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

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Modeling Canoeing Across the Mona Passage and the Anegada Passage

Connecting the Greater and the Lesser Antilles

For this second case study, I modeled routes between islands in the Greater and the Lesser Antilles in the Late Ceramic Age (AD 1200 – 1500). Inter-island interaction during this period is attested by archaeological evidence (e.g., Hofman 1993, 1995; 2013; Hofman and Hoogland 2011; Hoogland 1996; Hoogland and Hofman 1999). Ceramic and lithic materials with shared stylistic elements of the Chicoid series show the spread of Greater Antillean social concepts (Allaire 1990; Hofman and Hoogland 2011; Keegan and Hofman 2017). These objects and elements typically relate to the so-called Taíno, the term used to describe culturally and materially linked polities in the Late Ceramic Age Greater Antilles (Rouse 1992), and ritual and associated political ideas that are found in the Lesser Antillean arc (see Curet 2009; Hofman *et al.* 2008a; Hofman and Hoogland 2011; Mol 2013, 2014; Rodríguez Ramos 2010; Rodríguez Ramos and Pagán Jiménez 2006). The ceramic typologies establish both the temporal (the Late Ceramic Age) and geographic (Hispaniola to the northern Lesser Antilles) limits of the sites connected. However, there is limited data available concerning the specific provenance of stylistic elements from the Greater Antilles for any of the materials found in the smaller islands (Hofman and Hoogland 2007; Hofman *et al.* 2008a) and archaeologists have found little to no evidence of Lesser Antillean materials on the larger islands to the east (Knippenberg 2007), nor of reciprocated exchange. Routes modeled between sites across the Greater Antillean/Lesser Antillean divide were used to evaluate what areas or sites facilitated the spread of materials and ideas between the island chains and to propose possible reciprocal links between them.

The possible routes modelled between islands in the northern Lesser Antilles in the previous chapter were also likely known by Greater Antillean voyagers and these voyagers likely included them in an individual's or community's wayfinding map (*sensu* McNiven 2008; Terrell and Welsch 1998). Though not discussed in the previous case study, the networks and routes of exchange established between the islands of the northern Lesser Antilles in the Archaic Age were already connected to sites in the west (Righter *et al.* 2004). Island peoples continued to exchange Long Island flint in the Ceramic Age while adapting their strategies to include new materials and ideas. These components came from

beyond the Virgin Islands and Puerto Rico, the initial point of contact with the Greater Antilles from the Lesser Antilles. Whether these inter-island interactions were based on direct contact between Hispaniola and the Lesser Antilles, or mainly occurred through several steps or stops around Puerto Rico and the Virgin Islands, will be evaluated.

For this chapter, I selected route starting points from a series of connected sites drawn from the work of other researchers (*e.g.*, Allaire 1990; Curet 2009; Hofman and Hoogland 2011; Hofman *et al.* 2008a; Keegan and Hofman 2017; Mol 2013, 2014; Rodríguez Ramos 2010; Rodríguez Ramos and Pagán Jiménez 2006), with a shared time frame and similarities in materials that connect the so-called Taíno culture. I placed starting points within the broader context of regional exchange during the Late Ceramic Age to ensure that the resulting models reflected human reality (Curet 2005; Ingold 2000). This broader context safeguards that all routes modeled for this work are linked to known avenues of pre-Columbian Amerindian mobility.

Modeling between sites in ‘separate’ island chains is a way to evaluate the feasibility of long-lasting linkages across large channels. While these sites may not have been occupied at the same time, they are suggested to have all been involved in the same network of cultural and material exchange (*e.g.*, Hofman and Hoogland 2011; Hofman, *et al.* 2014; Keegan and Hofman 2017). Though these sites span over 300 years of history, their placement along canoe travel corridors suggests the continual use of transportation routes across the Anegada Passage and the existence of a cross-passage mental wayfinding map. The archaeological evidence that links these sites to connected communities provides justification for the creation of least-cost pathways over a longer time span. The long history of these connections (see Hofman 1993,

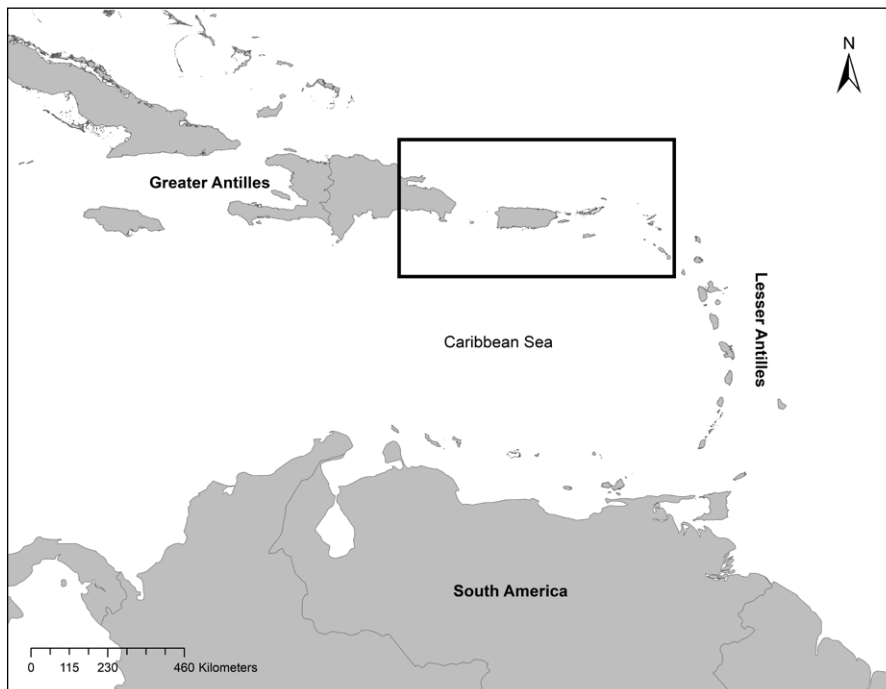


Figure 52: Map of the Caribbean region with the case study region outlined.

2013; Hofman and Hoogland 2011; Hofman *et al.* 2008a, 2008b, 2014; Keegan and Hofman 2017; Oliver 2009; Righter *et al.* 2004) supports the argument that seafarers would have engaged semi-regularly in cross-channel trade.

Sites used as the origin and termination points of these routes were selected for their evidence of interconnection through a review of a range of archeological assemblages and associated analysis of regional networks (Hofman *et al.* 2007; Keegan and Hofman 2017; Mol *et al.* 2015; Righter *et al.* 2004). Due to the lack of evidence for reciprocal exchange and limited presence of these Taíno-inspired objects in Lesser Antillean assemblages, the area of direct and indirect exchange for Greater Antillean materials, objects, and stylistic elements is not well-defined (Hofman *et al.* 2008a; Samson 2010). There is currently no material evidence of cultural influence to show a reciprocal link, or materials from the Lesser Antilles arriving in Hispaniola, between these two spheres. Therefore, archaeologists cannot be certain of the underlying motivations for the structure of social patterns forming these connections (Fitzpatrick 2015; Hofman *et al.* 2008a; Mol *et al.* 2015). While the degree and frequency of these interactions is unknown, a distinction can be made between those routes that connected the Greater Antilles with islands in the north and the islands of the Lesser Antilles in the south. This is likely due to the added difficulty in canoeing over larger distances. This case study, built upon material evidence, includes a basic structure of the Taíno culture from Hispaniola and Puerto Rico to support the mobility of peoples, materials, and ideas. The current research also expands on the background for some sites that were included as points in the case study. The hypothesis of reciprocal links between sites in the northern Lesser Antilles and sites in the Greater Antilles can be furthered, as there are no confirmed points of direct contact between them. The aim of this case study is to evaluate whether digital modeling can uncover possible travel corridors for moving of peoples, materials, and ideas in and out of the Greater Antilles.

6.1 Connecting the Greater Antilles and Lesser Antilles

Many archaeological studies have looked for ways to identify interaction between Amerindians of the Greater Antilles and the Lesser Antilles (see Allaire 1990; Crock and Petersen 2004; Hofman *et al.* 2008a; Whitehead 1995). By analyzing hypothetical reciprocal canoe routes that would have carried materials between islands, I suggest that materials and ideas were being moved across the Anegada Passage as a part either of one-to-one relationships or through multi-stage routes. I am evaluating what modeling reciprocal one-to-one relationships can reveal about direct and possible indirect exchange patterns.

In this case study, I analyzed the time cost and trajectory of reciprocal voyages to identify possible routes for the movement of archaeological materials. The physical structure of the islandscape changes by including islands across the Anegada Passage (*sensu* Broodbank 2000). The longer shape of the archipelago becomes apparent as the islands now appear to be spread out in a chain. While the northern Lesser Antilles are connected through a continuous visual progression, the Anegada Passage divides the northern Lesser Antilles and the Virgin Islands, breaking up a canoeer's viewshed.

At a little over 100 kilometers, the Anegada Passage is one of the few visual breaks between Caribbean islands (Friedman *et al.* 2009). This passage would represent the most challenging point for voyaging. At its center, canoeers would lose land-connected

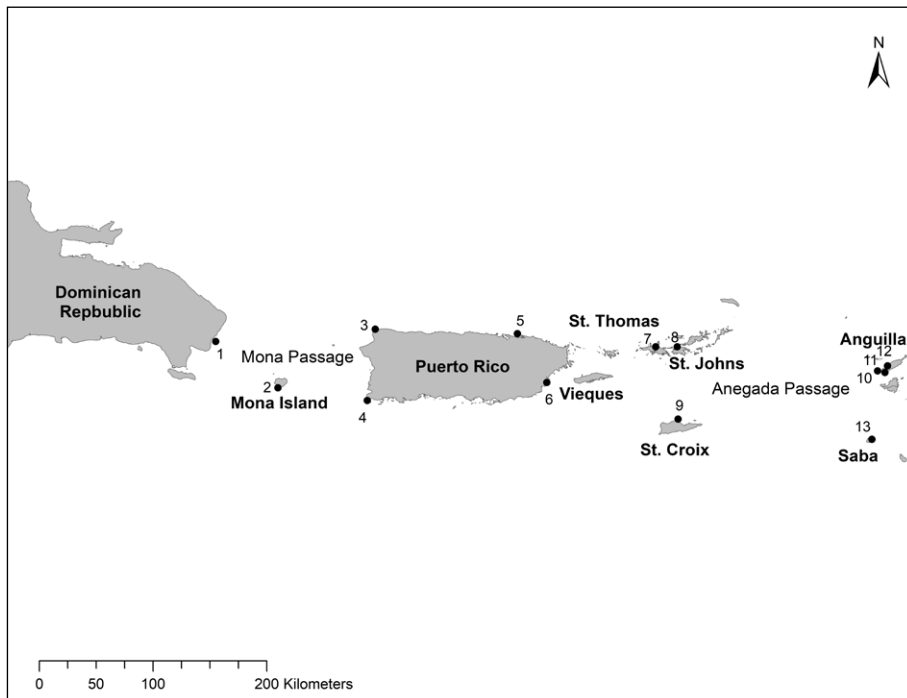


Figure 53: Map of the case study region. Points are as follows, 1: El Cabo, 2: Mona Island egress point, 3: Aguadilla Pueblo, 4 near Bajo Casabe in Cabo Rojo, 5: Punta Las Marias, 6: Punta Candeleiro, 7: Tuto, 8: Cinnamon Bay, 9: Salt River Site, 10: Barnes Bay, 11: Rendezvous Bay, 12: Sandy Ground, 13: Kelbey's Ridge Site.

cues and would have had to rely on other techniques and knowledge to navigate. These tactics would have included celestial navigation and watching for changes in current patterns, storms, or birds on the horizon (Agouridis 1997: 16-18; Bérard 2012; Bilić 2009; Billard *et al.* 2009; Fitzpatrick 2013; Lamarche 1993; Lewis 1994; Torres and Rodríguez Ramos 2008). These wayfinding techniques can only be observed indirectly using the model, due to the tool's focus on environmental factors. Canoe routes generated for this work can help to uncover what style of pathways were used and whether canoers passed by in-between islands. By modeling directed canoe routes I hope to show the layout of these possible canoe travel corridors.

These modeled canoe routes show that the possible pathways through the Anegada Passage often passed close to Puerto Rico, St. Croix, and the Virgin Islands. This movement is consistent with archaeological evidence from both sides of the passage. (Hofman 2013; Keegan and Hofman 2017; Rodríguez Ramos 2010; Righter *et al.* 2004). Similarities in materials from the Leeward and the Virgin Islands, including Lesser Antillean-sourced lithic materials, suggest these connections began in the Archaic Age (2000 – 800 BC) (Hofman *et al.* 2014; Knippenberg 2007; Pagán Jiménez 2011; Righter *et al.* 2004). Puerto Rican influences can also be seen in assemblages from the Lesser Antilles (Hofman *et al.* 2014; Knippenberg 2007). These lines of evidence suggest reciprocal relationships between communities in the Greater Antilles and the Lesser Antilles were in existence for hundreds of years before the start of the Ceramic Age.

6.1.1 Taíno across the Antillean Divide

Many archaeologists and contemporary communities refer to the groups of Caribbean Amerindians who lived on the islands of Hispaniola and Puerto Rico during the Late Ceramic Age as Taíno (*e.g.*, Rouse 1992). However, there is a strong debate over the use of the term and whether it can be used to cover all Ceramic Age polities or communities in the Greater, or even the Lesser, Antilles (*e.g.*, Curet 2009; Keegan and Hofman 2017; Rodríguez Ramos 2010; Rodríguez Ramos and Pagán Jiménez 2006). In recent discussions, regions within the Greater Antillean political sphere of influence have been given subset qualifiers (Curet 2009: 8-10). These regions can further be separated into regional and micro-regional communities, each adhering to the cultural norms of its area while still maintaining some tie to the Central Taíno community in Hispaniola. Though these terms and classifications are contested and, in many cases, may not adequately define the cultural associations of a past Antillean group, I have loosely used them here to form the base on which routes between distant communities can be modeled and inter-regional connection evaluated.

The Late Ceramic Age brought a widespread trend of stylistic and cultural elements connected with the spread and consolidation of Taíno culture to the Greater Antilles (Oliver 2009). Sites that lie on the outer edges of the so-called Central Taíno area have been referred to as the Western Taíno for those from Cuba and Jamaica, while the Eastern Taíno refers to those found in the Lesser Antilles, St. Croix, and the Virgin Islands (Curet 2009: 8-10; Crock 2005; Keegan 2013; Keegan and Hofman 2017). These regional splits are potentially still too general as individual communities in these areas observed Taíno practices and stylistic elements to different extents (Curet 2014). The current study uses the categorical split of Classic Taíno groups from Hispaniola and Eastern Taíno (Rouse 1992) from the Virgin Islands and northern Lesser Antilles (Crock and Petersen 2004) to showcase where crews launched their canoes when heading between the Greater and the Lesser Antilles.

Due to regional differences, the Taíno should be thought of as more of a “cultural mosaic” (Curet 2014; Wilson 2001). This cultural mosaic was made up of separate communities whose assemblages adhered to the stylistic and cultural patterns to varying extents (Curet 2014). So-called Taíno sites are largely identified by their villages’ layouts, burial practices, and ceramic manufacturing styles (Hofman *et al.* 2008a, 2008b; Rouse 1948, 1992; Samson 2010). Taíno culture is found on many archaeological sites within Cuba, Hispaniola, Puerto Rico, and the Lesser Antilles in a variety of ways and degrees, with a higher concentration in the central Greater Antilles (Rouse 1992). In many sites materials – ceramic, shell, bone, and stone – were stylized in a similar vein, following zoomorphic, anthropomorphic, or political themes common to that central area (Rouse 1992). Though numerous examples were produced locally (Crock 2000; Crock and Petersen 2004; Knippenberg 2004), the stylistic trends seen in these objects suggest a cross-channel link between communities. These elements are thought to have originated in the Greater Antilles (Hofman *et al.* 2008a; Oliver 2009; Rouse 1992).

These elements are intertwined with the strengthening of a political power and community organization under the direction of local chiefs, also known as caciques (Oliver 2009; Rouse 1992; Wilson 1990). In Hispaniola, these chiefdoms were hierarchical (Keegan and Hofman 2017; Wilson 1990). In Puerto Rico, the caciques’

power was malleable and adapted to fit local interpretations (Curet 2002; Keegan and Hofman 2017; Oliver 2009; Torres 2012). When progressing outside the center of Classic Taíno culture, defined by Rouse (1992) as Hispaniola and western Puerto Rico, the sociopolitical structure in the eastern chiefdoms varied (Curet 2014). In part, the “variation in leadership capabilities” resulted in fluid relationships between caciques and power (Righter *et al.* 2004: 104).

Structures, spaces, and materials can help to define the spheres of engagement within the core area of Taíno habitation (Curet 2014; Righter *et al.* 2004; Rouse 1992). The number, size, and style of ball courts and other physical structures and the objects associated with them indicate the level of interaction between Central Taíno habitation areas and periphery sites. These structures also separate cultural centers from outposts, and direct connections from possible indirect routes of exchange. Connections between movable objects and permanent structures to central areas and outposts follow forms of exchange and navigation techniques globally (Broodbank 2000, 2002; Fitzpatrick 2013; Terrell 1977). to participate in regional activities and be considered Taíno peoples (Curet 2005, 2009; Hoogland and Hofman 1999; Siegel 2004; Torres 2010). There were differences between outposts, which received objects and enforced cultural norms of a faraway polity, and gateway sites, which actively promoted Taíno wares and ideas. Siegel (1999: 214) defines outposts as camps or settlements that function as a branch or outlying position of a group. The presence of Taíno objects alongside plazas and ball courts in a site outside the Taíno core area suggests that the site likely acted as an outpost, such as the sites of Salt River on St. Croix (Faber-Morse 2004) and Belmont on Tortola (Drewett 2004). The relationship between outposts may have changed over time due to the shift in influence of Taíno polities over outlying communities. Routes between these communities may also have responded to changing alliances or sympathies.

Siegel (1999) also argues for a separation between “locally emerging polities” and the so-called “spheres of influence” that extended into the northern Lesser Antilles. Outpost communities were introduced to Taíno material through core-periphery relationships (Allaire 1990; Hofman and Hoogland 2011). These periphery sites adopted several aspects of Greater Antillean cultural identifiers without assuming the same polity structure observed in either Hispaniola or Puerto Rico (Curet 2009; Hoogland and Hofman 1999). The connections between periphery sites and those in the liminal space between core site and outpost can be evaluated to assess the flow of information and materials through the region.

Sites sometimes acted as both outposts and gateways, though to function as a gateway site the community must have put effort towards the dispersal of goods between different groups perpetuating core-periphery entanglements. It is difficult to establish how the transfer of materials and knowledge was organized, whether it was a concentrated effort to push a cultural narrative or the result of many different points of contact. These patterns of exchange could have resulted from multiple factors (Hofman *et al.* 2008a). Several of these factors are displayed in the production and deposition of Lesser Antillean artifacts. The evolving series of inter-island connections through gateway sites makes them ideal nodes for this case study.

6.1.2 Ceramic Styles

Ceramic typological evidence has been used to define cultural groups in the Caribbean for many years (*e.g.*, Hofman 1979; McKusick 1960; Rouse 1948, 1952, 1992). Correlations in ceramic stylistic elements between the Greater and the Lesser Antilles are a strong indicator of connection and interaction during the Ceramic Age. Pottery styles from the region have been discussed in depth by past researchers (see Faber-Morse 2004; Hofman and Jacobs 2000; Hofman *et al.* 2008a, 2008b; McKusick 1960; Roe 1989). As the focus of this study was to develop and utilize a method to evaluate least-cost pathway analysis over water environments, ceramic styles will be used to ground the placement of origin and termination points for route modeling. The ceramic evidence referenced here indicates possible political and cultural ties between the peoples of the Greater and the Lesser Antilles.

The provenance data of these artifacts is still fragmentary, although it has shown that many of the ceramics analyzed were produced locally. Hofman (1993) attributed the spread of these stylistic elements and/or similarities in local ceramics to the movement of Amerindian peoples from the Greater Antilles to the Lesser Antilles. These ceramic types in the northern Lesser Antilles would reflect the fusion and fission of interacting worldviews (Hoogland and Hofman 1999). These styles include Chican Ostionoid ceramics (Allaire 1990; Crock 2000; Crock and Petersen 2004; Curet and Stringer 2010; Hofman 1993; Hofman *et al.* 2008a; Tables 7 and 8). The Chican Ostionoid style is a distinct identifier of Taíno culture or influence and archaeologists have used this ceramic series to suggest contact across the Anegada Passage (Hofman *et al.* 2008a). The Chicoid ceramic style was popular from AD 1200 to 1500 (Rouse 1992; Siegel 1996), which coincides with this case study. Chican Ostionoid ceramics have been found in several assemblages across the northern Lesser Antilles (see Crock 2000; Henocq and Petit 1995; Hofman and Hoogland 2011; Hoogland and Hofman 1999). First identified in sites in the southern Dominican Republic (Hofman 2013; Keegan and Hofman 2017), the Boca Chica style of the Chican Ostionoid ceramic complex is found throughout Puerto Rico (Crock 2000; Hofman *et al.* 2008a) and some of the Leeward Islands (Hofman *et al.* 2008a; Hoogland and Hofman 1999). Boca Chica ceramics are strongly linked with the western side of Puerto Rico (Carlson and Torres 2011) and follow the narrative of shared ceramic culture in the Central Taíno sphere. Other examples of Chican ceramic styles that moved east include Esperanza, from Puerto Rico, and Capa, from Puerto Rico and the Virgin Islands (Rouse 1958; Siegel 1996; Torres 2012). These styles link to the transitional or outlying areas of Taíno polities, bridging the divide between Hispaniola and the Lesser Antilles. Thus, Chicoid ceramics can be used to justify modeling connections from Hispaniola past Puerto Rico and into the Lesser Antilles.

