Social Networking in the Kuril Islands
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Inland to Islands: Social Networks and the Development of Maritime Adaptations

Introduction

Ethnographic and archaeological research shows that maritime hunter-gatherers have colonized a wide range of environmental settings throughout the Holocene. What remains less well understood is how these populations expanded into more marginal areas and managed the increased environmental risk typically associated with these regions. In general, this research is aimed at understanding the adaptive strategies of maritime hunter-gatherers in mitigating the range of unpredictable environmental hazard events they experience. These hazard events include, but are not limited to, climate change such as broad cooling trends, biotic fluctuations such as changes in the abundance of sea mammals or fish and tectonic activity such as volcanic eruptions, earthquakes and tsunamis. It is argued here that understanding how maritime hunter-gatherers adapt to these unpredictable events is a critical component in understanding the colonization and settlement of diverse environments by maritime hunter-gatherers.

A network approach to understanding settlement histories

At the conceptual foundation of this research is the assertion that social networks are particularly important for colonization and persistent habitation of uncertain environments by ensuring a greater degree of adaptive flexibility to deal with infrequent and unpredictable hazardous events (Fitzhugh et al. 2011; Fitzhugh et al. 2004). In these settings, social networks allow for the dissemination of information that reduces environmental uncertainty by increasing spatial and temporal knowledge of hazard events. The access to broad environmental information through social network connections allows individuals to monitor environmental variations on a scale far beyond their individual capabilities. Furthermore, the consistent exchange of information and the development of trust between network participants can be formalized into a network of friendships providing a social "safety net" in times of hardship due to the direct impact of a hazard event. This "safety net" function of social networks is most eloquently demonstrated in ethnographic research of the !Kung San and the structure of the *hxaro* trading network

(Wiessner 1982). The *hxaro* trading network is a system that promotes a high degree of social interactions over wide spatial territories in order to mitigate the impact of semi-unpredictable droughts by maintaining friendships outside of the impacted territory.

If, as argued here, social networks function to disseminate information and reduce environmental uncertainty in unpredictable environments through formalized social relationships (Hamilton et al. 2007; Whallon 2006; Kelly 1995; Rautman 1993; Minc & Smith 1989; Minc 1986; Moore 1981), then the character of such networks should be implicated in the settlement and exchange history of hunter-gatherer populations residing in unpredictable environments. Fortunately, these settlement and exchange histories, even among small-scale maritime hunter-gatherers, often leave material traces that can be archaeologically investigated.

Environmental uncertainty in the Kuril Islands

The Kuril archipelago located in NE Asia is an excellent location to investigate the use of social networks as an adaptive strategy to uncertain environments due to the wide range of geographic and biotic variation occurring in the region. The Kuril archipelago includes 32 islands varying in size from 5 km^2 to 3,200 km^2 (and many smaller islets and outcrops), stretching in line for almost 1200 km from the northernmost Japanese island of Hokkaido to the Kamchatkan peninsula, see figure 1. The most significant boundary between regions is the Bussol Strait, which separates the southern three islands from the islands of the northern and central Kurils. This strait plays a significant factor in the distribution of flora and fauna in the Kuril Islands with higher biological diversity in the southern islands and significantly lower resource diversity in the more remote central and northern islands. This pattern is clearly observed in the flora of the Kuril Islands with the southern islands maintaining a significantly higher diversity of trees and shrubs, including spruce (*Picea*), larch (*Larix*) and oak (*Quercus*) as compared to the tundra-covered northern and central islands (Anderson et al. 2008). The fauna also demonstrates this pattern with the southern islands containing much higher diversity and abundances of terrestrial mammals (Hoekstra & Fagan 1998), insects, freshwater/terrestrial mollusks and freshwater fish

(Pietsch et al. 2001; Pietsch et al. 2003). The central islands, while ecologically less diverse and significantly smaller compared to the southern and even northernmost islands, do contain high abundances of marine mammals, particularly sea lions, seals and sea otters, at least at present.

