Trans-Pacific, pre-Columbian contacts between the Far East of Asia and the Northwest Coast of North America, have not generally been considered by archaeologists, although this is changing with regards to the early peopling of the Americas (Dixon, 2001; Erlandson, 2002). Computer simulations of voyaging suggest that such contacts were feasible if not inevitable at any time period. The example presented here is an historical one from the Japanese Edo Period (AD 1603 to 1867). The advantage of using an historical problem here is that the results of the simulated voyages can be compared to and evaluated against documented events. Certainly, climate change is an issue, however, studies of paleoenvironmental changes in the marine region around Japan (Oba, 1991; Oba et al., 1991) do not suggest radically different patterns of ocean circulation over the last 6000 years or more.

Considerable seafaring capability is evidenced on the Asian side of the Pacific from early times. Obsidian from Kozu-shima in the Izu Islands has been found in contexts dating to 30,000 years ago in South Canto District on the Japanese island of Honshu. This indicates that some form of watercraft capable of crossing fairly substantial stretches of sea was used in Japan by that time (Keally, 1991). By Early Jomon times (ca. 7300–5600 BP), watercraft made from dugouts with added freeboard were in use, and have been recovered by archaeologists (Chard, 1974: 126–27).

Jomon pottery has been recovered from the island of Efate in Vanuatu. Dickinson et al. (1999) have confirmed that the sherds correspond to the Jomon of northern Honshu ca.
5200-3600 B.C. They considered drift voyaging as a possible mechanism for the presence of Jomon pottery and other mechanisms such as group to group trade and third-party transport but felt these to be even more improbable. However, Jett (1999) points out that such a voyage would have entailed drifting against and across major wind and current circulatory systems. The conclusion was that purposeful voyaging is the likely scenario. Further, the distance from northern Honshu to Efete is about 7,500 km (4050 nautical miles) equivalent to a voyage from Japan to the Northwest Coast of North America. Such a voyage across the North Pacific would be far easier than south to Vanuatu as it is with the prevailing winds and currents.

Recently, (Lee and Robineau, 2004) reported petroglyphs from South Korea showing large boats hunting whales which may be as early as 5,000 B.C. Further, Kiyoshi Yamaura (1998: 325) discusses the sea mammal hunting cultures of the Okhotsk Sea. He cites the use of large boats hunting whales shown in petroglyphs from southern Hokkaido (ca. A.D. 100-200). From the middle of the first millennium A.D. considerable trade existed between this region and northwestern China (1998:330). He makes the suggestion that this trade may have influenced the development of the Bering Straight, Thule culture.

The first historical mentions of mercantile and warships in Japan date to about 2,000 years ago (Brooks, 1876). However, smaller watercraft of a wide variety of designs existed prior to that time. The most extensive treatment of traditional Japanese watercraft of all types is that of Shinji Nishimura (1922) although complete sets of his work are rare, at least in North America.

Japanese and other Asiatic artifacts have been recovered from archaeological sites and other contexts on Canada's Northwest Coast and the nearby Oregon Coast (Keddie, 1990; Quimby, 1985). These include artifacts such as coins and iron blades. Most often the finds are problematic in that, conceivably, artifacts dating to earlier time periods could have been carried to North America at a much later date and then introduced into the archaeological
record. MacDonald (1996) notes some parallels between some Bronze Age Chinese artifacts and ones found on the northern Northwest Coast of North America. However, the issue of relatively early contact across the Pacific has been difficult to resolve.

Although, not specifically considering direct maritime contacts between the Japan region and the Northwest Coast, Acheson (2003) discusses the long use of iron on the North American side of the Pacific. Iron was in the Bearing Sea region by the 1st millennium B.C. and its use was so common by Neo-Eskimos that a epimetallurgical technology was in use 1500 – 2000 years before contact with Russians (2003:216). Wrought iron is found along the Yukon Coast by A.D 1200 (2003:217). Acheson (2003:227) concludes that further south along the Northwest Coast the great variety of iron objects made and the sophistication of the iron working indicates a long established tradition. One problem in establishing the age of this tradition is the fact that many archaeological sites are assumed to be historic simply on the basis of the presence of iron (2003:228).

