

**Voyaging, Settlement, Prosperity and War:  
Hawai'i's Pre-History, 1260-1778**

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## **Ch. 2: Hawai‘i’s Economic Pre-History, 1200-1450**

### **2.1 Introduction**

Fifty years ago, we knew little about Hawaii’s pre-history, the period prior to Western contact in 1778 when there are no written records of events in Hawaii due to the lack of a written Hawaiian language. Our knowledge of Hawaii’s pre-history has since been totally transformed by a flood of archaeological investigations, some triggered by a remarkable group of academic archaeologists doing field work and some by state and federal regulations requiring archaeological investigation of building sites prior to development. The value of Hawaii’s rich archaeological record is magnified enormously by the vast body of oral traditions—the *Mo‘oelo*—compiled by a dedicated group of native Hawaiian and foreign historians in the nineteenth century. Today we have an astounding amount of information about the environments, economies, societies, and politics in pre-historic Hawaii that has allowed archaeologists to put together snapshots of the past. They reveal a complex dynamic society that undergoes substantial political, social, and economic change in its first 575 years.

Nonetheless, there are still huge gaps in our understanding of critical issues, such as the timing of critical changes in the transformation of Hawaii’s social structure or the size of the Hawaii population when Cook’s ship shockingly appeared over the horizon. There is often a dangerous tendency in these situations to try to fill in the gaps, to believe that we know more than we do. For any economic historian working on the pre-history of a society, it is critical to remain aware of what assumptions are being made in the historical analysis and how fragile the analysis might be if those

assumptions do not hold.<sup>1</sup>

All this applies with a vengeance to the prehistory of Hawaii and the vast gap between the first wave of immigrant voyagers who came upon the uninhabited, resource-rich archipelago between 1200 AD and 1260 AD and the complex, densely populated society of 1778 with its intensively irrigated taro fields, competing and warring states, massive stone temples, and complex culture. Hawaii's transformation over these  $575 \pm$  years is remarkable, as a new society emerges that retains its Polynesian roots, while evolving new, distinct features, such as hierarchical elites differentiated by divine status, high levels of income and leisure for most of the population, and competing states battling each other for warrior glory and *mana*. It is a story of societies networked with other far flung islands in the North and South Pacific until changes in Pacific Ocean winds end this globalization experiment. Left in splendid isolation for its next 300-400 years, Hawaiians develop new social, economic, and political institutions that diverge markedly from those brought with them from the Society and Marquesas Islands.<sup>2</sup>

This main focus of this book is Hawaii's history from 1778, when the arrival of the Discovery and the Resolution, the two ships in Captain James Cook's third exploratory expedition to the Pacific Ocean, ended several centuries of autonomous history. Yet understanding what happened after 1778 is almost impossible without reviewing what we know and what we don't know about the first  $575 \pm$  years of Hawaii's pre-history. This is partly because the Hawaii

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<sup>1</sup> Perhaps the best example of this is James Brander and Scott Taylor's (1998) analysis of the depopulation of Rapa Nui (Easter Island). They constructed an elegant general equilibrium model to explain why Rapa Nui's inhabitants "overharvested" the island's sugar palms and thereby reduced the island's resource base and sustainable population. Hunt (2011) demolishes the analysis by showing that the decline in the number of sugar palms was due to destruction caused by a growing population of rats rather than overharvesting.

<sup>2</sup> During their first 250-400 years in Hawaii, Hawaiians made some return voyages but they abruptly ceased, most likely in the 13<sup>th</sup> century.

encountered by a parade of western ships in the late 18<sup>th</sup>-century had changed substantially during its isolation and was still undergoing change at contact. For us to understand how and why Hawaii experienced such radical demographic, social, political, and economic transformations during the first 125 years of western contact, we need to grasp and attain some understanding of the big demographic, technological, and institutional changes that preceded the 1778 shock.

Archaeologists who have studied Hawaii extensively have typically spent inordinate time and energy categorizing Hawaiian pre-history into various periods.<sup>3</sup> It's a mistake that I'll try to avoid because the periodization of history has led to many of the biggest mischaracterizations and mistakes ever made by both historians and economic historians.<sup>4</sup> More important is to identify and characterize important events, trends, and breaks in trends rather than to try to divide history into artificially defined periods.

What are the big events and trends that characterize Hawaii pre-history? Here are six to consider. First, there is the discovery of Hawaii by voyagers sailing on double-hulled, double-masted canoes (*vaca moana*—canoes of the ocean) who most likely began their journeys in the Society Islands or Marquesas Islands sometime between 1200 and 1260 AD. Their discovery of a large archipelago that was both uninhabited and endowed with a spectacularly rich variety of natural resources likely brought new waves of voyagers from throughout Polynesia to Hawai'i over the next  $125 \pm$  years as well as new influxes of plants, animals, religious ideas, and technologies.

Second, the waves of immigrants and their descendants dramatically and intentionally transformed

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<sup>3</sup> Examples include Kirch (1985, 1994, 2010, 2012) and Homman (2013).

<sup>4</sup> The most famous example in economic history can be found in W.W. Rostow's book, *The Stages of Economic Growth: A Non-Communist Manifesto*. Rostow identified several "stages" which poor countries inevitably passed through on their way to becoming richer countries. Studies examining large panels of countries over long time periods have, however, little evidence of such linear progress through well-defined stages.

