# *Chapter 6*

# Seafaring Intensity and Island–Mainland Interaction along the Pacific Coast of North America

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In this paper we explore the changing role of seafaring in the development of island-based communities on the western coast of North America, from the Gulf of Alaska to central California. Our primary aim is to explore how social and economic developments are conditioned by life on islands, and how seafaring articulates with these developments. Islands are particularly well-suited for studying questions of social interaction and exchange because island geography sets clear thresholds on the distances at which interaction can occur. Through a comparative analysis of three cases drawn from the hunter-gatherer archaeological records of Kodiak (Alaska), Haida Gwaii (British Columbia), and the Northern Channel Islands (California), we argue that inter-island/island–mainland interaction is broadly predicated on two factors, the first being the degree of socio-economic self-sufficiency of island populations and the second related to nature of resource distributions (ideal free *vs* ideal despotic) and related socio-political dynamics.

**Evolution of seafaring intensity in the life history of island societies: a model**

All evidence suggests that initial island colonization off western North America was by relatively small scale, egalitarian, hunter-fisher-gatherer populations. So our model starts with such a population that has established itself on a sufficiently large island to allow for demographic expansion. We can expect that a small founding population would interact rather closely with its mainland (or other island) counterparts early in the colonization process to avoid demographic extinction. Connections would be maintained with outside populations for purposes both social (e.g. marriage partners) and economic (e.g. access to resources such as raw materials). New immigrants would also move onto the island bringing materials from their homelands (Fitzhugh 2004). During this colonization phase, the imperative to keep up mainland contacts would encourage the continuity of seafaring technologies and maintenance of bodies of knowledge and skills for occasional crossings, even though most daily activities would involve much more limited maritime activities (i.e. close to shore).

On large islands with great habitat diversity and environmental productivity, expanding populations would reduce the social, demographic, and economic imperatives for maintaining external contacts. Marriage and exchange with mainland populations should decrease as island habitats fill, leading to import of fewer off-island products as a result. A second phase, defined by relative isolation, then persists as long as island populations are demographically self-sustaining and families are able to maintain unfettered access to local resources — a condition known in human behavioural ecology as the ideal-free distribution (Boone 1992). Boat technologies are likely to focus on shorter-distance mobility for subsistence hunting, fishing, or gathering, and occasional movement of camps. Whether seafaring skills and technologies are maintained should depend more on the nature of local activities than voyaging.

Subsequent expansion of seafaring activities is expected if and when the resource distribution shifts from an ideal-free distribution towards an ideal-despotic distribution — that is when habitats become saturated and some people are able to benefit from control over critical resources by excluding others (or providing access in return for compensation: Summer 2005). Despotic behaviour within groups often becomes more pronounced within the context of population filling and the inability to move from a less-productive patch to a more-productive patch that is already occupied by others, or it could result from environmental changes that affect some resource patches more than others, leading to inter-community differences in resource accessibility (Kennett 2005).