There are four possible means by which Asiatic artifacts may have been introduced to the Northwest Coast. One is by long distance, indirect trade via Siberia and Alaska (Keddie, 1990: 2–4). The second is by direct intentional trans-oceanic contact. A third means is European sources after about 1550 (Keddie, 1995). The fourth means is by materials of Asiatic origin, including watercraft, drifting across the Pacific (Keddie, 1990:2; Quimby, 1985). In this regard, Quimby (1985) estimated from historical records the numbers of Japanese wrecks that should have landed on Northwest Coast shores between AD 500 and 1750 at 187. He felt that these wrecks were responsible for a large number of iron blades that might have been available to Native Americans prior to European contact.

The study presented here uses historical records to construct simulation models to investigate the possibility of the fourth means by which Asiatic artifacts may have reached the Northwest Coast. If the fourth means is likely certainly the second means, direct
intentional trans-oceanic contact is as likely given the level of maritime technology and skill on the Asian Pacific shores. The models are used to estimate the frequency of Japanese wrecks along the Canadian portion of the Northwest Coast and to suggest which areas have the greatest potential for the recovery of archaeological remains. The focus is primarily on Japanese vessels of the Edo Period (AD 1603–1867), particularly after about 1636 when the Japanese government gave orders dictating modifications to vessels that made them unseaworthy in the open ocean. A few additional historical cases from the 1870s are included. Despite this temporal focus, the results are also suggestive of possible drift contacts with Japan prior to European contact on the Northwest Coast and the ability for early direct intentional voyaging from Asia. Reasons intentional voyages may lie in the maritime trade in the Okhotsk Sea Region (Yamaura 1998) and a desire to cut out middlemen.

During the Edo Period, under the Tokugawa shoguns the government of Japan was initially open to the outside world (Posdneeoff, 1929: 23). At the beginning of the 17th century, they were particularly interested in European shipbuilding, enlisting the aid of William Adams, the English master mariner. Japanese vessels sailed to Manila and Mexico and formal relations with Mexico were established. However, reports from these voyages raised fears in the government about the spread of Catholicism and its accompaniment by Spanish soldiers of fortune as had happened elsewhere. These fears lead to the issuance of an edict in 1636, expelling foreign priests, limiting foreign merchants to the ports of Nagasaki and Hirado, and forbidding all Japanese citizens from leaving the country under threat of execution. The edict remained in effect until after the arrival of Commodore Perry of the U.S. Navy in 1853. The time of restricted foreign contact (1636–1867) is referred to as the Edict Period.

A more detailed discussion of the historical and archaeological background data specific to the problem of Japanese wrecks in Canadian waters is now presented followed by
a description of the simulation used here and finally, the results. Very complex computer simulations of the marine climates have been successfully developed for many oceanographic and archaeological applications. Of the archaeological projects undertaken to date, the majority were designed for the Pacific.

HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

During the so-called Edict Period of Japan, Japanese seamen were forbidden to venture beyond coastal waters in an attempt by the government to limit contact with the outside world (Posdneeoff, 1929). In order to enforce the edict of 1636, the Japanese government ordered all vessels of foreign design and all large traditional vessels capable of safely navigating on the open sea to be destroyed. The remaining small vessels used for coastal trade had a single small square sail, which was not easily handled other than when the vessel was running before the wind.

The design of ships was closely controlled and the requirement that they be built with an open stern and large square rudder was strictly enforced (Posdneeoff, 1929). This design purposely resulted in the loss of rudder and mast if a ship was caught in rough water. January weather was particularly dangerous as ships caught in the northeast monsoons could be forced eastward out to sea, and even coastal storms could result in the loss of any steering ability. It has been estimated that during the Edict Period alone, 1,800 vessels were lost—over 500 in 1842 (Webber, 1984: 66).

Since prevailing winds and currents in the North Pacific move from west to east (Defense Mapping Agency Hydrographic/Topographic Center [DMA], 1994), Japanese vessels lost at sea could have drifted to the eastern Pacific shores at any time over the last several thousand years. This is particularly true during the Edo Period when initially maritime trade was expanding and then when the edict dictated an unseaworthy design for coasting vessels. For some of these vessels, very precise data exist as to wind effects in the form of
performance polar diagrams. For others, reliable estimates of vessel characteristics can be based on sail type and hull measurements.