Hawai‘i’s diverse landscapes in order to accommodate the establishment of tens of thousands of small-scale farms, a development that was accompanied by a huge expansion in human population over the next  $500 \pm$  years to roughly  $400,000 \pm$  people in 1700. Third, for the first  $125 \pm$  years after Hawai‘i was discovered, it is likely that long-distance voyaging to and from Polynesia continued. But for reasons about which climate scientists are still just speculating, sometime in the late 14<sup>th</sup> or early 15<sup>th</sup> century these voyages stopped. An El Niño reversal of the prevailing winds may well have been the barrier that kept Hawaii isolated, although this is far from established. The end of trade, migration, and cultural and technical interchange with the Polynesian heartland ushered in four centuries of isolation, an unprecedented development for any society. Fourth, during the 14<sup>th</sup> and 15<sup>th</sup> centuries, numerous very prosperous and competing chiefdoms on O‘ahu were unified under a single *mō‘ī* (king) who reorganized the system of property rights in land, established the fundamental land unit of the *ahupua‘a*, and redistributed O‘ahu’s lands amongst his coalition of *ali‘i* (chiefs), *konohiki* (land managers), and *koa* (warriors). Similar developments occurred on Kauai, the other major island with fertile irrigable valleys. Fifth, the 15<sup>th</sup>- and 16<sup>th</sup>-century development of Hawaii’s remaining productive agricultural lands—the massive rain-fed, dry-land fields on the volcanic slopes of Maui’s Haleakala and Island of Hawai‘i’s Manua Kea, Mauna Loa, and North Kohala cinder cones, most likely was accompanied by changes in income distribution, increases in these islands’ population and the development of a form of hierarchical and centralized state—the “archaic state”—also found in the Dynasties of Ancient Egypt, the Inka Empire in South America, the Maya Empire in Central America, and the Aztec Empire in Mexico. Sixth, in Maui and Hawaii, large populations, economic surpluses, and states capable of mobilizing their people and resources into effective armies led to roughly  $350 \pm$  years of intra-island warfare on Maui and

Hawaii and inter-island warfare with the less populous but more prosperous states found on O‘ahu, Kaua‘i, and Moloka‘i (Homman, 2012).

It is tempting to make comparisons between the competing archaic states of pre-contact Hawaii and the competing nations states of pre-modern Europe (1500-1815). Louis XIV, Napoleon, and Fredrick the Great sometimes went to war with their neighbors to resolve grievances and sometimes went to war just because they thought their armies would prevail. It was no different in Hawai‘i. European states were marked by class distinctions, as were states in Hawai‘i. In 1500, European states, like Hawai‘i, had state religions. And some of Hawaii’s economic and political institutions resemble those of European feudalism. While the comparisons are useful, the pre-history of Hawai‘i and the other Polynesian island groups is sufficiently unique, interesting, and complex that its characterization will enable us not just to understand these societies better but also to place in better perspective our understanding of European and global history.

This introduction to Hawaii’s economic and political pre-history draws heavily on two types of sources: (1) the vast and growing archaeological record of Hawai‘i and other Polynesian societies that has accumulated since World War II and (2) the *Mo‘oelo*, the massive body of Hawaiian oral histories and traditions. The archaeological record has increased dramatically in size and quality since the 1950s when radiocarbon dating revolutionized the field. Where the archaeologists have truly excelled is not just in excavating more important sites but in critically interpreting this vast collection of physical data and from it creating a remarkably plausible, full vision of the changing politics, economics, religion, and culture of pre-historic Hawai‘i. Their heroic accomplishments build on the shoulders of historical giants, three pioneering Native Hawaiian historians and one immigrant from Sweden, who transcribed important parts of the *Mo‘oelo*, the oral histories and traditions of life in pre-historic Hawaii. The works of David Malo, Samuel Kamakau, John Papa ‘Īi,

and Abraham Fornander provide the historical foundations and frame through which the astounding information of the archaeological record can be used to reconstruct a history which at times seems almost to rival in detail those of many societies with written languages.

## **2.2. Why did They Voyage?**

East Polynesia with its 15 major archipelagos, was the last area on the globe to be reached by human settlement. It encompasses an enormous expanse of ocean, stretching from the northern tip of the Hawaiian archipelago—1,500 miles north of the Island of Hawai‘i—to Easter Island—4,650 miles southeast of the Island of Hawai‘i—to the southern tip of New Zealand—5,300 miles to the southwest of the Island of Hawai‘i. Recent advances in the science of radiocarbon dating and more judicious use of samples techniques have allowed archaeologists to determine much more accurately than in earlier research the time spans during which voyagers from Western Polynesia first arrived in different parts of Central and East Polynesia.<sup>5</sup> Two recent surveys retested some of the samples used in previous radiocarbon dating studies of early settlement in Polynesia and found very different results than earlier researchers who were limited to less advanced radiocarbon testing techniques and who dated some charcoal from wood that may not have been well connected to the settlement site, i.e., driftwood from another island.<sup>6</sup> The new results show that East Polynesia was settled during the 13<sup>th</sup> century or roughly 600 to 800 years later than social scientists and historians had estimated just 20-30 years ago.<sup>7</sup> The new archaeological research dramatically shrinks the prehistory of virtually all of the East Polynesia archipelagos, including the Society Islands, the

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<sup>5</sup> For a fascinating and lively review of the influence of radiocarbon dating on archaeology in Hawai‘i, see Kirch (2012), pp. 73-109.

<sup>6</sup> See Wilmshurst et al. (2011a) and Rieth et al. (2011).

<sup>7</sup> Early radiocarbon studies in the 1970s and 1980s had estimated a 13<sup>th</sup>-century date for Polynesian discovery and settlement of New Zealand.

