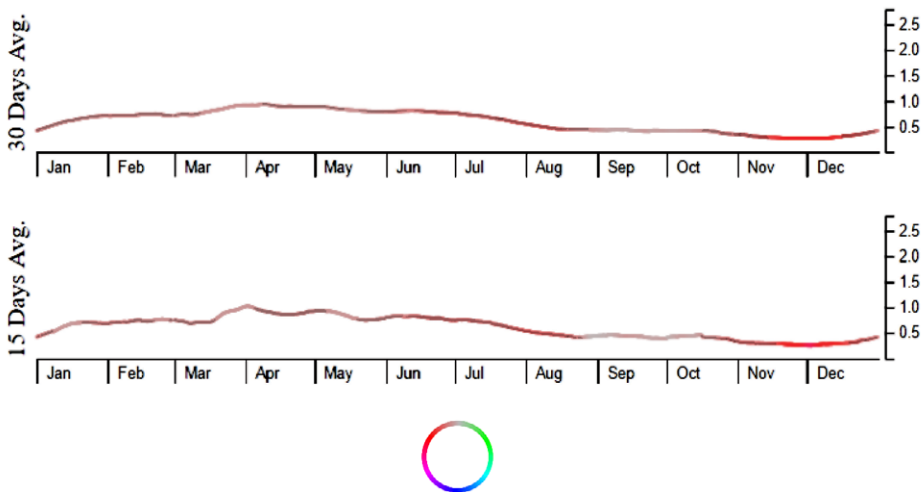


Figure 95: Graph showing the 15- and 30-day average values for direction and velocity of current at Point 2.

Point 2 (11.432648, 60.205078) shows the trend of current velocity off the northeast coast of Tobago (see Figure 94). Current direction at this point trends towards the northwest for most months over all years (see Figure 95; Appendix D). There are also shorter periods within several months where the current trends towards the northeast (see Figure 95; Appendix D). Currents from January to June fluctuate with average current strength of 0.5 knots to over 1.5 knots. This demonstrates both the strength and inconsistency of current force during these months. Current



Figure 96: Map showing location of Point 3 (7.1226996, -57.304688) that was evaluated using the current tool.

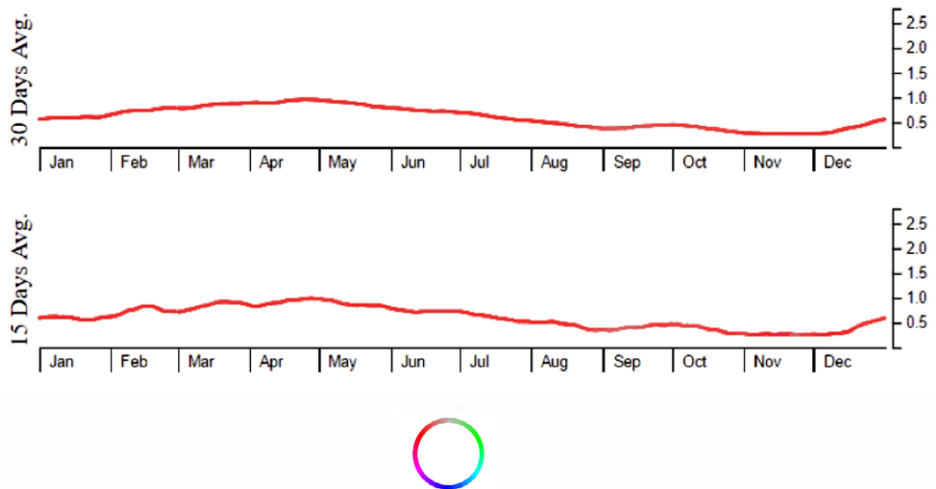


Figure 97: Graph showing the 15- and 30-day average values for direction and velocity of current at Point 3.

velocity values returned from August to September and October to December show movement toward the northeast and southeast, respectively. These periods also coincide with slower currents. The 15- and 30-day averages for current velocity and direction at Point 2 show a peak in current force towards the northwest between March and July (see Figure 95). Currents also tend to be slowest during November and December (see Figure 95). These averages suggest that the route tool should be used to check movement during these two periods to determine if either represented an optimal month for seafaring.

Current movement off the coast of South America seems to follow a more consistent pattern towards the northwest. Point 3 (9.275622, -59.32617) on the assumed direct path between Guyana and Grenada shows movement towards this direction over most months and years (see Figure 96). Both the 15- and 30-day averages of current velocity show a spike in strength between March and June (see Figure 97). The broad exception for current direction comes from some returns between August and December. Though this is a broad stretch of the year, most years do not concurrently have movement away from the northwest. In fact, most of these divergences to the south and east last only a month (see Figure 97). Movement to the south and east also coincided with the tendency for current velocity to fall below 0.5 knots. These changes were likely to be noticed by Amerindian canoers, and crews may have avoided travelling north in these periods. As currents would have pushed canoers to the south at a low velocity between August and December, crews returning from the Lesser Antilles may have chosen to travel to the mainland in this period.

Point 4 (7.1226996, -57.304688) was also sampled to test the strength and direction of current at an area near Suriname and Guyana (see Figure 98). Looking at current velocity at this point can inform on the conditions canoers would have met when travelling west from the Maroni River, at the border between Suriname and French Guiana. As mentioned above, collecting current values closer to the river mouth and the location of multiple Koriabo-connected sites, was impossible due to the extent of the underlying current data used by the tool. Measuring currents at Point 4 can be connected to possible origin points using the AmSeas3D data.

The current averages at Point 4 over 15- and 30-day periods show a reduced velocity when compared to currents from other areas within this case study. They average below 0.5 knots and trend towards the north. However, there is a spread in velocity up to one knot and direction headings to the south when looking at the individual results for data collected during all months from 2010 to 2016 (see Figure 99; Appendix D).

This trend is repeated in current values returned for Point 5 (6.55547, 57.01904). 15- and 30-day averages for this point show a low velocity trend towards the north (see Figures 100 and 101). Individual results, as with Point 5, show a movement towards the south as well. The slow current in this area could indicate that routes heading along the coast of Guyana were relatively easy compared to those least-cost routes running further out in the Atlantic.

As with the previous case studies, these points tested by the current tool help to select which months and years should be used as the base for modeled routes. I have chosen to compare movement in 2013 and 2014 for the months of January, April, August, and November for this case study to represent possible annual environmental

circumstances. For example, between August and December currents would have aided movement towards the south. This suggests that this period and the one from January to July were separate canoeing seasons. Crews may have chosen to travel north during the winter and spring, while moving south during the summer and fall. This assumption was evaluated through the route tool.

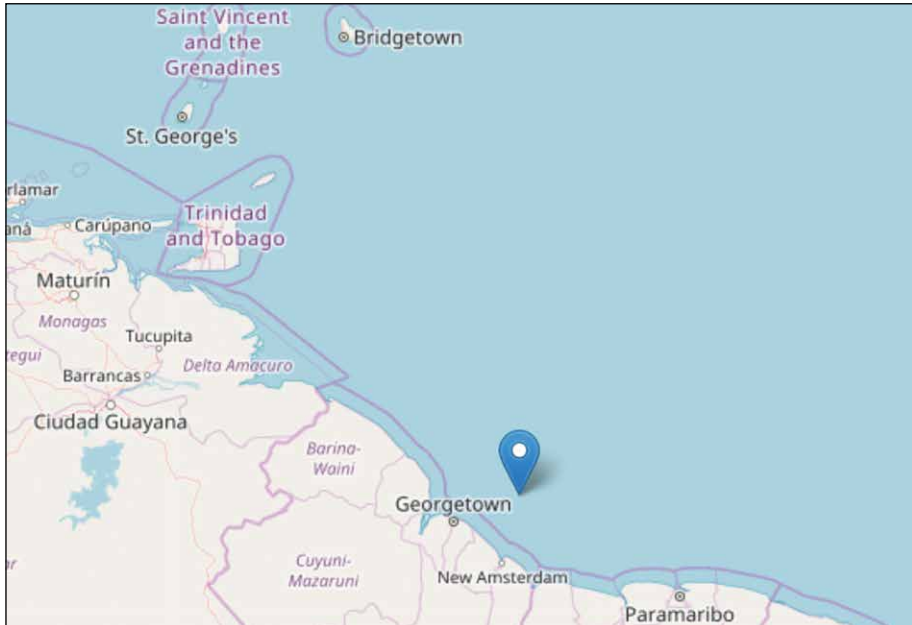


Figure 98: Map showing location of Point 4 (7.1226996, -57.304688) that was evaluated using the current tool.