There are two main 19th-century sources of information concerning Japanese vessels found off the Pacific coast of North America during this Edo Period. Horace Davis (1872) and Charles Wolcott Brooks (1876) both published works on the topic. Most of Davis’ information was originally obtained from Brooks, whose work is the more extensive compilation and the most useful for this analysis. It provides details that can be used to set parameters for the simulation such as duration of drift voyages and strategies used by the crew to control disabled vessels. It also serves as a check on the reasonableness of the results. A more recent discussion, largely based on their work was published by Bert Webber (1984).

Charles Brooks was a member of the California Academy of Sciences, Ex-Consul of Japan for California, and Attaché of the Japanese Embassy from 1871–1873. Brooks notes that, in at least 37 of the 60 cases he reported, he had either seen the survivors of Japanese wrecks or interviewed eyewitnesses. Apparently, Brooks could have documented many more occurrences, but felt that 60 were sufficient to make his point in a scientific paper. Davis presented his paper before the American Antiquarian Society in April of 1872. According to both Davis (1872) and Brooks (1876), several wrecks of Japanese vessels were found along the Canadian coast and adjacent areas of the Pacific Northwest. Figure 1 gives the place names listed by Brooks in his work that are relevant to this analysis.

However, recently more critical evaluations of the historical records put into question the wrecks on the British Columbia coast (Drury, 1945; Keddie, 1995; Kohl, 1982; Plummer, 1984). Despite this, Brooks’ documentation of Japanese wrecks near Canadian waters in Washington and Alaska do not appear to be in question (Keddie, 1995), suggesting that Brooks’ data can be used as a reference point for the simulation.
There does exist other evidence for Japanese wrecks in Canadian waters. Recently, Japanese pottery has been recovered in fishing nets off the west coast of Vancouver Island (James Delgado, pers. comm. 2002). A jar has been identified as a Japanese *tsubo*, a type of glazed brownware ceramic vessel dating to the 18th and 19th centuries. The fishermens’ nets have encountered enough resistance on the bottom to suggest a substantial structure or wreck. Apparently, similar finds have been occurring for decades in the area.

Secondary evidence also suggests the presence of metals of Asiatic origin on the Northwest Coast prior to European contact. Hobler (1986) has noted that on the central coast of British Columbia, wood bearing adze marks might have been worked with metal tools. Another suggestion of the early presence of metal of Asiatic origin comes from experiments conducted by Keddie (1990: 18). In his experiments Keddie worked stone, antler, and bone to see if the work marks were comparable to those on artifacts from the southern coast of British Columbia. He reached the conclusion that the work marks on the artifacts must have been the result of metal tools. Keddie eliminated copper as the metal as it is too soft to account for the sharpness of cuts he observed on artifacts. Iron is the likely material of the tools used in the carvings. There are several possible sources for iron, but one is the salvaging of Asiatic wrecks, although Keddie (1995) points out that some iron could have come from European sources after about 1550. Quimby (1985) favoured the Asiatic source, citing iron blades found in prehistoric context at the Ozette Site in northwestern Washington State as an example. Spectrographic analysis of trace elements suggests a Japanese origin (Gleeson, 1981). Other examples of iron tools in British Columbia include an iron blade in a 15th-century context on the Columbia River (Ames and Maschner, 1999) and another dating to the same time from the Tatshenshini River area (Beattie et al., 2000).

There are other reasons to expect Japanese wrecks in Canadian waters. Glass net floats of Japanese manufacture have long been collected from the Aleutian Islands to the
south coast of Oregon (Webber, 1984: 180–184). In addition, “[d]rifts of coconut, bamboo, and other Oriental woods are not infrequently found on the seaward shores of the Queen Charlotte Islands” (Emmons, 1911: 73–74). Wrecked ships would have followed a similar though not likely identical course.