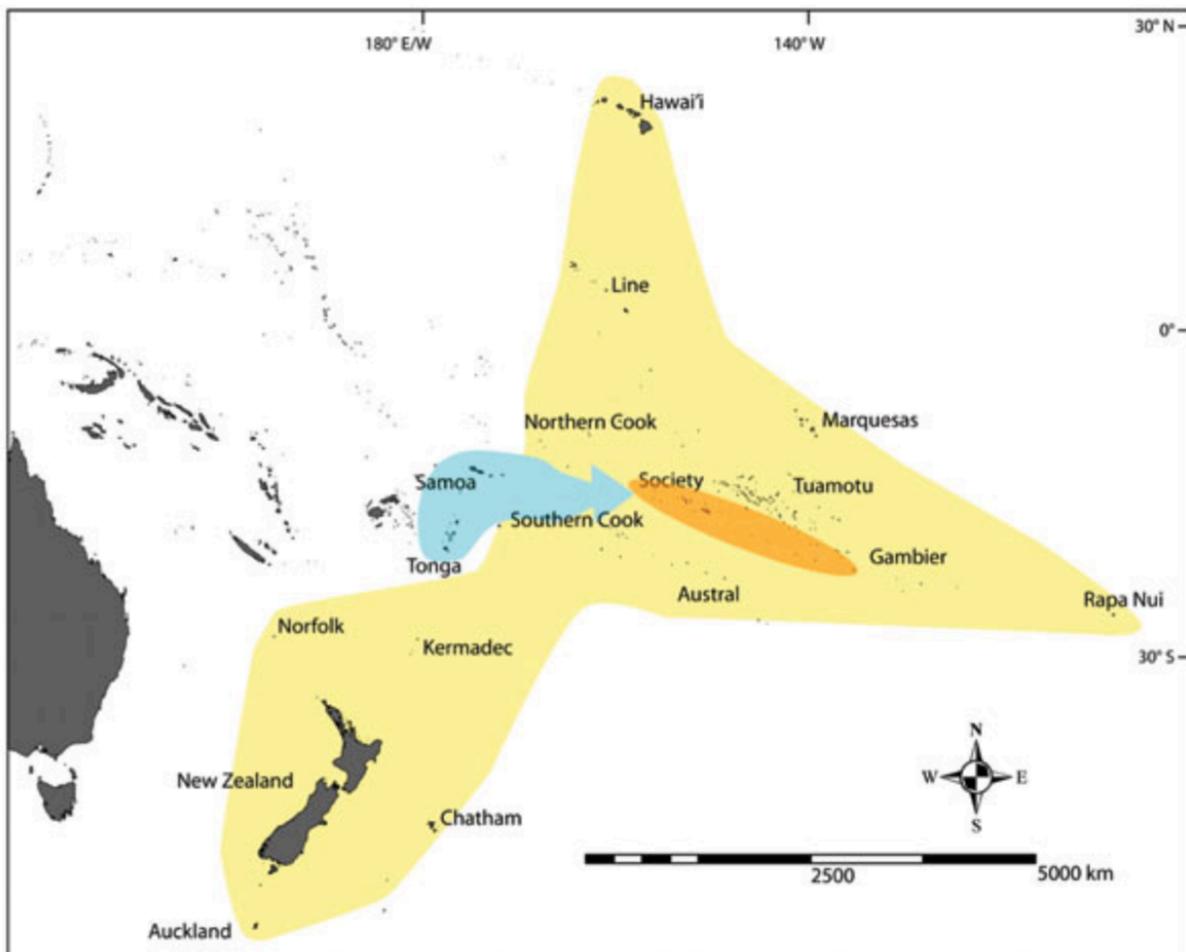
Marquesas Islands, Hawaii, and Rapa Nui, compressing trends and major historical events within a many fewer centuries.<sup>8</sup>

Consider these four central findings from the recent literature. First, in their seminal survey of radiocarbon dates of initial human colonization of East and Central Polynesia, Janet Wilmshurst, Terry Hunt, Carl Lipo, and Atholl Anderson (2011a) established that the initial settlement of Western Polynesia—Fiji, Tonga, and Samoa—proceeded over a 1,500-year period between 2300 and 800 BC. After the first settlement in Samoa around 800 BC, there were no major new Polynesian discoveries and settlements for roughly 1,800 years. It would not be until the 11<sup>th</sup> century AD that voyagers discovered the Society Islands (Tahiti) and the Tuamotu Islands. Second, Wilmshurst et al. (2011a) moved the dates of the voyages of discovery from West Polynesia (Fiji, Samoa, and Tonga) to Central Polynesia up several centuries, with first settlements in the Society Islands occurring between 1025 and 1120 AD and the Marquesas Islands between 1200 and 1277 AD. Since first voyages to Hawai‘i probably originated from the Society Islands via the Tuamotu Islands or from the Marquesas Island, the 12<sup>th</sup> century suddenly seems like the earliest period for Polynesian voyaging to and settlement of Hawai‘i. Third, a 2011 study by Timothy Rieth, Terry Hunt, Carl Lipo, and Janet Wilmshurst (2011, p. 2747) further confirms the settlement dates for the Hawaii archipelago. They conducted a meta-survey of 926 radiocarbon dates from the Island of Hawai‘i and concluded that “the current best estimate for the Polynesian colonization of this island [is] between AD 1220 and 1261.” Fourth, the Polynesians who colonized the Society Islands during the 11<sup>th</sup> or 12<sup>th</sup> centuries engaged in a pulse of clustered exploratory voyages during the 13<sup>th</sup> century that reached all three corner points in the Polynesian Triangle: The Northern point (Hawaii) between AD 1200 and 1261, the Eastern point (Rapa Nui) between 1200

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and 1253, and the Southern point (New Zealand) between 1230 and 1282 AD (see Figure 1).<sup>9</sup> Thus, voyages to Hawai‘i were not a unique phenomenon but rather one wave in a “pulse of discovery” during the 13<sup>th</sup> century that spread from the Society Islands in every conceivable direction. The clustered voyages of discovery provide a useful note of caution to anyone trying to understand the voyages to Hawai‘i, as their existence signals to us that they must be considered in

**Figure 1: Settlement of the Polynesian Triangle**



Source: Wilmschurst (2011a), p. 1816.

<sup>9</sup> Archaeological evidence on settlement sets a ceiling on the settlement date but does not establish a minimum bound. It is always possible that stratigraphic evidence of earlier settlement exists but has not yet been discovered. Archaeology in Hawaii has had a short life and may yet experience a few more major discoveries.

the context of the pulse of multiple waves of exploratory voyages from the Society Islands during the 13<sup>th</sup> century.

Why did a small group of Polynesian voyagers leave their home islands to sail on double-hulled, double-masted canoes (*vaca moana*) more than 2,400 miles into the unknown Northern Pacific Ocean to find a new home? To put some perspective on this question, I identify and discuss various characteristics of the environments of the Society Islands and the “unknown” destination islands as well as the risks associated with such voyaging that might have affected a young Polynesian couple’s decision to join a voyaging team.<sup>10</sup> The characteristics considered include the homeland’s and the unknown destination’s social organization, languages, returns to labor, availability of arable lands to claim and settle, natural resource endowments such as fresh water, forests, fish, and animals, environmental characteristics, voyage distance and difficulty, and the probability of surviving the voyage and establishing a viable new society.