Boca Chica Chicoid ceramics have been found on several sites in the Lesser Antilles, including the Kelbey's Ridge site on Saba (Hoogland and Hofman 1999, 2011, 2013). Other Leeward Islands with Chicoid ceramic stylistic influences include Anguilla and St. Martin. Isolated stylistic features from the Greater Antilles have been found on St. Martin, St. Eustatius, Antigua, Guadeloupe, Marie-Galante, Martinique, St. Lucia, St. Vincent and the Grenadines (see Allaire 1990; Bonnissent 2013; Crock 2000; de Waal 2006; Douglas 1991; Henocq and Petit 1995; Hofman 1993, 1995; Hoogland 1996; Knippenberg 2007, 2013; Rouse 1992). These islands provide possible locations for

Periods	Cuba			Hispaniola		Puerto Rico		Virgin Islands
	Western	Central	Eastern	Haiti	Dominican Republic	Western	Eastern	
IV			Pueblo Viejo	Carrier		Capa	Esperanza	
III	b	Bani		Meillac	Boca Chica		Santa Elena	Santa Elena
	a			(Macady)	(Corales)	Ostiones		(Ostiones Like)
II	b	Guayabo Blanco and Cayo Redondo		Cabaret and Couri	(Railroad Cave)	Cuevas		
	a							
I						(Coroso)	(Krum Bay)	

Table 7: “Chronological Profiles for the Eastern Caribbean Area” (Rouse 1958: 191, Figure 2). This chart roughly corresponds to the relationship between different ceramic styles in the Greater Antilles, though it has been updated by more recent scholars (see table 8 and Figure 54).

Time Period	Dates	Social organization	Community organization	Ideological organization	Disposal of the dead	Cultural complex
PII	500 BC - AD 600	Tribe/complex tribe	Village-oriented, central plaza ringed, by communal houses	Ancestor worship; egalitarian ethic	Community based; central plaza area	Hacienda Grande, Cuevas
PIII	AD 600 – AD 1200	Complex tribe/simple chiefdom	Small village-large village-ball court	Ancestor worship; incipient ascriptive social inequality	Community based; ball courts	Monserrate, Santa Elena
PIV	AD 1200 – AD 1500	Simple chiefdom/complex chiefdom	Polity-based, village hierarchy	Ancestor worship with ideology of domination	Clan-based; mounds; socially partitioned spatially and by grave goods	Esperanza, Capa, Boca Chica

Table 8: Social organization and cultural complex through time (Siegel 1996: Table 2; Torres 2013: 24.1).

origin nodes. However, not every island mentioned above will be used as a location for launch and landing points. Instead, a sample of islands will be selected as targets for the export and import of stylistic elements to assess the possible location of travel corridors and connectedness in these pre-Columbian communities.

6.1.3 Three Pointers and Shell Masks

Taíno cultural objects such as three pointers (*zemís*), shell masks (*guatizas*), and paraphernalia associated with the consumption of hallucinogens have been identified in assemblages from the Lesser Antilles (Allaire 1990; Crock 2000; Crock and Petersen 2004; Curet 1992; Hofman *et al.* 2008; Mol 2014; Oliver 2009; Wilson 2007). These objects often follow the

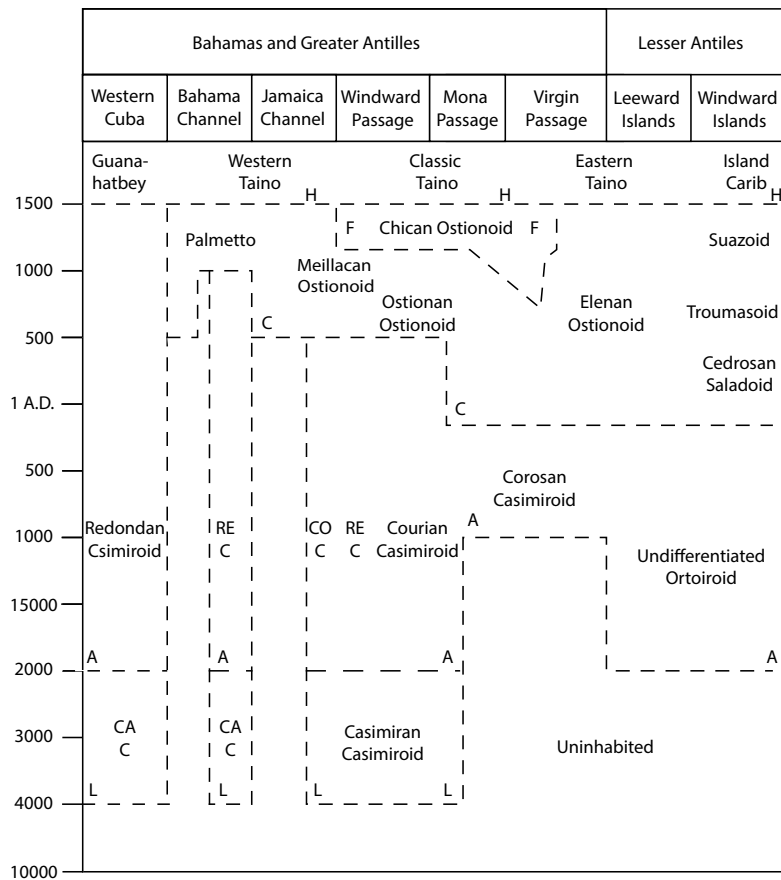


Figure 54: Modified from Rouse 1992 Figure 8, "Chronology of the series and sub-series of the West Indies" (Rouse 1992: 32.). This figure roughly shows the relationship between different ceramic styles in the Greater Antilles and Lesser Antilles. Here, the archaeological periods, or ages, are represented as A: Archaic, C: Ceramic, F: Formative, H: Historic, L: Lithic.

iconographic characteristics common in the Chicnan Ostionoid style and suggest the spread of Greater Antilles Late Ceramic Age Amerindian culture through the Caribbean region.

Of these objects, perhaps the clearest link to the political practices of the Greater Antilles are the three pointers. Three pointer figurines are made from various types of stone, shell, or wood. These items represent divine-like beings associated with Taíno ancestors and are often carved with anthropomorphic representations highlighting this connection (Oliver 2009). Three pointers can be shaped into statuettes, but often appear in a three-pointed isosceles shape (Breukel 2013; Oliver 2009; Rouse 1992). These objects were imbued with certain spiritual forces and their power could be transferred to anyone who physically possessed them (Oliver 2009). Three pointers have been linked with a Taíno cacique's political authority. As documented in ethnohistoric sources, the presence of three pointers connects to the competitive nature of different Taíno communities. The procurement of a rival's three pointers to gain their spiritual power was the objective of raids (Oliver 1995). The fact that these objects are found in the Lesser Antilles could indicate the spread of the "chieftain ideology of domination"

(Moscoso 1981; Siegel 2010). Three pointers are also a material link to the political objectives of those competing for dominance on islands like Puerto Rico. It is possible that caciques expanded their area of influence by exchanging or capturing three pointers (Oliver 2009). Three pointers were present in the Lesser Antilles from Saladoid times on, indicating that by the Late Ceramic Age they would have formed established links to Taíno political influence in the region.

Large stone three pointers have been found on Anguilla, Guadeloupe, and Dominica (Crock 2000; Hofman *et al.* 2007; Honeychurch 1997a; Knippenberg 2007; Oliver 2009). Small three pointers have been found throughout the Lesser Antilles, even as far south as Grenada (Crock 2000; Hofman *et al.* 2007; Honeychurch 1997; Knippenberg 2007; Oliver 2009). Three pointers have also been found on multiple islands of the Lesser Antilles, above and below the ‘direct influence’ split found around Guadeloupe (Hofman *et al.* 2008a). Three pointers found in these islands depict anthropomorphic, zoomorphic, or anthropozoomorphic features associated with Taíno ancestors and could have been used to solidify a cacique’s power in outpost communities (Curet 1992; Hofman *et al.* 2008a). They have been found on islands not directly addressed here, such as Guadeloupe and Dominica (Crock 2000; Hofman *et al.* 2008a; Honeychurch 1997a). The presence of these objects suggests that communities in the Greater Antilles were influencing the culture and production of three pointers in the Lesser Antilles (Crock 2000; Hofman and Hoogland 2011; Hoogland and Hofman 1999). That these objects were made locally would suggest that communities in the Lesser Antilles had some level of Taíno social and/or political affiliations.

Shell masks alongside three pointers and ceramic traits, also fall into the category of Taíno anthropomorphic stylistic elements. Anthropomorphic features associated with shell masks can range from representations of human faces to what could be considered masks (Hofman *et al.* 2008a). Several of these shell masks have been found in the Lesser Antilles, including on the islands of Anguilla, Antigua, Marie-Galante and La Désirade off Guadeloupe, St. Lucia, and Il de Ronde in the Grenadines (Hofman 1995; Hofman *et al.* 2004; Mol 2007, 2014). Ceramics that showed evidence of a Chicoid influence were also found on these islands. The presence of three pointers, shell masks, and ceramic stylistic traits indicate islands and sites to use as nodes to model canoe routes through the Greater and the Lesser Antilles.

6.2 Islands and Points

The macro-regional movement of cultural items shows the spread of Taíno cultural influence eastward from Hispaniola through Puerto Rico, ending in the Lesser Antilles. Movement of ceramics and other objects into the Lesser Antilles aligns with the existence of a “west to east corridor of influence” (Rodríguez Ramos 2001; Rodríguez Ramos and Pagán Jiménez 2006: 121). As evidence for cross-passage links is found throughout the Lesser Antilles, it is unclear which island communities were in direct contact with Taíno emissaries and which indirectly received materials from others within their own micro-regional sphere. Hofman *et al.* (2008a) argued that there is a distinct separation for the sphere of direct interaction around the island of Guadeloupe. Though Taíno materials are spread further to the south, items are more diffused there than in the

northern islands. This supports one-to-one relationships across the Anegada Passage terminating north of Guadeloupe.

The routes modeled for this case study help to illuminate which groups might have been in contact, and what sites would have acted as cultural mediators. For this research, I will focus on a comparison of movement between gateway sites, which acted as distribution and introduction points for Taíno influences in the Lesser Antilles, from the Dominican Republic through Puerto Rico, the Virgin Islands and St. Croix, to the islands of Saba and Anguilla in the northern Lesser Antilles.

6.2.1 Southeastern Hispaniola

As there is no confirmation, at least through the presence of reciprocated exchange, that any specific site in the Greater Antilles acted as an exportation center, the origin and termination points for the route model will be located on the southeastern portion of the island of Hispaniola, which was divided into several paramount chiefdoms (Curet *et al.* 2008). I restricted site selection in the Greater Antilles to this island as little remains of this region's Later Ceramic Age settlements (Samson 2010). There is a high density of Late Ceramic Age sites on this portion of the island, especially around the Punta Cana region (Keegan 2006). As there has also been a large amount of site destruction along the coastlines, only one site, El Cabo, will act as a distribution center and represent the origin of Taíno influence that spread from Hispaniola (Hofman and Hoogland 2016). This site will stand in for all other sites that could have engaged in the cross-island inter-regional trade evaluated.

El Cabo is an example of a Classic Taíno site (Keegan and Hofman 2017) that dates to the Late Ceramic Age (Samson 2010). The site overlooks the Mona Passage (Hofman *et al.* 2014), indicating it was a coastal connection point for canoers moving west from Mona Island and Puerto Rico. The structure of El Cabo, which could be classified as a Central Taíno site, is in line with intra-site settlement patterning from Puerto Rico. The site has roughly 50 structures, of which more than half were houses, reflecting four different configurations of house trajectories over a 250-year period (Samson 2010: 239-242). Excavations of the latest phase at El Cabo have produced Chican Ostionoid pottery, in line with other assemblages dating to this period (Hofman *et al.* 2007; Samson 2010; Samson and Hoogland 2007).

El Cabo was still occupied in the early period of European interaction (Samson 2010). Though it was one of the final areas to be placed under Spanish control, Spanish materials appear in the site's assemblage (Ernst and Hofman 2015; Hofman *et al.* 2014; Valcárcel *et al.* 2013). It is unlikely that these materials came into the site through direct contact due to the geographical distance between this site and initial Spanish settlements. The presence of these materials indicates that a series of well-defined exchange systems were used to transfer objects and ideas outside direct spheres of influence (Hofman *et al.* 2014). This feeds into the narrative of El Cabo existing as a point of transfer for materials both in and out of the Hispaniola (Hofman *et al.* 2014; Samson 2010), making the site a strong candidate for inclusion in this study.

6.2.2 Mona Island

Mona Island lies almost directly in the center of the 120-km long Mona Passage separating Hispaniola from Puerto Rico (Samson and Cooper 2015). Occupation of the island likely began around 2800 to 1000 BC, based in part on radiocarbon dates from Cueva de los Caracoles (Dávila Dávila 1998, 2003; Samson *et al.* 2014: 3). Peoples continued to come to Mona Island through the Ceramic Age and into the early colonial period (Crusoe and Deutschle 1974; Dávila Dávila 2003; Rouse 1952; Samson *et al.* 2014). Mona Island was a “magnet for indigenous communities” as late as the sixteenth century (Samson *et al.* 2014: 4), well after the period discussed in this chapter. In fact, Europeans entering the region recorded the importance of Mona Island to the indigenous peoples of the Antilles (Arana-Soto 1969; Samson *et al.* 2014). Mona Island likely played a key role in the initial expansion of peoples into the Antilles (Dávila Dávila 2003; Rouse 1992; Samson and Cooper 2015; Samson *et al.* 2014: 5), which may have established it as a point of contact or a rest area for navigators.

Despite its small size (50 km²) (Samson and Cooper 2015) large sites have been found on the island, including the site of Sardinera with the combined length of its middens running over two km² (Rouse 1952:366; Samson *et al.* 2014: 4). Mona Island also holds several cave sites (Dávila Dávila 1989, 2003; Rouse 1952; Samson *et al.* 2014; Vieten *et al.* 2016). Caves on Mona Island were widely used, by both Amerindians and Europeans, perhaps due to their status as a unique resource (Samson and Cooper 2015: 41; Samson *et al.* 2014). This use is documented through alterations to the cave walls and ceilings, either by incisions into the rock or by the addition of pigment (Samson *et al.* 2014: 7). In part, these caves were important to passing travelers because they are the only source of water on the island (Samson *et al.* 2014: 11). Additionally, the position of some of these cave sites along the north coast of the island may signal a connection between Mona Island and movement between Puerto Rico and Hispaniola. Communities engaging in and with these caves maintained connections across “generations, between people, ancestors, and non-human entities” that could have been understood by peoples across the Mona Passage and beyond (Samson and Cooper 2015: 52). The continuation of these connections may have linked Mona Island to an individual’s, or community’s, mental seafaring map and promote the use of the island as a node within this case study.

6.2.3 Puerto Rico

Curet *et al.* (2004) suggest that Puerto Rico was split into several smaller competitive polities, unlike Hispaniola that likely had larger chiefdoms. From AD 600 to 1200 the Puerto Rico population increased, leading to a dramatic surge in the number of sites on the island (Curet 1987; Curet *et al.* 2004). This trend coincided with a change in the social and physical patterns of sites, particularly in site layouts (Curet *et al.* 2004; Torres 2010). At least on the eastern end of the island, communities moved towards centralized habitation (Curet 1992; Siegel 2010; Torres 2010). This shift aligned with the consolidation of power under the burgeoning chiefdom system.

The geographic dispersal of these sites changed how peoples related to coastal areas. During this period, nucleated communities in the interior developed an arrangement of linear settlements near the coast (Crock 2000; Rodríguez Lopez 1992; Siegel 2010). Early connections with the coast likely cemented the position of interior communities

within broader inter-island networks. Canoe voyages were essential in maintaining micro- and macro-regional exchange networks that supported the exportation and expansion of Taíno culture. A continued presence on the coast ensured that these peoples remained in contact with their neighbors, both on their own island and beyond it.

In this modeling, some generalizations in the use of sites on Puerto Rico and its outward affiliations were made to justify connections between sites. I assumed connections could occur between all nodes and that connected areas were representative launch points for travel throughout the region. As with El Cabo, there are no confirmed specific site-to-site reciprocated connections. Areas close to the coast were chosen to be a part of this study to represent high contact areas. Nodes connected using the route tool were placed in areas with evidence of coastal habitation during some phase of the Ceramic Age. The resulting five areas with active settlements sometime between ca. AD 500 to 1500 – Punta Candelero, Punta Las Marias near Bajo, Casabe in Cabo Rojo, Aguadilla Pueblo, and Mona Island (see Keegan and Hofman 2017) – were selected as representatives for all possible connection points on these islands. In future research, evaluating more sites from around the coast will allow for a greater representation of pre-Columbian Puerto Rican communities within the network.

6.2.4 *St. Thomas and St. John*

Between the Greater Antilles and the Leeward Islands sit the Virgin Islands. Amerindians living in the Virgin Islands in the Ceramic Age were connected to the Taíno sphere of influence (Righter *et al.* 2004). The position of these islands makes it likely that they acted as stopover points for crews traveling across the Anegada Passage.

As on sites in the Lesser Antilles, Boca Chica style pottery has been found on two sites on St. Thomas (Righter *et al.* 2004). These ceramic materials evidencing zoomorphic stylistic elements include two petaloid celts, stone collar fragments, a vomiting stick (de Booy 1919), an anthropomorphic representation on a stone pestle (Kay 1976), and a shell carved into a bird effigy (Hatt 1924). Similar materials, including a sculpted stone head, stone bead and celt with sculpted anthropomorphic face, and Taíno-styled shell adornments have been found on St. John (Righter *et al.* 2004). Multiple shell inlays, which may have adorned several three pointer statues or figurines, were also recovered (Alegria 1981). These items have been associated with Greater Antillean elites or ceremonial activities (Righter *et al.* 2004) and support some form of involvement with Taíno religious and social hierarchy (Wild 2001). Righter *et al.* (2004) determined that these materials were a result of direct contact with eastern Puerto Rican Taíno communities during the Late Ceramic Age.

The sites of Tutu on St. Thomas (Lundberg 2002; Righter 2002; Righter *et al.* 2004) and Cinnamon Bay on St. John (Righter *et al.* 2004; Wild 2001) will be considered as additional nodes for modeling because they also possess material evidence of Taíno influence.

6.2.5 *St. Croix*

Another possible stopover point in the study area is the island of St. Croix, which lies at the southern edge of the Anegada Passage. Many sites on St. Croix dating to the Late Ceramic Age are found on the coast and within easy reach of approaching canoes (Hardy 2008). Some of these sites have been linked through archaeologi-

cal evidence to those on the Virgin Islands (Righter *et al.* 2004), Puerto Rico, and the Leeward Islands (Hardy 2008). As in the Virgin Islands, communities on St. Croix also adopted Ostionoid style pottery (Faber-Morse 1995, 2004; Lundberg and Righter 1999). Boca Chica stylistic elements found on pottery from the island reflect Later Ceramic Age connections between the island and others in the region (Hardy 2009). Ceramic sherds, which have been sourced to Puerto Rico, also appear in some assemblages (Ferguson and Glascock 2006; Hardy 2008). The Salt River site (Faber-Morse 2004) reflects ties to Eastern Taíno communities. Much like its counterparts on Puerto Rico, the Salt River site contained a ball court and Chican Ostionoid pottery (Faber-Morse 1995, 2004).

St. Croix has been considered as a key eastern outpost of the Classic Taíno sphere of influence (Rouse 1992; Keegan and Hofman 2017). The materials found within the island indicate peoples from the island participated in so-called Taíno culture through the production of Greater Antillean-styled ceramics and political objects, such as three pointers (Rouse 1992). The presence of larger structures, such as ball courts and civic ceremonial sites (Faber-Morse 2004; Rodríguez Ramos and Pagán Jiménez 2006), at places like Salt River suggest that peoples living on this island had a closer relationship with Greater Antillean social structures than those inhabiting islands to the east. As Curet (2003, 2005, 2009: 8-10, 26) suggests, it is likely that communities in the Eastern Taíno zone were in fact autonomous communities, or “peer polities”, that engaged in a shared regional culture without being wholly governed by it. However, due to its position between Puerto Rico and the Leeward Islands, it is possible that communities on the island facilitated the expansion of Greater Antillean objects and stylistic elements.

6.2.6 Anguilla

Crock and Peterson (2004) suggest that Anguilla was an active part of the Greater Antillean sphere of influence (see also Hofman *et al.* 2008a; Siegel 2010). An argument has been made for a lesser Taíno chiefdom operating on the island (Crock and Peterson 2004). A Taíno-related ceremonial site, Fountain Cave, with carved petroglyphs and a large stalagmite anthropomorphic statue, has been found on the island (Crock 2000; Waters 1991). These carvings are like those found on Hispaniola and Puerto Rico (Kerchache 1994; Stevens-Arroyo 1988). It is possible that, like in the Greater Antilles, multi-island chiefdoms developed around Anguilla and the islands in the Anguilla Bank (Crock and Peterson 2004: 144).

Anguillan assemblages show examples of decorated ceramics that resemble those found on Hispaniola and Puerto Rico, particularly the Boca Chica and Esperanza styles (Crock 2000; Crock and Peterson 2004), including the presence of zoomorphic and raised node adornos (Crock 2000). These styles stand out amongst the other pottery examples from the island as they are not heavily decorated (Crock and Peterson 2004). Amerindian villages on Anguilla were active members of Late Ceramic Age inter-island networks, though access to these ceramics was possibly restricted and subject to a good relationship between canoe owners and traders (Crock 2000). Crock (2000: 233) even suggests that a village’s yearly supply of ceramics may have arrived in one large canoe. Annual shipments of materials may relate to seasonal accessibility of routes across the Anegada Passage.