In addition to biotic and geographic variation, environmental uncertainty in the Kuril Islands is highly influenced by the frequency and magnitude of unpredictable natural hazard events. As part of the extremely active Kuril-Kamchatka subduction zone and their location in the sub-arctic North Pacific, the Kuril archipelago has a high proportion of volcanic eruptions, tsunamis, earthquakes, storms and climate change. For instance, recent evidence suggests volcanic eruptions occur somewhere in the island chain approximately every 10 years with 32 different eruptions occurring in the last 300 year period (Ishizuka 2001). Earthquakes and tsunamis are also documented to occur with regular frequency. In the past five years alone, three major earthquakes have produced significant tsunamis in the Kuril Islands. A couplet of related, high magnitude earthquakes only 90 days apart hit the central Kuril region in 2006 and 2007 registering magnitudes of approximately 8.4 and 8.1 triggering tsunamis of 15-20 m maximum vertical coastal run-up (MacInnes et al. 2009; MacInnes et al. 2007). Finally, weather and climate change while less catastrophic is potentially more hazardous to inhabitants of the Kuril Islands (Fitzhugh 2011). The Kuril Islands are statistically one of the foggiest places on earth with fog occurrence days exceeding 70% during summer months (Tokinaga and Xie 2009) and certain islands experiencing nearly 250 fog days per year (Razjigaeva et al. 2004) . The Kuril Islands are also significantly impacted by the Pacific Decadal Oscillation (PDO) phenomenon with declines of phytoplankton and salmon populations tied to the presence and severity of the PDO (Nagasawa 2000; Tadokoro et al. 2005).

Methodological considerations of a network approach

While a strong conceptual foundation is important to operationalizing a social network approach, archaeologists are faced with a much more difficult and complex methodological question when investigating social networks, how do archaeologists identify social networks in the archaeological record? Answering this question is even more difficult for archaeologists studying maritime hunter-gatherers as the archaeological record of small-scale, mobile hunter-gatherers is often highly fragmented and incomplete. Rather than attempt to identify a single, universal answer to this complex question, I will instead provide a case study of Kuril maritime hunter-gatherers that highlights the use of artifact sourcing methods as one option to infer exchange patterns and ultimately social networks.

Over the last two decades, artifact sourcing methods emphasizing elemental characterization have become increasingly widespread in archaeological research. The rise in these methods is likely due to the increased availability of elemental characterization equipment and technological advancements such as portable X-ray fluorescence and laser ablation. These advancement have allowed for portable and non-destructive characterization of even the smallest archaeological material such as lithic debitage or pottery sherds. With this rise in the availability and advancement of characterization methods, I argue that our ability to provide inferences of social networks from a fragmented and incomplete archaeological record has grown significantly.

Case Study: Social Networks during the Epi-Jomon period in the Kuril Islands

If, as stated before, social networks function to reduce environmental uncertainty and provide greater adaptive flexibility through information transmission and the formation of social safety nets then social networks should be important in the colonization and habitation of novel and uncertain environments. Given the significant biogeographical differences between the southern region of the Kuril Islands and the central and northern regions, populations living north of the Bussol strait are assumed here to have a higher degree of risk and uncertainty in the colonization and habitation of the central and northern environments. Thus, the initial baseline expectation for social network structure is that the central and northern populations would attempt to mitigate their geographic isolation and environmental uncertainty by maintaining social connections to populations in less risky environments such as the settlement in the islands of the southern region or even Hokkaido.

Prior to presenting an analytical framework for integrating sourcing data with a social network approach, I want to simply acknowledge that this research, as well as most social network research, is exploratory and not explanatory. Using social network analysis with archaeological data often requires aggregating artifact assemblages that represent the actions of multiple individuals over long periods of time (Phillips 2011). Social network models based upon aggregated artifact assemblages are often oversimplified, masking the dynamic nature of human relationships. However, with well-developed knowledge over site chronologies and sample size effects, social network analysis can be a beneficial method that produces a visual representation of social relationships.

In order to address the research question of social networks in the Kuril Islands, my colleague Colby Phillips and I evaluated two artifact assemblages from southern and central archaeological sites dating to the Epi-Jomon period. The Epi-Jomon period was emphasized in our research as this cultural period is recognized as the first major occupation of sites located in the central and northern regions.