Let’s begin by considering four somewhat inferential expectations regarding the voyagers’ potential destination, expectations that could have contributed to the initial group’s decision to voyage. First, Polynesians knew that the voyages themselves were risky due to weather, the ocean’s and the wind’s vicissitudes, faulty canoe construction, poor judgment by the navigator, and short food supplies. Tropical cyclone formation in the Pacific Ocean does not happen year round, with most tropical cyclones forming between mid-May/early June and mid-November. Experienced voyagers must have seen this pattern and could have planned accordingly to minimize risk. Voyages also faced the simple risk of a slower than expected voyage, in which food and water were

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<sup>10</sup> See Baines (1995) for an application of push-pull migration theory to 19<sup>th</sup>-century European migration.

exhausted and no immediate source of resupply was available.<sup>11</sup> Archaeologists and anthropologists have argued that the Polynesians accumulated practical and navigational knowledge over their many millennia of voyaging and that this enabled them to progressively reduce the risks associated with voyaging (Irwin 1992; Finney 1985, 2003; Anderson et al. 2008). With regard to the particular case of voyages to Hawai‘i, they took place 80-130 years into an expanded phase of Polynesian voyaging, in which the Society Islands had been settled and trade networks established with their ancestral lands in Western Polynesia. Both types of voyaging--discovery and trading--would have led to a renewed accumulation of navigational skills, ship architecture, wind patterns, and a higher confidence by participants in the likelihood of survival and success of these voyages of unknown length and circumstances. Ben Finney (1985, 2003) and Atholi Anderson, John Chappell, Michael Gagan and Richard Grove (2006) have also emphasized that Polynesian maritime technology did not allow for windward sailing and have argued that voyages of discovery were more likely during El Niño episodes, such as those 500-850 years, when wind directions temporarily reversed.

A second factor is that the voyagers might have reasonably expected that any newly discovered archipelago would be uninhabited. Such an expectation would have had historical roots in the Polynesians' recent voyages to the Society Islands and the Tuamotu Islands. A glance at European history shows that the presence of first peoples typically increases both resource and time costs required to establish a colony. First peoples, whether in Africa, Polynesia, or the Americas usually correctly perceived that European colonists ultimately wanted to occupy and claim some of their most productive lands. Not surprisingly, European colonists often encountered strong

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<sup>11</sup> For example, a Tahitian oral history relays that a voyage from the Marquesas to Tahiti "... was so long; food and water ran out. One hundred of the paddlers died; forty men remained." (cite)

resistance when they settled permanently and began to cultivate land and graze stock. Some clear-cut examples include Khoikhoi resistance to Dutch colonization in South Africa during the 17<sup>th</sup> century, Native American resistance to English colonization in New England and Virginia during the 17<sup>th</sup> century, and the Araucanian Indian resistance to the Spanish colonization of Argentina during the 18<sup>th</sup> century and the newly independent country's attempts to use more Pampas lands for cattle grazing during the 19<sup>th</sup> century.<sup>12</sup>

A third factor is that the colonists could have reasonably expected that a resource-rich destination would be discovered. Most potential voyagers would have known that the Polynesians had already discovered and settled numerous resource-rich islands chains during their first 3,500 years of voyaging: Tonga, Fiji, Samoa, the Society Islands, and the Tuamotu Islands, among others. With this spectacular record of success in both discovery and settlement, why might not attempt other risky yet potentially high payoff voyages of discovery and settlement? The expectation is high that someplace new will be discovered, that the voyage will pay off. That is, if the *vaca moana* and its human and animal passengers actually arrived at some destination that would be capable of supporting human life upon landing and sustaining it in the longer run. Some of these voyages of discovery—for example, to Samoa—took place more than 2,000 years earlier, and were, perhaps, a bit too distant in the oral histories and traditions to directly influence the decisions of groups of potential voyagers. But other successful voyages of discovery—to the Society Islands and the Tuamotu Islands, both uninhabited places—had taken place within the previous 50-200 years and were surely more prominent in the oral histories. Some voyagers may have been the children,

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<sup>12</sup> Whether or not discovery of islands that were already inhabited would have been desirable is an open question. Colonists with superior military capabilities might have been able to enslave a small local population or to trade or assimilate with them. See Dye and La Croix (2013a and 2013b) for discussion of resistance by first peoples in New South Wales, Argentina, and the Cape Colony to colonization. See Fogel (1994) for a discussion of the slave trade conducted between African chiefs and European colonists.

grandchildren or great grandchildren of explorers, i.e., people who had had contact with earlier voyagers.

Patrick Kirch (2012) discusses another clue that may have upgraded Polynesian voyagers' expectations that they might find a new resource-rich destination by voyaging to the North Pacific. Such travel might have seemed quite risky to its participants, as travel by celestial navigation to the east or slightly north had been the standard channel by which other discoveries had been made. So why risk a voyage to the north? Migrating golden plovers provided one clue. Small migratory birds who seasonally flew to the North for the summer and then returned to the same small plots of land from which they started for the winter, they surely prompted voyagers to consider these beautiful birds were returning from a destination to the North where they had found sufficient nourishment to survive their annual southern exodus. Their journey raised not just the expectation that a new place would be discovered but also that it might just sustain human life.

Not only did Polynesians sail their *vaca moanas* towards the unknown North, but they also embarked on long voyages to the southeast, the southwest, and the northeast. The clustering of these voyages within a short time frame could have been partly due to a return voyage to Central Polynesia from Hawai'i that rapidly spread the news of its success.<sup>13</sup> There is European precedent for such rapid dissemination: Christopher Columbus's return to Spain and Portugal from his first voyage in March 1493. His letter reporting on his discovery of resource-rich islands was reprinted and circulated through Spain and Portugal within a few weeks and through Europe within a few months. Adventurers flocked to Spain to join new voyages of discovery, and it took only 6+ months (September 1493) for the Spanish government to launch a 17-ship expedition, the first of

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<sup>13</sup> The Spanish tried to keep their discoveries of new lands a secret while the British tended to publicize them.

many more voyages by European explorers to the Americas.