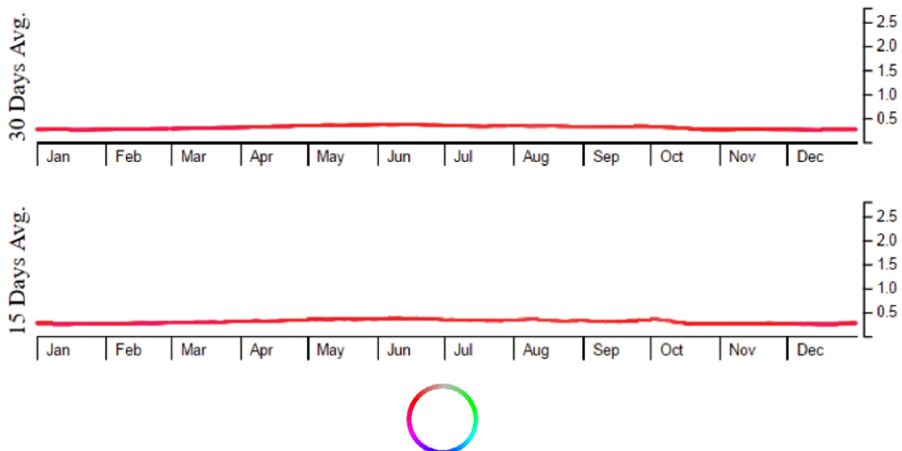


Figure 99: Graph showing the 15- and 30-day average values for direction and velocity of current at Point 4.

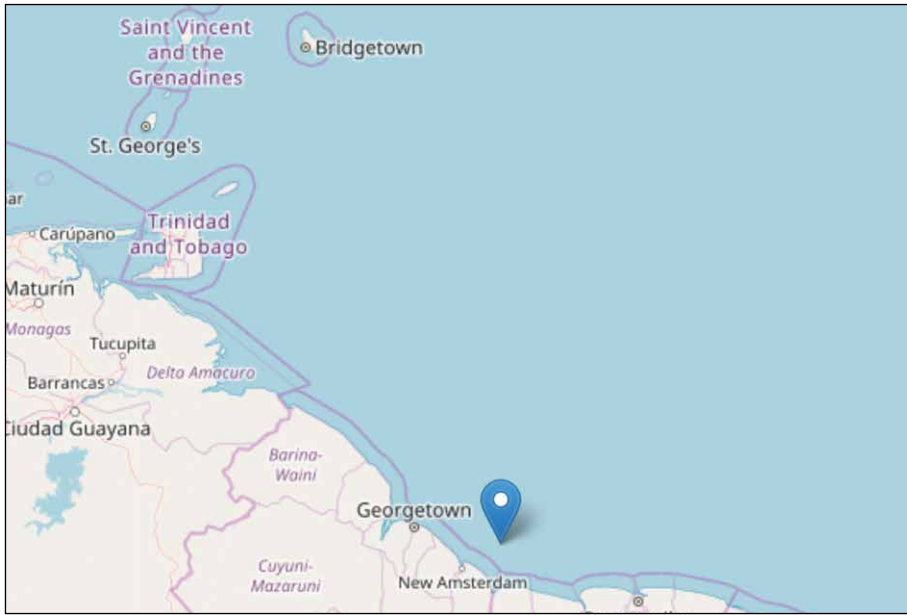


Figure 100: Map showing location of Point 5 (6.55547, -57.01904) that was evaluated using the current tool.

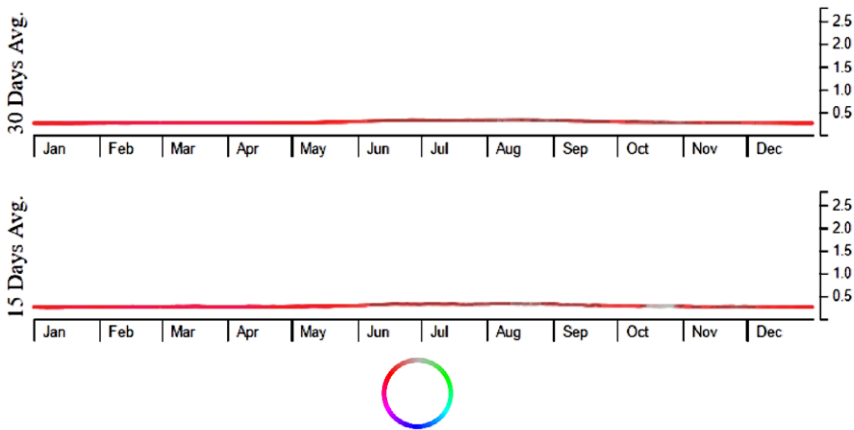


Figure 101: Graph showing the 15- and 30-day average values for direction and velocity of current at Point 5.

7.2.3 Route Cost

Another consideration in developing the routes was the physical ability of canoers to cover these distances. For voyages to cross directly from South America to Grenada, and vice versa, some routes exceeded 100 hours. This is substantially more than the regular time cost for routes to head between the Greater Antilles and the Leeward Islands, which typically took between 45 and 60 hours (see Chapter 5). As mentioned earlier, the routes modeled here fit with the time estimates made by Callaghan (2001) for direct crossing between the north coast of South America and the Greater Antilles,

thus corroborating the possibility of these long voyages. Route time costs could suggest those routes that were more likely to be followed. Crews may have chosen to break a voyage at a convenient place indicated through the modeled routes' layout.

The greater distances covered by these modeled routes may also show seasonal patterns more clearly than shorter routes hypothesized between the Leeward Islands. Though perhaps relegated to determining whether travel north or south resulted in lower cost routes, these seasonal separations may present an order to the annual mobility cycle absent in the previous two case studies. The distances covered by hypothetical routes between the mainland and the Windward Islands, and vice versa, may prove to show how interconnection in different months influenced mobility patterns.

Due to the extensive distances covered by canoers I had to adapt the settings for the route tool from those used previously. As with modifying parameters for modeling least-cost routes across a landscape, I changed the iteration level, or the total number of isochrone steps evaluated, to allow for the protracted lengths of routes, to allow for the protracted lengths of routes. To evaluate the best iteration level over these large distances, four tests were run on voyages between Guyana and sites on Grenada and St. Vincent in April. The values tested were for routes between Guyana Point C off the coast of Guyana and all sites on Grenada and St. Vincent iterated at 150, 300, 450, and 600 times per run. The results of these runs were mixed. Tests for an iteration parameter set at 150 did not run at all. Iterations over 300 points along a route returned only 51 routes. Tests for iterations for 450 points along a route resulted in 53 routes. Tests for iterations parameter set at 600 resulted in 53 routes. Additionally, routes tested at less than 450 points returned high levels of 'incomplete routes'. As such, I decided that due to processing constraints the iterations parameter would be set at 450 to ensure maximum return for the run time for all other months tested. This may shift the interpretation of network connections. Modifying the parameters to accommodate these longer route trajectories can affect the results, and therefore caution is necessary when comparing this case study to the previous two studies.

This number of points necessary to model routes could also indicate a high variability in the seascape and imply that canoers possibly following least-cost travel corridors in the region had to reevaluate their headings to ensure they continued towards their goal more frequently than canoe crews in the previous two studies. Still, the number of returned routes was fewer than for previous case studies. This smaller number may be linked to the distance crews needed to cover to create a direct route between a point off the coast of Guyana and Grenada or St. Vincent. Canoe voyages covering these distances would have experienced a higher failure rate, demonstrated by the issues with the model completing certain routes.

Overall completion of the modeled routes shows that trips from Grenada had a higher chance of success than those from St. Vincent. This suggests that Grenada played a larger role in an exchange network between the Lesser Antilles and the Guianas.

As expected from the geographic position of the islands, routes from Guyana Point B towards St. Vincent took longer than those heading to Grenada. However, the difference in route cost for routes traveling from the mainland to each of these two islands can range between one hour and 30 hours (see Appendix D). Canoe crews may have been able to identify weather patterns that could help them overcome fluctuating route costs, although this may have been difficult on direct voyages to St. Vincent or

Grenada due to the time and distance associated with these trips. Canoers also had to bring enough supplies with them to avoid failure if they were caught out at sea in a disadvantageous current. These tactics were essential parts of planning and undertaking canoe voyages, as suggested by the range of voyage lengths.