The research method presented here emphasizes the geochemical sourcing of both obsidian and pottery artifacts excavated during the three Kuril Biocomplexity Project field seasons from 2006-2008. With no local sources of obsidian identified in the Kuril Island chain, the mere presence of obsidian artifacts at archaeological sites in the central region immediately established that exchange relationships with regions containing raw obsidian, namely Hokkaido and Kamchatka, were very likely. Sourcing data was derived from the obsidian debitage through the combination portable X-ray fluorescence and laser-ablated ICP-MS at the Smithsonian Institute on 469 obsidian flakes. As identified in the geologic source distribution of obsidian debitage (figure 2), sites dating from the Epi-Jomon period and located in the southern region show a strong preference for obsidian originating from Hokkaido (Phillips and Speakman 2009; Phillips 2011). Epi-Jomon obsidian debitage from the central island sites demonstrate a different distribution pattern with a fairly even split between Hokkaido and Kamchatka sources. This data clearly suggests that inhabitants of the central islands were procuring obsidian through direct or indirect exchanges with populations outside of the island chain. Unfortunately, given that obsidian is not found locally but only in areas outside of the island chain, obsidian source data only highlights long-distance connections that are unable to evaluate the local and regional structure of social networks in the Kuril archipelago.

To understand the local and regional nature of the exchange relationships identified by obsidian sourcing, we emphasized the geochemical sourcing of ceramic artifacts. The primary benefit of using ceramic objects in the Kuril Islands is the spatial and temporal ubiquity of ceramic objects among archaeological sites. The spatial ubiquity of ceramic objects allows for higher resolution networks by incorporating ceramic artifact assemblages from a much larger number of archaeological sites. Furthermore, ceramic objects are also temporally ubiquitous allowing for higher resolution datasets by providing samples diagnostic of specific occupation phases such as the Early, Middle & Late Epi-Jomon. Due to these benefits, exchange networks derived from ceramic source data are assumed to better highlight relationships at the local, supra-local and regional levels within the island chain.

Fully understanding the increased difficulties associated with geochemical sourcing of ceramic artifacts as opposed to obsidian debitage, a pilot sample of 56 ceramics from eight archaeological sites dated to the Epi-Jomon period were submitted for elemental characterization methods at the Institute of the Earth's Crust, Russian Academy of Sciences-Irkutsk and the Elemental Analysis Facility at the Field Museum. As expected, results from geochemical sourcing of ceramic artifacts produce higher within group variability than obsidian data but do provide enough between group variation to identify four main source groups (see figure 3). In evaluating the distribution of archaeological sites in each source group it becomes clear that three of the four source groups identified are heavily represented by a single archaeological site. As identified in figure 4, ceramic source groups 1, 2 and 4 all contain a primary site the represents at least 50% of the sample assemblage associated with the ceramic source group. Interpretations of this distribution suggest that a majority of archaeological pottery is not transferred away from its local origins. In other words, pottery is most often manufactured, used and discarded in the same geographic location. However, while sample sizes are small for this ceramic pilot research, it is critical to note that a number of ceramic samples do not conform to this localized pattern. These non-local artifacts become critical data points in inferring social networks from sourcing data.

In order to integrate the ceramic sourcing data within the social network framework promoted here, a simple yet potentially controversial assumption is required. The assumption is that if a ceramic source group with a primary site (>50%) contain artifacts associated with other archaeological sites (non-local artifacts) then the two archaeological sites have a joint affiliation and are inferred to have a social connection. If we take this assumption one step further we can quantify the strength of the social relationship by the number of samples shared within each source group. For instance, in ceramic source group three (CSG-3), the sites of Ainu Creek (AIC) and Rasshua (RAS) each contain three samples suggesting a potentially well-established social connection between the sites, whereas the site of Tikhaya (TIK) only contains 1 sample in the source group suggesting a less well-established or lack of a social connection with either of the two previous sites.