Three pointers, shell masks, snuffing tubes, and vomiting spatulae found on the island also suggest the presence of a local polity (Crock 2000; Knippenberg 2004). Lesser Antilles three pointers were predominantly made on Anguilla (Crock 2000), as indicated by archaeological evidence that shows that calci-rudite three pointers were produced on the island (Crock 2000; Knippenberg 2004). The presence of locally manufactured three pointers at the sites of Rendezvous Bay, Barnes Bay, and Sandy Ground (Crock 2000; Crock and Peterson 1999) nominates these three points for inclusion in the network of sites modeled below. Movement to and from Barnes Bay will be modeled to evaluate possible one-to-one relationships between the Greater Antilles and the Lesser Antilles.

6.2.7 Saba

The site of Kelbey's Ridge (AD 1200 – 1350) has been suggested as a link in the Greater Antillean Taíno extended sphere during the Late Ceramic Age (see Hofman and Hoogland 2011; Hofman *et al.* 2008a, 2014; Hoogland and Hofman 1999; Mol *et al.* 2015). Saba complements Anguilla as a likely point of contact for those making the journey east due to the island's position close to the Anegada Passage, and thus to the Greater Antilles. Saba is currently the only Leeward Island with a large Boca Chica-style assemblage within the bounds of a Taíno-affiliated settlement (Hofman *et al.* 2008a). It is possible that Kelbey's Ridge may have been an outpost (Hofman *et al.* 2014), or perhaps a gateway site, for those in the Greater Antillean sphere.

Access to the Saba Bank may have also encouraged peoples to settle on Saba, tying access to marine resources to the success of the site. Kelbey's Ridge possibly began life as a resource procurement center (Hoogland and Hofman 1999, 2011; Keegan and Hofman 2017), evolving into a site that could exert influence over materials imported to the Lesser Antilles from the Greater Antilles (Keegan and Hofman 2017). The layout of Kelbey's Ridge suggests that it may have fallen within the sphere of Eastern Taíno influence (Keegan and Hofman 2017). As evidenced by the five 6 x 8 m diameter round or oval houses uncovered within its premises, Kelbey's Ridge was a habitation site (Hoogland and Hofman 1999). The house trajectory of these structures, with burials under the house floors (Hofman and Hoogland 2011; Hoogland and Hofman 1999, 2013), is similar to those found in the Greater Antilles and the Virgin Islands from the same period (Curet *et al.* 2005; Keegan 2007) and to that of El Cabo (Hofman and Hoogland 2013; Samson 2013), suggesting cultural affiliations between the peoples living at this site to those from the eastern part of Hispaniola.

It is possible that Kelbey's Ridge acted as a gateway site for Taíno ideas, as Chican Ostionoid style ceramics were manufactured on the island (Hofman 1993; Hofman and Hoogland 2011; Hoogland and Hofman 1999). Hoogland (1996) stresses the importance of these materials, suggesting they indicate that groups already present on Saba either were incorporated into the larger political sphere extending out from Hispaniola or were Taíno colonists on Saba. Ceramic links include decorated ceremonial vessels adorned with depictions of Taíno mythological figures. Non-local ceramic material has also been found on Saba in small numbers, which XRF testing suggests holds possible origins in neighboring islands and the Greater Antilles (Hofman *et al.* 2008c). These pieces also support the argument that there was some form of connection between peoples living in Hispaniola or Puerto Rico and Saba. Despite the 'for-

eign' stylistic elements, most of the pottery was manufactured locally (Hofman 1993; Hofman *et al.* 2008a, 2008c), suggesting that although these ceramics were not made from the same materials as those in the Greater Antilles, Lesser Antillean pottery was made in a similar tradition.

Hofman and Hoogland (1999: 178) have hypothesized that, in addition to sharing ceramic stylistic elements with the Greater Antilles, Kelbey's Ridge also acted as a periphery site representative of the so-called Central Taíno (*e.g.*, Curet 2009: 8-10, Rouse 1992) interaction sphere. It is possible that the site grew from its beginnings as a resource procurement camp to take advantage of passing exchange from the Greater Antilles to the Lesser Antilles. This may have included materials coming from as far away as mainland South America (Keegan and Hofman 2017), highlighting its possible role of intermediary of prestige goods (Hofman and Hoogland 2011; Hoogland and Hofman 1999). Saba's position may have placed it in a prime position to take advantage of travel corridors moving out from St. Croix. In this case, movement from Saba towards St. Croix and Puerto Rico should be tested to determine the ease of connection between the Greater and the Lesser Antilles.

6.3 Modeling Routes between the Greater Antilles and the Lesser Antilles

The canoe routes discussed here differ from the previous case study in part because of the geographic relationship between the islands. In the last chapter, the islands were clustered around the open space through which the canoe moved. Islands and sites studied in this chapter are laid out in an arc rather than a cluster. In many cases there is no island available to provide a break between the current's push and the open sea. Crews crossing between the Greater Antilles and Leeward Islands had to brave the large divide of the Anegada Passage instead.

The following runs will determine the least-cost connections between Hispaniola and the northern Lesser Antilles. Crews moving through this arc had to contend with both the resulting time cost and the associated trajectory of these voyages. Modeling these factors can indicate the more likely avenues of canoe movement across the broader region. Evaluating the cost and trajectory of routes can highlight stopover points along coastlines that are passed in the middle of a journey. The layout of these routes can suggest possible centers for connection over different periods of the year.

6.3.1 Underlying Environmental Factors

Route time costs are based upon the environmental data, namely currents. These currents are different at different times of year, thus influencing the seasonal variations inherent in these routes. The current tool (see Chapter 4) was used to evaluate the reliability of underlying currents and the existence of seafaring seasons. This tool samples the underlying current direction and force values (see Chapter 4), which can then be used to determine the months that can be assessed as optimal canoeing seasons. In keeping with the methods used in the previous chapter, several points were selected across the region to evaluate for regularities in the current. I could determine the currents' force and direction when they were least influenced by the presence of islands by checking current values in channels. Points were centered in the channels between the

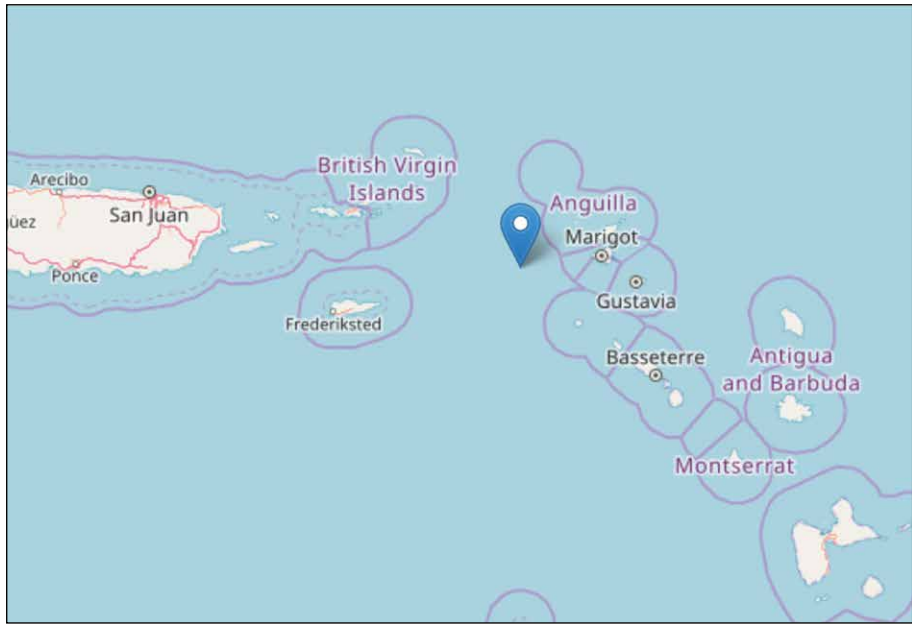


Figure 55: Map showing the first point (17.978733, -63.632813) tested with the current tool.

major islands of interest. These include the Mona Passage and the Anegada Passage. Two points were placed in the expanse between the Greater Antilles and the Leeward Islands to ensure that the currents at either end of the channel were evaluated.

Point 1 (17.978, -63.632) is located north of the Saba Bank at the eastern edge of the Anegada Passage. Here, current strength remains stable throughout the year (see Figure 55). Trends observed across all years show that current force remains below, or just above, 0.5 knots. Currents never exceed 0.75 knots. There is more variation in the direction of current. Currents typically head to the northwest or west, yet can also trend towards the east or south, most commonly from January to June 2014 to 2016 and July to December of 2013 (see Figure 56).

Three clear seasons emerge when looking at the 15- and 30-day averages for all years (see Figure 57). The first season centers on December to April (see Figure 57). During this time, currents head in a west to southwest direction. This could indicate that current values towards the northwest, west, southwest, and south averaged to move to the southwest. During the spring and summer, from May to September, current-forces push towards the northwest (see Figure 57). This is consistent with current movement through the northern Lesser Antilles during this period. From September to November current force pushed to the south and then the east, before returning to a westward movement (see Figure 57). Radical shifts in current direction over these months likely made this ‘travel season’ more difficult for crews.

Point 2 (18.135, -64.379) is located near the east Virgin Islands. It also lies north of the eastern edge of St. Croix (see Figure 58). Point 2 captures current movement at the western end of the Anegada Passage. Current strength values for this point sometimes resemble those observed in the northern Lesser Antilles, in that they do not commonly exceed one knot (see Chapter 5). At the second point, average current flow

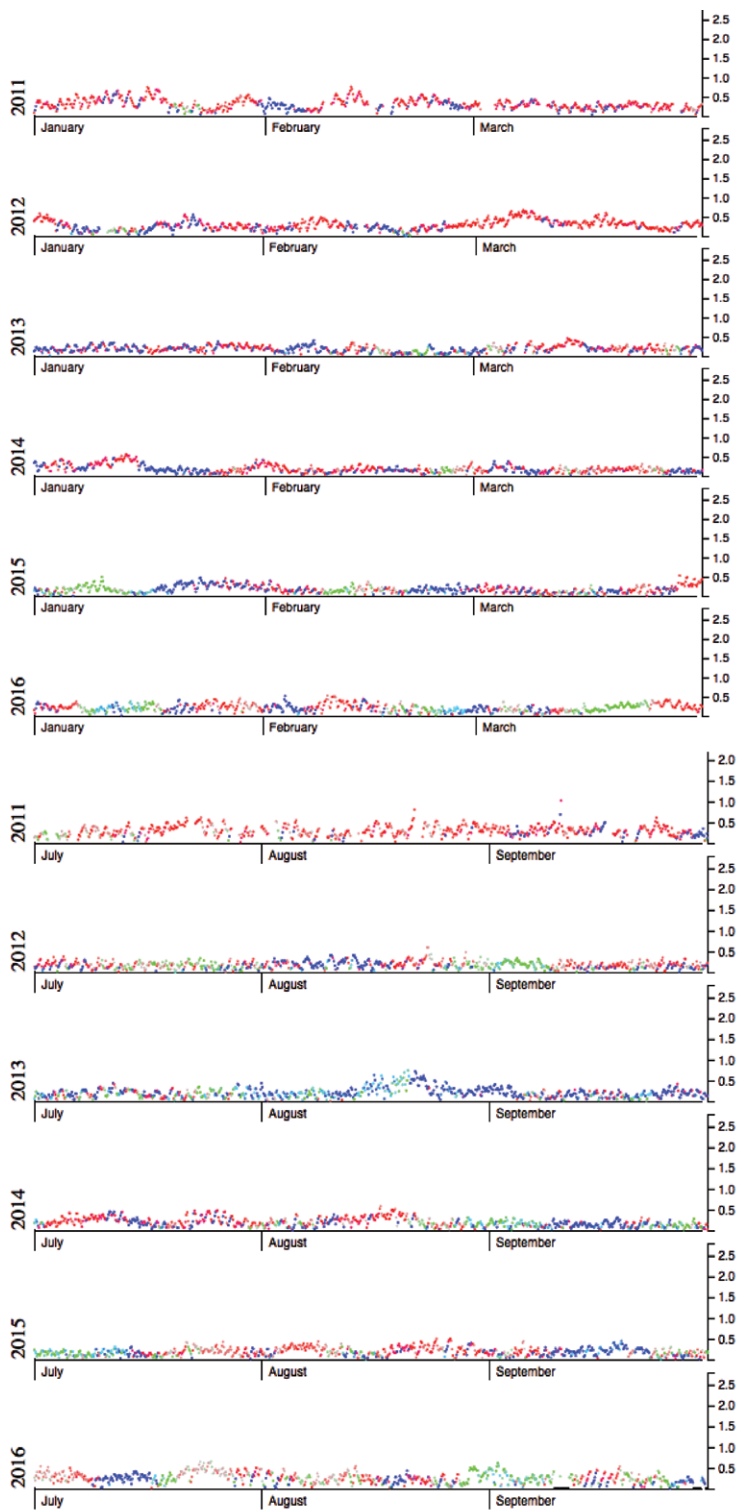
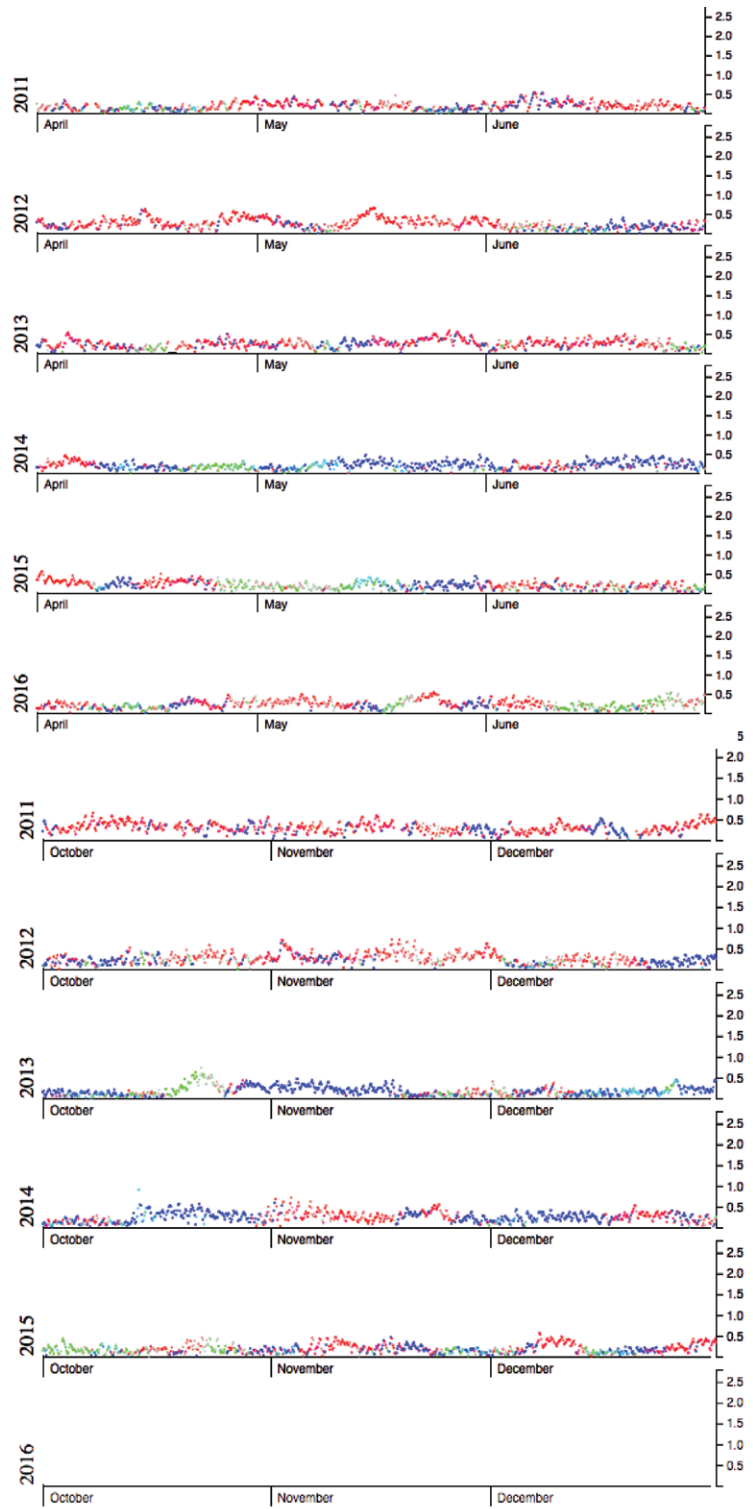


Figure 56 (continued on opposite page): Charts showing the direction and force of current at Point 1 (17.978733, -63.632813) from January to December 2011 to 2016.



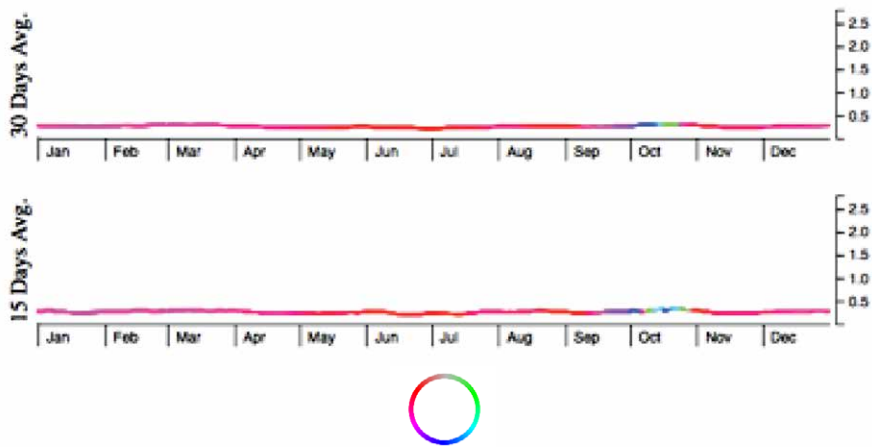


Figure 57: Charts showing the 15- and 30-day averages of direction and force of current at the Point 1 (17.978733, -63.632813) from 2011 to 2016. North moving currents are represented on the color wheel by grey, south by blue, west by red, and east by green (see Chapter 4).



Figure 58: Map showing point 2 (18.135412, -64.379883) tested with the current tool (see Chapter 4).

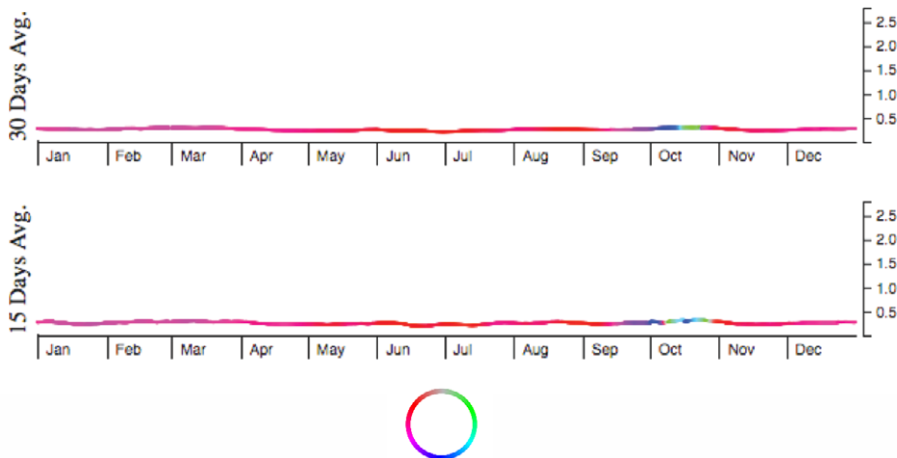


Figure 59: Charts showing the 15- and 30-day averages of direction and force of current at Point 2 (18.135412, -64.379883) from 2011 to 2016. North moving currents are represented on the color wheel by grey, south by blue, west by red, and east by green (see Chapter 4).

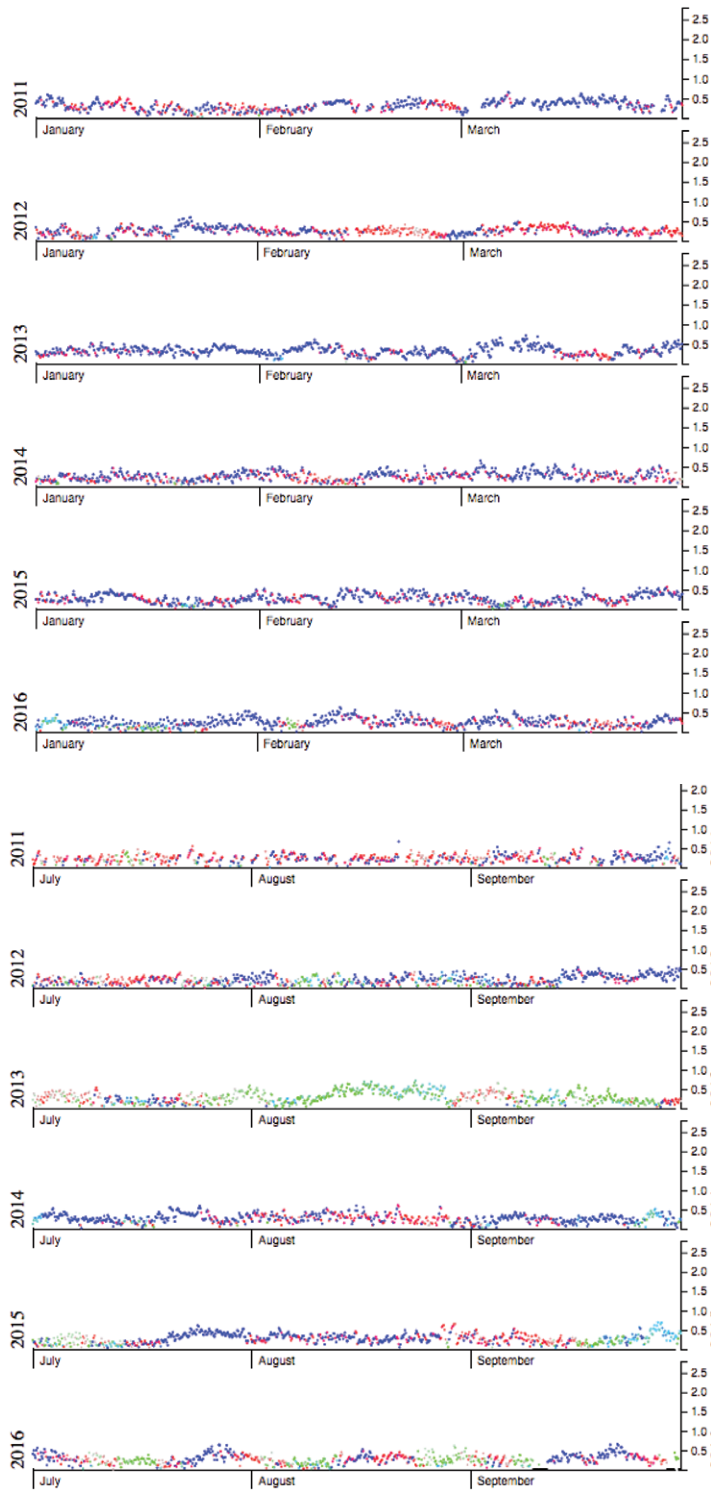


Figure 60 (continued on next page): Charts showing the direction and force of current at Point 2 (18.135412, -64.379883) from January to December 2011 to 2016.