The differences in these time costs can be linked to route layout, or the culmination of navigators' choices to best use current force. For example, in November, routes from Guyana Point C towards Argyle on St. Vincent that pass by Tobago and Trinidad have a higher cost than those that pass further east in the Atlantic. Canoers may have chosen to avoid direct contact with Trinidad and Tobago to dodge the additional time cost. Conversely, routes past these islands may have allowed for stopovers to break up the time cost of the whole journey. Stopping at either of these islands may also have allowed the real-world crews that may have followed these least-cost routes to alleviate some pressures.

Routes traveling from north to south during some months resulted in higher costs as well. For example, routes in November from Telescope Point to Guyana Point B typically took between 140 hours and 150 hours. This translates to six days of canoeing to make direct contact with Guyana. Routes from Argyle to Guyana Point A in January can exceed 160 hours, or roughly six and one-half days, to travel to a point so far off the coast of the mainland that it would be impossible to make port. It is possible that crews attempting a direct voyage would then have to travel for an excess of seven more days before reaching the Maroni River mouth. As a result, canoers traveling to the Maroni River mouth had to contend with a higher associated time cost than was advisable, due to the crew's need to rest and resupply. These time periods often show a similar reciprocated cost to travel to the islands. This could indicate that during some periods it was just as easy to travel north as it was to travel south.

Comparing leaving from the coastal area of Guyana to launching from further out to sea did show a small difference in time costs. At times, these routes may differ in cost by over 10 hours, although this may not have been such a great consideration for voyagers who were planning a trip of several days. This difference is compounded by the fact that some of these routes begin further into the Atlantic Ocean. Routes from Guyana Point A may have a lower returned cost but in practice a higher cost overall considering that part of the journey was not calculated. As time costs are similar regardless of a crew's starting position, the route costs can be compared against one another to assess seasonality.

Seasonal periods can affect what nodes become prominent within a network. There are examples of route cost comparison that indicate differences based on how a node's location influences travel corridors during the year. For example, movement from Guyana to La Poterie generally took less time in April than in November. In fact, in April La Poterie is consistently one of the least-cost points of contact when moving from the Guianas. However, time cost values, when averaged, show similar returns, which may indicate that the seasonal preference was minor, if it existed at all (see Table 17).

As most routes originating from the same node are comparable, I will now look at the trends in time costs over different seasons. The time costs for routes heading from Guyana Points B and C towards the Lesser Antilles stretches from 76 to 100 hours (three to four days) in April to between 90 and 130 hours three and three-fourths to five and one-half days in November (see Appendix D). Movement from Guyana Point A in April sometimes returns route-costs that are 20 hours less than the same routes costs in January and 30 less than those in August (see Appendix D). Routes

to sites on St. Vincent are typically 10 hours costlier than routes to Grenada in November. In April, the cost of moving to Grenada or St. Vincent has a difference of only five hours. These time costs indicate April may have been a preferred month for travel from the mainland to Grenada or St. Vincent in comparison to other months. This trend is supported by the data returned by the current tool (see Figures 93, 95, 97, 99, and 101; Appendix D).

From	To	Month	Min	Max	Average
Guyana Point A	Argyle, St Vincent	January	100.207	121.711	109.75
Guyana Point A	Argyle, St Vincent	April	82.418	97.035	87.392
Guyana Point A	Argyle, St Vincent	August	105.683	120.822	113.414
Guyana Point A	Argyle, St Vincent	November	105.003	116.716	109.45
Guyana Point A	La Poterie, Grenada	January	87.378	110.773	100.709
Guyana Point A	La Poterie, Grenada	April	77.227	95.133	83.714
Guyana Point A	La Poterie, Grenada	August	95.463	128.026	103.414
Guyana Point A	La Poterie, Grenada	November	111.065	123.405	116.804

Table 16: Time cost values for routes from Guyana point A to Argyle, St Vincent and La Poterie, Grenada.

From	To	Month	Min	Max	Average
Argyle, St Vincent	Guyana Point A	January	149.192	152.099	150.49
Argyle, St Vincent	Guyana Point A	November	143.035	151.976	148.574

Table 17: Time cost values for routes from Argyle, St. Vincent to Guyana point A.

From	To	Month	Min	Max	Average
Guyana Point B	Argyle, St Vincent	January	130.446	152.071	141.109
Guyana Point B	La Poterie, Grenada	January	120.365	152.058	136.378
Argyle, St Vincent	Guyana Point B	January	144.075	152.169	149.354
La Poterie, Grenada	Guyana Point B	January	NA	NA	NA
Telescope Point, Grenada	Guyana Point B	January	129.108	152.151	142.656

Table 18: Time-cost values for routes to and from Guyana point B and the Leeward Islands. As the reciprocal route from La Poterie was unable to complete, I have included a route from Telescope Point, 3 km south of the first site.

From	To	Month	Min	Max	Average
Guyana Point B	Argyle, St Vincent	November	107.362	141.138	121.209
Guyana Point B	La Poterie, Grenada	November	104.166	141.138	115.723
Guyana Point B	Argyle, St Vincent	April	107.362	141.138	121.209
Guyana Point B	La Poterie, Grenada	April	104.166	141.138	115.685

Table 19: Time-cost values for routes from Guyana point B to the Leeward islands, comparing results from November and April.

These seasonal variations point to the existence of optimal canoeing periods. April seemed to return the best odds for a successful voyage. Modeled travel in August and November resulted in costlier least-cost routes. This suggests that the spring may have been an optimal season for canoe travel in this region. Routes in August and November have the highest time costs of any months evaluated for travel to Grenada and St. Vincent from Points B and C. Time costs for some of these routes can reach over 115 hours (four and three-fourths days) in August and from 107 to 120 hours (four and one-half to five days) in November (see Appendix D). Routes to and from Guyana Point A also indicate that August had higher associated time-costs, where routes towards Grenada typically

From	To	Month	Min	Max	Average
Guyana Point B	Argyle, St Vincent	April	107.362	141.138	121.209
Guyana Point B	La Poterie, Grenada	April	104.166	141.138	115.685
Guyana Point B	Argyle, St Vincent	November	107.362	141.138	121.209
Guyana Point B	La Poterie, Grenada	November	104.166	141.138	115.723

Table 20: Time costs for routes from Guyana point A towards the Leeward Islands.

From	To	Month	Min	Max	Average
Guyana Point A	Argyle, St Vincent	January	100.207	121.711	109.75
Guyana Point A	Argyle, St Vincent	April	82.418	97.035	87.392
Guyana Point A	Argyle, St Vincent	August	105.683	120.822	113.414
Guyana Point A	Argyle, St Vincent	November	105.003	116.716	109.45
Guyana Point A	La Poterie, Grenada	January	87.378	110.773	100.709
Guyana Point A	La Poterie, Grenada	April	77.227	95.133	83.714
Guyana Point A	La Poterie, Grenada	August	95.463	128.026	103.414
Guyana Point A	La Poterie, Grenada	November	111.065	123.405	116.804

Table 21: Comparison of time costs for routes from Argyle, St. Vincent to Guyana point A.

From	To	Month	Min	Max	Average
Argyle, St Vincent	Guyana Point A	January	149.192	152.099	150.49
Argyle, St Vincent	Guyana Point A	November	143.035	151.976	148.574

Table 22: Examples of movement from Guyana point B towards the Leeward Islands and return costs. Due to the inability for routes to run from La Poterie, Grenada to Guyana point B, the time cost values for Telescope Point, Grenada (3 km to the south) to Guyana point B is shown.

From	To	Month	Min	Max	Average
Guyana Point B	Argyle, St Vincent	January	130.446	152.071	141.109
Guyana Point B	La Poterie, Grenada	January	120.365	152.058	136.378
Argyle, St Vincent	Guyana Point B	January	144.075	152.169	149.354
Telescope Point, Grenada	Guyana Point B	January	129.108	152.151	142.656

Table 23: Time cost comparison between the months of April and November for movement from Guyana point B to the Leeward Islands.

lasted between 100 and 105 hours (four days) while those to St. Vincent took from 108 to 116 hours (four and one-half days) (see Appendix D). Thus, neither August nor November were a prime month for voyaging from the mainland to the islands.

The separation between time costs over various months is much clearer than in the previous case studies, allowing a comparison of route layout to connect more closely with route cost. Building upon these findings, I will look at route layouts for all months evaluated, with extra attention for the possible optimal month of April and non-optimal month of November. Assessing these months will allow a comparison between routes run in an easier and harder month to travel.