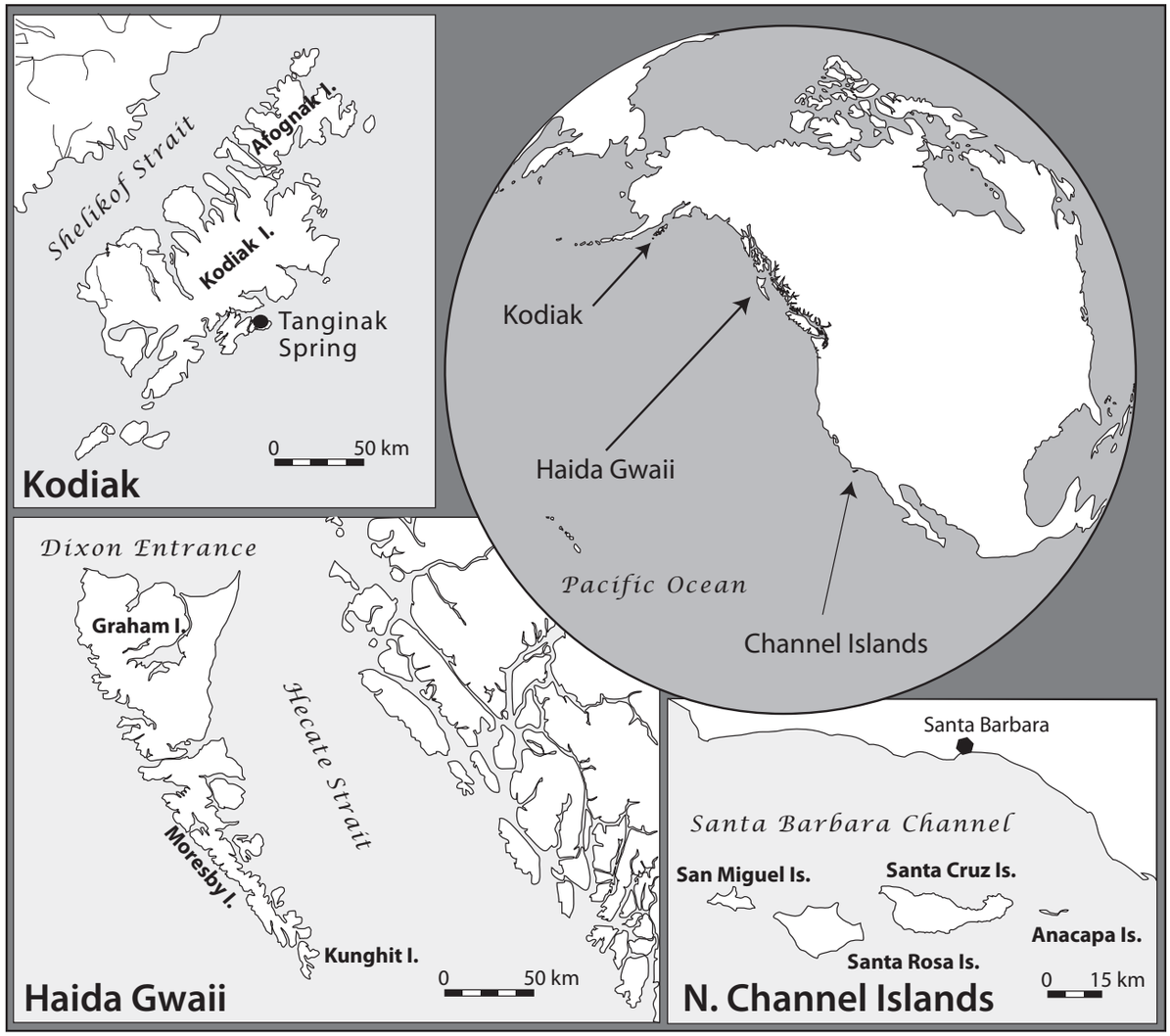


**Figure 6.1.** *Map of western North America showing locations of the Kodiak Archipelago, Haida Gwaii (Queen Charlotte Islands) and the Northern Channel Islands.*

Technological changes can stimulate despotic behaviour if they make it easier to exclude competitors from resource-extraction locations, or if they allow for more secure extraction of defendable resources. In some cases, despotic behaviour can develop where alienable surpluses are produced and controlled by dominant individuals (e.g. Earle 1987; 1997; Hayden 1995; Testart 1982). Despotic distributions are characterized by asymmetries in the availability and control of quality resources within and between groups. Competition for access to those resources stimulates social networking, trade and warfare (Kennett *et al.* 2009). Where quality resources (e.g. patches) are stable over extended periods of time, conditions are optimal for institutional socio-political inequalities to develop (Boone 1992). On the other hand, instability in the productivity of controlled resources should hamper the emergence of long-term political asymmetries, leading to endemic competition and shifting political fortunes on multi-annual and decadal time scales. Seafaring is expected to increase in scope and intensity as economic and socio-political competition intensifies.

Under these socioecological conditions we expect the development of symbolic or prestige ('political') economies and concomitant warfare (Fitzhugh 2003; Kennett 2005). Elites able to sponsor expensive and

**Table 6.1.** *Phases, periods and chronological ranges in the prehistory of Kodiak, Haida Gwaii, and the Northern Channel Islands.*

| Model phase correspondence | Archaeological periods | Approximate calendar age range* | Geological epoch |
|---|---|---|---|
| ***Kodiak Archipelago*** | | | |
| Political competition (despotic) | Late (Developed) Koniag | 500–200 BP (Contact) | Late Holocene |
| Political competition (despotic) | Early Koniag | 700–500 BP | |
| Political competition (despotic) | Late Kachemak | 2600–700 BP | |
| Self-sufficiency (ideal-free) | Early Kachemak | 3800–2600 BP | Middle Holocene |
| Self-sufficiency (ideal-free) | Ocean Bay II | 5100–3800 BP | |
| Colonization | Ocean Bay I | 7500–5100 BP | |
| ***Haida Gwaii*** | | | |
| Political competition (despotic) | Late Graham Tradition | 2000–200 BP (Contact) | Late Holocene |
| Self-sufficiency (ideal-free) | Early Graham Tradition | 5000–3000 BP | Mid Holocene |
| Self-sufficiency (ideal-free) | Moresby Tradition | 8900–5000 BP | |
| Self-sufficiency (ideal-free) | Kinggi Complex | 9500–8900 BP | Early Holocene |
| Colonization | <archaeologically unknown> | >9500 BP | Late Pleistocene |
| ***Northern Channel Islands*** | | | |
| Political competition (despotic) | Late Middle/Late | 1500–200 BP (Contact) | Late Holocene |
| Self-sufficiency (ideal-free/transitional) | Late Early/Middle | 3000–1500 BP | |
| Self-sufficiency (ideal-free) | Early | 7500–3000 BP | Middle Holocene |
| Seasonal Use? (ideal-free) | | 10,000–7500 BP | Early Holocene |
| Colonization-Seasonal Use | | 13,000–10,000 BP | Late Pleistocene |

* converted from radiocarbon ages with OxCal 4.0. Age ranges are coarse approximations.

risky voyages for trade or raiding, or who succeed in open-ocean hunting of dangerous prey such as whales, are able to build reputations at home, attract political support and discourage lesser competitors. Under these conditions, we should see greater investment in seafaring technology and increased flow of exotic goods onto islands. Innovative boat technologies are desirable in order to travel more often and at longer distances with larger quantities of exchange goods and/or large numbers of warriors to capture trophies and slaves. The new positive value placed on exchange of prestige goods likewise encourages a shift from typically risk-averse towards increasingly risk-prone voyaging and hunting (e.g. whaling: Alvard & Nolin 2002).

