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**Why Easter Island Collapsed:
An Answer for an Enduring Question**

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Abstract

Easter Island is the most isolated inhabited spot on Earth, devoid of heavy timber and most resources. Yet, the first European travellers to the island marvelled at large and delicately carved statues covering the whole of the island. For centuries, they wondered how those statues were built and transported, resorting to myth and fantasy to explain them. In the twentieth century, it was revealed that the first settlers to inhabit the island encountered a resource rich and bountiful tropical land, abundant in resources. They developed a complex society with strong hierarchy and sophisticated religious rituals, including the carving, transporting, and erecting of the large statues. Gradually, they exploited their resource base to extinction, and consequently fell into decline.

Historians have put to rest any theories about the transport and erection of statues. Instead, they debate the causes for decline, and wonder why the islanders permitted the continued exploitation of their resource base, even after they were aware that they were causing severe damages to the environment. Jared Diamond has asked the question, "What were they thinking when they cut down the last palm tree?" This study examines the available historical, archaeological, and anthropological evidence, and combines it with theories of institutional economics pertaining to the management and governing of common-pool resources, in order to arrive at a theory for explaining why Easter Islanders permitted the destruction of their island habitat, and what motivated them to continue doing so. The results show that Easter Island's ecosystem was unusually fragile, and consequently, in the long-term, decline and collapse was inevitable. The study concludes with implications for modern society.

1. Introduction

*In Easter Island... the shadows of the departed builders still possess the land... the whole air vibrates with a vast purpose and energy which has been and is no more. What was it? Why was it?*¹

In 1919 Katherine Routledge's romantic narrative, *The Mystery of Easter Island* introduced the spectacular marvels of Easter Island to a wider audience. The tiny island, a speck of land in the South Pacific some 2,000 kilometres from its closest inhabitable neighbour, is appreciably the most isolated inhabited spot on Earth. Routledge's meticulous examination of its landscape – dotted with enormous and elaborately carved statues of an ancient lost civilization – convinced her that Easter held a secret the world must discover. Her patient and thorough conversations with the only surviving links to the past, a small group of native inhabitants, raised a spectre of disturbing questions. Most had long since forgotten the symbols of their past, now toppled and lying face down upon the dirt. Some described them as haunting gods of an earlier era, whose scorn they endured. Others disavowed them. Still others remembered them as symbols of fear and violence. What was it? Why was it? She wondered aloud.

Routledge was by no means the first to ponder these questions. Almost two centuries earlier, on Easter Sunday 1722, a fleet of three Dutch trading ships in search of another group of islands identified a distant piece of land dotting the horizon. Their immediate impressions were unfavourable. "We originally, from a further distance, have considered the said Easter Island as sandy, the reason for that is this, that we counted as sand the withered grass, hay, or other scorched and burnt vegetation, because its wasted appearance could give no other

¹ Katherine Routledge, *The Mystery of Easter Island* (Kempton, IL: Adventures Unlimited Press, 1919).

impression than of a singular poverty and barrenness.”² Given its barren landscape, the Europeans were surprised to be greeted by the inhabitants, who reached their ships in shoddy canoes and atop reeds. Upon landing ashore, Captain Jacob Roggeveen marvelled at the sheer size and delicate design of the statues sitting atop their platforms, then still standing guard over the islanders. “The stone images at first caused us to be struck with astonishment, because we could not comprehend how it was possible that these people, who are devoid of heavy thick timber for making any machines, as well as strong ropes, nevertheless had been able to erect such images, which were fully 30 feet high and thick in proportion.”³ Over the course of the next two hundred years, as human traffic over the high seas increased, islanders came across more Europeans traversing the South Pacific. Whalers, pirates, traders, and explorers of every breed stopped briefly to speculate over the mystery of Easter Island.

Although Routledge was not the first, she was arguably the most important visitor to the Island.⁴ Her narrative popularized the myths of the seas, making them available to a different species of adventurer, the researcher.⁵ Along with archaeological excavations, the detailed anthropological interviews she conducted provide the first serious account for the emergence and existence of Easter’s inhabitants and its giant statues.⁶ More importantly, Routledge’s work paved the way for a slew of twentieth century scholars to follow and investigate, allowing the emergence of a wide range of explanations spanning from the

² Roggeveen, cited in Jared M. Diamond, *Collapse: How Societies Choose to Fail or Survive* (London: Penguin Books, 2006), 81.

³ Ibid.

⁴ Jo Anne Van Tilburg, *Among Stone Giants: The Life of Katherine Routledge and Her Remarkable Expedition to Easter Island* (London and New York, NY: Scribner, 2003).

⁵ Caroline Arnold, *Easter Island: Giant Stone Statues Tell of a Rich and Tragic Past* (New York, NY: Clarion Books, 2000), 7.

⁶ Routledge, (1919).

cooperation of extra-terrestrials to the more mundane but believable Polynesian sea-faring migrations. The systematic archaeological work of Alfred Métraux (1940), Thor Heyerdahl (1950), and William Mulloy produced a body of scholarship upon which contemporary historians, archaeologists, anthropologists, and economists have built.