7.2.4 Route Layout

Route layout proved a vital component to the analysis of relationships between the Guianas and the Lesser Antilles. Modeled canoe routes indicated places to look for connections. The longer distances found in this case study also led to interesting pathways either out into the Atlantic or along the coast of South America. To identify possible social links in these canoe routes, the trajectories of these pathways are compared below.

Were routes direct between the Windward Island and the mainland or do the hypothetical pathways suggest stopover locations that may indicate communities connected with these islands? Archaeological remains of Cayo or Koriabo ware are found in coastal mainland and Windward Islands deposits but are limited on Trinidad and Tobago. This contact, while not currently supported by material evidence, is suggested by ethnographic accounts (Boomert 2002). Analysis of these possible canoe travel corridors is focused more on showing what types of connections were possible. Computer-modeled routes may be one of the only ways to determine if these avoidances were due to environmental influence or social factors.

7.2.4.1 Grenada and St. Vincent

The first route layouts analyzed for this work are from Guyana Point A to the sites of La Poterie and Argyle. Generating routes to and from these points was an important step in determining the basic layout of routes from the Guianas. These routes indicate that canoers from the Guianas had several options in approaching the Windward Islands. When traveling from Guyana Point A, which is set to represent travel from the Maroni River mouth, navigators could steer towards the Galleons Passage, the east coast of Tobago, or further east into the Atlantic. Return voyages could also follow these three trajectories. In fact, it is more common to travel out into the Atlantic from Guyana Point A than it is from other points. Most routes from Guyana Point A do not head west to connect with the mainland at all. Thus, leaving from Guyana Point A may have been ideal for crews, possibly following pathways similar to these least-cost routes, to avoid connections with adversarial groups along the mainland coast or on the western side of Trinidad.

As suggested by the routes' associated time-costs, a seasonal component for travel to and from these islands. Least-cost canoe routes from Guyana Point A in April were more likely to approach Grenada's windward coast, having arced their route over the east side of Tobago (*e.g.*, route 1-0_2014-04-01T00, and route 1-0_2014-04-29T15; see Appendix D). Approaching the island from the east would have allowed the current to push the route into the island. This could have made the final part of the journey easier for any real-world paddlers who may have chosen to move near the travel corri-

dor suggested by the pathways modeled here. This technique of routes following optimal currents behind an island's coastline may be associated with the lower route costs in April. Grenada was much more likely to be approached from the east in all months but August, when pathways approached the island from the south (see Appendix D). August is the only month where routes from Guyana Point A pass over the north coast of Trinidad before heading to the site of La Poterie (*e.g.*, routes 1-0_2014-08-19T12, route 1-0_2014-08-20T00, and route 1-0-2014_08-20T03). This limited number of routes could suggest that any real-world canoers from the Guianas following the trends seen in the least-cost pathway models steered away from traveling past the north coast of Trinidad. In these cases, there may have been seasonal as well as social reasons, such as a desire to avoid antagonistic communities, behind route construction.

Trinidad, Tobago, and islands in the Grenadines may have acted as stopover locations for routes to St. Vincent. In April, movement from Guyana Point A towards Argyle approached the island from the south and passed closer to Tobago (*e.g.*, route 1-2_2014-02T06, route 1-2_2014-07T06, and route 1-2_2014-04-21T15) and was also more likely to pass by the island of Les Jolies Eaux (*e.g.*, route 1-2_2014-04-21T15,



Figure 102: Route between northern Guyana point C and Brighton, St. Vincent in August. Route launched at 3pm on the 21st of August 2014, Route: 1-5_2014-08-21T03_00 (Iteration 450).

and route 1-2_2014-04-22T00; see Figure 102). In April and August, routes from Guyana Point B towards St. Vincent sometimes pass by the Grenadines (*e.g.*, route 1-5_2014-08-20T15, route 1-5_2014-08-21T03, and route 1-2_2014-08-18T03). This indicates that in some cases the Grenadines played a role as stopover points for routes to and from the Guianas. Cayo material from the Grenadines, for example on Il de Ronde (Bright 2011; Roget 2002), may have been a result of these routes. It is possible that sites on the smaller islands may have seasonal components that align with the travel periods that routed past the island. Comparisons of archaeological examples from Les Jolies Eaux, St. Vincent, and the Guianas are necessary to examine the extent of interaction between these three areas.

Though these routes may not make physical contact with the islands, they pass close enough to allow for visual links. In some cases, least-cost canoe pathways to Brighton on the southern coast of St. Vincent pass within five km of the Grenadines (*e.g.*, route 1-3_2013-04-26T21; see Figure 90). Routes towards Argyle come within one km of the Grenadines coastline (*e.g.*, route 1-4_2013-04-26T00; see Appendix D). It is likely that these routes would have had visible connections with the island as they ran par-



Figure 103:
Movement from
Guyana point A
to Argyle, St.
Vincent in August.
Route launched at
3am on the 25th of
August 2014 Route:
1-2_2014-08-25T03
(Iteration 450).

allel to it (e.g., route 1-3_2013-04-05T21; see Appendix D). Visual cues from these islands may have helped orient canoers along their path and could have theoretically been represented as a part of a navigator's mental wayfinding map (*sensu* Crouch 2008; Llobera 2000; Tilley 1994).

Routes traveling both north and south may have sought to make contact with or avoid Tobago depending on the crew's relationship with peoples on that island. Hypothetical canoe routes from St. Vincent towards Guyana Point A sometimes pass further out into the Atlantic Ocean in August and July than in the other months (e.g., route 1-2_2014-08_25T03, and route 2_1_2014-01_30T12; see Figure 103). Movement this far away from the in-between islands could indicate that even though August had higher time costs, canoers looking to avoid interaction with antagonistic communities on Tobago may have chosen to head south during this month. Modeled canoe routes from Guyana Points B and C towards St. Vincent infrequently reached Tobago, as the routes were typically placed more than 25 km away from the island. Routes travelling along these paths to St. Vincent were more likely to have travelled directly to the island, as there were fewer opportunities for stopovers. This trend could



Figure 104: Route between the southern Guyana point B and Sauteurs Bay, Grenada in November. Route launched at 6pm on the 4th of November 2013, Route: 1-3_2013-11-04T18 (Iteration 450).

explain why the north of St. Vincent possesses a lower concentration of sites containing Cayo ceramics. Cayo stylistic elements may have come up to St. Vincent through contact with Grenada in the south.

The routes modeled in this case study suggest that travelers towards the islands from the mainland coast may have favored approaches to the east side of the islands, which is perhaps why sites are located on this side of the island. Most sites included in this research are on the east coast. Hofman and Hoogland (2012) state that Island Carib peoples settled on the windward side of the islands to make use of the steep cliffs and rough seas of the eastern coasts. Amerindian peoples could also have settled there to take advantage of landing spots suggested by these least-cost canoe routes. There are, however, some routes that pass by the west coast of the island in November and January (*e.g.*, route 1-3_2013-11-04T18, route 1-3_2013-11-10T03, and route 1-3_2014-01-15T03; see Figure 104) when heading from South America towards Sauteurs Bay. This pathway hugs the coast so closely that canoers who may have following this route would have had the opportunity to stop at many points before reaching Sauteurs Bay. Routes passing on the west side of Grenada benefited from the shelter provided by the island as the pathways run up the coast.



Figure 105: Route between the southern Guyana point B and Brighton, St. Vincent in April. Route launched at 9pm on the 26th of April 2013, Route: 1-3_2013-04-26T21 (Iteration 450).

7.2.4.2 Tobago

Ethnographic records show that the people on the island of Tobago at the time of contact identified as ‘Kal’ina’ (Boomert 2016). This connected them with Amerindian peoples from the Guianas who identified as Kalinago as well. There are few Cayo elements that would support connections between Tobago, the Guianas, and the Lesser Antilles. As suggested by Troumassoid assemblages, sites from this period could have acted as possible stopover areas for crews heading to the islands (Boomert 2016). However, sites yielding a concentration of Cayo ceramics have not been found on the island (Boomert 2016), indicating either that these peoples were not recipients of materials from the Guianas or that sites with concentrations of Cayo ware have yet to be found. Though some ceramic sherds hint at a possible connection with the Island Carib, interconnection cannot as yet be proven archaeologically. More survey work could be done around the island before a stronger statement can be made.