This model establishes expectations for the degree of interaction between offshore and mainland coasts evident in archaeological raw materials, faunal composition, and military structures and paraphernalia. Island archaeological deposits should contain moderate amounts of off-island materials early following colonization, while later periods of relative 'self-sufficiency' and isolation should result in relatively less off-island material. Where and when political competition emerges, off-island commodities should once again become significantly represented in assemblages and quite possibly indicate more extensive and longer-distance exchange interactions than previously. This pattern should be modified by contingent factors (environmental change, immigration and emigration, geographic scales, island–mainland proximity and travel conditions).

## Kodiak, Haida Gwaii and Northern Channel Islands

Comparison of the archaeological records of the Kodiak Archipelago, 'Haida Gwaii', and Northern Channel Islands (Fig. 6.1), three of the most isolated island archipelagos off western North America, gives us an opportunity to evaluate the changing role of seafaring through available human history in this region. Several parallels and other differences may be instructive as we look at maritime activities and seafaring and their relationship to social and economic developments. For ease of comparability, we will discuss each case in three phases: colonization (or the earliest phase represented archaeologically); an intermediate phase of established occupation — generally corresponding to the Mid Holocene; and a Late Holocene phase of population infilling after 3000 BP. The culture histories associated with these phases are presented in Table 6.1 (Fitzhugh 2003; Fedje & Mackie 2005; Kennett 2005). Four sources of evidence are examined to assess the importance and intensity of seafaring through time in the archaeological records of these cases: raw materials (especially lithic), faunal remains (terrestrial, near shore, and deeper marine resources), intrusive/non-local artefact styles and settlement patterns (size, permanence, and location with regard to island interiors, protected coasts, exposed coasts).

The true origins of western North American seafaring, defined broadly, are largely unobserved in the available archaeological record. In all three cases considered, the earliest archaeological manifestations

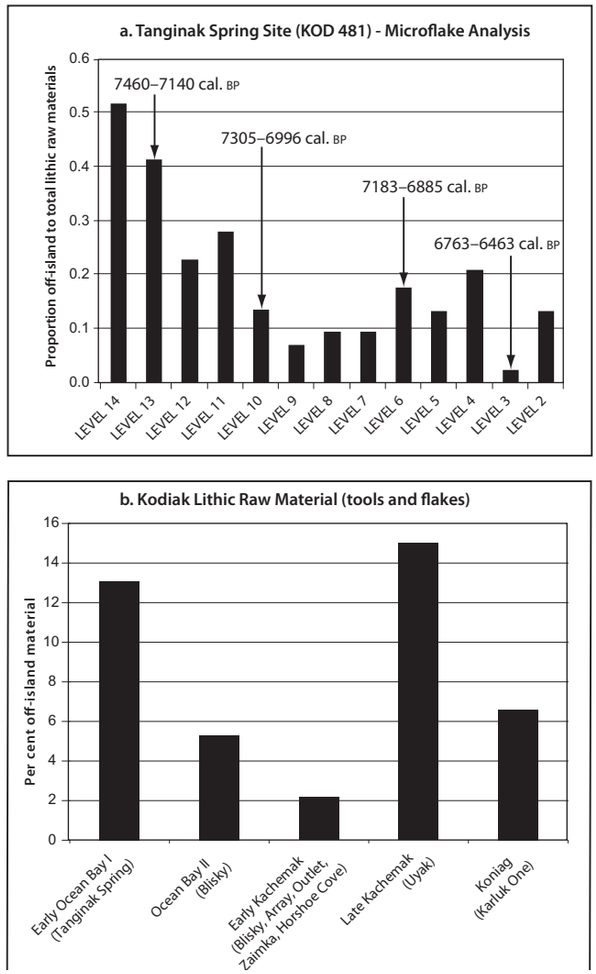


**Figure 6.2.** *Importance of off-island lithic raw material in Kodiak assemblages through time. (a) Analysis of microflake raw materials from the Tanginak Spring Site, showing a declining relative importance of off-island lithic raw material from the bottom of the site (Level 14) to the top (Level 2). Calibrated date ranges presented for Levels 13, 10, 6 and 3 are averaged 1 sigma intercept values (calibrated with OxCal 4.0). Microflake data were compiled by Reimer (2007) based on analysis of 68+ (⅛ inch sieve) water-screen collection lots. Sample sizes by level range from 142 (L. 14) to 11,090 (L. 7) with a mean of 2940 flakes. (b) Relative importance of off-island raw materials represented in stone tools and flakes aggregated by cultural period. The large proportion of off-island raw material in the Late Kachemak sample reflects the unique character of the Uyak site as a production locale for jewellery made from mainland coal during this interval. Organic raw materials such as caribou antler, walrus ivory, and bone are also significant in Late Kachemak and Koniag assemblages, but cannot be compared directly to earlier components lacking sufficient preservation.*

appear to be of capable and obligate maritime foragers, pursuing littoral and near-shore fish and sea mammals, presumably with boats, and certainly with harpoons, hooks, and similar paraphernalia (Fedje & Mackie 2005; Fitzhugh 2003; Kopperl 2003; Rick *et al.* 2001). The presence of people on some of these off-shore islands (e.g. Northern Channel Islands and Kodiak) itself indicates use of boats (Erlandson *et al.* 1996).