Based upon these assumptions, we can begin to construct simple connections between archaeological sites in the Kuril Islands. Removing any sites that only contain one sample in a source group due to potential sources of error originating from clay heterogeneity and small sample sizes, three network connections can be established between five archaeological sites. As identified from the site distribution of ceramic source group one (CSG-1), a potential connection exists between the sites of Kompanisky (KOM) and Chirpoi (CHI). This connection is not surprising given the close spatial proximity of the two archaeological sites. As identified from ceramic source group two (CSG-2), a connection or tie may also be established between the archaeological site of Rikorda (RIK), located near Hokkaido, and the site of Ainu Creek (AIC) located on the southern end of Urup Island. And finally, as identified from ceramic source group three (CSG-3), a social connection can be established between the sites of Ainu Creek (AIC) and Rasshua (RAS), a site located in the central part of the island chain.

Fully aware of the methodological and conceptual challenges in this research, we can attempt to address how the social network visualization can inform the broader research question of social networks and their relationship to the environmental risk and uncertainty. To reiterate, the initial expectation of this pilot research is that despite significant biogeographical barriers Epi-Jomon populations living in the central and northern regions will maintain social connections to populations in the less risky environments of the southern islands to access environmental information and maintain social safety nets. As identified in figure 5, the archaeological site of Rasshua, found in the central region of the island chain, does appear to have connections to the site of Ainu Creek found in the southern region of the island chain. The exchange partnership highlighted between populations of Rasshua and Ainu Creek provide an initial hypothesis as to how Rasshua inhabitants are accessing obsidian. In network terms, Ainu Creek is acting as a middleman or broker providing indirect access to resources and information deriving from populations further south. In anthropological terms, Ainu Creek could be acting as much more than a market middleman, by providing a social partner for Rasshua inhabitants to access during unpredictable hazard events. Working from only ceramic sourcing data, it is difficult to provide a definitive explanation of the relationship between Rasshua and Ainu Creek but the network approach taken here establishes that re-evaluation of artifacts from both sites with an emphasis on the potential connection between them could produce interesting archaeological interpretations.

The simplicity of the network model shown in figure 5 should not be identified as a deficiency in the social network methodology but rather a result of the archaeological data used in this research. First and foremost, the simple network model reflects the reality of the pilot sourcing data as a large majority of archaeological pottery does appear to be locally made, used and discarded. On its own this is an interesting conclusion that has implications for future research, namely that either social networking among Kuril maritime hunter-gatherers is not as important to colonization and habitation as promoted in this research or that pottery is not the best proxy for understanding exchange relationships between populations. Secondly, the simplicity of the network model emphasizes that the use of a social network research framework requires significant amounts of archaeological sourcing data and that small sample sizes cannot produce definitive conclusions. Fortunately, in this research situation nearly 500 ceramic samples from 18 different sites throughout the entire chain are available for analysis. Dramatically increasing the sample size of analyzed archaeology pottery, currently scheduled for this coming autumn, will provide significant benefits to developing more robust ceramic source groups and gaining confidence in constructing social connections between sites.

Conclusion

In conclusion, the allure of understanding social networks in archaeological research is undeniable. Ethnographic evidence clearly demonstrates the importance of social networking to exchange resources, information and in unpredictable environments, to develop social safety nets. However, the conceptual and methodological challenges associated with identifying social networks in the archaeological record can be significant enough to deter many from the application of a social network approach to understanding hunter-gatherer settlement histories. It is argued here that while social network analysis is challenging for archaeologists studying maritime hunter-gatherers, the potential for exploring and evaluating critical concepts such as hunter-gatherer social relationships is well worth the risk.