It is notable that the southwestern corner of Tobago was heavily occupied during the Ceramic Age/early colonial period (Boomert 2016). The placement of these sites



*Figure 106:
Movement from
Guyana Point A to
La Poterie, Grenada
in August. Route
launched at 3am on
the 5th of August
2014, Route:
1-0_2014-08-05T03
(Iteration 450).*

coincides with several routes modeled between Guyana and Grenada (see Appendix D). For example, routes modeled between these locations in November ran into the south-western side of the island. The fact that there are also Archaic Age sites along this coast suggests that the placement of the Ceramic Age/early colonial period sites was related to the canoe routes that passed through this channel. These archaeological places stand in contrast to the unexplored west side of the island.

There are many historic accounts of canoes running through Tobago in the sixteenth and seventeenth centuries (Boomert 2002, 2008). These include accounts of people stopping at the island to rest when traveling from the Guianas to the Windward Islands. Historic and ethnographic records also mention the force of the current around the island. Many chroniclers referred to the current around Tobago as so strong that sailing-ships could be pushed from the east coast of the island towards Grenada (Boomert 2010; Young 1812: 89-90). Connections between Tobago and Trinidad play a large role in these accounts as well. Historic records indicate that voyages from Trinidad and Tobago across the Galleons Passage typically took one day and night (Boomert 2002,



Figure 107: Route between Telescope Point, Grenada and the southern Guyana Point C in November. Route launched at 3pm on the 12th of November 2013, Route: 0-1_2013-11-12T15 (Iteration 450).

2010; Dauxion-Lavaysse 1820: 364-365). These mentions of navigation patterns and Amerindian canoe crews validate and support the routes modeled for this work.

Many of the modeled routes link up with the historic and ethnographic accounts, particularly those that run near Tobago. Pathways running to and from Guyana Point A often head past the island. Routes from this point were more likely to avoid the Galleons Passage and travel past the east end of Tobago instead (*e.g.*, route 1-0_2014-04-01T00, route 1-0_2014_08-05T03; Figure 106). In April and November, routes heading south from Grenada to Guyana passed by both sides of Tobago (*e.g.*, route 0-1_2013-11-12T00, route 0-1_2013-11-12T15; Figure 107). Looking at movement in the opposite direction, routes from the northern point off Guyana's coast in January were also likely to pass by both sides of Tobago on their way to Grenada (*e.g.*, route 1-2_2014-01-03T06).

Many routes to Guyana Point B from Grenada passed near or connected with Tobago. Several routes passed off Tobago's northwest coast (*e.g.*, route 0-1_2012-11-10T15), which can relate to the Ceramic Age/early colonial period presence on the island discussed by Boomert (2016). Most of these routes pass more than three km off the coast, which brings into question whether sites on this island would have been visible from routes in these travel corridors (see Brughmans *et al.* 2016; de Ruiter 2012, forthcoming). Most canoe pathways past the southwest coast of the island make a short connection with the coastline. Route 4-1_2013-11-16T03 is distinguished from other pathways by having the route from Barnes Bay run east below Tobago before turning south to Guyana. These routes indicate that canoers who possibly were traveling along pathways similar to these least-cost routes to and from Grenada could connect with different parts of the island and it is possible that peoples choose certain routes to ensure they could connect with specific areas or communities on Tobago.

How routes reach Grenada may have also influenced the ability of canoers on least-cost routes to successfully complete voyages. Routes north from Guyana to Grenada were more consistent in April, often passing through Galleons Passage (*e.g.*, route 1-0_2013-04-28T21, route 1-2_2013-04-29T21). However, routes moving from Guyana to St. Vincent in April typically avoided direct contact with Trinidad or Tobago (*e.g.*, route 1-4_2013-04-03T15; see Appendix D). These voyages can pass 10 km off the coast of Tobago. It is possible that if real-world canoers had knowledge of these least-cost routes, or were able to chart trajectories similar to their layout, they may have made trips during this period of the year to avoid direct contact with Tobago. This shift in route trajectory could indicate social preference for specific canoeing periods.

Depending on the preferences of crews, canoers could have stopped over on Tobago or avoided it. Routes moving to and from St. Vincent made regular contact with Tobago in November, (*e.g.*, route 2-1_2014-11-01T21, route 5-1_2013-11-14T06; see Figure 107) and in April, at points passing within three km of the northeastern edge. Routes leaving from Brighton Beach on the south side of St. Vincent were more likely to pass close to Tobago than routes leaving from Argyle. This could indicate that a closer connection should be evaluated for routes from the east side of Tobago, the south side of St. Vincent, and the whole of Grenada. These routes would have been visible to Amerindian peoples on the east side of Tobago, showing a possible connection between inhabitants of the island and those passing it in canoes. Several routes from both site nodes on the island pass close to Tobago (*e.g.*, route 5-1_2013-11-15T21). Some routes leaving Argyle even hug the coast of Tobago as they run past the island

(e.g., route 6-1_2013-11-14T06). This may fit with the premise that traveling south in November was easier than traveling south in January.

However, there are as yet no known prominent Ceramic Age/early colonial period sites on this side of the island (Boomert 2016) to judge as landing points for vessels or visual contact with canoe routes. This could be because crews may have avoided this area, which is possibly reflected in modeled routes leaving at different times of year. Hypothetical routes from St. Vincent to Guyana Point A in January are more likely to head out into the Atlantic (e.g., route 2-1_2014-01-30T12). Only one canoe route from Guyana to St. Vincent passes by Tobago in November. Route 1-5_2013-11-18T18 runs past the northwest coast of the island (see Figure 108). This route suggests lower probability for stopover potential than observed in canoe pathways that hug the coastline as it does not make direct contact with Tobago. This is in direct contrast to movement from St. Vincent to Guyana.

Modeled routes can also indicate possible preferences for navigation through Galleons Passage. Routes from Guyana to Grenada were more likely to pass through the channel between Tobago and Trinidad in November and August. This could be



Figure 108: Route between the southern Guyana Point C and Brighton, St. Vincent in November. Route launched at 6pm on the 18th of November 2013, Route: 1-5_2013-11-18T18 (Iteration 450).

related to the stronger northward current passing on the east side of Tobago in April. Crews may have wanted to seek shelter behind the islands during this season. In April routes towards Grenada also avoid direct contact with Trinidad and Tobago (e.g., route 1-4_2013-04-27T06). In the model for the 2013 environmental data, least-cost pathways stayed largely in the center of the channel, perhaps avoiding being in view of communities on these two islands. In the 2014 routes often go past the east coast of Tobago, though there are some exceptions (see Appendix D).

Whether direct contact was made, peoples moving from the south would have known how or when to maneuver to Tobago. The discrepancy in ease of movement based on the vessel's heading and the season of travel would have theoretically offered knowledgeable canoe navigators the choice of either avoiding or making connections with peoples on the island.

7.2.4.3 Trinidad

It was common for least-cost routes coming from the mainland to pass by Trinidad. Modeled canoe routes that moved closer to Trinidad than Tobago frequently travelled parallel to the larger island's east coast (e.g., route 1-0_2013-11-10T09, route 1-2_2013-11-10T09; see Appendix D) and in some cases a route even hugged the