VARIABLES, STRUCTURE, AND PARAMETERS OF THE SIMULATION

Computerized simulation programs have been used to investigate a number of archaeological and historical problems, including population dispersals (Levison, Ward & Webb, 1973; Thorne & Raymond, 1989), exploration strategies (Irwin et al. 1990), population origins (Callaghan, 1999; 2003a), maritime trade and interaction (Callaghan, 2001) and skill levels required for long distance trade between Ecuador and West Mexico (Callaghan, 2003b). Each of these simulations needed to incorporate some common variables such as vessel type, and wind and current patterns. Other factors needed to direct the simulations to specific questions and to allow the interpretation of the results are referred to here as parameters.

The problem of predicting where East Asian vessels may have landed or been wrecked on the Canadian Pacific Coast, and with what frequency is addressed here using computer simulations. There are four main variables to be considered: (1) current patterns; (2) wind patterns; (3) climate variability; and (4) vessel type. The structure of the simulation is the actual mechanics of the program; for example, how data are selected and success as a percentage of all voyages is calculated. Parameters include such factors as the starting position of the vessel, drift or directed voyage, duration at sea, and what constitutes a successful voyage.

Variables

Current Patterns
Current in a 1:1 ratio will affect any floating object. That is, the object will have the same speed and set as the current unless other forces are operating. The current of principal interest is the Kuro-shio current that is flowing northeast from ca. 15° and 40° N. Latitude off the coasts of Luzon, Taiwan, and Japan (DMA, 1994). This current then flows east to about 600 miles (ca. 1110 km) off the North American coast at ca. 45°–50° N. Latitude, where, for most of the year, the current bifurcates: one branch flowing north past Haida Gwaii (Queen Charlotte Islands), the other south past Vancouver Island. The current is not steady, and the eddy currents to the north and south of the main flow can be very complex. Overall these currents are relatively weak, seldom exceeding 0.5 knots even during the winter season when the northeast monsoon is likely to cause ships to be lost off the coast of Japan. Current speeds during the summer months are similar.

**Wind Patterns**

Any object floating with an appreciable part above the water will be more affected by wind than by currents unless the current is an exceptionally strong one, such as the Gulf Stream near the east coast of Florida. At that location, the Gulf Stream is several times stronger than the Kuro-shio current. This effect of wind on objects floating high in the water was used by traditional navigators in Kiribati to determine the direction of land when recent winds differed from the flow of the current (Lewis, 1972: 212).

Winds in this region of the North Pacific tend to be easterly, but there is a great deal of variation, both month-to-month and within months. This makes it likely that drifting vessels will move in and out of the eastward flowing currents and into eddy currents, making prediction of a vessel’s passage very difficult. Simulating large numbers of voyages from individual points in the western North Pacific circumvents this predictive difficulty by demonstrating a wide range of possible outcomes. The source of wind and current data is the CD-ROM version of the U. S. Navy *Marine Climatic Atlas of the World* (Version 1.1, 1995).
Past Climate Variability

Although past climatic variability cannot be included directly in the simulation, its effect on the interpretation of the results can be estimated qualitatively. Data are available that indicate climate variation in Japan during the Edo Period, including: (1) dates of past Cherry Festivals; (2) dates of first freezing and ice rupture at Lake Suwa; (3) dates of first snowfall and number of days with snow; and (4) tree rings (Fukui, 1977: 275). Of these, the data pertaining to past Cherry Festivals and Lake Suwa are the most useful. Records for the Cherry Festivals are available from the 8th century on. Arawaka (1957) shows that the periods from the 11th to the beginning of the 15th centuries and again in the beginning of the 16th century had colder spring temperatures than usual, while the remaining years through the 19th century had warmer spring temperatures. Data from Lake Suwa (1957) suggest a considerably colder than average period lasting from AD 1450 to 1700, followed by a period of warmer winters extending into the 20th century. These data indicate that, for most of the Edict Period, climatic conditions in Japan were not dissimilar to those presented in the U. S. Navy Pilot Charts (DMA, 1994). The data used to compile the charts were collected in the 19th and 20th centuries.