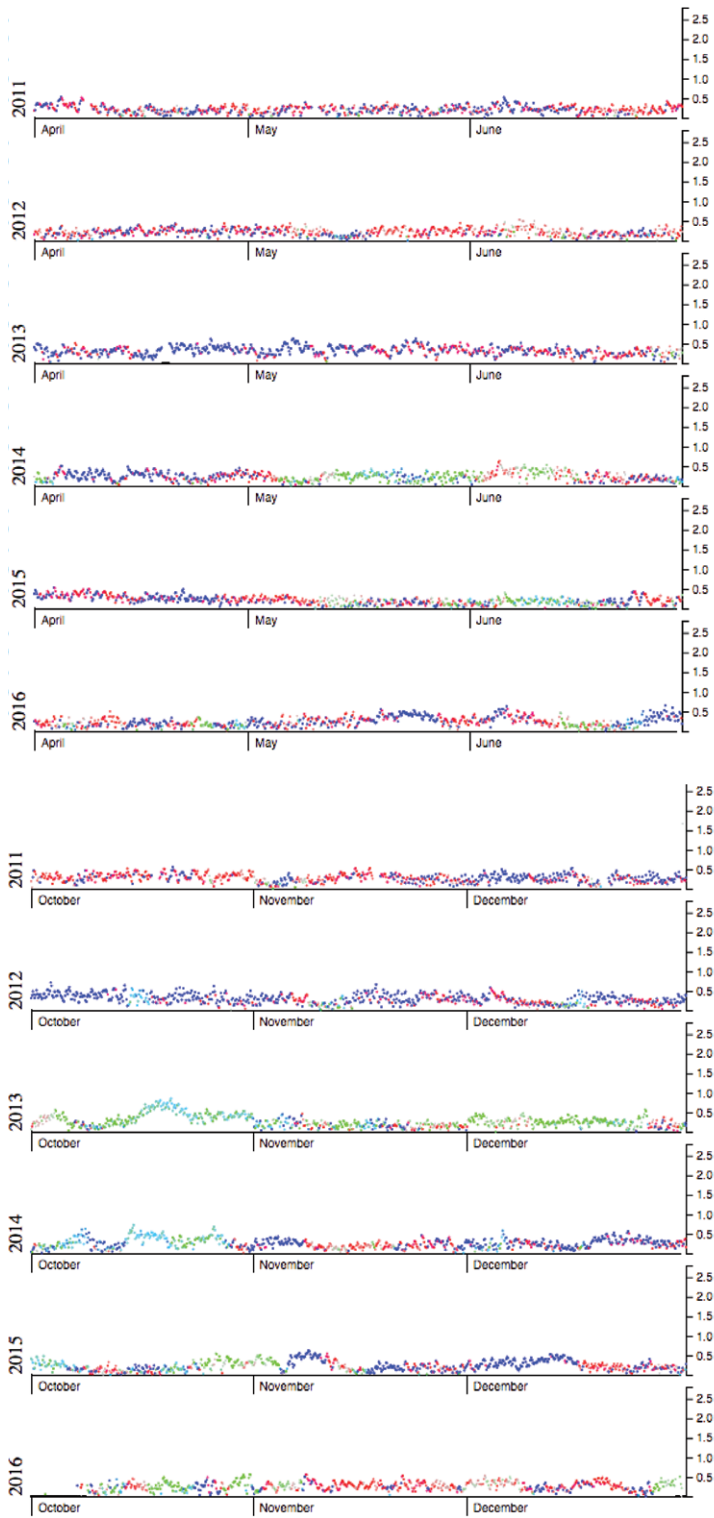


Figure 60 (continued).



Figure 61: Map showing point 3 (18.051867, -63.874512) tested with the current tool (see Chapter 4).

moves towards the south from January to March (see Figure 59). Between April and June, currents continue to head to the south. However, currents also move towards the northwest and northeast during this summer period. This shift could indicate that currents were less reliable in the ‘spring’ months. This mix of directions is repeated for the summer months of July to September. Between October and December routes more commonly trend south and east.

The averaged current direction values captured for Point 2 trend to the west and south between December and March across all years (see Figure 59). Current headings in fall, or between September and November, were highly variable (see Figure 59). In this season, currents begin by pushing to the southwest before heading to the south, then east, and finally to the north. The changes during this period, both in the 15- and 30-day averages suggests this period was not optimal for travelling through the western edge of the Anegada Passage. It is plausible that canoers waited for a period with a more consistent current force direction. However, this assumption needs to be evaluated further before it can be confirmed. Conversely, it could be that small trips were made during the fall period between neighboring islands.

To evaluate the consistency of these values across the entire channel, Point 3, (18.051, -63.973) in the center of the Anegada Passage was selected (see Figure 61). Currents associated with this point are similar to those in the first case study (see Chapter 5) in that they have a relatively low speed of below 0.5 knots, and a similar direction, from the west to southwest. Unlike the examples from the points on either side of the passage, movement at this point is relatively stable all year round. Only two periods of possible travel corridor seasonality exist. One, from October to February, shows movement trending slightly southwest. Another, from March to September, has

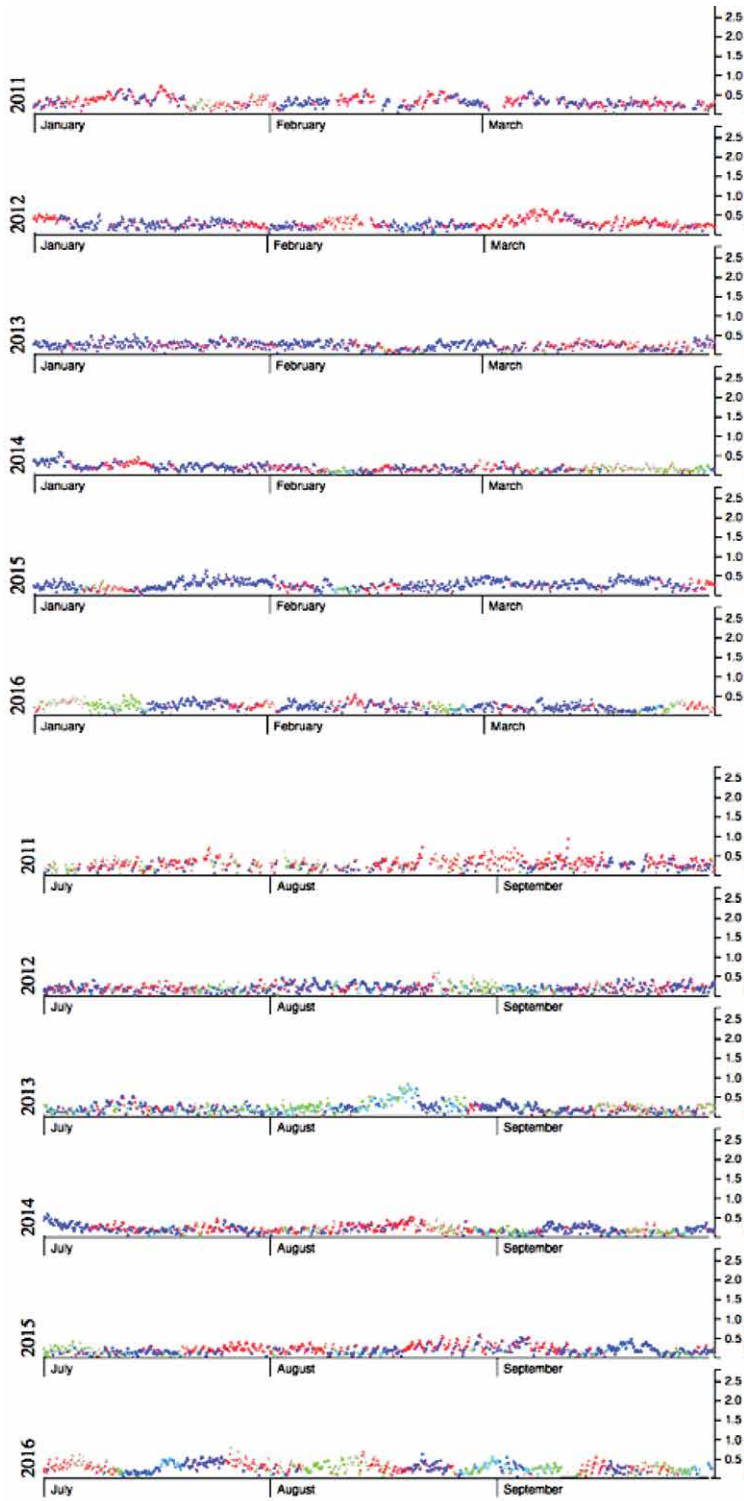
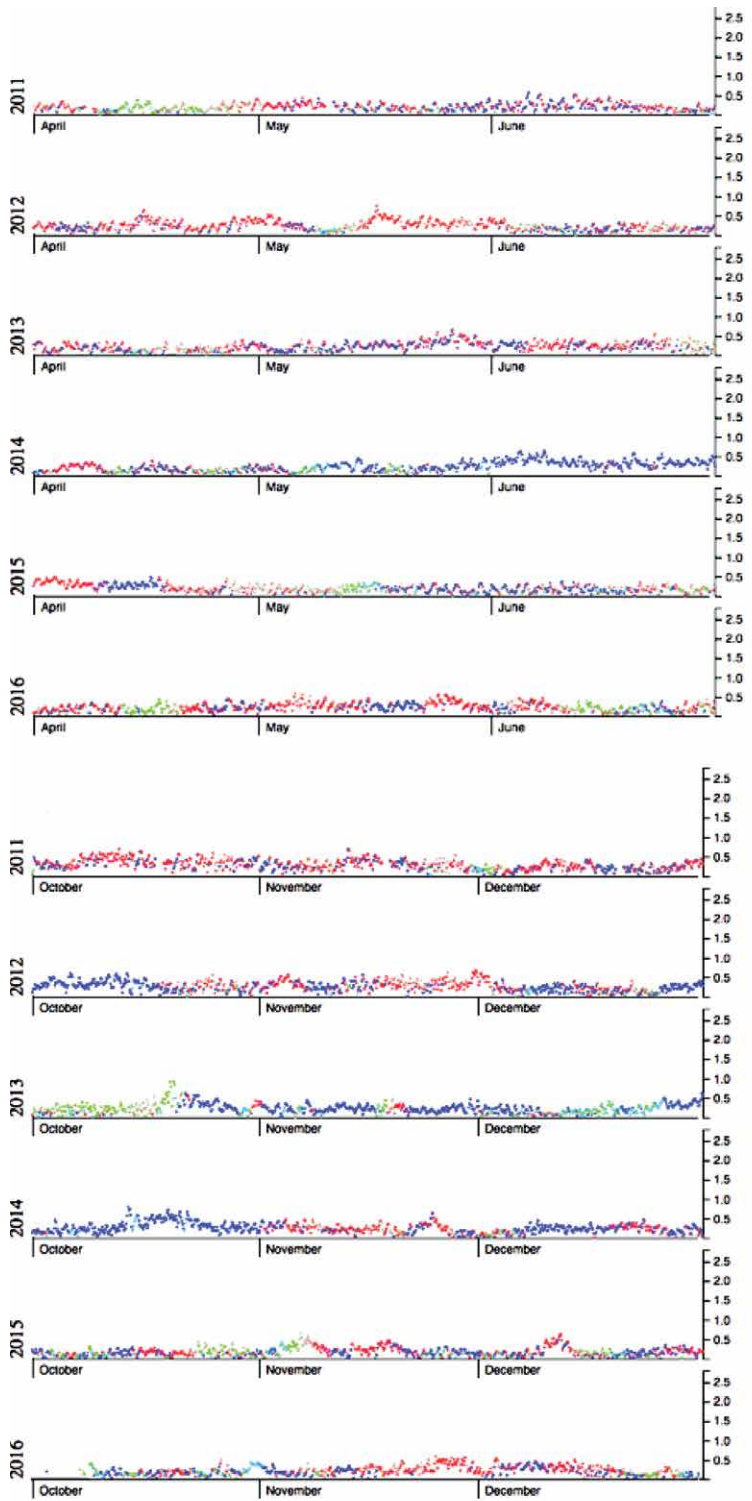


Figure 62 (continued on next page): Charts showing the direction and force of current at Point 3 (18.051867, -63.874512) from January to December 2011 to 2016.



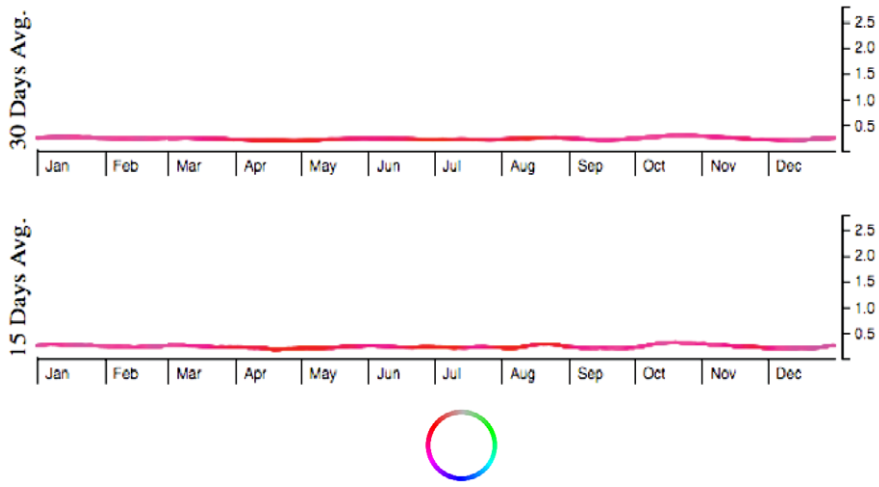


Figure 63: Charts showing the 15- and 30-day averages of direction and force of current at Point 3 (18.051867, -63.874512) from 2011 to 2016.

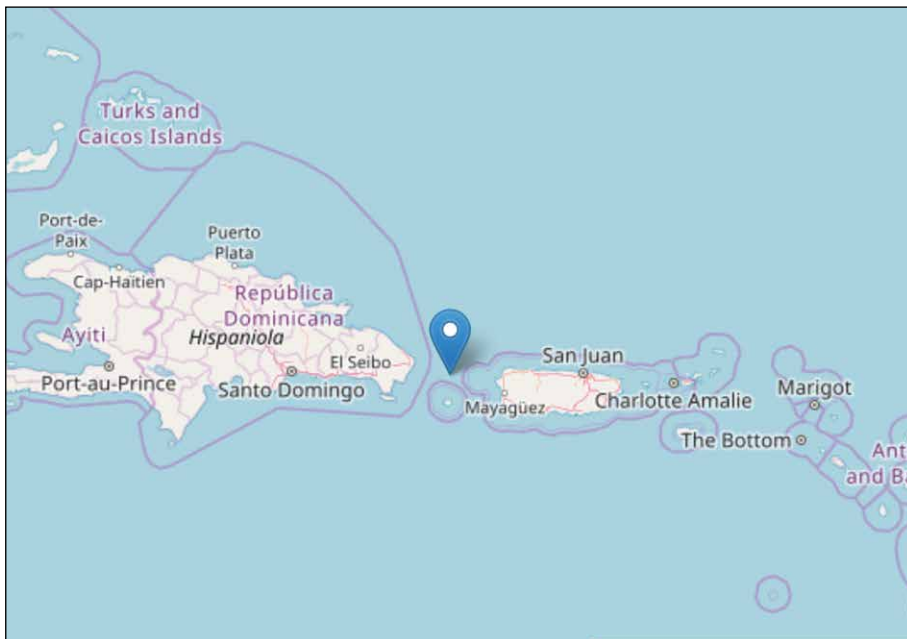
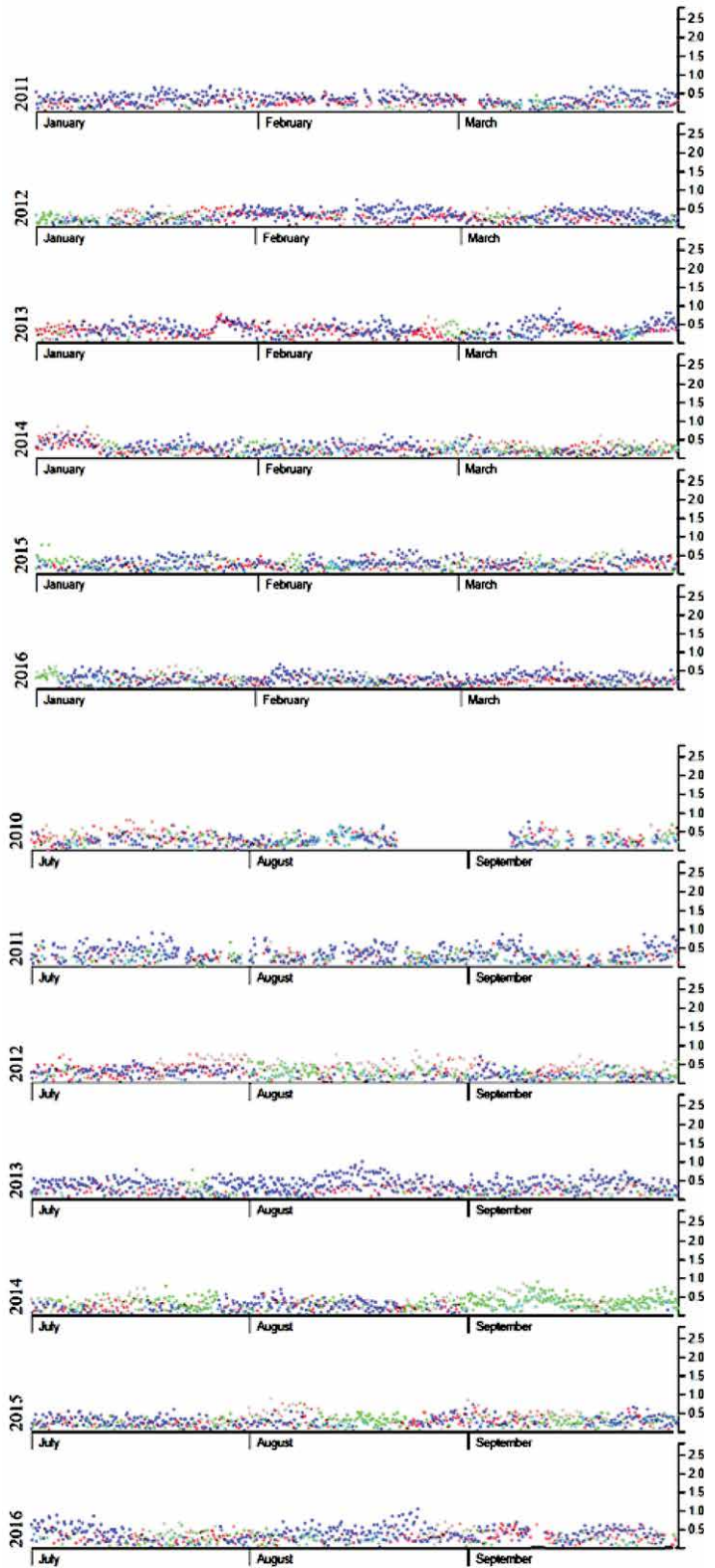


Figure 64: Map showing point 4 (18.417079, -67.884521) tested with the current tool (see Chapter 4).

Figure 65 (opposite page; continued on next page): Charts showing the direction and force of current at Point 4 (18.417079, -67.884521) from January to December 2010 to 2016.