Figures

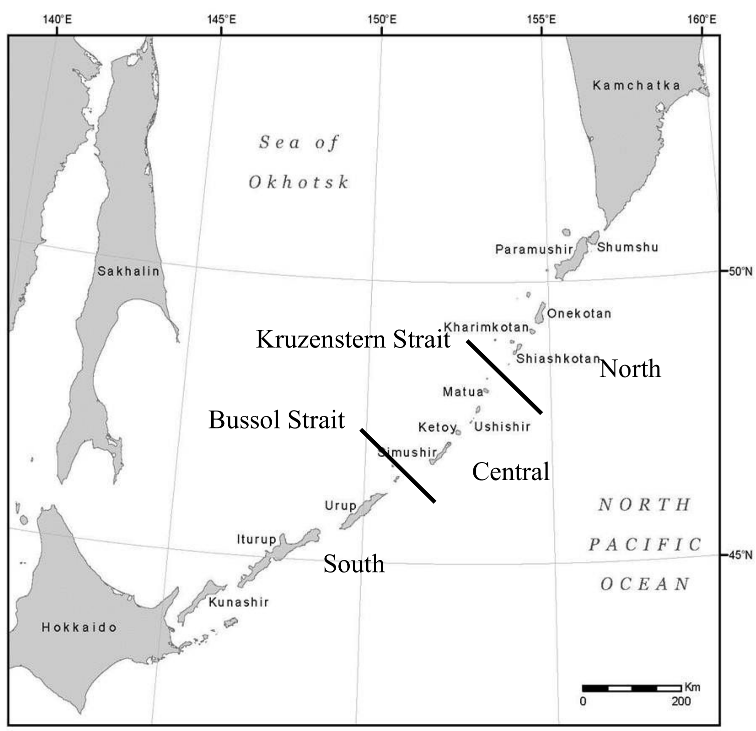


Figure 1. Map of Kuril Islands showing Bussol Strait
(Map by A. Freeburg)

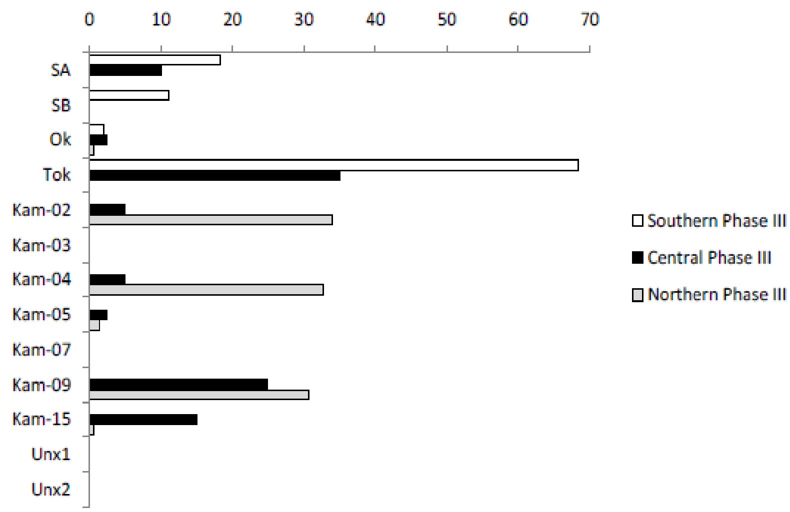


Figure 2. Frequency distribution of obsidian sources during Epi-Jomon (Phase III) from Phillips (2011)

Hokkiado sources: SA, SB, Ok, Tok
Kamchatka sources: Kam-02, 03, 04, 05, 07, 09, 15