From the model, we expect colonization phases to generate patterns of relatively high interaction between islands and off-island sources. This turns out to be a particularly difficult aspect of this model to evaluate for this (and perhaps any) stretch of coast because of the complications of changing sea levels and difficulties of knowing whether or not the oldest known sites are in fact residues of the colonization phases or just the oldest sites preserved or so far located (Fitzhugh 2004). The environmental record for the western North American coast suggests that we will often fail to find evidence of colonization events prior to the Middle Holocene, at which point most regions appear to have been substantially settled. Coastal-formation processes along this continental margin are complex and regionally variable. In addition to global (eustatic) sea-level change, tectonic processes periodically raise or lower local shorelines relative to neighbouring regions (Mann *et al.* 1998), and, in the northern segments from Washington State to the Alaska Peninsula, glacial isostasy complicates regional and local patterns (Fedje *et al.* 2005; Mann & Peteet 1994).

Nevertheless, in two of the three cases, we believe that we have meaningful, if different, evidence for a colonization sequence. On Kodiak, evidence from the Tanginak Spring site supports the idea that people were newcomers to the archipelago 7500 years ago (Fitzhugh 2004), maintaining more regular contacts with populations living outside the archipelago. As shown in Figure 6.2a, connections with the mainland were most apparent in raw material distributions in the earliest levels of the site (50 per cent off-island sources), declining significantly in less than 200 years (*c.* 10 per cent off-island). The next earliest components around Kodiak for which comparable data are available post-date the stabilization of non-local to local raw materials in the Tanginak Spring site, having an average of 2 per cent off-island lithic materials (Steffian *et al.* 2002). The lower average off-island raw material proportion compared to Tanginak Spring at these later Ocean Bay I sites may relate to the location of these sites with greater proximity to relatively higher-quality island chert sources compared with Tanginak Spring, but the dramatically lower proportion of off-island material in these and later assemblages of

the mid Holocene (Fig. 6.2b) suggests that islanders simply interacted less frequently with people on the mainland between 7000 and 2500 BP.

On the Northern Channel Islands, the exploration and colonization process during the late Pleistocene (Erlandson *et al.* 1996; Johnson *et al.* 2000) may have taken a different form, with indications that mainlanders may have occupied the islands periodically for several centuries to millennia before committing to year-round island life (Walker & Snethkamp 1984). This is based on the small sizes and limited number of sites dating to the late Pleistocene (but see Erlandson *et al.* 2009), though we must acknowledge the patchy record of Terminal Pleistocene sites, especially coastal locations where more permanent settlements would be likely be positioned, in this time period due to rising sea levels (Erlandson *et al.* 2008; Kennett *et al.* 2008). On Haida Gwaii, the evidence suggests that people had been living on the coast for an indeterminate period before the earliest known archaeological deposits were created (also in the late Pleistocene). In the context of seafaring, Haida Gwaii is a special case. It appears that there was no reason why these early hunter-gatherers needed boats because Haida Gwaii was connected to the mainland as recently as 12,000 years ago (Fedje *et al.* 2005). That fact, of course, does *not* mean that boats were not used in their colonization.

In each case the archaeological patterns of raw material and fauna suggest that in the millennia following early occupation there were periods of relative self-sufficiency (Kopperl 2003; Fedje & Mackie 2005; Erlandson *et al.* 1996). Rare contacts with the mainland are suggested by low quantities of off-island raw materials. In all cases, maritime subsistence appears to have been dominant. But in no case is there any indication of intense open-water navigation or the use of large boats, although the Rice Ridge site on Kodiak suggests a brief interval of whale and porpoise hunting at *c.* 7000 cal. BP (Kopperl 2003). Otherwise, it is remarkable how little change we see in boat-based activities throughout most of the Holocene.

The archaeological record of the late Holocene indicates a co-occurrence of population packing, intensified subsistence activities, emerging political competition, inequality and trade in prestige goods, and enhanced nautical activities. On Kodiak and perhaps Haida Gwaii, the emergence of status inequality is synchronous with the development of significant whale hunting activities (Acheson 2005; Fitzhugh 2003) and eventually expands to embrace large-scale, endemic warfare mobilized by large boats and long-distance raids (Maschner and Reedy-Maschner 1998; Moss & Erlandson 1992). For the Chumash, Bernard (2004, 46) suggests that the invention of the plank canoe was driven by a similar desire to pursue competitive status distinctions by hunting 'desirable, rare, dangerous, and/or difficult-to-acquire resources, including large pelagic fish' prior to the development of intensive Chumash shell-bead exchange. The development of Chumash complexity was, in part, built upon the unique opportunities created by quality island lithic sources, shells and an exclusive nautical technology for transporting beads to the mainland, in exchange for other valuable goods (Arnold 1995).