In the past two decades, this continuously growing body of work has arrived at almost unanimous consensus for the existence and symbolic meaning of the statues. The conventional wisdom is grounded in the diligent archaeological work of Jo Anne Van Tilburg (1994), John Flenley (1994, 2003), Paul Bahn (1994, 2003), and further promoted by eco-historians such as Clive Ponting (1991), I.G. Simmons (1989), David Christian (2004), and Jared Diamond (2006). It is a warning to contemporary human civilization: the story of an intelligent and sophisticated society capable of carving, transporting and erecting multi-tonne stone statues by exploiting the natural resources of their island habitat, but eventually collapsing because of the environmental degradation and resource exhaustion that they brought upon themselves. The accompanying metaphor, a gloomy prognosis for humanity's symbiotic relationship with the environment, has weaved itself into the public consciousness.

Unsurprisingly, a few dissident scholars challenge the status quo version of Easter's history. Benny Peiser and Paul Rainbird claim that evidence for ecological collapse on Easter is inconclusive, and that other causes for the destruction of Island society exist, but these causes are neglected by most. Peiser argues that the promotion of an *ecocide* scenario is the result of ulterior motives by "environmental campaigners" seeking to promote ecological collapse scenarios in order to stoke

anxieties about the future of the environment.⁷ He underscores inconsistencies with carbon dating techniques and records of oral traditions, and both Peiser and Rainbird suggest that Easter society only collapsed because of interaction with Europeans. Rainbird goes so far as to say, “an alternative view, and the one that perhaps ought to stand as the orthodox model until shown otherwise, is that it was the collision with the modern world system from the eighteenth century onwards that was directly responsible for the destruction of a fertile environment.”⁸ Their work is a reminder that even dominant theories should not escape scrutiny and criticism, and this study acknowledges legitimate claims from both Peiser and Rainbird. As will be shown however, their work is insufficient in countering the weight of overwhelming evidence that coincides with the sudden and dramatic destruction of Easter Island’s environment.

The abundance of archaeological evidence and historical debate has recently loaned itself to economists interested in using Easter’s history as a case study for the application of population and environmental models. Unfortunately, none of this scholarly attention has managed to produce a defensible theory to answer a question Jared Diamond posed to all in his 1995 article in *Discover* magazine. “Why didn’t they [Easter Islanders] look around, realize what they were doing, and stop before it was too late? What were they thinking when they cut down the last palm tree?”⁹ In fact, many scholars have alluded to potential causes for decline, and economic models have effectively charted the hypothetical course for the inverse relationship between population and resource consumption, but all have been hesitant to

⁷ Benny Peiser, "From Genocide to Ecocide: The Rape of Rapa Nui," *Energy & Environment* 16, no. 3&4 (2005): 535.

⁸ Paul Rainbird, "A Message for Our Future? The Rapa Nui (Easter Island) Ecodisaster and Pacific Island Environments," *World Archaeology* 33, no. 3 (2002): 448.

⁹ Jared M. Diamond, "Easter Island’s End," *Discover Magazine*, August 1995.

provide conclusive answers to Diamond's very legitimate question. This study is devoted to answering this one remaining mystery.

Such a speculative exercise, given the limited information about islander society, deters from participation in counterfactuals. Nevertheless, sufficient precedent for such exercises exists. Joseph Tainter's *The Collapse of Complex Societies* maps a prophetic theory for the causes of collapse. Tainter applies the theme of environmental degradation as causation to various historical case studies and defines collapse as a phenomenon where a society "displays a rapid, significant loss of an established level of socio-political complexity."¹⁰ Additionally, the strand of literature on institutional economics that is concerned with the management of common resources, and the socio-political structures that induce or alleviate collective action problems, provides a solid theoretical framework for explaining why Easter Islanders failed to stop the gradual but permanent destruction of their environment. Works by Mulloy and Métraux have shown that the hierarchical chieftainships on Easter Island had sufficient governance to create prohibitions on the harvest of birds and fish during certain times of the year.¹¹ Their work indicates that a governance structure that monitored the common resources of society may have existed, but failed. Based on this curious evidence, Diamond's question gains significance, what happened?

This study examines previous literature from archaeologists, anthropologists and historians of Easter Island, and combines it with theories of institutional economics pertaining to the management and governing of common-pool resources, in order to arrive at a hypothesis for why Islanders failed to develop effective common-pool resource

¹⁰ Joseph A. Tainter, *The Collapse of Complex Societies*, New Studies in Archaeology (Cambridge: Cambridge University Press, 1988).

¹¹ Alfred Métraux, *Ethnology of Easter Island* (Honolulu, HA: Bernice P. Bishop Museum, 1940).

governance on Easter. The assessment will show that governance strategies were ineffective in combating depletion, especially at later dates, when fewer resources remained, because of the nature of the resources base. Consequently, islanders continued their exploitative consumption behaviour, possibly even more furiously, even though they were fully aware that their resources were headed toward extinction.