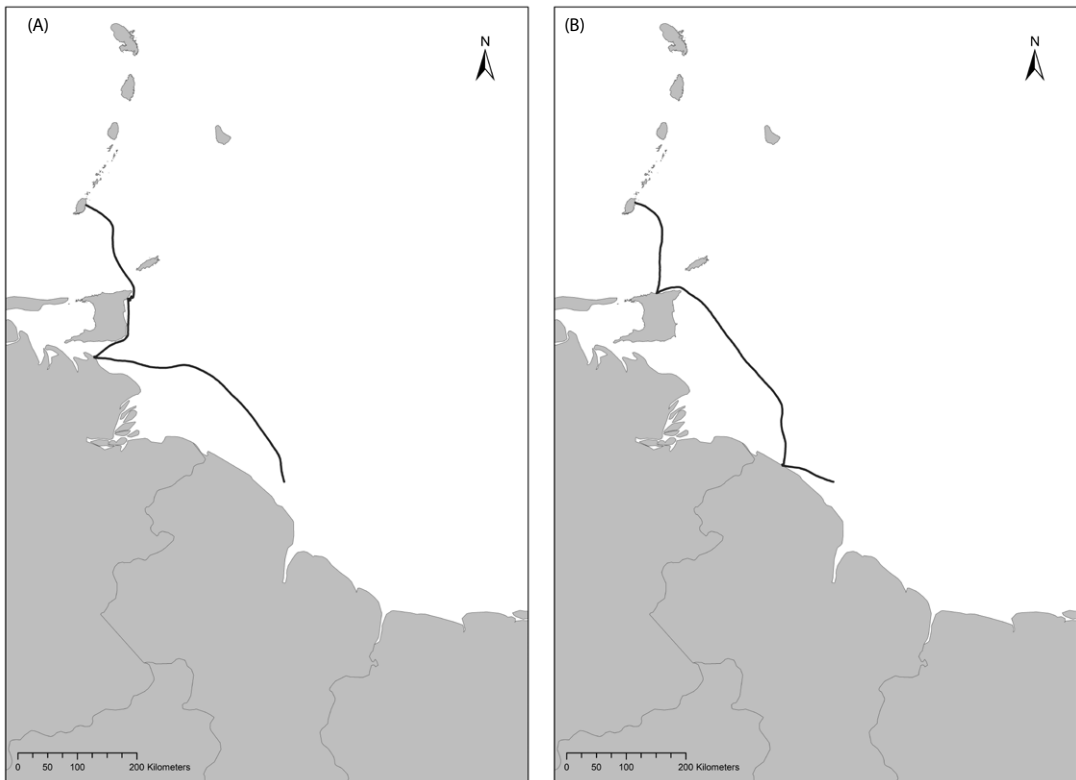


Figure 109: Routes between northern Guyana Point B and La Poterie, Grenada in April. (A): Route launched at 3am on the 26th of April 2014, Route: 1-0_2014-04-26T03 (Iteration 450), and (B) Route launched 3am on the 26th of April 2014, Route: 1-2_2014-04-01T06 (Iteration 450).

island's east coast (*e.g.*, route 1-0_2014-04-26T03, route 1-2_2014-04-01T06; see Figures 109 A and B). Routes from Grenada to Guyana also move closer to the east coast of Trinidad. These canoe pathways would have made direct contact with at least five Ceramic Age/early colonial sites on the coast of Trinidad including Manzanilla, St. Bernard, Lagon Doux, St. Catherines, and Guayaguayare (Boomert 2016).

It is likely that least-cost canoe routes traveling towards South America also passed by Trinidad's northeast coast despite the limited archaeological evidence of connection between the island and the southern Lesser Antilles. Routes from Guyana Point A are less likely to pass the island. Only routes in November and August come close to making direct contact with Trinidad's coastline (see Appendix D). Modeled routes would sometime head past the east coast of the island (*e.g.*, route 1-0_2014-08_24T15; Figure 110).

It is possible that Trinidad operated as a stopover point on a voyage from the mainland to the Lesser Antilles. For example, route 1-2_2013-11-14T06 also shows a pathway leaving from Guyana Point B making direct contact with the northeast tip of Trinidad, near Toco. This route also connects with the southwest corner of Tobago before heading north to the Grenadian site of La Poterie. These stopover points turn what

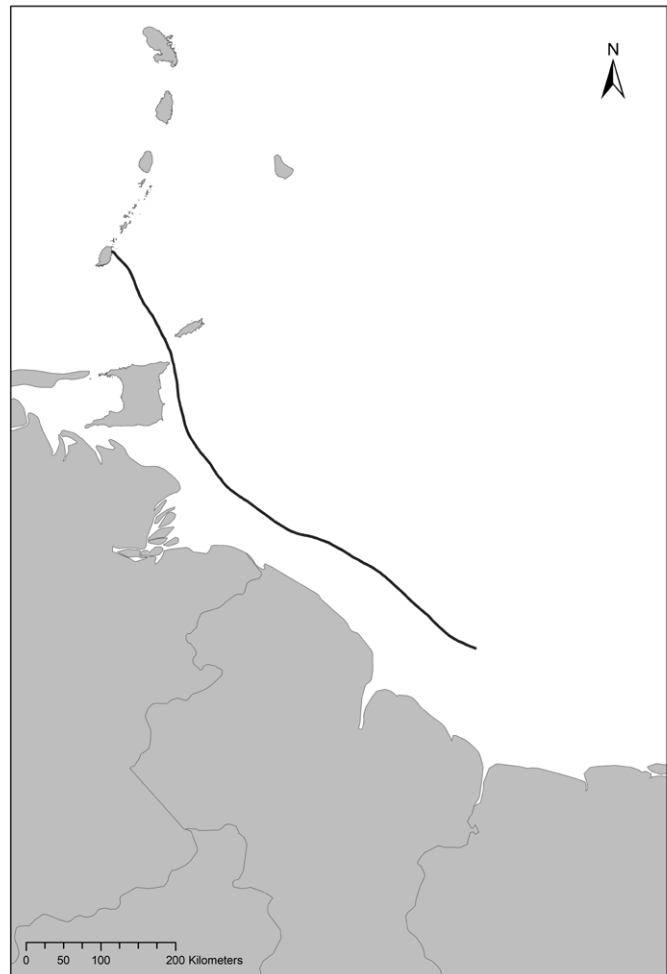
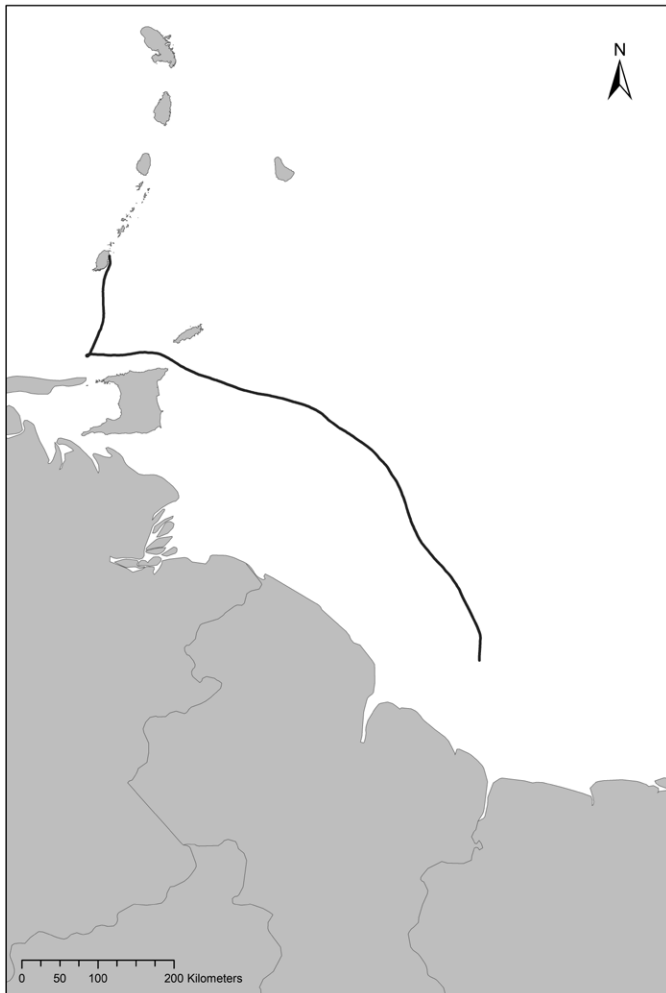


Figure 110:
Movement from
Guyana point A to
La Poterie, Grenada
in August. Route
launched at 3pm on
the 24th of August
2014, Route:
1-0_2014-08-24T15
(Iteration 450).

would be, by estimation, a roughly 700 km trip from Guyana to the Lesser Antilles into a 543-km voyage to Toco, with a second leg of 160 km to Grenada. This would have been advantageous to travelers, as it would lessen concerns over subsistence supplies and allow crews to travel with more materials for exchange rather than filling their canoe with food and water. Even if not used as a stopover point, some routes pass by the northeast coast of the island. Route 1-0_2014-08_28T03 also runs north of Trinidad, moving parallel to the island's north coast (see Figure 111). This route had a view of the island (routes 1-0_2014-08-19T12, route 1-0_2014-08-20T00, and route 1-0-2014_08-20T03). Any canoers who happened to follow a similar trajectory to the least-cost routes modeled in this work may have been able to reposition themselves at this point in their journey from these visual cues. This practice could have allowed for easier, or more direct, voyages to the Lesser Antilles.

There are as yet no large archaeological sites known in the area around Toco, although the area was likely used by Amerindian peoples during the period discussed here (Boomert 2016). Route 1-2_2014-04-01T06 (iteration 600), route 1-2_2014-04-01T06, and route 1-3_2014-04-01T06 also run by the northeast



*Figure 111:
Movement from
Guyana point A
to La Poterie,
Grenada passing
over Trinidad in
August. Route
launched at 3am
on 28th of January
2014, Route:
1-0_2014-08-28T03
(Iteration 450).*

coast of the island before heading north, suggesting that this might be an area for further study. It is also possible that canoers decided to push on to Blanchisseuse on the north coast before heading north to Grenada rather than stopping here. This area could also be further surveyed for identifying possible locations of archaeological sites.