On Kodiak, Haida Gwaii, and the Northern Channel Islands, evidence suggests generally low degrees of interaction with the adjacent mainland prior to 2000–3000 cal. BP and greater interaction in subsequent times. On the Northwest Coast, the natural expansion of cedar forests provided timber suitable for large canoe construction, and this has been suggested as a mechanism for increase in seafaring and social interaction over large expanses of the coast (Ames & Maschner 1999). On Kodiak, and farther north, large boats capable of transporting dozens of people were made of sea-mammal skins stretched over driftwood frames. These voyages covered one-way distances of up to 900 km (Davydov 1976, 22–3). While these distances would have been covered close enough to shore to escape hazardous weather conditions when possible, the presence of hostile populations there would have encouraged off-shore travel. Sails and swift movement would have been advantageous to successful voyages, but are not known to have been used prior to European contact.[1] This voyaging represents a particularly hazardous activity, with risks of capsizing and drowning, exposure, or drifting off-course into enemy territory or out to sea. Skin boats also require drying every few days in order to tighten the seams and prevent rot (Stefansson 1913, 106). Added to these hazards are the challenges inherent in traversing unfamiliar territory with potentially hostile occupants and the common goal of travel, which was often to raid enemy villages, kill the adult males and capture women and children as slaves and concubines (Holmberg 1985, 57–9; Moss & Erlandson 1992). In the case of the Channel Islands, the plank canoe was first developed about 1500 years ago (Gamble 2002), facilitating travel in more difficult weather and larger volumes of cargo to and from the mainland. It appears within the context of population infilling, increased inter-village conflict, and greater contact with the mainland coast via exchange (Kennett 2005). The importance of large boats for trade and warfare in the late Holocene for each of these three cases is striking.

Data on settlement patterns strongly suggest residentially mobile camps and small populations in the earliest occupations of Kodiak (Ocean Bay phase),

Haida Gwaii (the Kinggi Complex and Moresby Tradition), and Northern Channel Islands. Fitzhugh (2003) notes a tendency for early sites to be located on semi-protected coasts of southeast Kodiak. In the subsequent interval from about 4500–1400 BP, sites continue this tendency of semi-protected settlement placement, with increased focus on specialized processing sites on seasonally productive salmon streams (Saltonstall & Steffian 2006, 81). In the past 1400 years, however, settlement patterns expand into the unprotected regions of outer Kodiak, a pattern that becomes quite prevalent for winter settlements in the last 600 years before Russian contact. Reasons for this expansion appear to relate to increases in whale hunting and defensiveness (Fitzhugh 2003). On Haida Gwaii, archaeological sites from the early Holocene are primarily located on the eastern side of the archipelago and in protected inner and mid bay locations (Mackie & Sumpter 2005, 342, 369). In the southernmost tip of Haida Gwaii, sites of the late prehistoric, Late Graham (Kunghit) tradition are almost exclusively located on more exposed coastal stretches (Acheson 2005, 318), especially along the more linear west coast of Moresby Island (Mackie & Sumpter 2005, 362–3). Mackie & Sumpter (2005) demonstrate that this shift represents a statistical movement of settlements away from productive salmon streams, despite a general pattern of increasing salmon production represented in archaeological faunal assemblages (Mackie & Acheson 2005, 291). Evidence of whale bone in faunal and tool assemblages of the Late Graham tradition suggest a late prehistoric whale hunting tradition similar to that found on Kodiak (Acheson 2005, 320).

On the smaller Northern Channel Islands, the earliest occupations are thin midden deposits (camps and shelters) lacking evidence of constructed house floors or evidence of settled occupation (Rick *et al.* 2006). Well-watered regions like the north coast of Santa Rosa Island developed more extensive archaeological deposits, while other areas saw sparse occupation. The interior region becomes more important in the mid Holocene for plant exploitation (Kennett 2005). In the late Holocene, populations aggregated into coastal villages and became oriented more towards the movement of goods by sea. These villages were strategically placed in defensible locations. The emergence of political inequality during this time was partly dependent on the opportunistic development of maritime exchange in valuable shell beads for mainland food and other resources in the context of habitat saturation and heightened territoriality (Kennett *et al.* 2009). This was made possible by more or less exclusive control of productive patches (Arnold 1990), and the emergence of a sub-continental scale prestige economy valuing shell beads made in the Northern Channel Islands (Bennyhoff & Hughes 1987). Neither Kodiak nor Haida Gwaii appears to have controlled such an exclusive commodity and they fit more easily into the Northwest Coast pattern of smaller-scale political contests for status and social power (Coupland 2004).

**Seafaring and social development in western North America**

Evidence of connectedness between these islands and adjacent mainland coasts, of the degree of exploitation of marine faunas, and of settlement patterns, and material culture, provides proxies for seafaring intensity. Our model predicts initially high levels of contact shortly after colonization, followed by relatively low levels of contact for demographically and economically self-sufficient island populations when a range of suitable habitats is available, when competition for productive resources is low, and when outcomes of individual contests are simply structured by immediate circumstances and abilities (ideal free distribution). Our model also predicts increased seafaring (more exotic materials, more open-ocean foraging) in the context of habitat saturation, increased competition and greater territoriality (ideal despotic distribution). Demographic expansion and increased population densities identified in each of the archaeological cases during the late Holocene, lead us to expect this condition, and increased seafaring activities, synchronously with the emergence of politically ranked, complex hunter-gatherer lifestyles.