It is also possible that conditions in the Society Islands could have pushed some residents to engage in a risky North Pacific voyage of discovery and migration. Population pressure and the accompanying increase in labor supply could have depressed wage rates and led to diminished expectations of future opportunities for those people without access to land. Migration to a new uninhabited place had the potential of offering more access to land and higher incomes for the migrants.

In 18<sup>th</sup>- and 19<sup>th</sup>-century England, laws governing the land inheritance that provided for the entire estate to be passed to the firstborn son—a legal institution known as *primogeniture*—pushed a not inconsiderable number of landless second sons into military careers or migration to a British colony. Many Pacific islands and atolls have only small amounts of arable land, and these lands could have been fully claimed and occupied just a few decades after initial settlement began. Polynesians had reached the Society Islands 80-130 years before the Hawai‘i voyages began and this could have been sufficient time for all of the archipelago’s best arable lands to be claimed or assigned. New arrivals from Central Polynesia or second sons may have perceived the land to be locked up. Of course, families who had initially claimed and developed large tracts of could be potentially subject to challenge by coalitions of new arrivals, second sons, and existing owners. Two economic historians, Gary Libecap and John Umbeck, showed in pioneering studies of the California gold fields (Umbeck 1977) and the Nevada silver deposits (Libecap 1978; 1994) how property rights in these newly discovered resources adjusted to accommodate changes in the might of alternative coalitions of claimants.<sup>14</sup> However, one alternative to such gamesmanship and the

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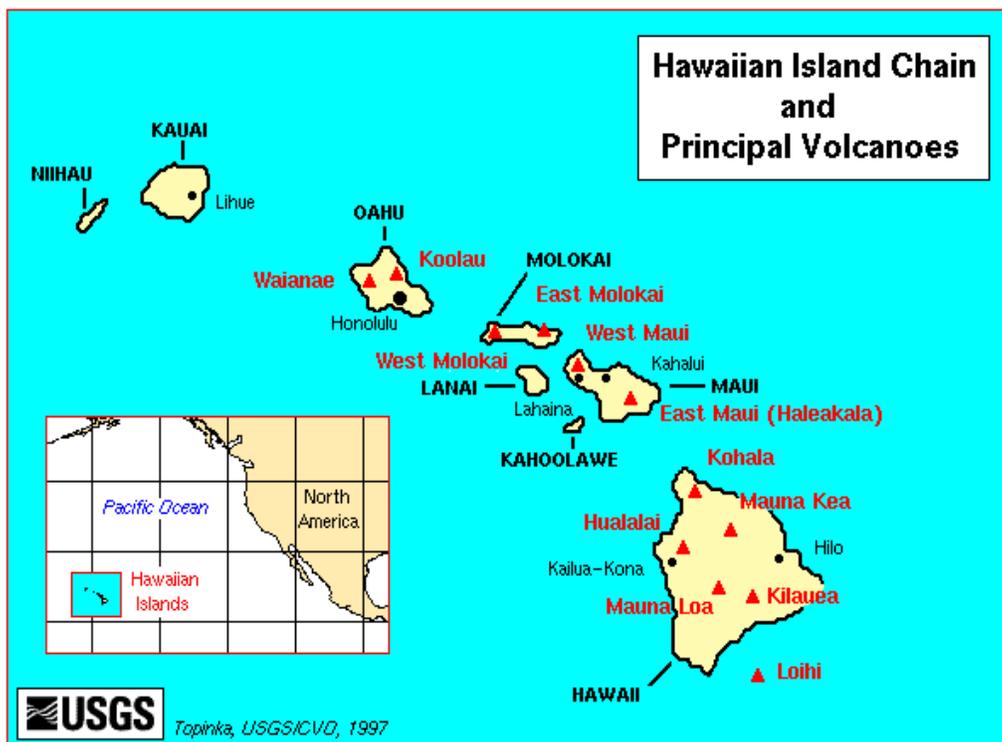
<sup>14</sup> See John Umbeck’s (1977) analysis of how groups of miners established *de facto* property rights to unclaimed land during the 1848- California gold rush provided the seminal discussion of property rights formation in newly

conflict and violence that it could entail was migration. Why fight when new productive new lands might be just over the horizon?

### 2.3 Settlement

The first settlers to arrive in Hawai‘i were surely stunned eight resource-rich tropical islands with a land area of 6,435 square miles of generally mountainous terrain. That said, the vast majority of the lands were not suitable for cultivation (Figure 2). Some islands—Ni‘ihau, Kaho‘olawe, and Lana‘i—had little rainfall and could not support large populations, while the other five islands—O‘ahu, Hawai‘i, Kaua‘i, Maui, and Moloka‘i—had arid leeward coasts and

**Figure 2: Hawaiian Island Chain and Principal Volcanoes**



discovered lands. See Gary Libecap (1981) for a discussion of establishment of property rights in Nevada silver deposits. See Dean Lueck (1995) for a discussion of the use and efficiency of rules of first possession to claim property rights in land. See Sumner La Croix (1994) for a discussion of the role of government in the establishment of property rights during the 1851- gold rush in Victoria, Australia.

wet windward coasts.<sup>15</sup> It is highly likely that the first settlements were concentrated on the windward coasts of O‘ahu and Kaua‘i, as their environments were particularly suited to the development of small “ponded taro” farms.<sup>16</sup> These two islands were older geologically, and constant trade winds and rain had carved deep valleys into their aging volcanic land masses. The windward valleys were natural collectors of the rainfall, and the small valleys’ sizable but manageable streams could, with some investment of labor by the settlers, be diverted through carefully constructed poned taro terraces at higher elevations and carefully delineated taro ponds on the valley’s floor. Both islands were also enveloped by coral reefs that harbored incredibly varied populations of reef fish, mollusks, algae, sponges, and other marine life; most communities were concentrated on the shoreline as reef and ocean fish provided much of the protein for Hawaii’s *maka ‘āinana* (common people).