The remainder of this study is structured as follows. Part II provides a historical overview of Easter Island, beginning with the arrival of the Polynesian population and ending in 1722, with their “discovery” by the Dutch. The overview will assess the evolution of scholarship regarding the island, and elaborate on the aforementioned conventional theory of population growth leading to environmental degradation and eventual collapse – the classic “Malthusian trap.” Additionally, the alternative hypothesis of Rainbird and Peiser is provided, if only to reinforce the overall validity of the traditional hypothesis. Part III focuses on the theoretical models for common-pool resource management, and their application to Easter Island. This section will elaborate on the feasibility of creating a resource governing institution on Easter Island, as well as the likely causes for why they were never created; or if created, why they failed. The answers are surprisingly deterministic; suggesting that in the long-term, islanders never had a chance, no matter how much they tried. Part IV concludes by identifying modern implications, and readdressing the question, is Easter a metaphor for the contemporary world? Is Easter – a remote and isolated ecosystem analogous to Earth’s place in the universe – a microcosm of the Earth?

2. A Brief History of Easter Island

The predominant approaches for arriving at the history of human habitation on Easter Island (*Rapa Nui*) are through archaeological excavation, pollen analysis, carbon dating of midden heaps, and

recitation of oral traditions. Each method adds valuable information to the overall story of *Rapa Nui*, but each poses its own set of challenges. Archaeological excavation and carbon dating provide a date range of an estimated two hundred years. Pollen analysis, which examines soil erosion and the types of fauna found on the island, is available in only a few locations around the island, and while it is accurate in identification, provides date ranges similar to carbon dating. Oral traditions, while rich with content, are unreliable sources of information that often contradict one another or the other aforementioned scientific evidence. Researchers can at best piece together the history of the island by weaving the information provided by each source into a cohesive and linear timeline.

2.1 Origins of the *Rapanui* People

The Polynesian inhabitants of *Rapa Nui* are the descendants of a group of settler colonists that arrived on the island c. CE 400. An estimated twenty to thirty settlers arrived with their chief *Hotu Matu'a*, on large conjoined sea-faring canoes built for long distance travel.¹² The settlers brought many traditional Polynesian staple foods with them including chickens, rats (considered a delicacy),¹³ taro, yam, sweet potato, bananas, gourds, paper mulberry, turmeric, and arrowroot.¹⁴ Based on linguistic evidence and wind patterns along the South Pacific, archaeologists and historians assume that the origins of the *Rapanui* are the archipelago chain of the Mangareva's. Pitcairn Island may have served as a touch off point, since its central location is the closest land

¹² Bahn and Flenley speculate that even a modest canoe of roughly fifteen metres could carry about 18,000 pounds, providing sufficient room for supplies. Cited in John Flenley and Paul G. Bahn, *The Enigmas of Easter Island: Island on the Edge*, 2nd ed. (Oxford and New York, NY: Oxford University Press, 2003), 64.

¹³ Paul G. Ed Bahn and John R. Flenley, *Easter Island Earth Island* (London: Thames and Hudson, 1992), 19.

¹⁴ Métraux, (1940): 153-58.

mass to *Rapa Nui*, a distance of roughly 2,000 kilometres North-west.¹⁵ Linguistic evidence ties *Rapanui* language to the Polynesian language tree.¹⁶ Captain Cook, whose 1774 expedition landed on *Rapa Nui* for four days whilst in search of the then undiscovered southern continent of Antarctica, confirms this linguistic connection. His Tahitian translator was able to communicate with the *Rapanui*, whose language was familiar to his own.¹⁷

This theory of *Rapanui* origin has faced opposition. Beginning in the 1950's, and persistent even in some circles today, Norwegian explorer Thor Heyerdahl proposed an opposing theory which still maintains its adherents. Heyerdahl believed that the island received multiple waves of immigrants, the first of which were "stone-age peoples of the Americas,"¹⁸ travelling west from the coast of modern day Chile. He based his theory on the visual similarities of *Rapa Nui's* large statues (*moai*) with Incan statues found in Peru, and engineered his own raft journey from Chile to the South Pacific in order to prove that it could be done (he landed near the Marquesas archipelago).¹⁹ To account for the Polynesian heritage there today, Heyerdahl claimed that the Polynesians, a more backward Neolithic people that could never have created such statues, arrived afterward and killed off the original American inhabitants.²⁰ The romantic records of his rafting adventure – spanning one hundred and seven days – made for a widely readable myth about

¹⁵ Green, cited in Flenley and Bahn, (2003).

¹⁶ Joseph C. Finney and James D. Alexander, "The Rapanui Language of Easter Island: Where Does It Fit in the Polynesian Family Tree?," in *Easter Island in Pacific Context; South Seas Symposium: Proceedings of the Fourth International Conference on Easter Island and East Polynesia*, ed. Christopher M. Stevenson, Georgia Lee, and F.J. Morin (Los Osos, CA: The Easter Island Foundation, 1998).

¹⁷ Flenley and Bahn, (2003).

¹⁸ Thor Heyerdahl, *The Kon-Tiki Expedition: By Raft across the South Seas* (London: Allen and Unwin, Ltd, 1950).

¹⁹ Bahn and Flenley, (1992).