On a few occasions, routes ran along the north coast of Trinidad when traveling between Guyana and the site of La Poterie on Grenada (*e.g.*, November: route 1-2_2013-11-17T15, April: route 1-2_2014-04-01T06 (iteration 300/iteration 450)) and might have passed by the Ceramic Age site of Blanchisseuse. The November route turns to the north roughly 10 km west of the site (see Figure 112) and the April pathway runs into the coast almost directly where Blanchisseuse is located. It is possible that this site could have acted as an origin point into the southern Lesser Antilles from Trinidad. Communities near Blanchisseuse may have been in contact with peoples living close to La Poterie, as it is only movement towards this site that results in this trajectory. Archaeological materials from this site and the Guianas should be re-evaluated to gauge Blanchisseuse as a stopover point.

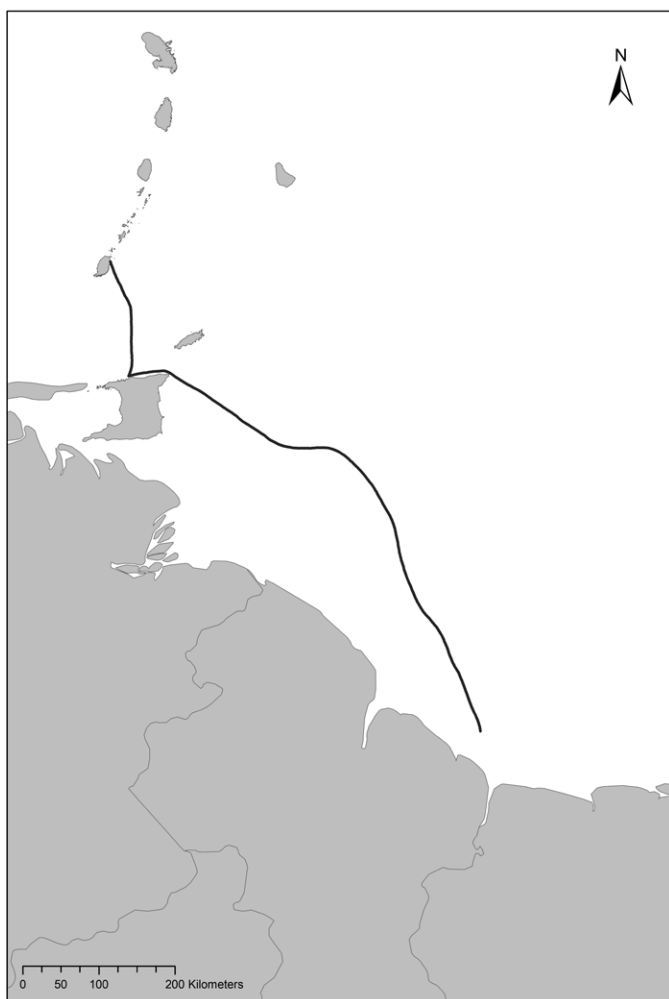


Figure 112: Route between the southern Guyana point C and La Poterie, Grenada in November. Route launched at 3pm on the 17th of November 2013, Route: 1-2_2013-11-17T15 (Iteration 450).

Routes that connect Guyana with Sauteurs Bay on Grenada follow this trend as well (route 1-3_2013-11-07T09, route 1-3_2013-11-09T00; and Figure 113), passing the entire north coast of Trinidad before turning north near Venezuela east of the Dragon's Mouth. The pathway arcs over 10 km above Trinidad before heading south towards the Dragon's Mouth. Pathways that run away from the coastline of the island may have limited the opportunities for the canoers following least-cost routes to reach Trinidad, and the site of Blanchisseuse.

The absence of other major sites on the north coast of Trinidad raises the question of how closely Blanchisseuse was related to outward exchange routes rather than intra-island connections. Routes past this site could have been added to the knowledge collected in mental wayfinding maps of individual navigators in previous generations (*sensu* Ingold 2009; Terrell and Welsch 1998; Terrell *et al.* 1997), making it a place of known safety for communities to turn towards the Lesser Antilles when canoeing over the north coast of Trinidad. Even if the site proves not to be connected to exchange routes between the Guianas and the Lesser Antilles, the modeled canoe pathways that

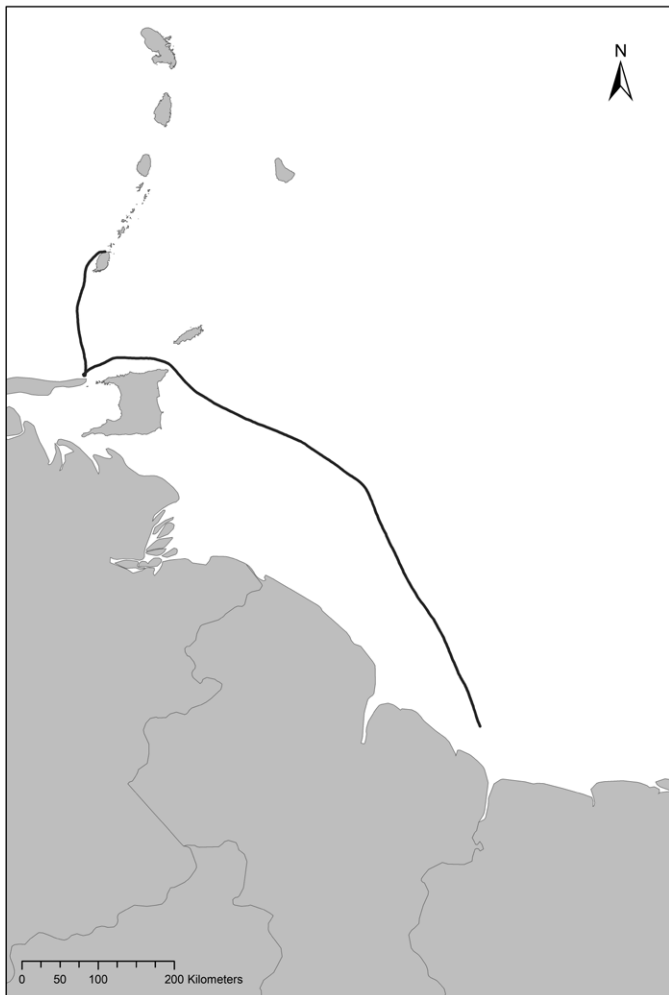


Figure 113: Route between the southern Guyana Point B and Sauteurs Bay, Grenada in November. Route launched at 12am on the 9th of November 2013, Route: 1-3_2013-11-09T00 (Iteration 450).

move past or to this site suggest the placement of Blanchisseuse was related to the location of sea routes. Though Blanchisseuse is associated with the Saladoid series (300 BC – AD 600), it is one of three Ceramic Age/early colonial period sites on Trinidad that yielded pieces stylistically linked to a specific production site (Mount Irvine) on Tobago (Boomert 2010, 2016). Pathways running past this site may indicate why Blanchisseuse was located at this point on the north coast, as the area was sparsely settled due to the limited number of accessible beaches and *mountainous* terrain off the coast (Boomert 2009, 2010). This raises the question of connection between the peoples of Trinidad and communities heading north to the Lesser Antilles. More research is necessary to explore whether there are sites along the north coast of Trinidad that align with the placement of canoe routes modeled for this work.

Connections between the mainland and Grenada can also be evaluated to determine the level of contact with Trinidad. Routes heading towards Galby Bay from Guyana were more likely to pass through the channel between Trinidad and Tobago than those terminating at other sites on Grenada. Routes modeled towards this site tend to pass closer to the coast of Trinidad than pathways connecting Guyana and La Poterie because Galby Bay's location on Granada allowed routes to approach the island from the south more readily. Movement from Guyana towards points in the Lesser Antilles in August primarily runs close to Trinidad and Tobago. These routes often head to either the northeast coast of Trinidad, the west coast of Tobago, or the east coast of Tobago, but usually not more than 25 km (*e.g.*, route 1-5_2013-08-23T06, route 1-6_2013-08-06T03). Route 4-1_2013-11-15T00 passes both the east coast of Trinidad and the southwestern tip of Tobago, suggesting links between communities Trinidad and on Tobago. Canoers seeking to avoid contact with these islands probably would probably not have travelled north during this month.