The islands of Maui and Hawai‘i were younger geologically, and when the first Polynesian voyagers landed, their still active volcanoes had not yet had time to sink back into the earth’s crust or to be eroded as substantially as O‘ahu or Kaua‘i by the sub-tropical trade winds and rain.<sup>17</sup> Although Maui and Hawaii are both rich in a variety of land and marine resources, neither island has the profusion of valleys and streams that settlers used to build irrigation-fed poned- and terraced-taro farms on the more elderly neighbor islands. Although Maui (727.2 sq. miles) and Hawai‘i (4,028 sq. miles) are the two largest islands, Table 1, column 1, shows that

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<sup>15</sup> The classic reference to the different constraints and opportunities that present themselves in windward and leeward coasts of Pacific islands is Patrick Kirch’s 1994 book, *The Wet and the Dry*.

<sup>16</sup> Patrick Kirch (2012) argues that first arrivals probably landed at beaches amenable to landing of their *vaca moanas*, locations like O‘ahu’s Waimanolo Beach, Waikiki Beach, or the Waihee coast on Maui.

<sup>17</sup> The earliest volcanic formations in the Hawai‘i archipelago—e.g., Necker Island, Nihoa Island, French Frigate Shoals—have been subject to such erosion and sinking that they are barely above sea level. Necker’s elevation is 156 feet, Nihoa’s is 910 feet, and French Frigate Shoals’ has a small 121-foot pinnacle but otherwise the highest point is just 9.8 feet above sea level.

they have less acreage suitable for irrigation-fed cultivation than the smaller O‘ahu (596.7 sq. miles) or Kaua‘i (552.3 sq. miles). Each of these two younger islands has, however, much more land on the slopes of their volcanoes that could be used for dry land cultivation than the other three islands combined (Table 1, column 2). Successful cultivation on these upper slopes depended on receiving sufficient rainfall, and we know from the oral traditions—the *Mo‘oelo*—and Hawai‘i’s religious rituals—that annual rainfall in these areas of pre-historic Hawaii varied substantially; historic rainfall data from the 19<sup>th</sup> and 20<sup>th</sup> centuries provides quantitative evidence for variation, albeit for a potentially different climactic period.<sup>18</sup> It is, therefore, not surprising that settlers initially invested in clearing up-land valley lands that could support taro production on farms irrigated with water from mountain streams and only started cultivation of sweet potatoes on rain-fed lands. We know the settlement patterns because of the creative contributions of archaeologists, geneticists, biologists, palynologists, and related social scientists

**Table1: Square Kilometers of Arable Land in Hawaii, By Island and By Type**

Island	Sq. Kilometers of Land With High Potential for Irrigation-fed Cultivation	Sq. Kilometers of Land With High Potential for Dryland Cultivation	Total Island Area in Sq. Kilometers
Hawai‘i	14.3	556.6	10,433
O‘ahu	83.3	34.1	1,546
Kaua‘i	57.6	0	1,430
Moloka‘i	8.7	7.5	673
Maui	25.7	139.4	1,884

Source: Kirch (2010) using data from Ladefoged et al. (2009).

<sup>18</sup> Add rainfall data.

who analyzed pollen and plant residues in Oahu's marshes and ponds, fossils from Oahu's flightless geese and ducks, and bones from the Polynesian rat.

Palynology—the science of plant pollen, spores, microscopic plankton, and their fossils—has made a particularly important contribution to our understanding of how and when the first generations of O'ahu's people transformed their environment as they settled the island.<sup>19</sup> In the early 1990s an archaeologist, Stephen Athens, drilled sedimented cores from the floors of ancient fish ponds near Haleiwa on O'ahu's north shore and from Kawainui marsh in Kailua, Oahu. Jerome Ward, a palynologist, conducted radiocarbon dating on the cores' pollen layers and found that in the period prior to 922 - 1152 AD on the north shore and in the period prior to 1219 - 1403 AD in Kailua, a large percentage of the plant pollen came from one particular type of palm tree: the *loulou*, a 30-foot tall tree with edible nuts and long fronds. After these periods, the percent of *loulou* pollen that the scientists found among pollen in the sedimented cores rapidly decreases. The same rapid decrease in the same time period is found for pollen from the *koa*, a hardwood tree famous today for its durability, beauty, and high price, and two almost extinct shrubs, the *'a'ali'i* and the *kanaloa*. Patrick Kirch (2012, p. 103) paints a picture of 13<sup>th</sup>-century windward O'ahu coastal areas covered by “[d]ryland forests towered over by tall *loulou* palms, interspersed with *koa* and other hardwood trees, [that] had shaded lower spreading shrubs, such as the *'a'ali'i* and the now nearly extinct *kanaloa*.”

The decline in the populations of plants that were previously widespread came about in the same time as several varieties of native snails suffered precipitous population declines, yet

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<sup>19</sup> This section follows Kirch's (2012, pp. 101-109) lively description of the analysis of pollens in sedimented marsh and pond cores by J. Stephen Athens (1997); analysis of Polynesian rat fossils by J. Stephen Athens, H.D. Tuggle, J.V. Ward, and D.J. Welch (2002); and analysis of Hawaii flightless birds fossils by Alan Ziegler (2002); analysis of native snails by

the number of shells for a (hitchhiker) snail often found in the roots of taro plants increased. During the same time period, the populations of several types of flightless geese and ducks on O‘ahu, in particular the *Thambetochen* (“astonishing goose”), the *Cherlychlynechen* (“turtle-jawed goose”) and the *Ptaiochen*, suffered sharp drops. Given the lack of natural predators in Hawai‘i for lumbering flightless birds, the culprit would seem to be members of the most invasive species, the *homo sapiens*, who were harvesting them for sustenance and burning and clearing the habits of these animals.

There was, however, one more migrant from Central Polynesia who also played a big role in the decline of Hawai‘i’s *loulou* palm forests: The Polynesian rat (*rattus exulans*). Radiocarbon dating of rat bones from sinkholes on the ‘Ewa plain of O‘ahu has traced them to the same (but broader) time period when the first settlers arrived. Hitchhikers on the Polynesians voyaging canoes, the rats would have found the *loulou* palm nuts to be an fine food source, and, as they multiplied and fed, they contributed to the intentional human deforestation of O‘ahu and quickened the subsequent transition of these vast forested lands into their centuries-long use as taro farms.