²⁰ Ibid.

the island, and therefore, Heyerdahl's theory pervaded and remains entrenched in the public consciousness. Unfortunately, Heyerdahl could never provide much evidence besides conjecture and correlation to support his theory, and consequently, his *Kon-Tiki* theory never garnered much attention from other scholars. As archaeologist Patrick Kirch has stated, "Heyerdahl's theory was never taken seriously by scholars, since it ignores the mass of linguistic, ethnographic, ethnobiological, and archaeological evidence."²¹

In fact, the evidence reinforces Kirch. Excavations of the Polynesian rat in the earliest settlement layers reinforce Polynesian and not American ancestry.²² DNA analysis of *Rapanui* descendants, as well as anthropological evidence of skulls, clearly indicates that the *Rapanui* are of Polynesian descent. Additionally, statues bearing resemblances to the *moai* (although dissimilar in size) have been found in Tahiti and the Marquesas.²³ Thus, the inescapable conclusion based upon provable evidence indicates that the *Rapanui* are of Polynesian origin; any link with the Americas is tenuous and requires significantly more evidence.

2.2 A Thriving Culture

The *Rapanui* were a Neolithic, agrarian chiefdom. Archaeological excavation of agricultural grounds provides researchers with evidence that *Rapanui* society was structured similar to other Polynesian societies. Land was divided among clans, which eventually became small villages and tribes. The land was partitioned in clearly demarcated parcels,

²¹ Patrick Vinton Kirch, *On the Road of the Winds: An Archaeological History of the Pacific Islands before European Contact*. (Berkeley and Los Angeles: University of California Press, 2000), 238.

²² Patrick M. Chapman and George W. Gill, "An Analysis of Easter Island Population History," in *Easter Island in Pacific Context South Seas Symposium: Proceedings of the Fourth International Conference on Easter Island and East Polynesia*, ed. Christopher M. Stevenson, Georgia Lee, and F.J. Morin (Los Osos, CA: Bearsville and Cloud Mountain Presses, 1998), 144.

²³ Flenley and Bahn, (2003).

beginning in the centre of the island and extending to the shoreline and beyond, in a wedge-shaped manner.²⁴ All resources were reserved for the village head, and each village had sole rights to all resources available on their land, including their portion of the sea. On *Rapa Nui* however, resources were distributed unequally in various parts of the island, what one region lacked, another had in bountiful scores. This forced trade and cooperation as a natural part of life. In addition, over ninety-five percent of the large statues (*moai*) were made in a single quarry using the rock from an extinct volcano (*Rano Raraku*). Since transport of statues required some tribes to cross the territories of other tribes, passage rights had to be secured.

Rapa Nui's statues have come to represent the legends of the island. They undoubtedly represent an exorbitant use of human and natural resources. They range from between thirty to eighty tons, and were transported great distances across the island on specially designed roads. Lacking mechanical power of any kind, the *Rapanui* relied solely on human strength and trees to transport and erect them. It is assumed that they were moved by either a roller system, or large sleds made from wood, and erected with ropes and gradually propped up with stones from underneath. Carbon dating of coral reef fragments shaped as the eyes of the statues dates from roughly the twelfth to the early seventeenth century, with the majority of the coral falling in the range of the fourteenth and fifteenth centuries.²⁵ During peak production however, it is likely that each tribe devoted a percentage of its population to construction and design of the statues, and supplied their artisans with the resources they

²⁴ Jo Anne Van Tilburg, *Easter Island: Archaeology, Ecology and Culture* (London: British Museum Press, 1994).

²⁵ W. Beck and G. Burr, "Mata Ki Te Rangi: Eyes toward the Heavens - Climate and Radiocarbon Dates," in *Easter Island: Scientific Explorations into the World's Environmental Problems in Microcosm*, ed. John Loret and John T. Tanacredi (New York, NY: Kluwer/Plenum, 2003), 98.

required. Naturally, this indicates that food surpluses were common at the time.

Individual roles in society were highly stratified, with head of kin for each tribe paying ultimate tribute to the king, who descended from the family of *Hotu Mota'u*. The king was highly revered and played a ceremonial and cultural role. Much of his body, hair, and hands were considered *tapu* or *rahui*, which forbid his contact with others.²⁶ In addition, the king had the power to order crops and other resources *tapu*, prohibiting their harvest until he permitted.²⁷ “The bearing of the king on the magico-economic activity of his people is shown not only in the influence of his *mana* [essence] on the welfare of the people but also in his power over nature... There is still a belief among the natives that a great many plants vanished from the island with the kings who controlled them.”²⁸ His spiritual power controlled the well-being of the island, and islanders tied their hopes to the prophetic words of their king.

By the arrival of Captain Cook in 1774, this society had all but collapsed. Cook mentions that although there was evidence of agriculture and the foundations for housing structures on other parts of the island, virtually all inhabitants lived on a single spot on the island.²⁹ They maintained a different location called *Orongo*, near the huge crater *Rano Kau*, for religious ceremony, but the majority of the island was uninhabited. Cook also noted that all of the *moai* statues had been toppled, many faced down, with rocks placed on the ground, in a fashion designed to break the statues at the neck.³⁰ A new religion had replaced them, this one centred on the worship of a birdman. Birdman rock art is prevalent around the island today, but the highest concentration is found

²⁶ Métraux, (1940).