Vessel Type

The type of vessel and how it is propelled make up the final variables of the problem, as the shape of an object both above and below the waterline will dictate wind effects. The vessel type used in the simulation is an Edict Period vessel based on a reconstruction by the Japanese shipbuilding guild under Niinuma Tomenoshin at Ohfunato-City (Shunichi, 1993). It was chosen for its common usage during the period and detailed information available with regards to its construction.

Structure
The program is based on the United States Navy *Marine Climatic Atlas* (U.S. Navy, 1995) and includes all of the world’s seas and oceans with the exception of Arctic waters. The data are organized in a resolution of one degree Marsden squares (one degree of longitude by one degree of latitude). The program randomly selects wind and current data that are frequency-weighted according to the compiled observations of the *Marine Climatic Atlas*. These forces are then allowed to operate on vessels for a twenty-four hour period before a new selection is made. The actual distance and direction traveled are based on the wind and current data combined with the performance characteristics of individual vessels and parameters selected by the program operator. Examples of parameters here include the use of sails, sea anchors to keep a vessel oriented into the wind during storms, or droques to slow the vessel and prevent following seas from swamping the vessel. Also included here are changes of bearing when under sail. This last feature is important when assessing the level of navigational skill required to reach a selected target during directed voyages.

The result of the simulations is expressed as the percentage of successes for a particular vessel type from selected points in the North Pacific reaching the Canadian Pacific Coast. This program will not pinpoint the location of wrecks or for that matter landing sites for intentional voyages. Given the vagaries of inshore winds and currents, it is unlikely that any program could without knowing the exact conditions that a vessel encountered along its route, in which case the program would be redundant. Since the operator can geographically define success, the percentage of East Asian wrecks at a landing at particular location can be calculated.

**Parameters**

Parameters of the simulation are choices made by the program operator in order to set up the simulation to answer a particular question. This includes information including: (1) the point of origin and destination; (2) crew strategy; (3) performance characteristics; (4)
duration of voyages; (5) time of year; and (6) number of simulations. Table 1 summarizes data from Brooks (1876) that are used to define some of the parameters of the simulation. These are particularly relevant for the Edict Period vessel, but many are also relevant to other vessels. The table gives point of origin, destination, landfall or discovery, duration at sea, and presence of survivors. Where survivors are indicated as “No,” it does not necessarily mean that there were no survivors. In some cases, crew may have been rescued at sea and the vessel abandoned. All cases for which any of this information is available are included. For reference, Brooks’ report of Japanese vessels in Canadian waters, have not been omitted. This is despite that these appear to be cases that happened south of Canadian waters and later became confused in the historical literature. However, these examples have not been used to set parameters. Each of the parameters is discussed in more detail below.

Point of Origin and Destination

There have been extensive changes to the nomenclature of Japan’s political geography and in other parts of the North Pacific. Brooks’ usage is followed in Table 1, while current nomenclature is provided in the notes. Brooks’ data are used to define starting points for drift voyages. In most of the cases that Brooks cites, where the destination is given for lost vessels, they are enroute to or from the central Honshu area (around present-day Tokyo). The ships were sailing from or returning to ports all along the eastern seaboard of Japan, from the southern island of Kyushu to the northern island of Hokkaido. In one case (wreck #60), we have the approximate position of the vessel when it was disabled, that position being between Latitude 39° and 40° N. with an approximate Longitude of 142° E., immediately off the coast of modern Miyako in northern Honshu. Vessels appear to have been disabled and blown out to sea all along Japan’s eastern seaboard and may not even have been out of sight of the coast when disaster struck. On the basis of Brooks’ information, five staging areas were chosen off the coasts of Hokkaido, northern, central and southern Honshu, and Kyushu.
The beginning location of voyages is important as sometimes only minor changes in the starting position can result in quite different outcomes. In this case, Brooks’ data indicate a large geographic range for the beginning of drift voyages.