The contributions of archaeologists, palynologists, linguists, anthropologists, and the 19<sup>th</sup>-century compilers of the *Mo‘oelo* have brought us to the point where we understand better when Hawaii was first settled and the process by which the forested lands of O‘ahu were first cleared and converted to thousands of small taro farms. So is there anything that other social scientists could contribute to our understanding of early settlement in Hawai‘i? Over the last two decades, social scientists have been far from silent recently regarding the topic of colonization, with the post-1492 institutional origins of the colonized “neo-Europes” now at the epicenter of an expanding debate over how much European and Asian colonialism is to blame for the great gap between rich and

poor countries that we see today.<sup>20</sup> Several competing teams of economic historians, development economists, and political scientists have recently offered a variety of new theoretical frameworks to understand how colonial settlement proceeds and why certain types of institutions develop in certain places. Consider these three competing yet complementary frameworks.

According to the **factor-endowments** theory developed by Stanley Engerman and Kenneth Sokoloff, the original factor endowments of a colony determined whether colonists choose to impose coercive labor institutions and use labor on large plantations owned by an elite or to allow free labor who work on and often own a larger number of smaller farms. They argue that European colonizers set up institutions to use free labor in sparsely inhabited, temperate lands, where they found fewer opportunities to extract rents by exploiting indigenous populations or importing slaves,<sup>21</sup> and where soil characteristics fit such crops as wheat for which the average total cost of production is minimized on a small-scale farm. Conversely, they set up institutions to use coerced labor in more tropical lands where soil characteristics fit such crops as cotton and sugar for which the average total cost of production is minimized on large-scale farms where there are opportunities to reap rents by exploiting indigenous populations or importing slaves. They argue that the initial institutions tend to persist and this institutional path-dependence has dramatically affected each type of society's long-run economic growth.

Daron Acemoglu, Simon Johnson, and James Robinson (AJR) suggest that the effects of colonization are dependent on the **disease environment** of the place being colonized. When colonial settlement is accompanied by high risks of serious illness and death, few people from the home country choose to migrate. Without a substantial group of settlers placing pressure on

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<sup>20</sup> The term "neo-Europes" originated with Alfred Crosby, *Ecological Imperialism*.

<sup>21</sup> Engerman and Sokoloff, "Factor Endowments."

the colonial executive to restrict its actions, the colonial authorities impose governance institutions designed to allow colonial elites to extract economic rents from the country's population and resource base. As in the Engerman and Sokoloff theory of colonization, AJR argue that these extractive governance institutions tend to persist even after the colony gains its independence and tend to be reflected in lower rates of annual output growth. By contrast, when colonists face a less threatening disease environment, there are more migrants and they "demanded rights and protection similar to, or even better than, those they were familiar with in their home countries."<sup>22</sup> Once again, initial institutions tend to persist, and the institutions limiting and checking the power of the colonial executive lead to higher rates of annual output growth both before and after independence.

Another distinguished team of scholars, Douglass North, Barry Weingast, and William Summerhill (1997), has argued that in most cases, governance institutions in the colony tend to **mirror** those in the home country. Thus, when the executive in the home country is less limited and checked in its exercise of power, so is the executive in the colonized country, and vice versa.

Consider now how these competing and complementary theories of colonization might help put some perspective on the Polynesian colonization of the Hawai'i archipelago. **First**, unlike European countries, chiefdoms in the Central Polynesia homelands (known as "Hawaiki" in the *Mo'oele*) were unable to maintain political control over the Hawai'i colony. Voyages were dangerous and long, the chiefdoms were not sufficiently centralized to organize large military expeditions, and it's unclear exactly what high-value product—e.g., spices, gold, animal

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<sup>22</sup> Acemoglu, Johnson and Robinson, "Reversal of Fortune," p. 1266; "Colonial Origins," p. 1370; and "Institutions," pp. 414-16.

pelts—could be profitably exported back to Hawaiki on *vaca moana*.<sup>23</sup> The lack of colonial political ties was important for the development of Hawai‘i, as it meant that new chiefdoms in Hawaii were focused on achieving their own objectives rather than ones set by Hawaiki chiefs.

**Second**, the Polynesian colonists did not encounter first peoples in Hawai‘i. Nor is there is any archaeological evidence pointing to earlier human settlement.<sup>24</sup> By contrast, virtually all of the lands colonized by the English, French, Portuguese, Spanish, Dutch, and Russians were inhabited. The absence of first peoples living in Hawaii had several implications for the way Polynesian voyagers proceeded to settle. The Polynesian colonists did not face resistance from native peoples already settled in Hawaii. Nor did they have any particular reason to fight amongst themselves during the initial settlement period. Land in Hawaii capable of being cultivated in taro was abundant, with more than enough for all of the few hundred people who made the initial voyage and for several waves of subsequent migrants. With no external enemy to fight and no reason to fight among themselves, this likely meant that less of the colonists’ time and resources was devoted to preparations for war and more to investments in clearing and burning forests for new farms, building simple irrigation works, constructing canoes for fishing, mining volcanic glass and basalt, making fish hooks, and other productive activities.

The absence of first peoples also implies that Polynesian immigrants did not face additional disease burdens from human sources and that they probably had morbidity and

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<sup>23</sup> Adzes from Hawai‘i have been found on the Marquesas Island.

<sup>24</sup> Handy and Handy (1972) argued that the Polynesians found an aboriginal people who subsequently were enslaved and marginalized, the *kauwa*. While the historical record of western visitors to Hawaii acknowledges a small enslaved class of undetermined size, the modern archaeological record provides no evidence that Polynesian settlers encountered an aboriginal people. One Hawaiian observer estimated that there were roughly 1,000 *kauwa* at the time of western contact.

mortality rates that were similar to those experienced in Hawaiki.<sup>25</sup> The lack of competition for land from free peoples also meant the new arrivals were free to select the best geographic locations to colonize first. In an economy centered around agriculture, this meant land with superior access to water sources. And as we have already discussed (Table 1), most of these lands suitable for ponded-taro production were to be found on O‘ahu and Kaua‘i.