²⁷ Ibid., 134.

²⁸ Ibid., 133.

²⁹ Diamond, (2006).

³⁰ Flenley and Bahn, (2003): 149.

in the *Orongo* site.³¹ The site is a ceremonial village, and elaborate annual traditions took place for at least a century, according to the archaeological record. Still, it is unclear how the Birdman tradition evolved, whether it had already begun in 1722 when Roggeveen first visited,³² because of warfare and collapse, or merely new gods replacing the old. Roggeveen does note however that the *moai* were erect, and his records have no mention of a birdlike figure, implying a likely possibility that the tradition evolved after 1722.

2.3 The Bounties of *Rapa Nui*

The available archaeological evidence indicates that the first settlers to arrive found the island to be lush and bountiful, with abundant flora and fauna. Pollen samples of lake sediment cores show that several species of trees and tall brush grew on the island, the most important of which was a species of palm tree similar to the Chilean Palm, which grew in abundance.³³ Even without pollen samples, Mulloy's excavations revealed root moulds throughout the island, leading him to deduce that the "area was once covered with significantly more vegetation than has been reported in historic times."³⁴ Further evidence for the palms was found when archaeologist Paul Flenley discovered pine nut shells that had been collected and stored by islanders as food.³⁵

The forest supported a range of up to twenty-five species of sea birds, prompting the claim by archaeologist David Steadman that *Rapa*

³¹ Ibid., 175.

³² Roggeveen only stayed one day on the island, and did not do a survey.

³³ D. Mann et al., "Prehistoric Destruction of the Primeval Soils and Vegetation of Rapa Nui (Isla De Pasua, Easter Island)," in *Easter Island: Scientific Exploration into the World's Environmental Problems in Microcosm*, ed. John Loret and John T. Tanacredi (New York, NY: Kluwer/Plenum, 2003).

³⁴ Mulloy, cited in Flenley and Bahn, (2003): xii.

³⁵ Ibid., 82-83.

Nui was the “richest sea-bird island in the world.”³⁶ Steadman’s meticulous excavations have sifted through over 6,433 bones of birds and other vertebrates, providing the bulk of evidence for identifying the island’s original habitat.³⁷ Additionally, both Simmons and Steadman have noted that since these species evolved without behavioural defence mechanisms against human predation, they made for easy prey, and it is likely that the *Rapanui* were able to rely heavily on them during the incipient phases of colonization, while the crops they brought with them were being sown and nurtured.³⁸ Fresh water lakes found in the base of *Rapa Nui*’s three extinct volcanoes provided the fresh water supply for agriculture and consumption, although it is noted that the fresh water supplies were limited and islanders had to rely on captured rainwater as a source for water.

The *Rapanui*, a sea-faring people by nature, were superb anglers. *Rapa Nui* lacks some of the warm water corals that enable shallow water fishing and seafood harvesting that is predominant in other Polynesian islands. Nonetheless, Steadman’s excavations of midden heaps has identified seals, large tuna, and an unusually high incidence of porpoise bones,³⁹ indicating that the early settlers were capable of deep-water fishing, which required large canoes. Thus, in the initial period of colonization the shortage of shallow water fish was easily supplemented by the abundance of larger deep-water fish.

In short, the island was a fertile paradise for the first arrivals who had endured great distances in order to find it. In addition to the alien

³⁶ Ibid., 88-89.

³⁷ Diamond, (2006).

³⁸ I.G. Simmons, *Changing the Face of the Earth: Culture, Environment, History* (Oxford: Basil Blackwell, 1989).; Flenley and Bahn, (2003): 88.

³⁹ In early heaps the porpoise bones accounted for roughly one-third of the total bones, an unusually high number when compared to other Polynesian islands, where they account for only 1% of the bones in the middens. Cited in Diamond, *Collapse: How Societies Choose to Fail or Survive*, 105.

crops and animals brought to the island, the native resource base provided for comfortable survival. There was abundant food and great resources for exploitation. Unfortunately, as noted above, the native species did not evolve with defences against the immigrant species, and it is likely that the *Rapanui* quickly hunted them to extinction. Steadman suggests, “Humans caused extinctions of up to half of the known land birds throughout the tropical Pacific through predation, habitat alteration, competition and predation from introduced rats, and introduced avian diseases.”⁴⁰ The excavations of midden heaps corroborate this evidence, which reveal a general decline and eventual extinction of twenty-three of the initial twenty-five bird species.⁴¹ Further, there is evidence that the Polynesian rat, once unleashed onto the landscape, competed with native birds for food and hindered the growth of the palm trees by nibbling on seeds and nuts. All of the pine nuts that Flenley found had evidence of gnawing by the Polynesian rat, which burrowed into the nut in order to eat the kernel.⁴² The consequences were devastating because rats actively inhibited the growth and regeneration of the foundation of *Rapanui* resource base. Trees were not only utilized for the construction of homes and canoes, transport and erection of the *Moai* statues, and firewood, they also ensured that *Rapa Nui*'s soils stayed nutrient rich and prevented erosion.