**Crew Strategy**

The second parameter set using Brooks’ data is whether the disabled vessels are allowed by the crew to drift before the wind or if some attempt is made to sail in a particular direction. In most cases where data are available, the vessels first lose their rudder and then are dismasted by storms. The loss of the rudder is due to its construction as dictated by the edict. When a rudder is lost, the vessel orients itself lengthwise to the wind, which is usually parallel to the waves and swells. If the mast is not already lost, the vessel is in grave danger of floundering as the mast rolls out and causes the vessel to roll over along with it. If the mast has not been lost, the crew must quickly cut it down or risk total loss. In two cases, wrecks #s 59 and 60, the crew was able to temporarily jury rig a mast and sail with the wind behind them. In the case of wreck #35, the mast was not lost but the crew was forced to sail before the wind with no ability to steer other than dragging the anchor until the cable broke. In this latter instance, the crew sometimes sailed before the wind and sometimes drifted without sail. Dening (1963: 138–153) notes that the limited empirical evidence of known drift voyages in Polynesia suggests a common pattern of behaviour in which, sailors conclude they are lost early in the voyage and respond by allowing the vessel to drift before the wind with no attempt to navigate in a particular direction. This strategy allows close to the maximum distance to be covered in a given time when there is no clear indication of relative location. Given the above information, this parameter is set with the vessels’ performance characteristics reflecting a vessel drifting while oriented across the wind.

**Performance Characteristics**
In calculating performance characteristics to set the third parameter, two factors need to be considered: the draft of the vessel, and its size. Brooks (1876: 8) states that vessels registered for the coasting trade in 1874 ranged from eight to 383 tons. The Edict Period replica, Kesen-Maru (Shunichi, 1993: 36), built by the Japanese shipbuilding guild under Niinuma Tomenoshin at Ohfunato-City, is a 30-ton vessel of the bezai-bune type developed at the end of the 17th century. By early in the 18th century, it was commonly used along the coast of Japan. The vessel type is an improvement on an earlier type, the sengoku-bune. The draft has been calculated from Niinuma Tomenoshin’s plans (1993: 38), a partial rendering of which is shown in Figure 2, and assumes a laden vessel following Brooks’ data. The size and characteristics of this vessel are used for this Edict Period simulation, owing to its history, its popularity among traders, and the detailed information available from Tomenoshin’s reconstruction.

**Duration of Voyages**

The duration of the voyage is the fourth parameter. Brooks gives durations for drift voyages ranging from 17 days to over 17 months (Table 1). The longest voyage recorded is of about 17 months (wreck #11) duration, which ended with survivors being taken off at Latitude 32° 45’N. and Longitude 126° 57’E. This is approximately 390 nautical miles (ca. 667 km) west of Los Angeles. The vessel was likely closer to the North American coast when further north. It is at about this position that the currents begin to move westward toward the Hawaiian Islands and the winds begin to prevail from an easterly direction. The fact that the ships were often laden with comestibles such as barley, rice, beans, dried fish, and oil accounts for how crew members were able to survive these lengthy drift voyages. As Brooks (1876: 20) also notes, the northern region of the Pacific experiences heavy rainfall, which would have supplied crews with at least intermittent access to fresh water. Given this
information regarding known durations of trips with survivors coming this close to the North American coast, I set the duration for the termination of simulated voyages at 18 months.

Time of Year

The fifth parameter is the time of year that voyages begin. In previous work (Callaghan, 1999, 2001), voyages were simulated for all seasons of the year. However, from Brooks’ data it is clear that the storms accompanying the winter monsoon are the primary cause of ships being lost off the Japanese coast. The winter monsoon pattern (Fukui, 1977: 66–68) is not a continuous phenomenon, but waxes and wanes throughout its season. The monsoon can appear as early as the last 10 days of September, but always has its first manifestation by mid-October. Based on 20th-century data, the monsoon appears within the last 10 days of November with a 30–32% frequency. Its maximum observed frequency of 62% is reached between January 21st and January 25th. There occurs a sharp decrease to 14% in the pattern from February 5th–9th, followed by an increase to 52%, then another decline to 30% in the last days of the month. The monsoon pattern steadily decreases through March and disappears by April. The northwest winds associated with the monsoon pattern are variable in duration as well (1977: 76–80), as might be expected. The longest durations are recorded for Kanto District, which includes Tokyo. Here the northwesterly winds blow continuously for two weeks once a year on average.