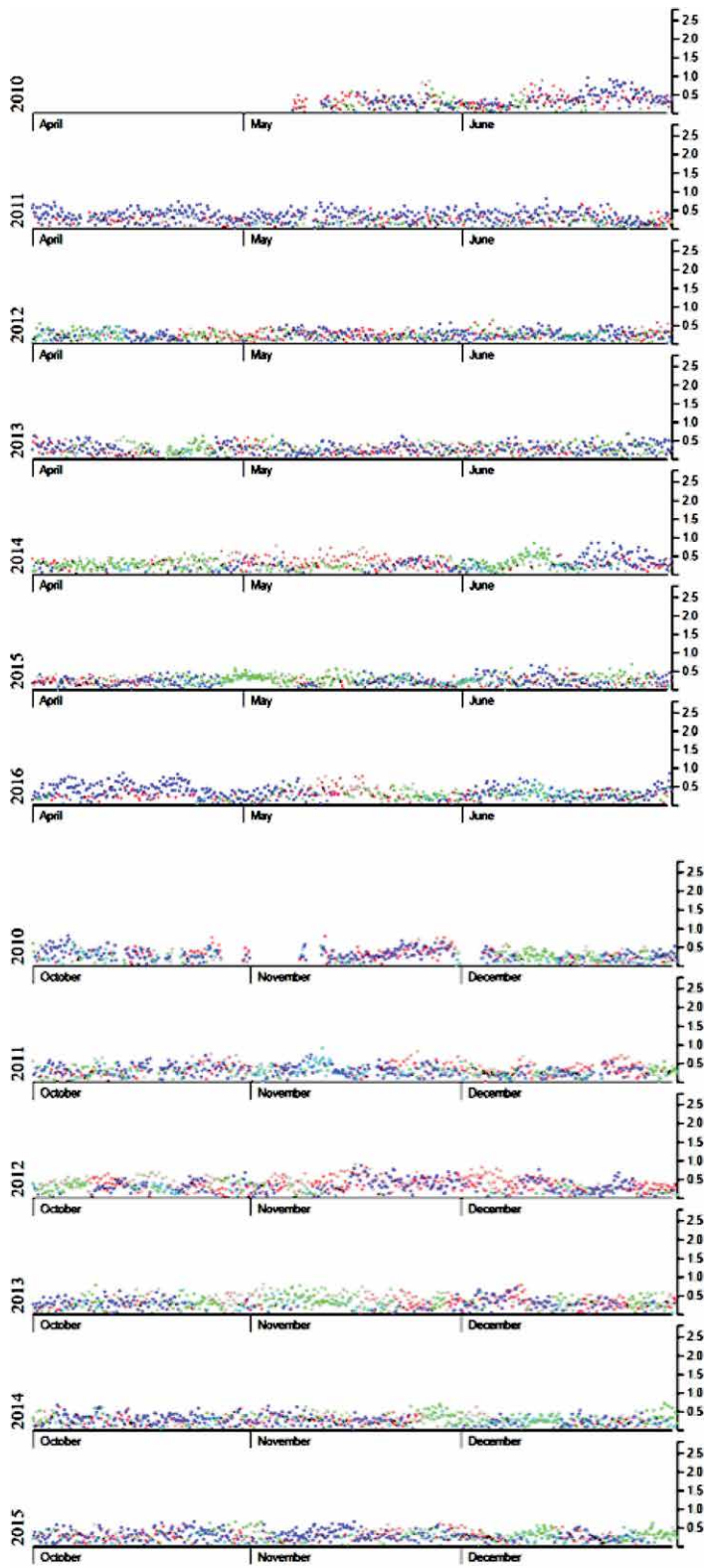


Figure 65 (continued).

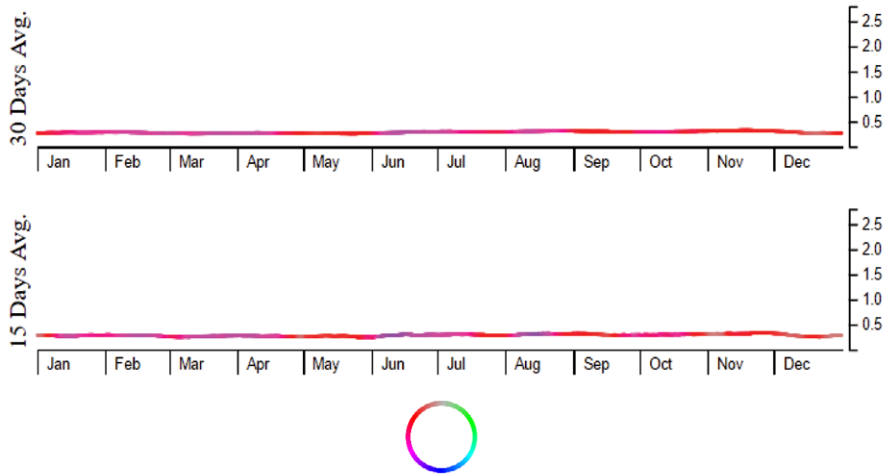


Figure 66: Charts showing the 15- and 30-day averages of direction and force of current at Point 4 (18.417079, -67.884521) from 2011 to 2016.

currents heading due west on average (see Figure 62). Although these directions are applicable for further modeling, it must be borne in mind that some of the consistency in these directions may be a result of averaging.

Point 4 (18.417079, -67.884521) is located between Hispaniola and Puerto Rico in the Mona Passage (see Figure 64). Though the channel is small, a point between these two islands was necessary as travel through this corridor was an essential part of movement east (Samson and Cooper 2015a, 2015b). The importance of canoe routes across this channel has been highlighted by archaeological finds in caves on Mona Island (Samson and Cooper 2015a, 2015b; Samson *et al.* 2013). Based on these finds, the point is placed directly north of Mona Island.

Current forces in the Mona Passage show a limited range of direction values. Though there is a slight trend in current movement to the southwest in February and April, the rest of the year shows a concerted westward movement. Following the trends observed at the first, second, and third points, there is a seasonal period between September and October with shifts in directions. In this case study, current strength is similar to that seen in the northern Lesser Antilles. All current force values stay below one knot, often close to 0.5 knots. This indicates that while current direction may have partially determined seasonal travel directions, crews wanting to go against the current could overcome its force.

Current force and direction values returned at these four points indicate there are three seasonal periods in this case study. To compare these travel periods with those in Chapter 5, I will be evaluating routes from January, April, July, and October. January, April, and July all represent key separations in average current direction at all points. Adding the additional non-conforming month of October to these runs allowed me to determine if radical shifts in underlying current affected route times within one period. These seasonal patterns will act as a guide for when to model routes between the Greater Antilles and the Leeward Islands.

6.3.2 Failed Routes and Navigation Challenges

In some cases, routes could not be completed between Greater Antillean and Lesser Antillean points. This is due to an insurmountable current that runs through the region, which did not allow the modeled routes to overcome pathway loops, leading to failed or incomplete routes. In these cases, direct pathways with loops were discounted and instead route segments were judged to increase the accuracy of the model's analysis. As most generated routes connect the northern Lesser Antilles directly to Hispaniola in both directions of the reciprocal routes, it is probable that Amerindian canoers did not use these impractically long routes. It is more likely that crews looked for opportunities to stop on the coastlines of in-between islands. These stopover points, or areas where routes run close to or into coastlines, could be possible areas to consider in future modeling. As this case study considers least-cost routes, or the optimal scenario, as the most likely past reality, we can discount routes that do not fit into that ideal.

Some routes modeled for this case study are not physically possible. This includes routes that run through islands (*e.g.*, route 0-1_2011-04-29T03). However, these points of contact with an island can be strong indicators of stopover potential. For example, movement through the Rojo Cabo area sometimes disrupts routes. In these cases, where the island has not been properly excluded from the underlying environmental data, it is impossible to say whether the trajectory or cost of the route is representative of a possible canoe pathway. Routes which run through islands were typically excluded from consideration in this case study.

Other unusable routes included loops. Although loops in these models were smaller than those detailed in the previous chapter, they still indicate routes that are not truly representative of a least-cost route. For example, route 2-10_2011-04-05T18 runs past the north coast of Mona Island only to loop back and come south along the eastern coast. This route can be discounted because it adds segments. A more extreme example of loops on a route is shown in route 2-10_2011-04-10T15, which loops at several points. These hypothetical routes, although based on environment constraints, may indicate that Amerindian canoers could have waited for better currents rather than running the risk of taking these routes.

There are also routes with superfluous segments. For example, route 1-9_2011-01-16T06 pushes north from Anguilla, loops around in the north, before returning to Anguilla to head west. This route can be discounted because of the additional time the loop added to the voyage. This pattern is observed in other routes, such as route 1-9_2011-01-17T03, route 1-9_2011-01-17T06, route 1-9_2011-01-18T06, and route 1-9_2011-01-22T21, 23T12. Amerindian canoers traveling along similar corridors to these least-cost routes perhaps chose to wait for optimal currents or push against the currents seen here to circumvent these additional route segments.

6.3.3 Route Cost

This research evaluates generated optimal routes and the time costs of canoe pathways between islands. To determine if a route's time cost was an effective method for analyzing canoe movement, I compared time costs for routes across the various channels in the region. Without first evaluating the limits and advantages of routes through the Mona Passage and the Anegada Passage it would be impossible to know whether seasonality or current variation played a role in cementing the location of canoe corridors throughout the year.

I attempted to model canoe routes from El Cabo on the Dominican Republic to all nodes within the case study area to determine how seasonality affected route time costs when crossing from the west to the east. I hoped to determine if direct voyages from El Cabo across the Anegada Passage were possible. However, the route model was not able to model pathways past Puerto Rico. This indicates that in-between points Mona Island and Puerto Rico need to be assessed to determine where crews may have started their journey across the Anegada Passage. Reciprocal links from the Leeward Islands would also need to be evaluated to determine the difficulty encountered on the return trip. Though routes originating in the Leeward Islands were not able to reach Hispaniola directly, they provided the opportunity to evaluate the indirect interaction sphere of peoples in the Lesser Antilles.

Because of these preliminary findings, I also modelled between Mona Island, the four points on Puerto Rico, the Kelbey's Ridge site on Saba, and the Barnes Bay site on Anguilla, towards all other points in the case study. These key points within the interaction sphere represent both the outer limit (*i.e.* the Leeward Islands), and the center (*i.e.* Puerto Rico), of the study area. While all canoe pathways are directed from an origin point to a termination point, sometimes routes moved past nodes on in-between islands. This practice could indicate where direct routes may have been disrupted in favor of rest points. Routes modeled from these points are the best to judge the direct and indirect movement of peoples, materials and ideas between the Greater Antilles and the Lesser Antilles. Patterns appeared when modeling canoe routes heading east and west. For example, moving from east to west is less costly than heading in the other direction. The change in difficulty depending on the canoe's heading may have played a role in a crew's decision to take stopover breaks along the coast of Puerto Rico. Patterns, like this one, helped to set the rhythms of travel and rest across the case study region.

Time costs of several routes between the same areas can demonstrate if and where canoe travel corridors existed in the region. It is possible that due to the similarity in underlying current strength the seasonal influences on routes were limited. However, small variations in route costs may exist based on the location of nodes within the case study region. Origin and termination points are located at or near areas where the archeological evidence shows peoples interacted, which ties the generated optimal pathways to reality. As many of the islands within this case study are located near one another, or between other islands, I only modeled reciprocal routes between half of the sites due to the similarity in time cost between different points and due to the large time investment of the digital modeling component. This time component relates to the run times between origin and termination points, but also to the number of returned routes that would need to be analyzed. As discussed in Chapter 5, for every month models were run, each reciprocal canoe corridor has at least 480 individually modeled routes associated with it. If I successfully modeled routes from one origin point to all termination points discussed above for every month and year possible I would have generated over 125,000 routes. By limiting the number of sites and seasons evaluated, I could effectively and thoroughly compare the feasibility of canoeing across the Anegada Passage in different seasons.

6.3.3.1 Movement across the Mona Passage

Comparing movement between Mona Island and Puerto Rico underscores the importance of islands as shelters against stronger currents. The Mona Passage presented a challenge to Amerindian canoes as it was the first channel crews needed to cross when heading east from the Dominican Republic. It was the initial space where voyages could be blown off course. The Mona Passage also holds a stopover area,

From	To	Month	Min	Max	Average
Dominican Republic	Mona Island	January	11.08	15.133	12.669
Dominican Republic	Mona Island	April	10.7	14.485	12.682
Dominican Republic	Mona Island	July	10.083	14.436	12.379
Dominican Republic	Mona Island	October	9.74	15.715	12.606
Dominican Republic	Puerto Rico(SE)	January	47.956	52.149	50.507
Dominican Republic	Puerto Rico(SE)	April	22.937	52.055	49.741
Dominican Republic	Puerto Rico(SE)	July	48.202	52.171	51.21
Dominican Republic	Puerto Rico(SE)	October	49.758	52.064	51.268
Dominican Republic	Puerto Rico(SW)	January	18.037	43.437	24.7033
Dominican Republic	Puerto Rico(SW)	April	22.937	46.0115	18.6793
Dominican Republic	Puerto Rico(SW)	July	17.805	51.119	24.292
Dominican Republic	Puerto Rico(SW)	October	24.786	46.765	30.537
Dominican Republic	Puerto Rico(NW)	January	18.108	46.147	24.23
Dominican Republic	Puerto Rico(NW)	April	18.436	50.656	23.094
Dominican Republic	Puerto Rico(NW)	July	16.474	38.876	21.151
Dominican Republic	Puerto Rico(NW)	October	21.931	40.8371	27.542
Dominican Republic	Puerto Rico(NE)	January	38.81	52.183	47.053
Dominican Republic	Puerto Rico(NE)	April	41.683	52.105	47.04
Dominican Republic	Puerto Rico(NE)	July	36.392	51.788	45.461
Dominican Republic	Puerto Rico(NE)	October	33.022	51.955	33.022

Table 9: Route cost times (in hours) from the point off the coast of the Dominican Republic near El Cabo towards Mona Island and Puerto Rico in all months.

From	To	Month	Min	Max	Average
Dominican Republic	Mona Island	April	10.7	14.485	12.682
Mona Island	Puerto Rico (NW)	April	16.279	52.105	21.216
		Total	26.979	66.59	33.898
Dominican Republic	Puerto Rico(NW)	April	22.937	46.0115	18.6793
Dominican Republic	Mona Island	April	10.7	14.485	12.682
Mona Island	Puerto Rico (SW)	April	12.806	50.992	18.859
		Total	23.506	65.477	31.541
Dominican Republic	Puerto Rico(SW)	April	18.436	50.656	23.094

Table 10: Two tables showing the cost differences between traveling directly from the Dominican Republic to Puerto Rico and traveling through Mona Island in April.

Mona Island. For these modeled routes, Amerindian peoples leaving El Cabo could canoe towards three landing points, one on Mona Island, a second at the southwest corner of Puerto Rico, and a third near the northwest corner of Puerto Rico. The node on Mona Island is located near the only entrance point onto the island. The Puerto Rican points are located near Amerindian population centers on the island. It is possible that canoers could have stopped elsewhere along the coastlines of Mona Island or Puerto Rico at sites that have not yet been archaeologically uncovered. These points provide a base for modeling voyaging times towards the western coast of Mona Island and Puerto Rico.

Modeled canoe routes from El Cabo crossing the Mona Passage illustrate the ease of movement between the Dominican Republic and Puerto Rico (see Table 9; Appendix C). Though Mona Island may have provided a possible rest area for canoers traveling along routes like those modeled here, it may not have been necessary for crews to stop over on the island. This was because time costs returned by direct routes between the two islands were roughly only 10 hours more than those would for pathways stopping at Mona Island (see Table 8; Appendix C). At the lowest end of the range of time costs, the differences could be as low as five hours (see Table 8). However, crews crossing the Mona Passage may have chosen to stop anyway to break up the voyage, conserve their ene.g., or to visit sites on the island. There were social motivations to stop at the island, as it was significant to local Amerindians and sites in the caves on the north side of the island may have been key wayfinding points for pre-Columbian navigators (Samson and Copper 2015; Samson *et al.* 2015; Vieten *et al.* 2015).

Movement from El Cabo towards either the northwest or the southwest corner of Puerto Rico resulted in relatively similar route costs to voyages that included a leg to Mona Island and a second leg from Mona Island to Puerto Rico. For example, in April moving between Mona Island and the northwest corner of Puerto Rico takes roughly 21 hours, while traveling to the southwest corner takes around 18 hours (see Table 8; Appendix C). These values are similar to time costs returned for direct voyages from Puerto Rico. The difference between the average route costs for these direct voyages and those that stopped on Mona Island was less than five hours across all months evaluated (see Appendix C). The consistency in route time costs indicates that route time did not necessarily play a large role in Amerindian crews' determining where on Puerto Rico they would make landfall, if crews followed the same trajectories as the least-cost pathways modeled here.

6.3.3.2 Movement across the Anegada Passage

While the Mona Passage provided the first test to canoers carrying Taíno materials from El Cabo, the Anegada Passage represented a greater obstacle. Movement across the Anegada Passage began in the Archaic Age (Hofman *et al.* 2008a; Righter *et al.* 2004), which may indicate that an established navigational mental map was in use at the onset of the Ceramic Age. Terrell and Welsch (1998) and Terrell *et al.* (1997: 168) suggest that peoples maintained knowledge of friendly, or inherited friendships, places over generations in order to facilitate. It is possible that such systems also existed across the Caribbean archipelago from the Greater Antilles and into the Lesser Antilles, as suggested by Samson and Cooper (2015).

The longest leg of any voyage from Hispaniola to the Leeward Islands did not offer crews opportunities to rest until reaching the Virgin Islands or St. Croix. Demonstrated by sites in the Virgin Islands, in-between communities likely acted as go-between or friendly ports for canoers making the hop across the Anegada Passage (Righter *et al.* 2004). The placement of these sites strengthened ties across the Antillean divide, and many seafaring communities likely knew their positions. Canoers crossing this passage may have adhered more to seasonal schedules than was observed in movement through the Leeward Islands (see Chapter 5). These islands can be tied to different micro-regions with a southern and northern division between routes that pass by St. Croix or the Virgin Islands.

The three micro-regions within this case study had different optimal seasons for crossing, or beginning the trip across, the Anegada Passage. Based solely on a comparison of route completion over the four months evaluated, movement across the passage was unhindered throughout the year. The inability of the model to generate routes between the Dominican Republic and the Lesser Antilles, exemplified by the failed route between El Cabo and Saba, suggests that direct routes between these areas likely did not exist. To analyze these three regions, I modeled direct travel between Puerto Rico and the northern Lesser Antilles, Puerto Rico and the Virgin Islands, and Puerto Rico and St. Croix (see Figure 67). This allowed for an evaluation of route time costs for direct travel and routes with stopovers in the north or south.

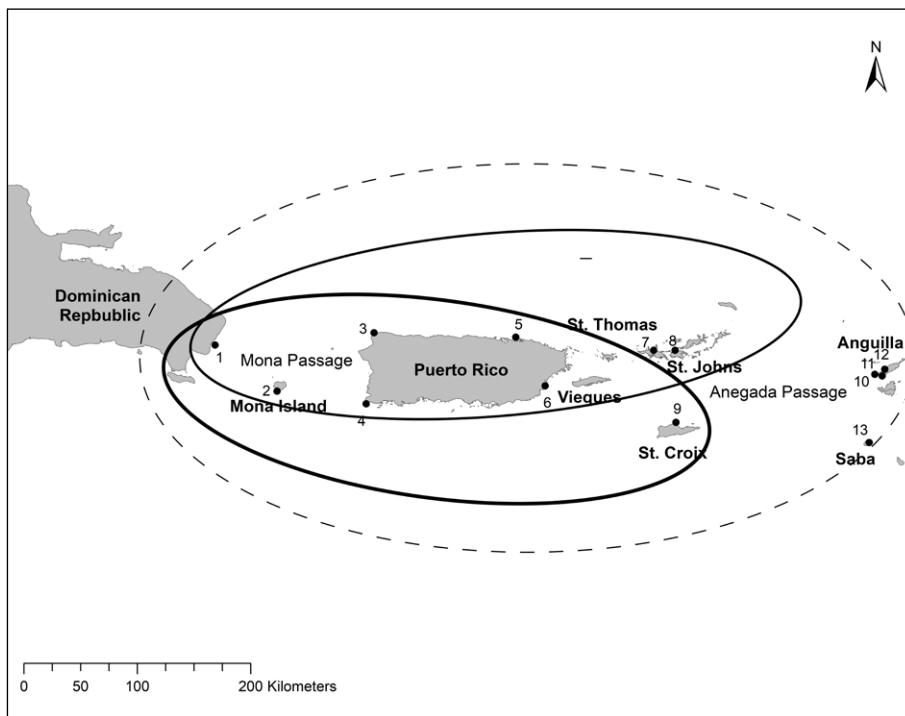


Figure 67: Map showing three micro-regions within this case study encircled. From top to bottom: Puerto Rico and the Northern Lesser Antilles, Puerto Rico and the Virgin Islands, and Puerto Rico and St. Croix.

Puerto Rico and the northern Lesser Antilles

Testing movement across the Anegada Passage proved to be the only way to measure possible travel corridors, as routes from Hispaniola to the Lesser Antilles could not be calculated under the model's parameters and the underlying current data. There were no direct travel corridors between the so-called Central Taíno sphere and the periphery Taíno sites. Instead, past seafarers likely stopped at either Puerto Rico, the Virgin Island, or St. Croix. Route modeling allows for new ways to evaluate the theories of connections between zones of interaction between sites in the Greater Antilles and Saba proposed by Hofman and Hoogland (1999) (see also Allaire 1990; Hofman and Hoogland 2011; Hofman *et al.* 2007; Keegan and Hofman 2017). As such, routes were modeled between Puerto Rico and Saba as well as Puerto Rico and Anguilla.

There is no clear distinction between route costs for voyages between Anguilla or Saba and Puerto Rico (see Tables 9 and 10; Appendix C). Heading from Saba or Anguilla to the southeast point on Puerto Rico takes roughly 45 hours during all months assessed (see Tables 9 and 10; Appendix C). Reciprocated movement from the Greater Antilles shows similar results, where routes to Saba or Anguilla often come within five hours of one another (see Appendix C). The lack of extreme differences in average time costs when launching from the two islands towards the northeast of Puerto Rico suggests that Amerindian communities on Saba and Anguilla had equal physical access to the Greater Antilles and vice versa. Both sites could have acted as gateways for Taíno materials into the Lesser Antilles.

Based solely on route cost there is no clear best choice of origin, termination, or connection point for routes moving between Puerto Rico and the Lesser Antilles. This is supported by the similarity of Greater Antillean materials or stylistic elements in archaeological assemblages in these areas. Archaeological evidence from Saba and Anguilla does not indicate one site was preferred over the other in interactions with Puerto Rico (Hofman and Hoogland 2011, 2013; Hoogland and Hofman 1999). As a result, direct travel preferences were probably the result of route layouts or social factors rather than the time of canoe voyages.