2.4 Population Growth and the Malthusian Trap

There is considerable speculation over historic population size in *Rapa Nui*. Roggeveen's first expedition estimated between two to three thousand inhabitants, although he did not survey the whole island. Oral

⁴⁰ Flenley and Bahn, (2003): 88.

⁴¹ Diamond, (2006).

⁴² Flenley and Bahn, (2003): 100.

traditions recorded by Routledge spoke of ancestors “thick as grass,”⁴³ but islanders cannot provide a timeframe or reference to what this should signify. Métraux used population densities from neighbouring islands to arrive at his estimates for peak population of 3,000 to 4,000.⁴⁴ Still another survey based on housing foundations concluded that the population remained low until c. CE 1100, after which it doubled every century until CE 1400.⁴⁵ Other indicators such as increases and decreases of food remains in midden heaps add fuel to debate about competing estimates, ranging from a low of 2,000 to a high of roughly 30,000. Majority estimates today fall somewhere in between 7,000 to 10,000.⁴⁶

Population size estimates are critical to the theory that asserts that unchecked population growth exhausted the natural resource base and eventually overshot the carrying capacity, causing social upheaval related to competition for resources, and eventually, the decline of the society – the model for the classic Malthusian trap. In his *Essay on the Principle of Population* (1798), Reverend Thomas Malthus argues that increases in real income arising from productivity improvements cause population growth. Indeed, the relative abundance of trees on Easter Island on the eve of Polynesian arrival enabled the first inhabitants to effectively utilize the resource and expand their population. The island was equipped to sustain a discriminate population size; as long as that population remained constant relative to the resources available, a steady state existed. As the population moved beyond the carrying capacity, overuse

⁴³ Routledge, (1919).

⁴⁴ Métraux, (1940).

⁴⁵ Christopher M. Stevenson, "The Socio-Political Structure of the Southern Coastal Area of Easter Island Ad 1300-1864," in *Island Societies: Archaeological Approaches to Evolution and Transformation. 11th International Congress of Anthropological and Ethnological Sciences : Selected Revised Papers*, ed. Patrick Vinton Kirch (Cambridge: Cambridge University Press, 1986).

⁴⁶ Estimates by Bahn and Flenley, Van Tilburg, Stevenson.

resulted in a gradual dwindling of resources since there would not be sufficient time for trees to regenerate and birds and other species would be over-hunted. This process in turn reduced the real income productivity of islanders, since fewer resources were distributed amongst a larger population. Malthus suggests that in the absence of productivity gains, the population will overshoot the carrying capacity and must readjust.⁴⁷ In *A Concise History of World Population*, Massimo Livi-Bacci explains, “In the long run, demographic growth moves in tandem with the growth of available resources, the latter imposing an impassable limit on the former.”⁴⁸ The resource base dwindled, but the population continued to grow at an estimated one percent per decade,⁴⁹ exacerbating the reduction of per-capita availability of said resources.

Evidence for overpopulation is abundant. Food shortages became more common as the native flora and fauna species dwindled and eventually died out. Steadman’s excavations show that gradually, the variety of bones in midden heaps was reduced to chicken and rats, as well as fewer and fewer deep-sea fish because of the reduced number of canoes available. Increasingly, “less productive areas of the island, with poorer soils became occupied as the population ruthlessly increased.”⁵⁰ Land needed for agriculture by the growing population contributed to the clearing of tree cover, feeding the vicious cycle.

The greatest tragedy, but also the likeliest indicator of societal decline, is evidenced between the thirteenth and sixteenth century, when manufacture of the *Moai* statues suddenly ceased. “In short, work quickly

⁴⁷ Thomas R. Malthus, *An Essay on the Principle of Population* (London: Routledge, 1996).

⁴⁸ Massimo Livi-Bacci, *A Concise History of World Population* (Cambridge, MA and Oxford: Blackwell, 1992), 35.

⁴⁹ Estimates found in Jean Louis Rallu, *Pre- and Post- Contact Population in Island Polynesia*, ed. Patrick Vinton Kirch and Jean-Louis Rallu, *The Growth and Collapse of Pacific Island Societies: Archaeological and Demographic Perspectives* (Honolulu: University of Hawai'i Press, 2007).

⁵⁰ Flenley and Bahn, (2003):158

ground to a halt because of an ever-increasing imbalance between the production of essentials (food) and that of non-essentials (statues).⁵¹ The majority of the statues remain unfinished, sitting in the quarry in *Rano Raraku*. In addition, two separate studies, conducted by Métraux and Mulloy respectively, show an increased prevalence of obsidian spear points and other weapons from the sixteenth century onward, culminating with a high in the seventeenth and eighteenth centuries.⁵²

Thomas Homer-Dixon's "Environmental Scarcities and Violent Conflict" (1994) examines modern cases of conflict and concludes that population growth and resource maldistribution which lead to scarcities in forests, water, fisheries, and cropland are triggers for violence.⁵³ The evidence of more weapons on Easter is a clear indication that environmental scarcities triggered violence on their island. A breakdown of the hierarchical social structure and intermittent warfare is corroborated by oral traditions of the *Rapanui* descendants and a trend that appears to have occurred late in the island's history, when much of the population began to live in fortified caves designed to prevent entry.⁵⁴ Bahn and Flenley note, "One of the most remarkable features of Easter Island's culture is that peace reigned for over a millennium before crisis led to violence."⁵⁵ The rise of the warrior class succeeded the spiritual and religious class, the result of competition over declining resources.⁵⁶ In the end, on *Rapanui*, it was as Malthus predicted; corrective checks forced the adjustment of *Rapanui* populations to levels that were supported by the remaining resource base.