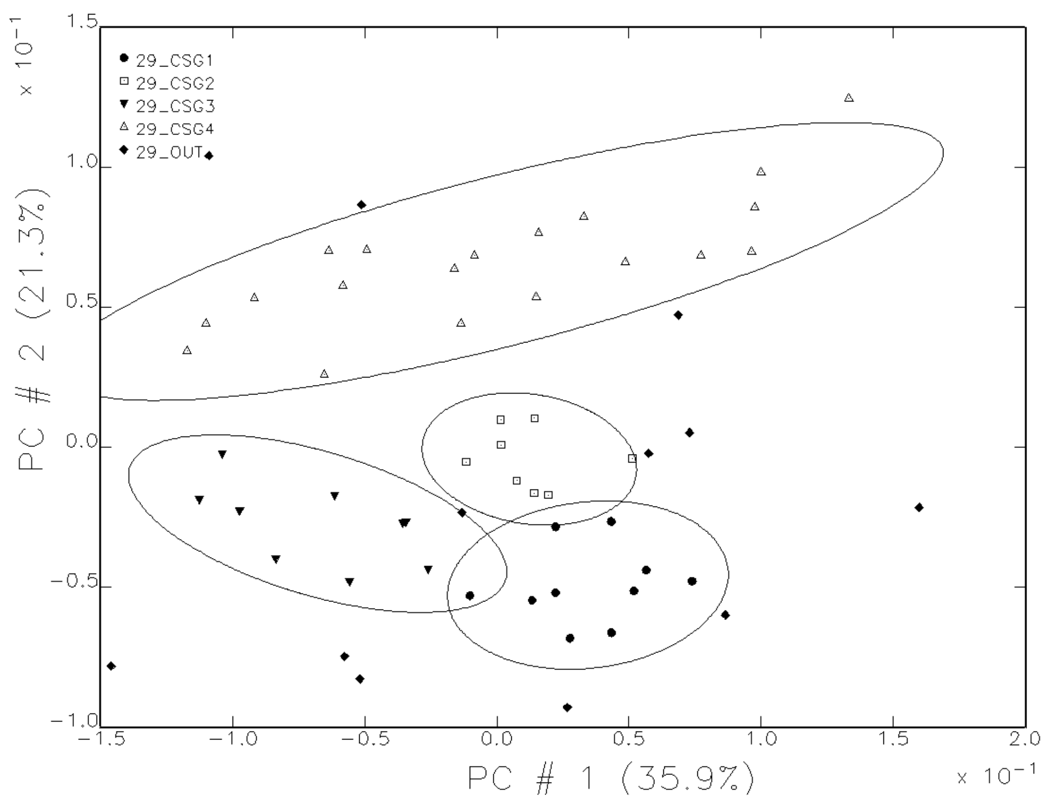
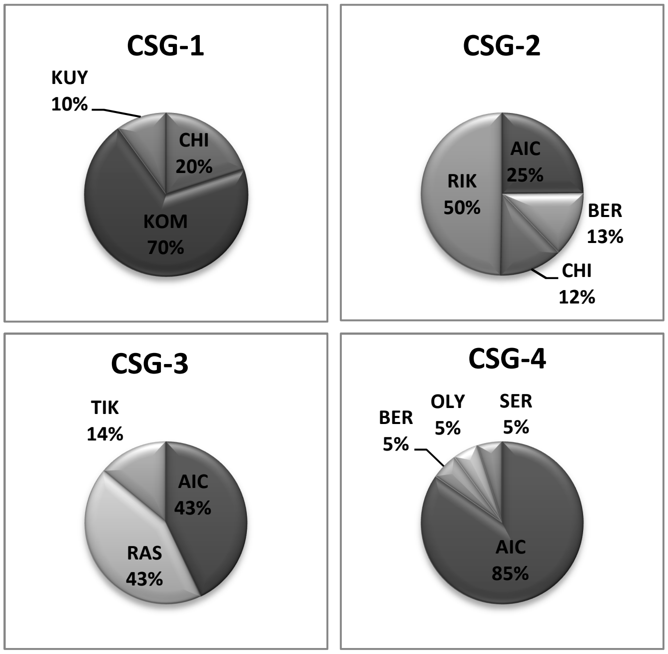


Figure 3. Biplot of Principal Component loading scores for Epi-Jomon ceramics showing four identifiable source groups



CSG-1 (n=10)
Primary site: Kompaniskii (KOM) – 70%
Network ties: KOM-CHI

CSG-2 (n=8)
Primary site: Rikorda (RIK) – 50%
Network ties: RIK-AIC

CSG-3 (n=9)
Primary site: Unknown (RAS or AIC)
Network ties: RAS-AIC

CSG-4 (n=20)
Primary site: Ainu Creek (AIC) – 85%
Network ties: None

Outliers (n=9)

Figure 4. Distribution of archaeological sites in ceramic source groups and determination of primary site (inferred region of geologic origin)

Figure 5. Epi-Jomon social network connections between archaeological sites inferred from ceramic sourcing data.

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