Canoers following similar routes moving from Saba or Anguilla to Puerto Rico may have preferred to travel to the southeast corner of the island, as the modeled least-cost routes took less time than those to the northern coast. This preference may be limited as the cost difference for moving from the Leeward Islands to either coastal area is quite small (see Tables 9 and 10; Appendix C). The difference between traveling to the northeast and southeast corner of the island is typically between one and three hours (see Table 9; Appendix C). These similar results indicate that the route time cost was not the dominant factor behind choosing which area of Puerto Rico to land on; however, the location of the northeast Puerto Rican point, further to the west than the southeastern point, means this hypothesis could benefit from further evaluation (see Figure 53).

From	To	Month	Min	Max	Average
Anguilla	Puerto Rico(NE)	January	43.705	51.902	47.607
Anguilla	Puerto Rico(NE)	April	47.043	52.181	50.213
Anguilla	Puerto Rico(SE)	January	40.924	50.503	46.122
Anguilla	Puerto Rico(SE)	April	41.329	50.976	46.038

Table 11: Time costs for routes from Anguilla to Puerto Rico on January and April.

From	To	Month	Min	Max	Average
Saba	Puerto Rico(SE)	January	41.48	49.341	45.504
Saba	Puerto Rico(SE)	April	41.369	48.658	44.739
Saba	Puerto Rico(SE)	July	41.682	51.98	47.852
Saba	St. Croix	January	26.551	32.964	29.826
Saba	St. Croix	April	25.678	29.116	27.356
Saba	St. Croix	July	25.477	32.359	28.856
Saba	St. Thomas	January	29.831	39.5277	33.244
Saba	St. Thomas	April	31.368	35.147	32.95
Saba	St. Thomas	July	29.825	37.747	34.0553

Table 12: Time costs for routes from Saba to Puerto Rico, St. Croix, and St. Thomas in January, April, and July.

Puerto Rico and the Virgin Islands

Movement to the north of the channel allowed for contact between Puerto Rico, the Virgin Islands, and the Lesser Antilles. The small differences in time cost, however, would not create a distinct preference for travel from either island to the west. The similarity between cost values for routes heading either directly towards the Greater Antilles or through the Virgin Islands suggests that an additional time cost was not a disincentive to traveling indirectly across the Anegada Passage.

For example, time costs when traveling from Anguilla are slightly less than travel from Saba when moving towards St. John and St. Thomas (see Appendix C). These lower time costs could be a result of Anguilla's higher placement in the Lesser Antillean island chain. However, as with direct travel to Puerto Rico, the difference in voyage costs between these two islands and the Virgin Islands typically falls within a five-hour range (see Table 11; Appendix C). This can also be said for traveling towards St. Thomas and St. John from Puerto Rico. Travel to either of these two islands returns a similar cost when traveling from both the Greater Antilles and the Lesser Antilles. These results are due to the close placement of St. Thomas and St. John. Cost values when moving from Saba to the sites on St. Thomas and St. John are relatively equal across the year (see Table 12; Appendix C). For example, values range from 29 to 35 hours for travel between Saba and the Virgin Island sites (see Table 12; Appendix C). The time costs returned for the canoe routes between Saba and St. John or St. Thomas rarely go above 40 hours (see Table 12; Appendix C). This similarity in route costs indicates that time cost was not a reason to prefer travel either from Saba to St. John or St. Thomas. A trip from Saba to St. Thomas has a time cost of around 30 to 35 hours (see Table 12; Appendix C). If this time is added to the 21-hour voyage from St. Thomas to the northeastern node on Puerto Rican it returns almost the same time cost as the direct route, 49 hours (see Appendix C). It is possible real-world canoers traveling along pathways with similar trajectories to these least-cost routes lacked a preference for travel periods, suggesting that canoers would choose where to navigate their vessels based on other factors.

However, there are exceptions to this rule depending on the point towards which the modeled routes are heading. Pathways running from Saba towards the southeast corner of Puerto Rico are costlier than those towards the Virgin Islands. Here, direct

From	To	Month	Min	Max	Average
Puerto Rico (NE)	St. Thomas	January	17.768	29.633	25.802
Puerto Rico (NE)	St. Thomas	April	19.47	27.595	24.147
Puerto Rico (NE)	St. Thomas	July	21.609	37.337	26.895
Puerto Rico (NE)	St. Thomas	October	21.07	31.415	25.747

Table 13: Time costs for routes from the Puerto Rico northeastern node to St. Thomas.

From	To	Month	Min	Max	Average
Saba	St. Thomas	January	29.831	39.5277	33.244
Saba	St. Thomas	April	31.368	35.147	32.95
Saba	St. Thomas	July	29.825	37.747	34.0553
Saba	St. Johns	January	26.551	32.964	29.826
Saba	St. Johns	April	27.555	32.109	29.513
Saba	St. Johns	July	27.538	34.847	31.2577

Table 14: Time costs for routes from Saba to St. Thomas and St. Johns.

routes to the southeast coast of the larger island ranges from a maximum of 52 hours to a minimum of 40 hours (see Table 10; Appendix C). However, this route is less costly those moving directly towards the northwest coast of Puerto Rico. Based on these hypothetical pathways, it is possible that canoers favored direct movement to Puerto Rico’s southeast corner or chose to head to the north if they wanted to break their journey’s time cost by resting on the Virgin Islands. It is also conceivable that real-world crews headed further south to stop over on St. Croix when traveling towards Puerto Rico’s southern edge. This would have a similar effect of providing a rest point as moving towards the Virgin Islands.

Puerto Rico and St. Croix

Routes through the south of the channel sometimes connected with St. Croix, which is consistent with the archaeology that has been found on the island (see Faber-Morse 1995, 2004; Hardy 2008; Lundberg and Righter 1999). The cost values returned for routes to and from St. Croix indicate it would be an ideal stopover point when moving through the Anegada Passage. For example, it typically took 30 hours in January to canoe from Saba to St. Croix (see Table 13; Appendix C). Canoe voyages from St. Croix to Puerto Rico lasted roughly 18 hours (see Table 13; Appendix C). As mentioned above, a direct voyage between Saba and the southeast of Puerto Rico typically takes 45 hours (see Table 13; Appendix C). The combined total cost of moving from Saba through St. Croix towards Puerto Rico carries almost same time cost as a direct crossing (see Table 13; Appendix C). The slight difference between a direct and indirect crossing from the Leeward Islands to Puerto Rico suggests routes that stopped at St. Croix may have had a greater chance of success, because if crews used these pathways they could rest and recuperate on the island. The Salt River site on St. Croix (see Figure 53) was likely a popular stopover location as resting at the site would not have added an extra time cost to the voyage. This is supported by archaeological evidence from the island (Faber-Morse 2004; Homan *et al.* 2007).

From	To	Month	Min	Max	Average
Saba	St. Croix	April	25.678	29.116	27.356
St. Croix	Puerto Rico (SE)	April	15.353	19.793	17.453
		Total	41.031	48.909	44.809

Table 15: Example of route time costs from Saba to Puerto Rico through St. Croix in April.

Beyond archaeological evidence, the ease of movement between Saba and St. Croix and St. Croix and Puerto Rico indicates St. Croix was probably a link in exchange networks connecting Puerto Rico and the island of Saba. The time costs for voyages heading from St. Croix to the south of Puerto Rico were lower than for routes heading to the north. Modeled routes between St. Croix and the southwest coast of Puerto Rico returned time costs of roughly 17 hours in April (see Appendix C). This is less than half the time cost of voyages connecting St. Croix and the northwest point of Puerto Rico in the same month (see Appendix C). The reciprocal voyage from the northwest point of Puerto Rico towards St. Croix is shorter, around 35 hours (see Appendix C). From this point, if real-world canoes were following similar pathways to the ones modeled here they might have to paddle an additional 10 hours to make the return trip possible. Therefore, the time costs of the hypothetical routes suggest that on the return voyage to the Leeward Islands crews traveling along these movement corridors may have found stopping at St. Croix undesirable due to the added time cost.

However, the ease of movement from Saba towards St. Croix and Puerto Rico may support the conclusion that St. Croix not only represented a prominent link within exchange networks but also was the main tie between Kelby's Ridge on Saba and the so-called Taíno culture of the Greater Antilles. This stop may have supplanted any direct connections between Puerto Rico, or even Hispaniola, and Saba. More research between materials in assemblages on St. Croix, Saba, Puerto Rico and the island of Hispaniola could be compared to check the parameters of this possible mobility network.

Most of the route costs generated for trips across the Anegada Passage do not indicate one season is more cost-effective than another. At best, the time cost for routes across this expanse could indicate whether it is easier to travel east or west. As the cost difference between seasons can be as little as one hour, these pathway time costs are suggestive rather than definitive examples of an optimal travel period. The lack of a clear optimal travel period is mirrored in those routes that offered stopping points. Routes heading through the south of the channel were less likely to come into a position allowing a stopover than those in the north, possibly due to the similar cost of traveling direct versus through the Virgin Islands. Given the low difference in time cost across modeled routes, it is possible canoers traveling along similar trajectories to the least-cost routes choose to stopover based on social preferences.

6.3.4 Route Trajectory

During my analysis, it became clear that route trajectories would be a key factor in determining the importance of specific canoe pathways. The similarity between route costs for voyages modeled in this case study suggest that Amerindian canoers following like travel corridors may have had more freedom to select routes that would benefit them socially or economically. These trajectories can be grouped into corridors of

movement that split off in many directions depending on the origin point, the canoe's heading, and in some cases an extended time cost. Discussing a crew's deviation from the typical route layout is valuable as these pathways often pass by in between islands. Instead of weighing the pros and cons of attempting a route of a specific length, canoe navigators may have focused on where canoe travel corridors were located. This could have involved reliance on mental maps, constructed over a lifetime of learning from older canoers who instructed individuals in the art paddling between in similar ways peoples taught others to traverse landscapes (*sensu* Ingold 1993, 2011). As such, a comparison of the trajectory of canoe runs can point to possible indirect connections more accurately than just comparing similar route cost. The following sections detail notable route layouts returned for this case study.

6.3.4.1 Movement across the Mona Passage

The first route layout analysis centers on movement across the Mona Passage. Routes through this channel are a key component in any journey between the Dominican Republic and the Lesser Antilles and can suggest possible points of departure from the Dominican Republic as well as connections between Hispaniola, Mona Island and Puerto Rico.

Reciprocated links between Puerto Rico and the Dominican Republic demonstrate the ease of movement across the channel. Many routes between the larger islands also included possible connections with Mona Island. Routes moving from the Dominican Republic and Puerto Rico often pass the northwest coast of the island. These routes coincide with the placement of cave sites on the island that overlook the sea to the north (Samson *et al.* 2013; Samson and Cooper 2015a, 2015b). However, although routes pass close to the island, there is no guarantee that direct contact with the coast of Mona Island was made due to the presence of high cliffs on the island's north coast (Samson and Cooper 2015a, 2015b). It is possible that if real-world crews choose to travel along these modeled least-cost routes, they may have chosen not to stop over at the island but to take advantage of the visual aid provided by the coastline to visually reinforce Mona Island's relationship to a communal mental navigation map (*sensu* Ingold 1993; Lewis 1994; Terrell 1997). It is possible that over time canoers altered travel corridors to come in sight of these caves, adapting navigation maps to fit with changing cultural places (*sensu* McNiven 2008). Routes that travel north of Mona Island, such as route 0-3_2012-04-12T06, would have been in prime position to view the caves set into the island's northern coastal cliffs (Samson *et al.* 2013). In some cases, these routes lie less than 10 km off the coast of the island (*e.g.*, route 0-3_2012-04-08T00; see Appendix C). If people in these caves lit fires, the smoke created could be visible to passing canoes (Brughmans *et al.* 2017).

Several routes modeled for this work demonstrate the possibility of a relationship between seafarers and peoples on Mona Island. However, these routes show that relationships with the island change depending on the origin of the canoe pathway. For example, routes from the southwest coast of Puerto Rico, or the Boquerón peninsula, are less likely to make direct contact with the island than routes coming from the north coast (*e.g.*, route 3-0_2012-04-20T15; see Appendix C). When pathways from Boquerón do make direct contact, it is because they move diagonally northwest, or directly west before heading north, mirroring routes coming from the Dominican Republic (*e.g.*, route 0-3_2012-04-08T00, route 0-3_2012-04-12T06_00, and route 3-0_2011-10-22T09;

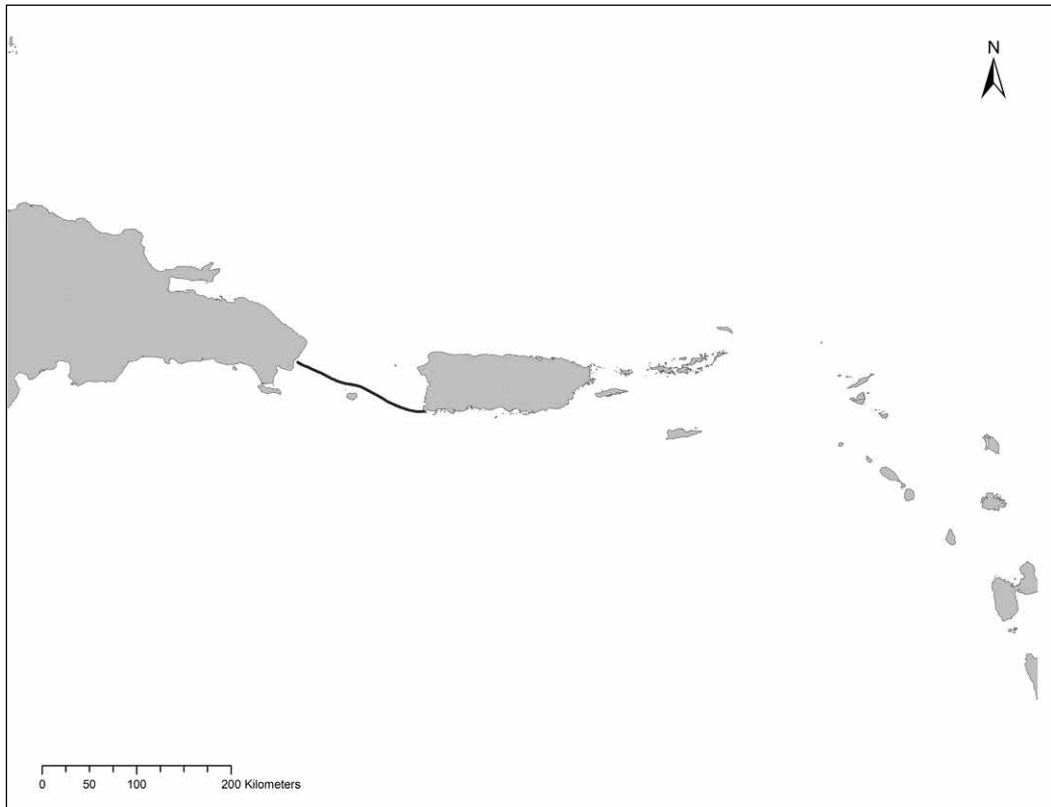


Figure 68: Route from near the site of El Cabo on the Dominican Republic to the southwest corner of Puerto Rico, or the Boquerón peninsula, in April. Route launched at 12am on the 8th of April 2012, Route: 0-3_2012-04-08T00.

Figure 68; see Appendix C). These routes follow Mona Island’s eastern coastline. Canoe routes from the southeast of Puerto Rico also follow this trajectory (see Appendix C). This variation in possible relationships with Mona Island may also suggest the ability of canoe navigators to avoid or connect with peoples on the island.

Routes completing the reciprocal voyage past Mona Island sometimes headed directly across the channel. Canoe routes heading towards Boquerón typically went due east from the Dominican Republic to connect with the western coast of Puerto Rico (*e.g.*, route 3-0_2012-04-17T00_00, route 0-3_2012-04-23T09, and route 0-3_2012-07-05T09; see Appendix C). Some routes even travel north while still protected from stronger currents by the island; these routes mimic real world seafaring choices (*sensu* Billard *et al.* 2009; Bowditch 2002). These trends may also point towards the location of possible stopover points along the coast of Puerto Rico. As these routes hug the coastline, taking advantage of protective navigation techniques, canoers that may have travelled along them could have met with other peoples who lived along the coast. Sites along these stretches of coastline passed by canoers likely acted as recipients and distributors for materials from the Dominican Republic. This area could represent the first stage of exchange towards the northern Lesser Antilles.

Routes from and to the Dominican Republic also hint at the location of additional origin sites for Taíno peoples who were exporting materials to the west coast of Puerto Rico. Some April routes from El Cabo pass the northwest coast of the Dominican Republic before turning towards the northwest coast of Puerto Rico (*e.g.*, route 0-11_2011-04-03T00, route 0-11_2011-04-09T09; see Appendix C). During all months, routes are pushed far to the north of the node on the Dominican Republic, passing parallel to the city of Uvero Alto (*e.g.*, route 0-1_2012-07-16T09, route 0-1_2012-07-10T06, route 0-1_2012-04-07T21_00, and route 0-1_2012-04-15T15_00_ishochrone; Figure 69; see Appendix C) or Punta Cana (*e.g.*, route 0-10_2011-04-14T03, route 0-10_2011-01-3T09; Figure 69; see Appendix C). In a few cases, pathways launched in April movement to the north of El Cabo before heading directly east from Punta Cana (*e.g.*, route 0-11_2011-04-07T12). Other routes show canoes headed north for roughly five km before heading east (*e.g.*, route 0-3_2012-04-02T12_00). This last route is shaped to take advantage of the current that runs to the north of Puerto Rico. The routes to and from the Dominican Republic that pass by this location support the idea that the Punta Cana region was an export center of Taíno materials. The link between the higher density of known habitation sites in this area (see Keegan 2006) and these least-cost routes should be explored in future works.

These routes can point to areas where reciprocated links were established to exchange materials between Puerto Rico and the Dominican Republic. The presence of foreign materials within sites found between these areas or along the modeled routes should be re-evaluated in this context. The location of El Cabo fits within this interpretation, as it is located south of the densely populated Punta Cana region (see Keegan 2006; Figure 69). Even though selection of El Cabo as a node may have influenced this interpretation, the fact that routes never approach the site from the south indicates that the northeastern coast of Hispaniola should be considered for possible stopover connections due to its continual connection with Puerto Rico within the routes modeled. In future, routes directly to and from the Punta Cana region can be tested to evaluate ease of connection between this heavily populated area and Puerto Rico.

Canoe routes returned by the route tool often mimicked real-world sailing practices of small vessels whose navigators may have favored predictable currents. This is reflected in the stretches of times where routes followed similar pathways, or micro-travel periods. For example, routes from route 0-11_2011-04-10T06 to route 0-11_2011-04-10T15 show movement between the northwest coast of Puerto Rico and the northwest coast of the Dominican Republic. Leaving during this nine-hour stretch increased the opportunities of people from El Cabo to connect with communities on the north coast of the Dominican Republic and Puerto Rico. Stretches like these would have made travel safer for Amerindians as navigators with the right wayfinding map could navigate these predictable micro-travel period trends to reach their destinations.

How origin points and destination points were connected, or the trajectory of routes between them, likely shaped travel rhythms in the region. This is true for crews connecting with export areas on the Dominican Republic and canoers hoping to pass by Mona Island. Those who wanted to head towards Mona Island from Puerto Rico may have prioritized coming from the south coast of the island to allow currents to push them past the smaller island. Where crews launched their vessels affected in the terms of contact.



Figure 69: Route from near the site of El Cabo on the Dominican Republic to the northwest corner of Puerto Rico. (A) Route launched at 3pm on the 15th of April 2012, Route: 0-1_2012-04-15T15, (B) Route launched at 3am on the 8th of July 2012, Route: 0-1_2012-07-08T03.

As a result, possible decisions made by navigators had a great effect on how materials were moved across the Mona Passage.

6.3.4.2 Movement above and below Puerto Rico

Though routes across channels have shown to be significant aspects of route trajectories, movement along the coast of islands can also indicate important areas of connection. In many cases routes along the coast could relate to possible regional control of caciques over canoe corridors (Curet *et al.* 2004; Crock 2005; Siegel 2001). The concepts of Eastern and Western Taíno communities, and the separation of more divided polities on Puerto Rico, may be related to the movement of Lesser Antillean and Greater Antillean material through the island (Crock 2005; Curet *et al.* 2004). Where canoers moved past the coastline, they could have altered the shape of these communities and the regions they influenced. Peoples in these areas could have viewed canoers coming and going along the coast (Torres and Rodríguez Ramos 2008), increasing their connection to inter-regional mobility networks. Therefore, a discussion of pathways along Puerto Rico's coast is an important step to uncovering mobility patterns connecting Hispaniola to the Leeward Islands.

Canoe pathways often hugged the coasts of Puerto Rico. There are several archaeological sites along the south edge of the island (Crock 2005; Keegan and Hofman 2017; Pagán Jiménez 2007). It is possible that sites grew along these coastal areas and the nearby interior inhabitation zones, to take advantage of both mangroves along the



Figure 70: Route from the Dominican Republic towards northeast of Puerto Rico in January. Route launched at 12am on the 30th of January 2011, Route: 0-12_2011-01-30T00.