The available data from these three cases are consistent with the predictions of our model (Figs. 6.3, 6.4), although the colonization pattern is missing from the Haida Gwaii case, and probably the Northern Channel Island case as well, owing to drowned coastlines. For this reason, finding an archaeological signature of colonization on Kodiak is intriguing. The evidence for terminal Pleistocene and early Holocene on the Northern Channel Islands suggests that, despite very early evidence of human activities, the Northern Channel Islands may not have been permanently settled until the end of the Early Holocene (Kennett 2005). People may have travelled to the islands seasonally to take advantage of the islands' resources, but moved back to the mainland seasonally. This interpretation suggests that the 'colonization' phase was protracted or delayed, an expected pattern if the mainland population density was low and the islands too isolating for available maritime technology.

For the majority of the Holocene, despite relatively low levels of mainland interaction the archaeological

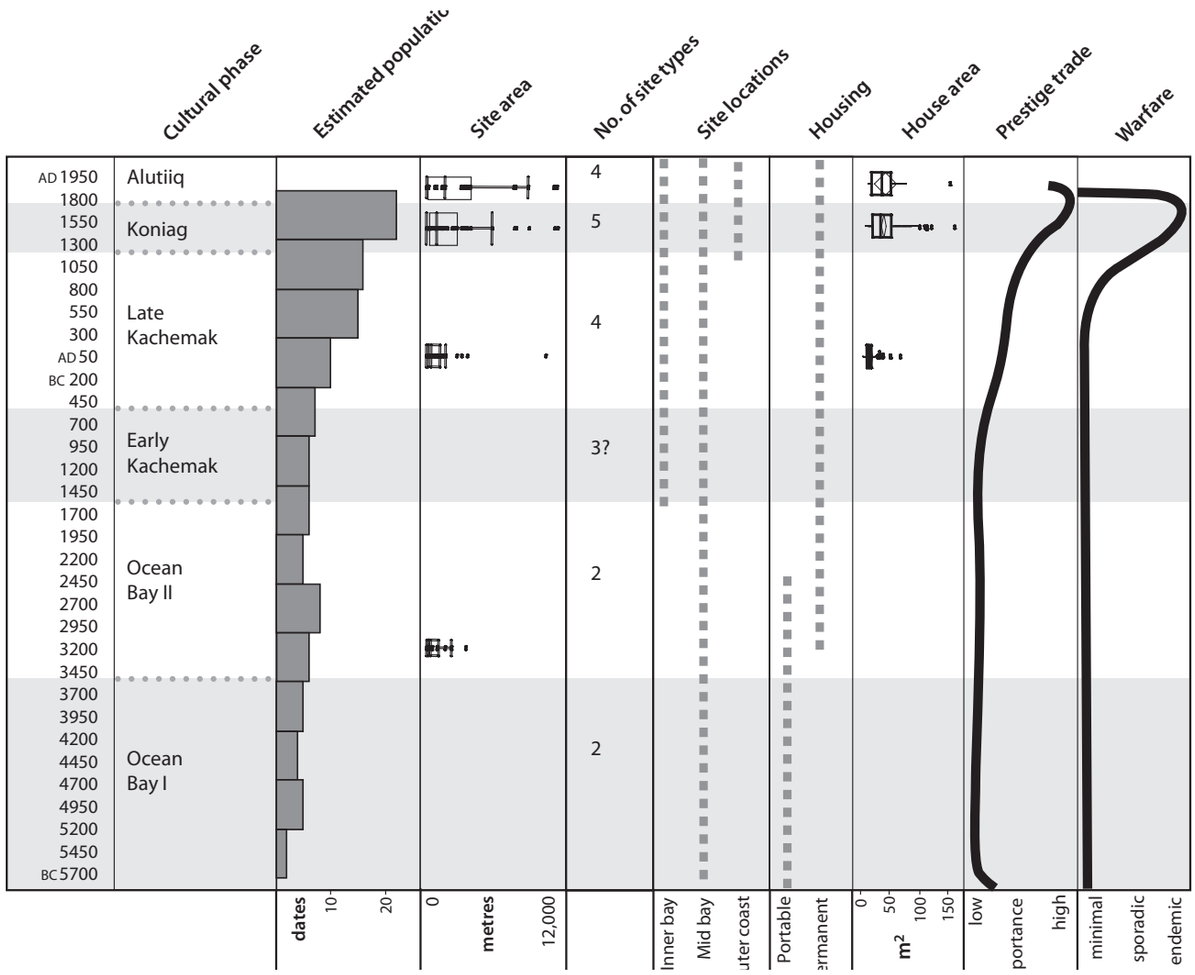


**Figure 6.3.** *Relationship between demography, site area, variety, and placement, house permanence, house area, exotic trade, and warfare on Kodiak during the last 7500 years. Population estimates are based on radiocarbon date frequencies counting one date per site per 100 years. Site and house area box plots are aggregated by time period. Warfare is estimated from dated defensive sites. (Data compiled and redrawn from Fitzhugh 2003, figs. 9.6, 9.9, 10.1).*

records in each region indicate significant levels of maritime foraging (Kopperl 2003; Fedje & Mackie 2005; Rick *et al.* 2001). The early evidence suggests most food was acquired from near-shore locations that afforded diverse and productive habitats and the opportunity to seek shelter as needed. In spite of the early appearance (and then apparent 2000-year hiatus) of deep-water hunting (whales and porpoise) on Kodiak, maritime foraging increased in taxonomic diversity and in technological sophistication (e.g. mass-harvesting technologies) in the later Holocene records of each region (Fitzhugh 2003; Kennett 2005; Kopperl 2003; Mackie & Acheson 2005; Partlow 2000).