In general, the absence of first peoples is consistent with higher rates of population growth and output growth. This is important in our context, as several archaeologists estimate that Hawai‘i’s overall population likely increased to at least 200,000 people by 1500 AD. If the initial waves of immigrants brought 10,000 people to Hawai‘i, this would require a 6.7 percent annual growth rate in population. From a broad historical perspective, such a high rate of population growth would be an outlier and might cause us to reevaluate either the numbers who migrated from Hawaiki or the terminal population. Despite the red flags such a high population growth rate raises for an economic historian, the absence of competing first peoples makes it just a bit more plausible.

**Third**, when the first Polynesians voyagers arrived in Hawai‘i, they encountered an environment in which they could cheaply and productively forage for food to survive the initial years of their migration. Fresh water was abundant, and fishing within and beyond the islands’ reefs for a variety of ocean fish, reef fish, and mollusks could be immediately pursued. A large stock of flightless birds (discussed on pp. 17-18) provided another initial source of protein that could provide sustenance until newly cleared lands yielded adequate supplies of staple foods in

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<sup>25</sup> European soldiers, sailors, bishops, and bureaucrats living in colonies in the tropics had extremely high morbidity and mortality rates. See references in Acemoglu, Johnson, and Robinson (2001; 2002). The absence of first peoples also meant that the disease environment introduced to the Islands by the waves of colonists from Central Polynesia did not decimate populations of first peoples as did the post-1492 waves of European colonists to the non-European world.

the Polynesian diet: taro, yams, and sweet potatoes. The transition to a farm economy probably did not take very long, as many of the small streams in the rich valleys of the windward coasts of O‘ahu, Kaua‘i, and Moloka‘i could be quickly harnessed to grow taro in irrigated ponds. In the absence of natural disasters, in particular hurricanes and tsunamis, and major conflicts among settlers, it’s likely that the new farms were very productive, probably yielding an agricultural surplus—additional food beyond that required to feed the farmer and his family. It is, however, important not to overestimate the extent of potential surplus during a period of extremely high population growth. This is because societies experiencing high population growth usually have high **dependency ratios, i.e.**, there is a high ratio of dependents—the elderly and the very young, but in this case children—to the working population. Agricultural production that generates a large surplus when each farmer has three dependents to feed will generate less or no surplus when there are five dependents to feed. A high population growth rate and an accompanying high dependency ratio clearly diminish the potential agricultural surplus available to feed workers specializing in non-subsistence production, it is important to remember how resource-rich the Hawai‘i archipelago was and remains. Hawaii’s environment is truly unique, with tens of thousands of unique species, protective coral reefs, soils that had not previously been exploited for cultivation, abundant rainfall on the windward sides of the island chain, a semi-tropical environment with multiple growing seasons, and trade winds that provide natural air conditioning. Even if high population growth served to reduce the realized agricultural surplus realized (relative to the potential surplus available at a lower population growth rate), the rich environment encountered by Polynesian migrants and their descendants provides a signal that the early colonists may still have realized substantial surpluses.

**Fourth**, following the pattern we observe in European settlement colonies, the initial

governance institution observed in Hawai‘i—the chiefdom—**mirrored** the institutions that were in place throughout the Society Islands and the Marquesas Islands when the migrants set off on their voyages in the 13<sup>th</sup> and 14<sup>th</sup> centuries (Earle 1997). The Hawai‘i case is consistent with the initial practices of new European colonies in North America, Australia, and South Africa in the 17<sup>th</sup> and 18<sup>th</sup> centuries who also tended initially to adopt political and economic institutions that mirrored those in the home country. Many of these colonies found that some institutions and practices that had been developed within the context of the more land-scarce and labor-abundant European continent were not well suited to their new environments and needed to be adapted to a context in which land was relatively abundant and cheap and labor was relatively scarce and expensive. For example, government grants or sales of small contiguous farm lands with well defined property rights were often made to replicate the system of land rights found in European farm communities at the time. The decisions of some colonists to ignore the official system of land rights and move beyond the official settlement boundaries of the colony to clear and claim new lands opened a number of paths by which the transplanted property rights and governance institutions could eventually adapt to the new environment.

The use by Polynesians colonizing Hawaii of a governance institution transplanted from the Society Islands and the Marquesas Islands was, however, much less likely to require adaptation. One reason is that the Society Islands had only been discovered and settled during the 12<sup>th</sup> century and the Marquesas during the 13<sup>th</sup> century. It is unlikely that either archipelago had become very densely populated in such a short period of time and that the chiefdom—a governance institution best used for populations less than a few thousand people—had become an outmoded governance institutions. Its transplantation from a recently settled tropical archipelago with relatively abundant land and scarce labor to the newly discovered land-

abundant, labor-scarce sub-tropical Hawai‘i archipelago was, in all likelihood, a good match. A second reason is that production of the staple food—taro--during the first 150 years of settlement was generally concentrated in valleys with streams that could be diverted into small-scale irrigation systems. Such small-scale independent irrigation systems are often well managed today by small cooperative organizations and would be unlikely to benefit much from more centralized and bureaucratized management and governance. When, however, the potential agricultural surplus that could be realized from the valleys’ taro production increased, it would not be surprising to see kinship-based chiefdoms fade in favor of new governance institutions, as they did in Oahu’s fundamental governance and land reforms of the late 15<sup>th</sup> century.

#### **2.4 Conclusion**

It would be too much to call the Polynesian discovery and settlement of the Hawaiian archipelago “a smooth sail”. Long journeys over a dangerous Pacific Ocean; foraging for food; clearing, burning, and preparing land to become ponded-taro farms; building irrigation facilities from scratch; and organizing a new society were all enormous challenges about which we knew little prior to recent advances in the archaeological record. We still have almost no direct knowledge of the voyages; most of the discussion of them in the paper is inferential. The discussion does show that many of the stars were lined up for a smooth settlement, as many of the factors that disrupted or complicated colonization in the rest of the world were missing in Hawaii. Most importantly, this helps explain how, from a few hundred people in 1225, the Islands could grow to a population of 250,000-300,000 in 1475.

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