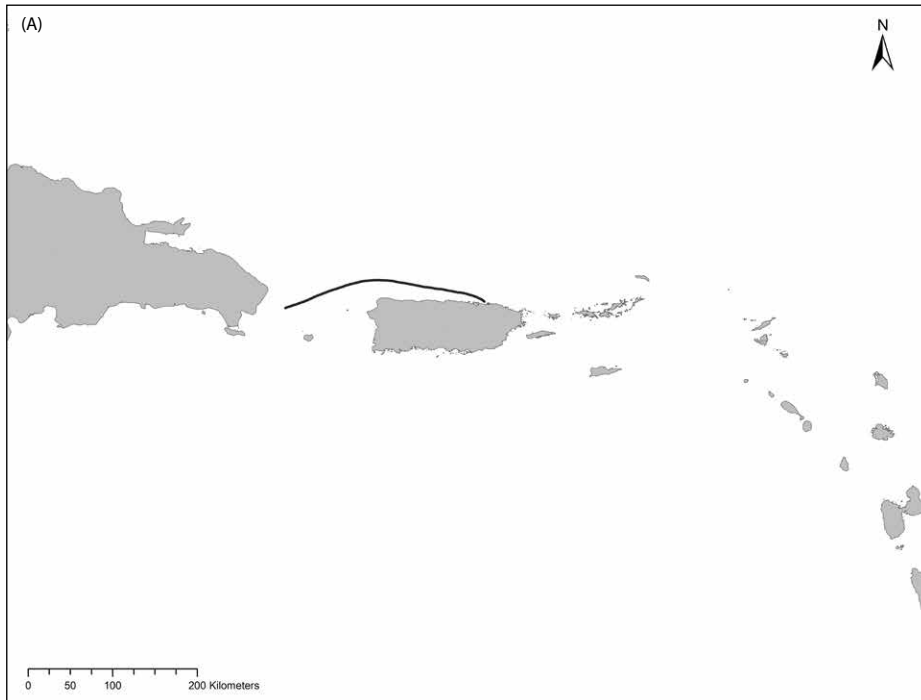


Figure 71: Route between northeast of Puerto Rico towards the Dominican Republic in January. This route has a looped section at the right end of the pathway over Puerto Rico's northeastern coast. (A) Route launched at 9pm on the 8th of January 2011, Route: 12-0_2011-01-08T21, (B) Route launched at 6pm on the 4th of January 2011, Route: 12-0_2011-01-04T18.

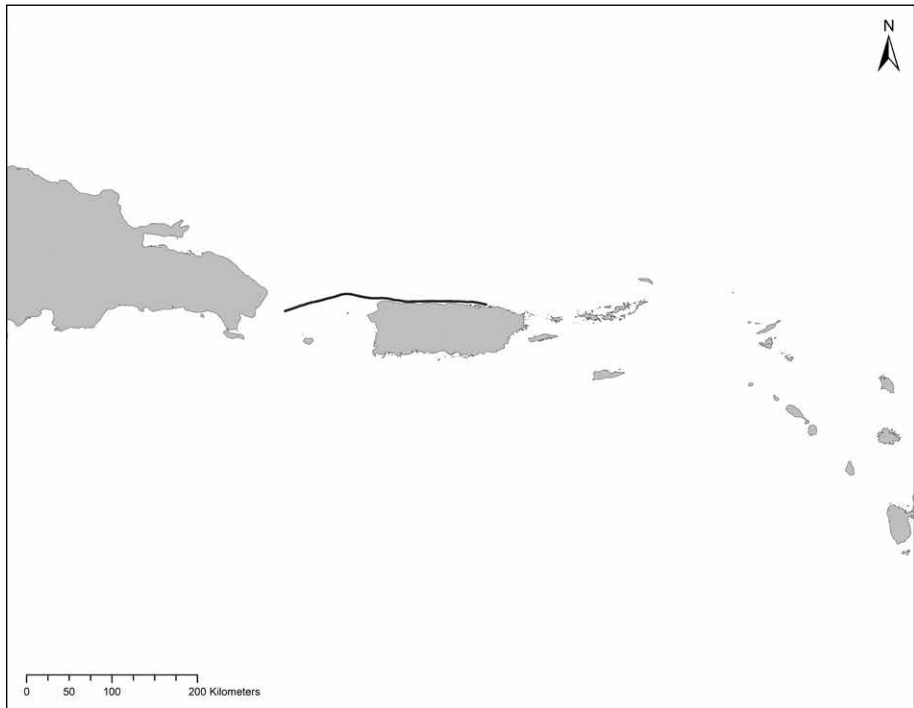


Figure 72: Route between northeast of Puerto Rico towards the Dominican Republic in July. Route launched at 3pm on the 3rd of July 2011, Route: 12-0_2011-07-03T15.

coast (Martinuzzi *et al.* 2009) and the canoe corridors that travelled along the southern coast. Routes also passed along the north coast. Though there are not as many mangroves or sites currently recorded in this area, crews that may have traveled along these hypothetical least-cost coastal pathways would have been presented with opportunities to rest and meet with different peoples.

Voyages from the Dominican Republic often hug the north coastline of Puerto Rico when moving east (*e.g.*, route 0-12_2011-01-30T00; Figure 70; see Appendix C). This stands in contrast to routes from the northeast of Puerto Rico towards the Dominican Republic that typically arced far north of the coast (*e.g.*, route 12-0_2011-01-08T21; Figure 71; see Appendix C). Some of these arced routes can be discounted as they begin by heading east before looping back around by the point to head west, possibly due to a strong current rising up along the coast during these periods (*e.g.*, route 12-0_2011-01-04T18; Figure 71; see Appendix C). In reality, canoers leaving from this point may have waited out adverse currents until it was easier to paddle west.

Hypothetical routes moving past Puerto Rico indicate that real-world canoers traveling in this direction had the option to go above or below the island depending on the heading of their vessel and the season of the year. Route layouts past the island suggest that in January and October it was easier to go east when moving above the island and west when moving below it (*e.g.*, see Figures 71 and 73; Appendix C). This pattern is also seen to a lesser extent in pathways modeled for the month of April (see Appendix C). Moving in either direction in July over the top of Puerto Rico shows routes relatively near the coast (*e.g.*, route 12-0_2011-07-03T15; see Figure 72;

Appendix C). As a result, traveling in July increased safety for those who may have been traveling along the same trajectory as the hypothetical least-cost routes modeled here, suggesting that this may have been the preferred season to travel north of the island when heading east. In these cases, routes that passed far off the coast of Puerto Rico may be viewed skeptically. Here, crews that may have traveled in the same direction as these routes could have chosen to hug the coastline and prioritize safety and resource access over speed. Following these respective routes increased voyage safety levels as the pathways stayed as close to the coastline as possible (see Figure 72). Similarly, these seasonal direction preferences could have made taking stops easier in certain periods.

These seasonal separations between January, October, April, and July could also have formed the base for reciprocal travel seasons. For example, an Amerindian group from El Cabo that followed similar least-cost pathways to those modeled here could decide to travel to the northeast coast of Puerto Rico in April and return in July. This ensured those would-be canoers had a greater chance of sticking to the coastline when traveling east and west. The direction of travel also influenced stopover connections for routes passing by Puerto Rico. These options are corroborated by the cost values for these routes (see Appendix C).

Sailing seasons that influenced travel to and from Puerto Rico also affected a crew's ability to pass by Mona Island, as routes to Puerto Rico do not always pass by the coast of the island. Periods during which canoe pathways pass the island vary over the year and depend largely on the direction of travel. When moving east from the Dominican Republic some routes pass north of Mona Island before hugging the underside of Puerto Rico (see Figure 73). Canoe routes in April pass closer to the southern edge of Puerto Rico (*e.g.*, route 0-1_2011-04-13T00; Figure 73; see Appendix C). January canoe routes do not hug the coastline as much, but typically pass closer to Mona Island (*e.g.*, route 0-1_2011-01-10T18, route 0-1_2011-01-13T21; Figure 73; see Appendix C). Even in cases where modeled canoe pathways reach the southwest corner of Puerto Rico, January routes do not adhere as closely to the coastline as routes in other months (*e.g.*, route 0-1_2011-01-13T06; see Appendix C). This could suggest a possible seasonal preference existed not just within the confines of the modeled routes but among real-world canoers as well, with past canoers possibly avoiding travel to the west in January.

Many hypothetical routes would have allowed for canoers following similar travel corridors to stop at Mona Island. Crews who wished to stop at the island had to land on the island's southwest coast, as the rest of the island's coastline consists of high cliffs. From landing beaches Amerindians could then walk to the caves on the island's north coast. Some of the modeled canoe routes employed interesting techniques to reach this landing area. Many routes pass over the north coast of Mona Island before coming around the western coast to reach the landing point (*e.g.*, route 2-1_2011-04-04T00, route 2-1_2011-04-08T15, route 2-10_2011-04-05T09, and route 2-1_2011-04-23T21; Figure 74; see Appendix C). In January, these routes could arc further to the north of Mona Island (*e.g.*, route 2-1_2011-01-07T03, route 2-1_2011-01-08T03; see Figure 74). Canoers who may have gone to the far side of Mona Island before attempting to make landfall would have been sheltered from the current as they approached the landing area. Additionally, these routes would have had direct visual access to the northern coast of Mona Island (Samson and Cooper 2015a, 2015b). The distance between the pathways and the caves would have been possible

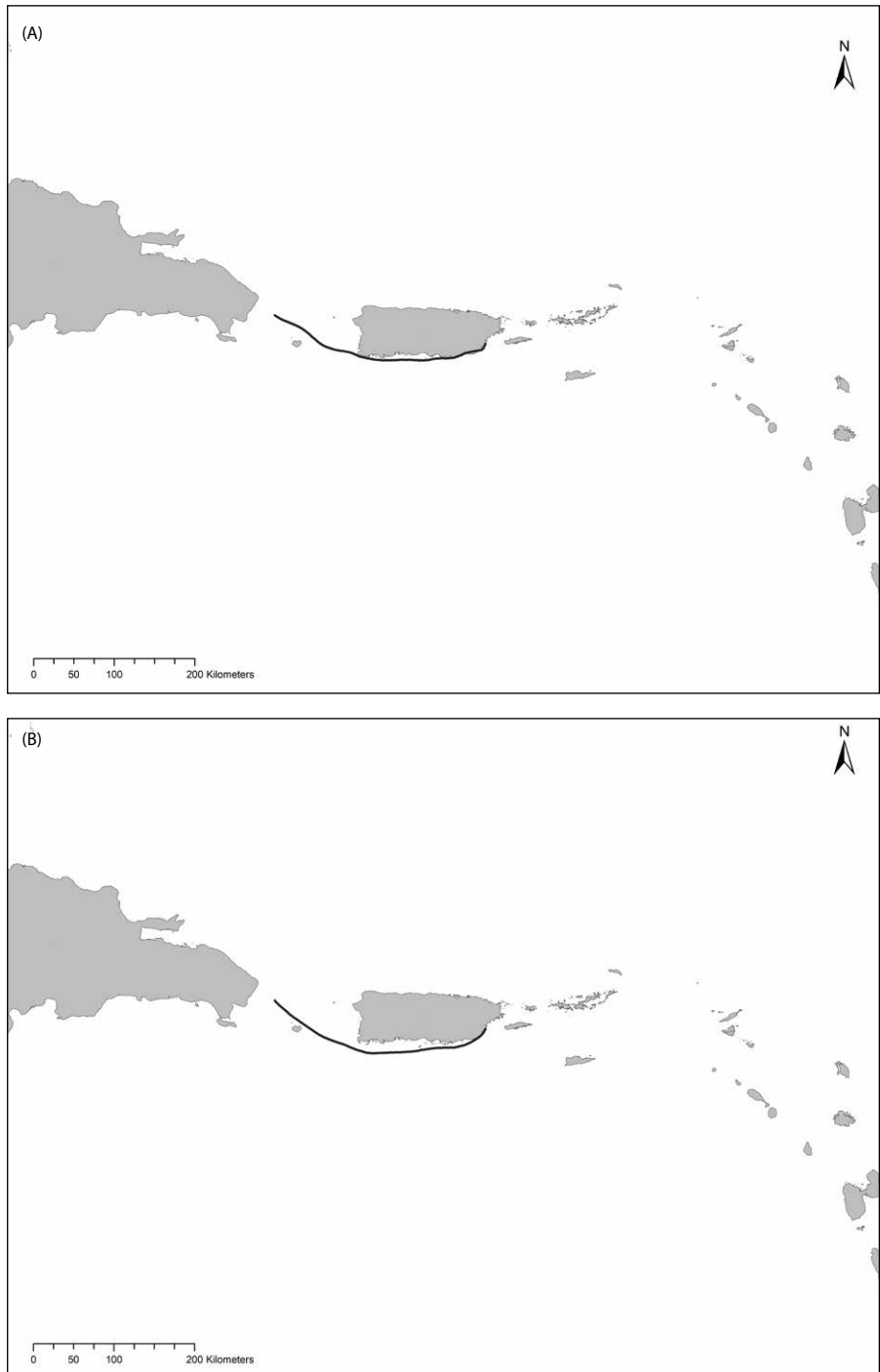


Figure 73: Route from near the site of El Cabo on the Dominican Republic to the south-east corner of Puerto Rico. (A) Route launched at 12am on the 13th of April 2011, Route: 0-1_2011-04-13T00, (B) Route launched at 9pm on the 13th of January 2011, Route: 0-1_2011-01-13T21.

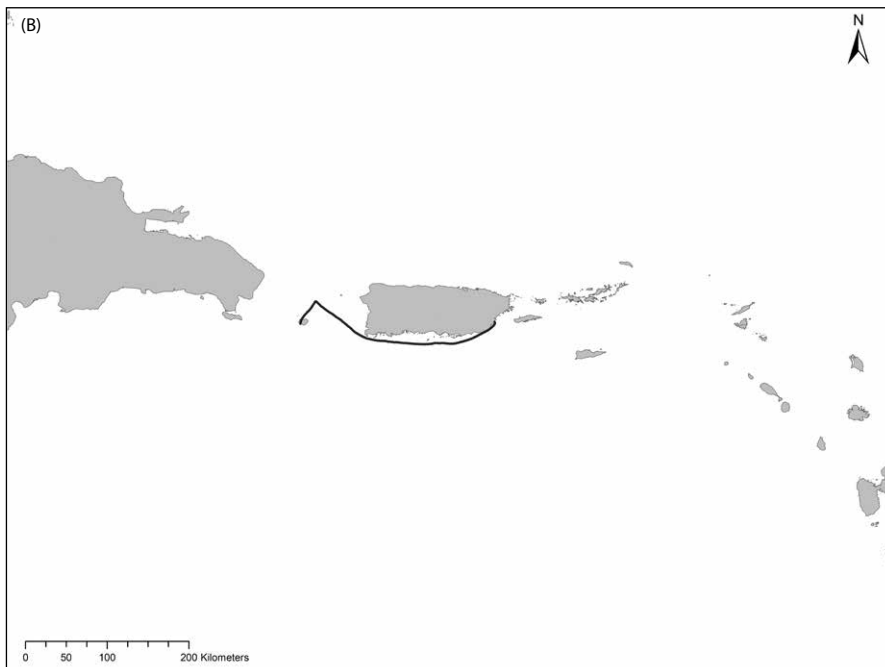


Figure 74 (continued on next page): Route from the Southwest of Puerto Rico towards Mona Island. (A) Route launched at 9pm on the 23rd of April 2011, Route: 2-1_2011-04-23T21, (B) Route launched at 3am on the 7th of January 2011, Route: 2-1_2011-01-07T03, (C) Route launched at 3am on the 8th of January 2011, Route: 2-1_2011-01-08T03.

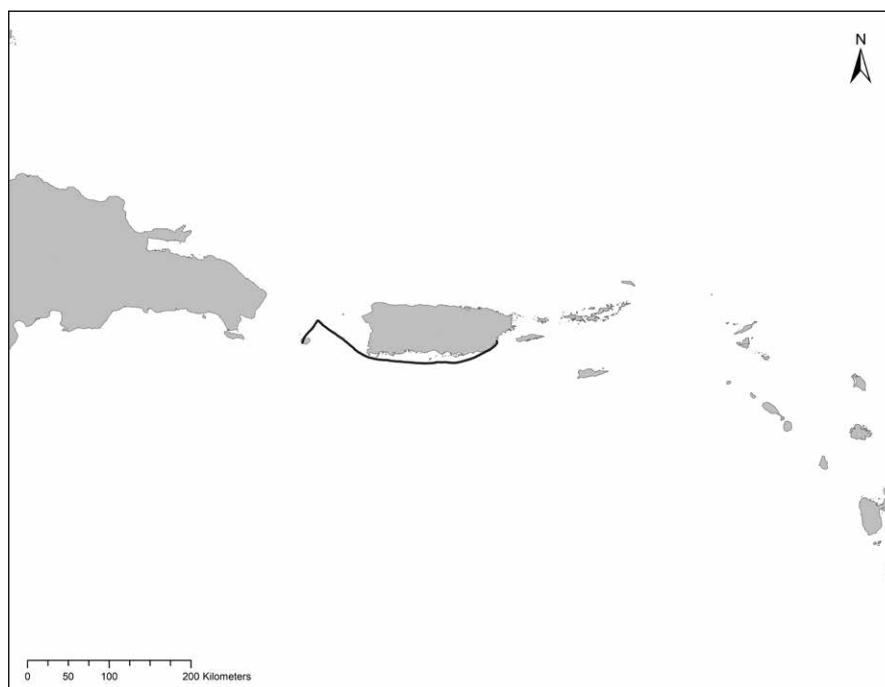


Figure 74 (continued).

to see across, cementing relationships between the peoples on Mona Island and those passing it. Given their visual prominence, these caves also represent a strong candidate for Amerindian wayfinding points.

Some least-cost pathways leaving from the southwestern edge of Puerto Rico move partway up the west coast of the island before heading east towards Mona (*e.g.*, route 2-1_2011-01-08T03; Figure 74; see Appendix C). These routes sometimes moved northwest only to turn back south off the coast of the Dominican Republic near El Cabo (*e.g.*, route 3-2_2012-04-16T12; see Appendix C). If indeed crews travelled along these routes they may have continued on the coast towards El Cabo. These routes indicate that El Cabo was well placed to take advantage of least-cost routes from Puerto Rico, as routes head straight across would reach the site area.

Movement around Vieques

As routes modelled for this work pass along both the southern and northern coastline of the Vieques, movement past the landmass links with most of the island's sites (Pagán Jiménez 2007). Most sites on Vieques lie on the southern coast (Pagán Jiménez 2007) and pathways that run along this edge of the island are more likely to make direct contact with Vieques' coastline. This is consistent with the tendency of modelled canoe routes to pass south of the island (*e.g.*, route 1-3_2011-07-18T21; Figure 75; see Appendix C). On the other hand, routes that pass the northern coast typically directly connect with the northwest portion of the island (*e.g.*, route 1-3_2011-07-18T12; Figure 76). This pattern is related to the trend of site placement on the island, as routes often connect with the coastline near to most northern



Figure 75: Route between Saba and Puerto Rico that passes below Vieques in July. Route launched at 9pm on the 18th of July 2011, Route: 1-3_2011-07-18T21.



Figure 76: Route between Saba and Puerto Rico that passes over Vieques in July. Route launched at 12pm on the 18th of July 2011, Route: 1-3_2011-07-18T12.



Figure 77: Routes between Saba and Puerto Rico that pass below Vieques in October.
 (A) Route launched at 5:12pm on the 23rd of April 2012, Route: 1-3_2012-04-23T17_12 and
 (B) Route launched at 12 am on the 17th of January 2011, Route: 1-3_2011-01-17T00.

sites (Pagán Jiménez 2007) (*e.g.*, route 1-3_2011-07-18T12; Figure 76; see Appendix C). Perhaps real-world canoers traveling near these least-cost routes found it was easier to push south when slightly sheltered by the island, making landfall in this area easier. Amerindians may have established sites where canoe pathways met the coastline. This could indicate a connection between route trajectories and site placement.

Vieques may have had a prominent role in the network of Ceramic Age sites due to its placement and the location of sites on the island. The modelled pathways show the ease of connection between Vieques and Puerto Rico, as well as prominent positions along routes travelling to the southeastern portion of Puerto Rico from the Lesser Antilles. Movement from Saba and Anguilla to Punta Candelerero almost always connects with Vieques (see Appendix C). Considering the island's status as a feasting or gathering site (Crock 2005; Hofman *et al.* 2014; Pagán Jiménez 2007), this leads to interesting questions about the connection between canoe travel routes and feasting and procurement sites.

Movement past Isla De Culebra

Isla De Culebra was selected by Rouse (1992) and Oliver (1995: 493) as a representation of a transitional area for so-called Taíno cultural material and stylistic elements. It is possible that communities on this island could choose to either engage or disengage with certain stylistic ideas coming from the eastern edge of Puerto Rico (Oliver 1995: 495). This may be highlighted through comparison with materials on and modeled optimal movement around Vieques. Isla De Culebra does not have the same intensity of occupation as Vieques (Crock 2005; Pagán Jiménez 2007). This could be due to the infrequency of contact made with the island when not moving to or from the Virgin Islands, as there is a lack of direct connections with the Lesser Antilles. However, many routes pass by Isla De Culebra when moving between the northwest coast of Puerto Rico and many of the Virgin Islands (see Appendix C). This could indicate that although Isla De Culebra did not play a major role in exchange across the Anegada Passage, it may have been a key point for canoers paddling in the Virgin Islands.

For example, routes between Puerto Rico and St. Thomas often reach either the north or south coast of the island (*e.g.*, route 12-8_2011-01-04T21, route 12-8_2011-05T00; see Appendix C). Other routes form a straight line between Puerto Rico and St. Thomas by passing to the north of the island (*e.g.*, route 12-8_2011-01-12T15). While routes heading from Saba to the northwest coast of Puerto Rico had ample opportunity to contact Isla De Culebra (*e.g.*, route 1-2_2012-04-27T21; Figure 78 and 79), there were no direct connections between the two, suggesting that any connection was an indirect one.

Both St. Thomas and Isla De Culebra may have been visible to real-world crews paddling in a similar trajectory to form a possible travel corridor. This makes both islands candidates for visual navigation markers for crews. These visual links and the close relationship between route and island establish the options for some crews passing through the Virgin Islands to stop at Isla De Culebra. A deeper comparison of materials from St. Thomas, Puerto Rico, and Isla De Culebra could further uncover the island's involvement in the broader Late Ceramic Age sphere of inter-island interaction.