⁵¹ Ibid.

⁵² Métraux, (1940): 166.

⁵³ Homer-Dixon, Thomas. Environmental Scarcities and Violent Conflict: Evidence from Cases. *International Security* 19, no. 1 (1994): 18.

⁵⁴ Flenley and Bahn, (2003): 98.

⁵⁵ Bahn and Flenley, (1992): 186.

⁵⁶ Nicholas Thomas, *Out of Time: History and Evolution in Anthropological Discourse*, 2nd ed. (Ann Arbor, MI: University of Michigan Press, 1989), 163.

In 1998, economists James Brander and M. Scott Taylor attempted to test this hypothesis by constructing a formal “Ricardo-Malthus model” linking population dynamics and renewable resource dynamics.⁵⁷ The model sought to generate a time series for population size and resource stock, and predict population dynamics in relation to carrying capacity and harvesting productivity in a steady state.⁵⁸ As applied to *Rapa Nui*, the model indicated that the first three hundred years of human existence would have little impact on the resource base (consisting of the ecological complex of forest and soil). Afterwards however, the population increases to a level above the carrying capacity of the resource base, and begins to deplete resources at a level quicker than their regeneration. During this same period, the population continues to rise geometrically, and around the mid twelfth century overshoots the resource supply, which continues to dwindle. Thus, the inverse relationship between resources and population growth leads to a population overshoot that continues to increase for a period, but sees a precipitous decline in the mid fourteenth century and never manages to recover to its maximum levels (See Appendix A). Although highly simplified and limited in variables, the predictions of the “Ricardo-Malthus model” are in line with the majority of estimates presented by the aforementioned historians and archaeologists. For most, it served to reinforce the prevalent hypothesis. More importantly, the article was a watershed moment in the study of *Rapa Nui*. It had a reverberating effect, serving as a starting point for much more research on the topic. This study returns to this model and the subsequent research by others in Part III.

⁵⁷ James A. Brander and M. Scott Taylor, "The Simple Economics of Easter Island: A Ricardo-Malthus Model of Renewable Resource Use," *The American Economic Review* 88, no. 1 (1998): 119.

⁵⁸ *Ibid.*

2.5 Environmental Collapse

When comparing the evidence for what existed on *Rapanui* during the first centuries of human colonization to what remained on the island by 1722, there can be no disputing the notion that the resource base was exploited to exhaustion. It is likely that islanders were not aware that *Rapa Nui's* ecosystem was more fragile than other Polynesian islands, and consequently did not know the irreparable damage they were causing by felling trees. Nevertheless, the very resource they exploited for the majority of construction and artistic efforts was the same resource that sustained the entire habitat on the island. As trees dwindled, the forest floor exposed or eliminated the habitats of many of the birds, disrupting mating patterns, and leaving them exposed to predators. The Polynesian rat had easier access to eggs laid on the ground, and the *Rapanui* could more efficiently hunt. Additionally, archaeological excavation has shown that the forests were burned in order to clear land for agriculture and fertilise the soil with the resultant ash.⁵⁹ Orliac and Orliac have identified over 30,000 fragments of wood burned to charcoal used for daily fuel sources.⁶⁰ Regeneration was inhibited by rats gnawing at seeds and by eating at shoots. The consequences of reduced tree cover were nutrient leaching and soil erosion, wind damage, soil evaporation, and eventual reduction in crop yields, which forced islanders to constantly search for new regions of the island for agriculture (See Appendix C for relationship network). Research by Mann, *et al.* has shown that widespread burning and soil erosion occurred at some point after CE 1200. Their hypothesis states that human habitation on the island passed through two phases.

⁵⁹ Van Tilburg, (1994): 63.

⁶⁰ Catherine Orliac and Michel Orliac, "The Disappearance of Easter Island's Forest: Over-Exploitation or Climatic Catastrophe," in *Easter Island in Pacific Context; South Seas Symposium: Proceedings of the Fourth International Conference on Easter Island and East Polynesia*, ed. Christopher M. Stevenson, Georgia Lee, and F.J. Morin (Los Osos, CA: The Easter Island Foundation, 1998).

The first phase began at c. CE 300 to about CE 1200, and marked by people hunting and gathering on the island. At c. CE 1200 the island's ecology passed into the second phase, associated with large scale burning of areas in the interior for agriculture. A need for agriculture was the likely result of a growing population and depressed natural resources (see Appendix B).⁶¹

Tree extinction eventually led to the abandonment of deep-sea fishing, a further loss of badly needed protein.⁶² Evidence for this is found in midden heaps dating to this period. In these heaps, the bones of the deep-sea fish are replaced with bones of marine animals that can be gathered rather than fished, but these too eventually show signs of reduction and eventual disappearance, indicating that they were also overexploited.⁶³

This theory is buttressed by new research that suggests that *Rapa Nui* went through a period of prolonged and severe droughts during the Little Ice Age c. 1350-1500. The freezing of waters in the North Arctic reduced water levels around much of the rest of the world, especially equatorial zones south of the equator. Hunter-Anderson (1998) has collected much recent evidence that reflects changing temperatures throughout the island.⁶⁴ In combination with human induced felling of trees, it is likely that this scenario may have exacerbated the predominant causes.