Of the drift voyages listed by Brooks, 12 either note the date when disaster struck or it can be estimated from the duration of the voyage and time of rescue or landfall. Of these disasters, only one (wreck #41) occurred in June, outside of the northeast monsoon months from October to February. One disaster (wreck #11) occurred in late October, two (wrecks # s 14 and 23) in late November, three (wrecks # s 36, 59, and 60) in early to mid-December, and two (wrecks # s 42 and 50) in early and mid-January, respectively. In February, three
vessels were lost: one (wreck #5) early, one (wreck #25) in mid-month, and one (wreck #28) late in the month.

The average percentage of ship reports recording gale winds of 34–40 knots (fresh gale) or greater per month is provided by the Pilot Charts for the North Pacific (DMA, 1994). Table 2 outlines the average percentages of gale winds occurring off the east coast of Hokkaido, Northern Honshu, and Southern Honshu during different parts of the monsoon season.

Despite the risk of being at sea during the harsh winter weather, sailors would be tempted by the abundance of the fish catches at this time of year, catches that would then be exported along with other goods to more populous regions of central Honshu. Fukui (1977: 82) notes that substantial catches, especially of yellow-tail tuna, are often possible during the winter monsoon, particularly with the passage of cold fronts when heavy gusts occur. Cold fronts create conditions that are hazardous to vessels as wind velocities can reach approximately 30–40 knots (a moderate to fresh gale). Most accidents occur when these conditions are maintained for 12 or more hours.

**Number of Simulations**

The final parameter is the number of simulations run. One thousand voyages were run from each of the five regions listed above: Hokkaido, northern Honshu, central Honshu, southern Honshu, and Kyushu. Simulations from these positions were run during each of the six months of the winter monsoon, for a total of 30,000 simulations.

In all, six parameters were set in the simulation: (1) the start point for voyages; (2) whether an attempt was made to steer the vessel; (3) draft and size of the vessel; (4) voyage duration; (5) time of year; and (6) number of voyages run. As vessels have been reported lost along most of Japan's east coast, the five regions noted above were selected as start points. In almost all cases, historic records indicate that no attempt was made to steer or control the
vessels. Size and draft were selected on the basis of the segoku-bune replica. Voyage duration was selected as 18 months maximum, again on the basis of historical records. Time of year chosen was the winter monsoon when winds and storms were most likely to result in vessels drifting in to the Kuro-shio current. A total of one thousand voyages were run from each region.

RESULTS

At the beginning of this paper I cited four possible ways in which Asiatic artifacts could have been introduced to the Canadian Pacific Coast. One way is by long distance indirect trade from via Siberia and Alaska for which there is good evidence (Keddie, 1990: 2–4). The second is by direct intentional trans-oceanic contact. The third means is by articles of Asiatic origin, including watercraft, drifting across the Pacific (Keddie, 1990: 2; Quimby, 1985). A fourth means is European sources after about 1550 (Keddie, 1995). The objective of this analysis was to investigate the third possibility and estimate the frequency of such events and suggest where they may have occurred. One point of this from the perspective of archaeology is to keep minds open to the possibilities and perhaps in the future help to distinguish between various sources of Asiatic materials. Another is that if simulated drift voyages correspond to historical records, the simulation should give useful insights into early intentional voyaging.

The results of the simulation are presented in Table 3. Vessels caught in storms off the east coast of central Honshu during the months of December through February have the greatest chance of making landfall in Canadian waters. Vessels off the coast of Hokkaido have the second greatest chance of drifting onto Canadian shores during the same months. This result is not surprising given the climatic data. Northern Honshu ranks third, while southern Honshu and Kyushu rank a somewhat distant fourth and fifth respectively.
What is surprising is the total number of vessels that drift to the shores of Vancouver Island and Haida Gwaii. Of the total of 30,000 simulated voyages, 930 reached Canadian shores. Four hundred and twenty-one reached the southwest coast of Haida Gwaii, and 509 reached the west coast of Vancouver Island, mostly on the central coast and the southern tip, but also on the northern coast. Although this sounds like a very large number of vessels, it is only 3.1 percent of the 30,000 drift voyages simulated. Taken in the context of the estimate of 1,800 vessels lost during the Edict Period, this translates to about 25 ships reaching Haida Gwaii and 30 reaching Vancouver Island.