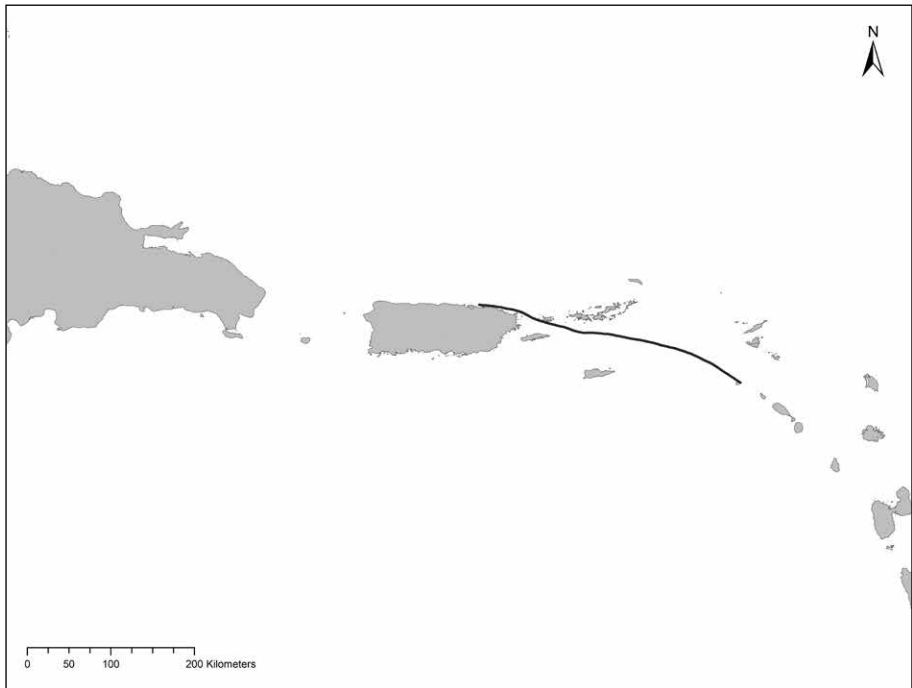


Figure 78: Route between Saba and Puerto Rico that passes below Isla De Culebra in April. Route launched at 9pm on the 27th of April 2012, Route: 1-2_2012-04-27T21.



Figure 79: Route between Saba and Puerto Rico that passes below St. Thomas and to the north of Isla De Culebra in April. Route launched at 6pm on the 27th of April 2012, Route: 1-2_2012-04-27T18.

6.3.4.3 Movement across the Anegada Passage

Many of these routes represent possible corridors of connection between the so-called Central Taíno interaction sphere and the Taíno periphery sites. Movement across the channel may be able to shed light on the specifics of these connections. Analysis of modeled pathways can indicate whether the trajectory of optimal routes fit with social relationships uncovered in assemblages (*e.g.*, Crock and Peterson 2004; Curet *et al.* 2004; Faber-Morse 2004; Hoogland and Hofman 1999; Keegan and Hofman 2017; Righter *et al.* 2004; Torres 2010), tying Anguilla, Saba, St. Croix, and the Virgin Islands to the broader regional exchange network. These interactions between island communities may have varied depending on the cost and layout of routes and the geographic relationship of the islands to one another.

The biggest challenge for crews lay in crossing the Anegada Passage, due to the size of the channel and the visual disconnect at its center (Torres and Rodríguez Ramos 2008). Routes often covered large stretches of the channel out of sight of land. The modeled routes also indicate increased difficulty as currents often pushed the pathways to head away from a straight-across route. It is possible that crews used these currents to their advantage by engaging with the islands they passed when forced into an indirect route. The least-cost pathways modeled here suggest there may have been many opportunities for real-world crews traveling in this area to stop and participate in exchange or use in-between islands as visual markers.



Figure 80: Route between Saba and Puerto Rico that passes below St. Thomas in January. Route launched at 3pm on the 23rd of January 2011, Route: 1-2_2011-01-23T15.

Least-cost routes running from the Lesser Antilles to Puerto Rico suggest that canoers may have had many opportunities to engage with peoples on the Virgin Islands. Many routes modeled for this work show routes that head north to the Virgin Islands before moving towards the Greater Antilles (*e.g.*, route 1-2_2011-01-23T15; Figure 80). Routes like these highlight the connection between Saba and Virgin Islands sites like Tutu and Magens Bay that lie along pathways (see Figure 80; Appendix C). Pathways from Anguilla to Puerto Rico also show movement that passed Late Ceramic Age Virgin Island sites (see Appendix C). This is another indication that site location was linked with route trajectory.

However, not all routes originating in Saba and Anguilla follow the same travel corridors to Puerto Rico, as routes ran both north and south of the Virgin Islands (*e.g.*, route 1-2_2011-01-23T15, route 1-2_2011-01-28T00; see Figures 80 and 81). The modeled routes suggest that canoers travelling in these areas may have been able to choose which portion of the Virgin Islands they passed on their way to Puerto Rico. These choices often resulted from the position of the origin point in relationship to the Virgin Islands. Modeled canoe pathways suggest Anguilla had a better connection with peoples on the northern coasts of the Virgin Islands (see Appendix C), including northern islands that are not passed by routes leaving Saba, such as Virgin Gorda and Anegada (see Figure 80). As such, past navigators who may have followed similar trajectories and were looking to travel to the north of the Virgin Islands could have chosen to launch their vessels from Anguilla to take advantage of the currents pushing



Figure 81: Route between Saba and Puerto Rico that passes St. Thomas and to the north of Isla De Culebra in January. Route launched at 12am on the 28th of January 2011, Route: 1-2_2011-01-28T00.

them northward. This may have involved first moving from Saba to Anguilla before embarking west. Conversely, if peoples adhered to least-cost routes and wanted to avoid interactions with peoples in the north of the Virgin Islands they may have chosen to launch from Saba.

Movement to St. Croix

St. Croix, which represents the other micro-region of the Anegada Passage, could have played a major role in connecting the communities in the northern Lesser Antilles to communities in the Central Taíno sphere. It stands as the southern mirror of the Virgin Islands, offering crews blown to the southeast a chance to rest or engage with communities before reaching Puerto Rico. Routes from St. Croix that pass below Puerto Rico hug the contours of the island, as is common in routes traveling to the west (*e.g.*, route 9-10_2011-01-22T06; Figure 84).

Routes from Saba to St. Croix typically head almost straight across the channel (*e.g.*, route 1-0_2011-07-17T18; Figure 82; see Appendix C) and sometimes enter the Saba Bank. These routes are dependent on the season, with routes in October less likely to connect with the area. Still, the fact that most pathways to St. Croix head through this resource area suggests pathways may have been linked to specific sea-based resources in a communal mental map. It is likely that individual knowledge of this area differed (*sensu* Ingold 2011; Tilley 1994). However, possible community relationships



Figure 82: Route between Saba and St. Croix in October. Route launched at 9pm on the 10th of October 2011, Route: 1-0_2011-10-10T21.

with the fishing grounds at Saba Bank may have supported this connection (*sensu* Basso 1996; Hofman and Hoogland 2011; Schlanger 1992). This trajectory may have been a motivating factor for crews to leave from Saba to Puerto Rico, as they could take advantage of fishing resources when heading past St. Croix. Reciprocal routes from St. Croix to Saba had a greater probability of moving deeper into the Saba Bank than voyages heading west (*e.g.*, route 1-0_2011-10-10T21; Figure 83).

Connections between St. Croix and Puerto Rico suggest that canoers may have stopped on the island to take advantage of the higher success rates for routes from the middle of the passage. Routes from St. Croix to the east side of Puerto Rico succeed more often than voyages originating in the Lesser Antilles (see Appendix C). Passing through St. Croix can seem complicated compared with the straight across routes from Saba to Puerto Rico. However, as mentioned in the route cost section, the overall time cost for traveling in either canoe corridor is relatively similar (see Table 10). Traveling through St. Croix may have benefited canoers, as it would have given crews an opportunity to resupply and rest.

The hypothesis that St. Croix was actively in contact with communities in the northern Lesser Antilles and in the Central Taíno sphere is also supported by the close connection of routes from St. Croix to the west coast of Puerto Rico. Some westward-heading routes that pass below Puerto Rico hug the contours of the island (*e.g.*, route 9-10_2011-01-22T06; Figure 84) and these pathways suggest that canoers on similar routes could choose to push towards the underside of the island. The coast-



Figure 83: Route between St. Croix and Saba in July. Route launched at 9am on the 20th of July 2011, Route: 11-1_2011-07-20T09.



Figure 84: Route from St. Croix to the southwest corner of Puerto Rico that hugs the island's south coast. Route launched at 6am on the 22nd of January 2011, Route: 9-10_2011-01-22T06.

line is closely followed once contact is made with Puerto Rico (see Figure 85). This contrasts with voyages heading east where routes tend to separate somewhat from the coast. While east-facing voyages still stay relatively close to the coastline, they do not follow the coast as closely as routes heading west. The constant contact with the coast would have allowed groups traveling from St. Croix to take advantage of local resources and stopover points, and to contact Puerto Rican Taíno communities. To determine if there was a special connection between St. Croix and Puerto Rico, taking another look at the archaeological evidence would be beneficial.

Modeled routes suggest that canoers' may have had a preference for hugging the coast of St. Croix, as shown by the routes between Saba and the southeastern point on Puerto Rico, such as route 1-3_2011-07-16T12 and route 1-3_2011-07-25T18 (see Figures 85 and 86). These routes reaffirm the model's tendency to mimic real-world trends of following along areas of safety near coastlines (see Figures 86 and 87). For example, route 1-3_2011-07-25T18 shows a route hugging the coastline as it passes by St. Croix and passing by a series of sites on the south side of the island. Route 1-3_2011-07-16T12 along the north coast of the island passes by Salt River, one of the selected node points in this case study. It is possible that the Salt River site grew out of the need for a stopover point between Saba and Puerto Rico, possibly developed over years of peoples passing by this stretch of coastline. Canoe routes from Saba to St. Croix are more likely to run along the north coast of the island, signaling the possible significance of Salt River to Amerindian communities.

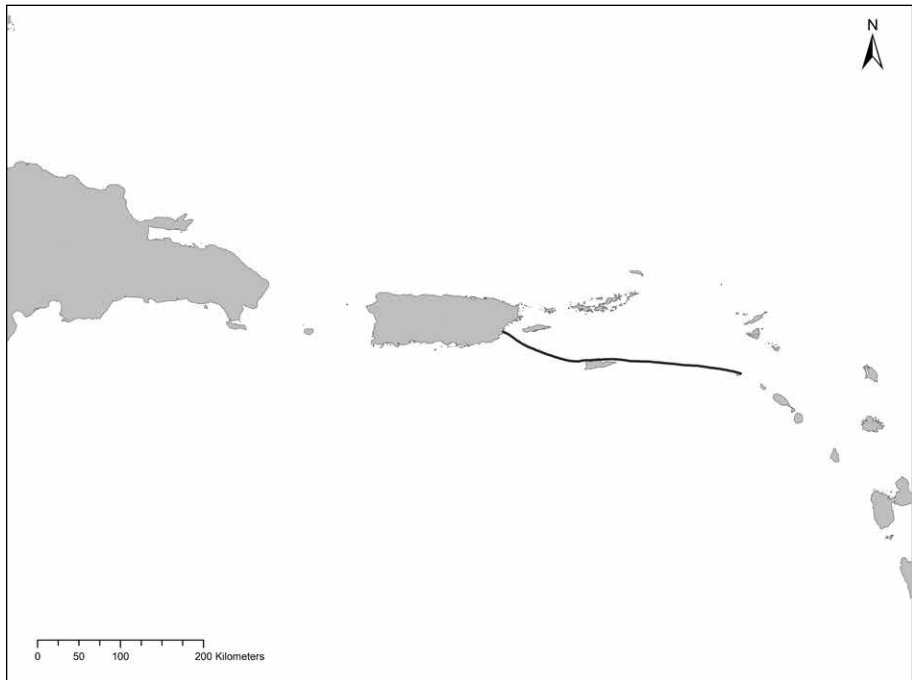


Figure 85: Route between Saba and Puerto Rico that passes above St. Croix in July. Route launched at 12pm on the 16th of July 2011, Route: 1-3_2011-07-16T12.

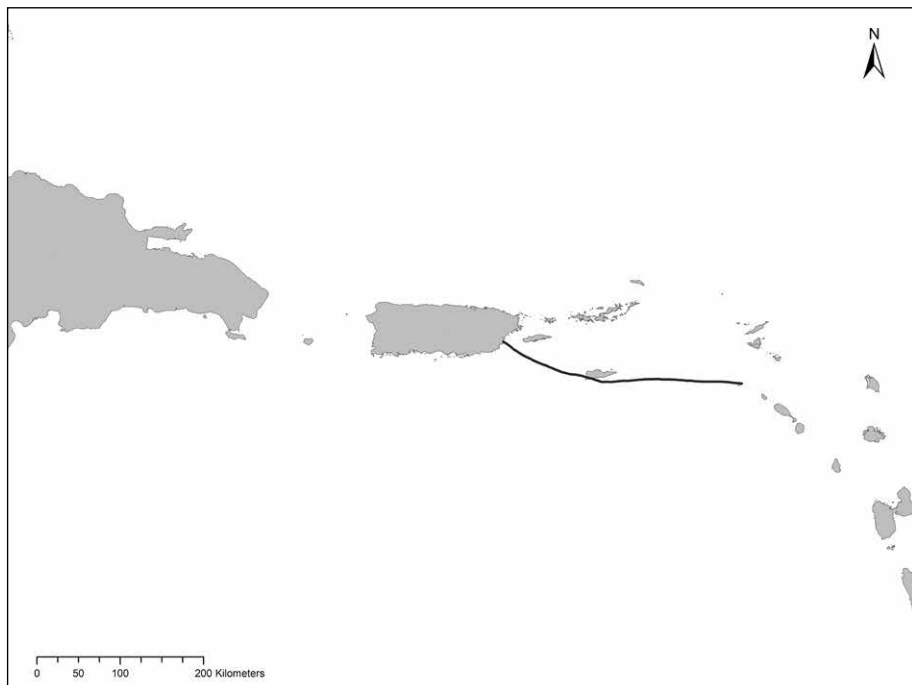


Figure 86: Route between Saba and Puerto Rico that passes below St. Croix in July. Route launched at 6pm on the 25th of July 2011, Route: 1-3_2011-07-16T06.

6.4 Conclusion

The mobility of materials and peoples across these routes demonstrates the underlying tensions of movement between islands. Tracking movement between sites on neighboring islands may not be as easy as straight lines on a map indicate. Connections between neighboring islands likely depended on an intricate interaction between social structure and the placement of canoe routes.

This case study joins the first in demonstrating the value of evaluating links between islands using least-cost pathway methods, showing its specific utility for island chains. Analyzing the time costs and trajectories of routes for possible trips between separate island groups adds support to existing theories about inter-island travel (Hofman *et al.* 2008a; Keegan and Hofman 2017). Tying together several routes to form canoeing travel corridors suggest what pathways acted as sections within longer voyages. Evaluating traveling in different directions can inform on which routes from different islands best served crews that may have paddled along the least-cost corridors. Canoe routes generated by the isochrone route tool can indicate what areas of the sea were likely used in the past and how these corridors may have linked together to form the pre-Columbian Amerindian mobility network that connected the Greater and the Lesser Antilles.

These modeled routes establish that route trajectories and the location of canoe travel corridors offer insight into connections between islands. Pathway layout provided a broad scope for comparison between seasons and between island linkages. The consistency of route placement, both in direct and in indirect routes, shows that past navigators would have been able to retrace these pathways over several years. Amerindian peoples from these islands may have been equipped with the navigation knowledge necessary to complete routes successfully. This foreknowledge of canoers may have minimized the likelihood of crews not completing a voyage. The inability of some modeled routes to complete over longer distances could suggest that these routes were not used by past canoe crews. Similarly, the preference for specific route trajectories or time costs may have influenced canoers' movement between islands.

Several routes returned by the model indicated stopover opportunities. Many routes, however, went directly towards their destination without coming close to the coastline of another island (see Appendix C). The position of islands within this region allowed for a greater number of routes to avoid connecting with in-between islands when traveling across the Anegada Passage. Still, the number of routes that pass in-between islands indicates that if Amerindian seafarers moved through these travel corridors they could choose when to connect with other islands. That the time costs associated with indirect routes that pass by in-between islands are often similar to costs for direct routes suggests that peoples could have preferred to utilize stopovers for the opportunity to resupply and connect with local communities. These decisions could have strong implications for the existence of an exchange network with many stopover possibilities, as routes passing by sites on in-between islands showcase possible connections built around canoe travel corridors.

The archaeological sites located along modeled routes may indicate two processes. First, the placement of sites along modeled canoe routes could signify that Amerindian peoples used them as safe landing sites where necessary. Second, that Amerindians wished to be a part of an inter-island mobility network and established

sites that could take advantage of canoe travel corridors. At present, it is not possible to differentiate between these two processes nor are they exclusive to each other. In fact, they may be intricately linked.

More work needs to be done to evaluate connections between origin points, termination points, and the sites passed on the voyages connecting them. It is possible that evaluating movement and exchange along these corridors can reveal more information on how Taíno materials and ideas were spread throughout the region. Furthermore, route analysis considered alongside archaeological materials may help to identify what were direct one-to-one avenues of exchange and what sites were considered hubs for distributing imported materials to communities on other islands.

The resulting pathways suggest possible candidates for central points in a possible or hypothetical exchange network. If the location of modeled corridors past the Virgin Islands and St. Croix accurately reflect pre-Columbian travel in the region, they could indicate possible stopover connections in both the north and south of the Anegada Passage. The inclusion of Mona Island in this study supports the theory that stopover points in the Mona Passage were a vital part of seafaring mental maps. This connection supports the theory of navigation points, like the caves on Mona Island being viewed and remembered from the sea (Samson and Cooper 2015). The connection between community knowledge of sites and their role as landmarks for navigation has been discussed in other works (Ingold 2000; Tilley 1994). This is consistent with the association between points within a landscape and the seafarer (*sensu* Ingold 2009) as well as the association of meaning to sea-based activities (*sensu* Cooney 2003; McNiven 2008), including navigation. The caves containing archaeological evidence on the north coast of the island overlook many of the routes modeled for this case study. This work supports the theory that these sites were used as a highly visual connection point for crews paddling by the north coast of the island (Samson *et al.* 2013; Samson and Cooper 2015a). This connection suggests that navigation markers were a key part of any route, even short voyages.

Modeled movement from El Cabo towards Mona Island also resulted in the greatest number of completed routes, which shows the importance of short distance connections in a broader inter-island mobility network. Theories of the spread of Taíno materials to the west are also supported by the ease of movement from El Cabo past sites on Puerto Rico. This ease demonstrates links were possible for many months of the year and likely supported canoe travel corridors over generations. The consistency in current force throughout this region suggests that canoers could travel between points during multiple periods of the year. This is true for shorter and longer voyages. It could be that if Amerindian crews were using routes similar to these least-cost routes they may have relied on shorter voyages, allowing navigators to put several route segments together to form their entire trip. Longer trips may show a slight seasonal component for voyages crossing larger expanses, like the Anegada Passage. This could mean that peoples traveling from El Cabo through Mona Island to Puerto Rico were planning voyages in smaller stages to reach beneficial currents at a later time.

Traveling through the Anegada Passage relied on extensive planning. Mental way-finding maps may have helped crews from either side of the channel plan a suitable route for crossing the expanse. This route could have been direct, or taken through the Virgin Islands or St. Croix. Routes modeled for this work do not indicate any specific

site acted as an optimal departure point for cross-channel connections on either side of the Anegada Passage. It is difficult to determine whether Saba or Anguilla was the better candidate for a connection point for Taíno peoples and materials to move into the northern Lesser Antilles based on the currently available data. In many cases, the differences in route layout and time costs would not have prohibited Amerindian canoers from choosing to visit a friendly island or avoid a hostile one.

The makeup of assemblages in the Leeward Islands suggests contact was ubiquitous. In this sense, it is possible that there was not one connection point but rather several. These connection points could have functioned as semi-equal partners within the broader network of mobility and exchange. Peoples may have used different departure points depending on what in-between connections they wished to make on the way towards their destination.

Even when sites on the east side of the Anegada Passage are indicated as periphery connections to the Central Taíno (Rouse 1992), it is unlikely that there was direct contact with communities living in Hispaniola. For example, even though Kelbey's Ridge likely acted as a periphery site for so-called Taíno culture (Hofman 1993; Hoogland and Hofman 1999; Keegan and Hofman 2017), the optimal routes discussed above indicate that it would have been impossible to travel directly between the sites where these stylistic elements originate, such as the eastern Dominican Republic. In part, this is due to the model's inability to complete routes over this distance, containing an abundance of loops or time cost errors that prevented the pathway from being calculated. Furthermore, the frequency that modeled routes pass St. Croix could indicate that Taíno materials passed through this island. This could reaffirm St. Croix's status as a gateway site and Kelbey's Ridge as a periphery site. This is likely also the case for relationships between sites on Anguilla, the Virgin Islands, and Puerto Rico. The establishment of sites in the Leeward Islands as Taíno periphery outposts that monitored access to objects and stylistic elements may have influenced the placement of travel corridors to the south and the position of gateway sites within the Eastern Taíno sphere. Route modeling could be extended from Kelbey's Ridge to islands in the south to assess if there were any limiting factors when moving between Puerto Rico, St. Croix, and other islands. Communities on islands within the Anegada Passage, like St. Croix and St. Thomas, should be reevaluated as mediators of Greater Antillean materials and their relationships with the islands to the east and west reconsidered.

Route modeling is not the only method that can expand our understanding of possible Taíno expansion into the Leeward Islands. In the future, comparison of routes with additional archaeological evidence, such as XRF (*e.g.*, Hofman *et al.* 2008c) and isotopic (*e.g.*, Laffoon 2012; Laffoon and Hoogland 2009, 2012) research, can aid in locating links between the Greater Antilles and the Lesser Antilles. As more information becomes available, a finer understanding of how the routes fit with archaeological assemblages can influence how we understand connections in this region.