Broadly speaking, the middle Holocene was a time of low connectivity with mainland populations. On Kodiak and Haida Gwaii, settlement patterns generally reflect a focus on semi-protected and protected coastal locations, while on the Channel Islands, settlement focus turns towards increased use of island interiors. From early through middle Holocene, settlements shift from generalized and residentially mobile foraging towards an increasingly specialized and structured use of the environment. This parallels growing residential permanence and reduced foraging ranges. Populations grew gradually through this time, though not as rapidly as in the late Holocene. On Kodiak, the evidence also suggests reduced levels of maritime foraging, as people turned towards capture and storage of anadromous fish (Fitzhugh 2002; 2003; Steffian *et al.* 2006). On Haida Gwaii, more

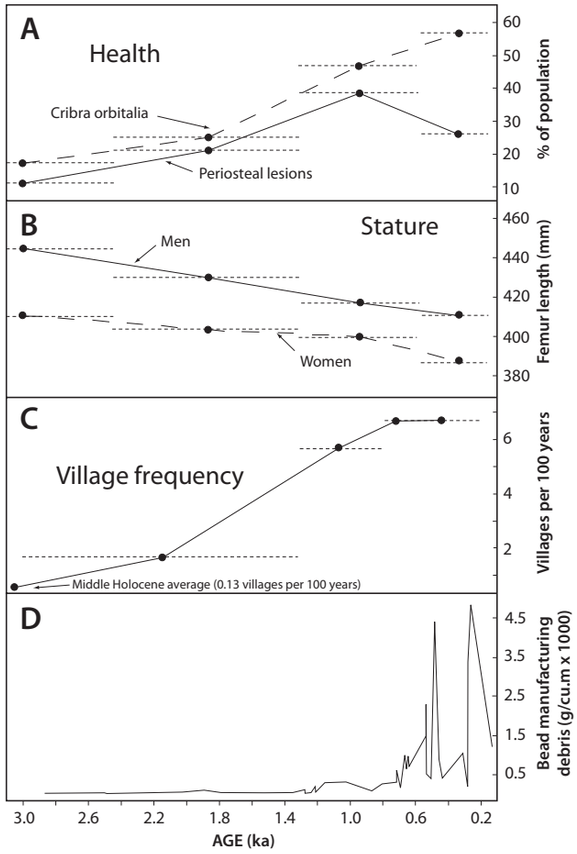


**Figure 6.4.** *Relationship between demography, health, stature, and bead making on the Northern Channel Islands during the last 3000 years: A) changes in health through time (Lambert 1994); B) changes in body size (stature) through time based on femur length (Lambert 1994); C) Number of villages per 100 years (Kennett 2005); D) Olivella bead-manufacturing debris (g/cu.m × 1000) from Late Holocene villages (Kennett 2005).*

attention was paid to terrestrial resources such as the indigenous caribou (*Rangifer dawsonii*: Fedje & Mackie 2005). Northern Channel Island settlement data suggest a greater emphasis on the use of interior plant foods and periodic movement into the interior for short periods of time.

Early in the Late Holocene, beginning around 2000–2500 years ago, we see growing evidence of political competition on Kodiak and the Northern Channel Islands. On Kodiak, we see signs of regional social affiliation and incipient ranking, and of importation of previously unused exotic materials, much of it of purely decorative and symbolic value (such as coal for labret manufacture: Steffian & Saltonstall 2001). Whale hunting and localized defensive features become apparent (Fitzhugh 2003). Intense interest in the treatment of human bones suggests the emergence of lineage ranking systems and possibly war captive slavery (Simon & Steffian 1994). Incipient ranking appears on the Northern Channel Islands after 1500 years ago in the context of population expansion to increasingly marginal island habitats, intensified fishing, and increased sedentism in strategic locations, with signs of territoriality, violence and trade (Kennett & Kennett 2000).

Although the timing differs between regions, there are parallels in the late Holocene of movement of primary village residence to the outer coastal regions and away from interior and protected environments (Acheson 2005; Erlandson *et al.* 1992; Fitzhugh 2003; Kennett 2005; Mackie & Sumpter 2005; Perry 2004). Settlements shift to defensive locations and cease to be mapped onto local resource distributions, in favour of social and defensive locations. Subsistence activities include higher-risk fishing and whale hunting, dramatic expansion of mainland contacts in the form of trade, and increased militarism. In all regions, boats came to be used not only for domestic production, but also for prestige exchange and warfare. Boat capacity, if not seaworthiness, appears to have expanded in the late Holocene to accommodate the growth of competitive exchange and warfare.