These predicted numbers of ships are greater than those cited by Brooks (1876), which amount to only three—one on Haida Gwaii (wreck #10), one at Nootka Sound (wreck #58), and one rescued about 90 nautical miles (ca. 167 km) west of Vancouver Island (wreck #13)—and even these are questionable (Keddie, 1995). However, Brooks did also state that the total of 60 cases he described was not the total available. Furthermore, he notes that there was an increase in the number of disabled ships rescued or recorded over time (1876: 20). He attributes this to increased shipping in the North Pacific resulting in more such instances being recorded, rather than to an increase in the actual number of disabled ships.

In terms of archaeological investigations, the simulation cannot pinpoint probable locations of the wrecks, as was noted above. It is, however, possible to make some suggestions as to where such investigations might be most successful. Although fewer simulated voyages ended in Haida Gwaii than Vancouver Island, they were in a more concentrated area. On Haida Gwaii, wrecks were limited to a stretch of coast approximately 80 km long, while they were distributed along the entire 450 km coast of Vancouver Island.

Comparing other landfalls made by the simulated voyages to Brooks’ (1876) data is difficult if done numerically as we should not necessarily see his sample as representative of all possibilities. However, some general comparison is possible. Figure 3 shows a sample of
200 simulated drift voyages beginning off the coast of Hokkaido in January. If we compare the results to the positions of landfall or discovery from Brooks' (1876) work in Table 1, wrecks are seen in comparable positions. The Hawaiian Islands, the Aleutian Islands, Cape Flattery, and Point Adams all have simulated drift voyages ending in their vicinity. There are also voyages ending on Vancouver Island, Haida Gwaii, and near Sitka, although Brooks’ records of Japanese wrecks may be questionable for these locations. Even given the small number of simulations in the sample presented here there is a fairly good agreement with the historical data.

As a result of the simulation’s success in its agreement with the historical data a second one was run to investigate intentional voyaging from the eastern Okhotsk Sea. It was noted above that considerable navigation skill was in existence from Jomon times, and large boats were used for whaling in the region at least by A.D. 100-200 (Yamaura, 1998). Similar vessels may have been in use in the region of South Korea as early as 5,000 B.C. (Lee and Robineau, 2004). Further, there was considerable trade on the region in the first millennium A.D. (Yumaura, 1998).

Intentional voyages were simulated for all months of the year with crossings from west to east in between 30 and 48 days. In the historical records of drift voyages sailors survived much longer than this although their survival is the result of sailing in relatively large, enclosed vessels with edible cargoes. People have survived drift voyages of six months in open boats, certainly long enough to traverse the distances between Japan and the northwest coast of North America. However, these voyages have been in tropical waters where survival rates are higher than they would be during winter in the northern North Pacific (McCance, et al., 1957). Still, traders used to traveling in northern waters, and prepared for the trip would likely not have had difficulty in the summer months. This is especially true if stops were made in the Aleutian Islands, the southern of which are at
approximately the same latitude as southern Kamchatka and Vancouver Island. Latitude sailing then would have been a simple method of navigation as was practiced by the Norse with open boats in similarly northern waters (Jett 2000).

Archaeologically then the problem is not were such direct contacts feasible but how do we distinguish them from unintentional drifts and indirect trade. There is no easy answer to this problem however a start would be to stop assigning historic dates to North American Northwest Coast sites simply on the presence of exotic materials such as iron, a practice noted by Acheson (2003:228). Another beginning, although one which would not give conclusive answers at present, would be more frequent spectrographic analysis of iron tools recovered from Northwest Coast sites. If we keep an open mind to the possibility, a method of distinguishing the ways by which such objects crossed the Pacific may be found.

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Figure Captions

Figure 1. The North Pacific Ocean.

Figure 2. The Edict Period Replica Kesen-Maru after the Drawing by Niinuma Tomenoshin (Shunichi 1993).

Figure 3. Sample of Drift Voyages.