7.2.4.4 Mainland South America

Modeled routes also revealed possible links between coastal mainland areas. This is consistent with the concentration of Koriabo sites along the coastal stretch between French Guiana and Venezuela (Boomert 1986). Several routes leaving from mainland Guyana Point B first move away from the coast before returning to make landfall below the Orinoco River mouth (*e.g.*, route 1-3_2014-04-26T03, route 1-0_2014-04-26T03, and route 1-2_2014-04-01T06). The area below the Orinoco was considered Kaliña territory and there are many Koriabo-associated sites along this stretch of coastline and in the interior (Boomert 1986: Figure 11). Koriabo settlements in this area were likely connected to canoe routes from Guyana.

Routes originating more south in the Guianas also would have been pushed towards the mainland, highlighting the possible connections between southern coastal areas of Venezuela, Suriname, and French Guiana. The locations of Koriabo-associated sites in this region suggest that the trajectory of canoe routes influenced the placement of sites. This is consistent with findings from the previous case studies, for example the connection between canoe routes modeled from Flinty Bay, Long Island to Jolly Beach, Antigua that pass by the site of Anse á La Gourde on Guadeloupe. Routes originating further off the coast from Guyana Point A do not show least-cost canoe routes coming back into contact with the South American coast. However, it is possible that canoers who chose to follow pathways similar to

these least-cost routes near the mainland coastline to take advantage of stopover points or navigation markers. Kalíña raiding parties may have chosen to allow the current to push them towards land when interacting with Arawakan communities in and around coastal Venezuela.

7.2.4.5 Realistic Seafaring

Modeled route trajectories often mimic existing seafaring techniques. This includes routes curving towards islands or taking shelter behind coastlines. As mentioned above, routes coming from South America often passed off the east coast of Trinidad. Canoers who may have traveled these routes could take shelter from the current by passing on the west side of Tobago. This was true for canoe routes modeled past Tobago and for those moving between the Greater Antilles and the Leeward Islands that ran past St. Croix. Even over long distances, modeled routes tend to either pass behind the shelter or close to the coastline of an island. This would have proved beneficial to any real-world canoers traveling along similar corridors, as paddlers may have had the chance to rest on an island or face calmer seas while sheltered by its coastline

In some cases, least-cost pathways pushed north with the current until they could move directly west into Grenada (*e.g.*, route 1-0_2013-11-21T06; see Appendix D). This tactic may have allowed canoers following these least-cost travel corridors to be pushed into the islands of the Lesser Antilles without having to fight westward against the current. Similar to other realistic navigation practices, some routes that passed by Tobago also exhibit the curve or banana feature seen in Chapters 5 and 6. Here the curve towards the Windward Islands or arc of the voyage comes east of Tobago (*e.g.*, route 1-0_2013-11-22T21; see Appendix D). If crews followed similar routes, the current would have pushed tired paddlers either into Tobago or the southern islands. This would have facilitated the creation of a stopover on Tobago, allowing crews to rest before heading into the Windward Islands. Pathways heading south often took a different approach. Routes from the Lesser Antilles towards the Guianas did not head as far east into the Atlantic, possibly because currents often push east into the South American coastline. Both examples show that navigators may have focused on working with the current when possible, as the ability to move with the current into land increased the safety level of these voyages.

Canoe routes from this case study also indicated the differing reliability of canoeing periods. Beginning a certain route to take advantage of specific currents is a common sailing technique still in use today (Bowditch 2002). Several routes between Guyana and the Lesser Antilles showed evidence of reliable canoeing periods. These were separated into optimal and least optimal months. For example, April was a better month for canoeing north than November. These travel periods indicate possible preferences for a particular sea corridor for movement by canoe between two locations. In these cases, movement south was optimal in November, suggesting that peoples in the past may have traveled north in one season and south in another. These corridors can be measured against one another to determine what routes could have existed as part of a seasonal mobility pattern between sites on the mainland and in the islands. In future studies, researchers can evaluate if there are any seasonal components to Cayo assemblages that could confirm the use of seasonal corridors.

7.3 Conclusion

Archaeological, linguistic, and ethnohistorical evidence suggests that peoples frequently traveled between the South American mainland and the Lesser Antilles during the Late Ceramic Age and early colonial period. The archeological evidence of stylistic links between Cayo and Koriabo ceramics establishes that intensive connections existed between Grenada, St. Vincent, and the Guianas (Boomert 2008, 2010; Hofman and Hoogland 2012). The foundation of these ceramic styles fits with linguistic commonalities in these regions. Allaire (1977, 2013) attests to the exchange and similarity of language between the Kaliña and the Kalinago communities. Taylor and Hoff (1980) suggests a shared trading language evolved over the need to communicate across the mainland-island. Ethnohistoric accounts also attest the regularity of these interactions, some accounts suggesting they happened on an annual basis (de Laet 1931).

Though some routes modeled for this work passed far to the east of any islands, many canoe pathways included the potential for stopovers on Trinidad and Tobago. As there are still some gaps in the archaeological hypotheses concerning the connection between Trinidad, Tobago, the Guianas, and the Lesser Antilles (Boomert 2008, 2016), the possibility of stopping over at these islands can point to new areas for archaeological survey that can help fill these gaps. Additional surveys might be of importance for the northeast corner of Tobago and Trinidad, which is frequently passed or touched by modeled routes. Linguistic and ethnohistoric lines of evidence also point to connections between Tobago, the Lesser Antilles, and the Guianas. Archaeological evidence has yet to match these accounts (Allaire 1970; Boomert 2002). However, modeled routes between the Guianas and the Windward Islands suggest that canoers may also have connected with other islands, primarily Trinidad, Tobago, and the Grenadines.

If crews indeed followed these modeled least-cost travel corridors, they possibly traveled north from the mainland during January and returned south in November. November has more routes outside of the channel between Tobago and Trinidad and is also associated with a lower current velocity. It is possible that the consistency in the modeled least-cost pathways suggests that crews attempting to follow a least-cost corridor had more freedom to paddle where they wanted. Freedom of movement in this month may have allowed crews to raid communities in the south more easily. The raiding culture discussed by Boomert (2016) might be a reason for the lack of connection between Trinidad and the Windward Islands. Though there are shared linguistic characteristics between these areas and historic accounts exist of peoples moving through the islands (Boomert 2008), there is little archaeological evidence to support this to date.

Looking at route layout without considering the archaeological background of the islands suggests that Tobago and Trinidad were active partners in exchange routes between the Guianas and the Lesser Antilles. However, there is limited material evidence to support movement through or stopover on Trinidad and Tobago. Additional archaeological evidence may also be able to tie in with social factors that linked islands in the southern Lesser Antilles. It might be that the absence of material support for movement through these islands, raiding or otherwise, is because these regions on Tobago and Trinidad have not been surveyed. In the future, more research is necessary to develop our knowledge of coastal areas, both in these islands and in the islands of the Grenadines. Route trajectories that show connection with islands in the Grenadines may also point to other areas to survey for Cayo sites.

It is possible that social factors and not least-cost routes dictated connections between the South American mainland and the Lesser Antilles. Antagonistic relationships between communities on the Windward Islands and Trinidad or Tobago could have motivated canoers to leave during periods of the year that would have ensured less contact with the latter islands. Ethnographic evidence might support the opposite response, where crews would seek to leave during times of higher probability for stopovers. Least-cost pathways can only provide suggestions of where people moved and not information on issues of avoidance. At this point, it is difficult to say which side of the avoidance/connection dichotomy influenced Amerindian mobility in this region.

These modeled routes point towards the existence of seasonal canoe travel corridors. While not exhaustive, the results of this analysis show that canoers likely had a comprehensive knowledge of their environment. Canoe navigators would have been able to travel from mainland South America to the Windward Islands with varying degrees of success. Crews approaching islands would have been able to use these views and cues to navigate their vessels to sites within possible mental wayfinding maps. These voyages allowed for the intermingling of mainland and island peoples and their cultural traditions leading to the genesis of the Cayo complex. Routes modeled here represent these trips and offer several possible avenues of success for canoers voyaging north to the Windward Islands. This case study showed the benefits of applying least-cost pathways to island-mainland interconnection research, and that canoe routes were linked as much to social factors (*i.e.* avoidance or connection) as environment. These hypothetical canoe routes also provide possible locations for future survey and excavation, allowing for future exploration of inter-island interaction through the Lesser Antilles.