By the time of European/Asian contact with the native people of western North America, seafaring had emerged as a political necessity for those who would compete for positions of social standing and power. For island occupants, access to the labour and resources to launch long-distance boat voyages with large entourages for trade or warfare, was a critical determinant of political competitiveness. While we think this condition emerged from newly despotic conditions in competition for subsistence security, once it developed the ownership of large vessels, skilled navigators and productive commodities amplified inequalities. Even so, on the Northwest Coast and Kodiak and possibly also on the Channel Islands, the underlying resource variability was insufficiently centralized to support supra-village inequalities that lasted multiple generations.

## Conclusions

The archaeological record along the western coast of North America from Kodiak south to the Channel Islands is examined here in light of a model predicting shifting degrees of connectivity between island inhabitants and adjacent mainland neighbours, related to the nature of demographic and ecological self-sufficiency and the development of competition

for resources. While boats are implicated in some of the developments along this coast, the centrality of seafaring has rarely been the focus of examination (but see Ames 2002; Arnold 1995; 2001). Boats were used along the west coast of North America throughout the Holocene and the presence of humans on the Northern Channel Islands of California in the terminal Pleistocene indicate very early use of boating technology (Johnson *et al.* 2000).

Across the region, however, a shift in the scale of boat construction and function is linked to the growth of complex economic, social, and political developments in the late Holocene. Arnold (1995) has argued that innovations in boat technology and the concomitant development of elite-controlled island–mainland trade networks were central to the emergent complexity of the Santa Barbara Channel region. Accordingly, a causal role in the social evolution of this region is attributed to a change in the nature of seafaring, linked to several other environmental and demographic factors. Farther north along the Northwest Coast of North America, Ames & Maschner (1999) have suggested that environmental changes and the establishment of the coastal forests *c.* 3500 BP provided the resources for the construction of the first large freight and war canoes that fed the growth of complex hunter-gatherers throughout the region. Ames (2002) has also discussed the role of canoes as containers for aquatic foraging, changing the equation dictating predictable foraging ranges for shellfish, aquatic plants, fish and marine animals.

The model presented in this paper elucidates change in the intensity of interactions between island populations and nearby mainland regions through the Holocene, which in turn reveals significant parallels in the nature of seafaring between relatively insular places. While the western North American cases are embedded in larger maritime traditions, this model could provide additional insights in other cases of more remote seafaring. Kennett *et al.* (2006) develop a similar model for the exploration and colonization of Oceania.

Seafaring is a risky endeavour that might be promoted when conditions favour its benefits relative to the cost of available alternatives. Erlandson (this volume) notes that despite the evidence for hundreds of thousands of years of aquatic adaptation in hominin prehistory, the technologies for long-distance seafaring were late developments, within the last 4000 years. Anderson (this volume), for example, calls our attention to the later development of sail technology and similar innovations for long-range seafaring. While late Pleistocene people occasionally travelled relatively long distances over water, such movements only became regularized relatively late in the Holocene.

Our study of prehistoric western North American boating suggests that this new focus on seafaring as a way of life depended on the development of competitive political economies. So the question arises, why did such competitively motivated technological development and seafaring practice emerge in many parts of the world only so recently and in relatively high synchronicity (within a few thousand years)?

Any satisfying answer will need to explain the motivations that stimulated people to engage in high risk, frequent seafaring as well as the relatively late and roughly synchronized developments. One catalyst may have been global sea-level stabilization and its expected effects on ecological patch stability (e.g. Fladmark 1989). More stable patches over time would allow for more permanent settlement of specific resource hotspots leading to unprecedented degrees of coastal sedentism and the development of a social geography with more asymmetrical access to resources. This would have enabled the growth of larger population concentrations, and created a stimulus for competitiveness (Boone 1992).

Fitzhugh (2001; Fitzhugh & Trusler 2009) explores the idea that technological innovation should be motivated by socio-ecological circumstances of high risk, when potential innovators perceive advantages to trying something new instead of sticking with known strategies and techniques. From this perspective, we could say that aquatic subsistence adaptations themselves have been remarkably stable and low risk from Pleistocene times through much of the Holocene, encouraging relatively little innovation in maritime technologies or seafaring activities. Late Holocene developments then appear to relate to a change in demographic and social circumstances. Accordingly, the development of large, ocean-going vessels and innovations in nautical equipment and techniques are expected where people recognized benefits of cornering exchange markets, vanquishing competitors and attracting allies and subordinates through demonstrations of prowess in daring open-ocean activities. The surprisingly late developments in long-distance voyaging around the world could be in part, then, a product of socially driven risk-taking behaviour stimulating new maritime technologies, increased whaling, maritime trade, warfare and journeys of discovery.

**Note**

1. Martin Frobisher's crew observed Inuit use of the sail in eastern Canada during their second and third expedi-

tions to Davis Strait in the late sixteenth century. Non-European style, grass-matt sails were also observed on skin boats around the coast of northern Alaska in the nineteenth century (Driver & Massey 1957, 292). Norse from Greenland are known to have interacted with Thule Eskimo (Inuit) groups on both sides of Davis Strait earlier in the second millennium, before the collapse of the Greenland colonies, so Inuit could have learned sailing technology from them (Driver & Massey 1957, 292; Schledermann 1996). Alaskan sailing could have diffused from eastern Canada. This information suggests that sailing was known in Alaska and the North American arctic well before Vitus Bering's expedition in AD 1741 and possibly far back into precontact times.

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