⁶¹ Mann et al., "Prehistoric Destruction of the Primeval Soils and Vegetation of Rapa Nui (Isla De Pasua, Easter Island)," 148-49.

⁶² Flenley and Bahn, (2003): 192.

⁶³ Ibid., 158.

⁶⁴ Rosalind L. Hunter-Anderson, "Human Vs. Climatic Impacts at Rapa Nui, Did the People Really Cut Down All Those Trees?," in *Easter Island in Pacific Context; South Seas Symposium: Proceedings of the Fourth International Conference on Easter Island and East Polynesia*, ed. Christopher M. Stevenson, Georgia Lee, and F.J. Morin (Los Osos, CA: The Easter Island Foundation, 1998).

Resources, technology, and social behaviour interact to produce and shape cultural adaptations.⁶⁵ In the case of the *Rapanui*, they were forced to breed more and more chickens as their main source of protein, and their agricultural production was limited primarily to the crops they brought with them. Social networks of exchange disintegrated, as did their religion and politics, and the oral histories of the last few centuries are intertwined heavily with stories of cannibalism.⁶⁶ Diamond justifies this behaviour by pointing out that the *Rapanui* were substituting for their protein deficient diet and cannibalism evolved out of desperation.⁶⁷ Bahn and Flenley, Van Tilburg, and Mulloy debate this however, arguing that there is only incidental archaeological evidence for cannibalism, and attribute the oral traditions to a few specific incidents that were magnified out of proportion because of the shock effect.⁶⁸ Nevertheless, the fact remains that the environmental collapse on *Rapa Nui* forced the islanders to adapt by abandoning many of the cultural traits they had cultivated for nearly a millennium.

The fact that the Polynesians changed the island habitat in which they resided is by no means unprecedented. Kirch has noted that all Polynesian societies manipulated their environments for the maximization of their culture and survival.⁶⁹ On other islands the environment was either able to recover, or the exploitation was not so severe as to spin uncontrollably into complete collapse. It should be noted that *Rapa Nui's* fragility is unique. Nonetheless, Timothy Weiskel has stated that “since at least the advent of sedentary agriculture humankind has acted as a powerful biological and geological agent in complex ecosystems, almost invariably without a corresponding awareness of its own impact upon the

⁶⁵ Van Tilburg, (1994): 97.

⁶⁶ Ibid.

⁶⁷ Diamond, (2006).

⁶⁸ Flenley and Bahn, (2003).

⁶⁹ Kirch, (2000).

environment.”⁷⁰ As *Rapa Nui*’s resources dwindled, its human population reckoned with the hardship of reduced per-capita availability, and adapted their culture accordingly.

2.6 An Alternative Hypothesis

The hypothesis detailed above seeks to give a holistic explanation of the *Rapanui* people and culture. It combines several methods of analysis in order to derive a timeline of events that describe, as best possible, the island’s human history. As mentioned in the introduction to this chapter however, each method used has certain inadequacies, most notably with dating and date ranges. There is little doubt that upon arrival on the island, the original settlers of *Rapa Nui* had the benefits of a rich forest. The debate however, has focused on the cause of *Rapanui* collapse. In a polemic article written for the journal *Energy & Environment* (2005), Benny Peiser attacks the conventional hypothesis as a denial of Easter’s post-European history and as a rhetorical weapon of “environmental determinists and cultural pessimists.”⁷¹ His article begins where Paul Rainbird’s previous article left off, questioning the environmental collapses on Easter Island.⁷² His charges are directed most specifically at Jared Diamond’s 1995 article in *Discover* magazine. Peiser charges Diamond of denying, or at the least, neglecting to mention, the tragic history of the *Rapanui* after 1722. He claims that the evidence of *Rapanui* collapse prior to European contact is circumstantial, and based disproportionately on “untrustworthy” and “unreliable” oral traditions of the *Rapanui*.⁷³ His article focuses primarily on events after

⁷⁰ Timothy C. Weiskel and Richard A. Gray, "Historical Aspects of Environmental Decline," in *Environmental Decline and Public Policy* (Ann Arbor, MI: The Pierian Press, 1992).

⁷¹ Peiser, "From Genocide to Ecocide: The Rape of Rapa Nui," 535.

⁷² See Rainbird, (2002).

⁷³ Peiser, (2005): 516.

1722, and consequently, they are beyond the scope of this study, but because of the severity of the charges levied, they deserve a brief mention.

From the eighteenth to twentieth centuries, *Rapanui* traditions are marked by two notable events. Oral traditions speak of an epic war between tribes, sometime late in the history of the island. The second event is the tragic occurrence of slave traders passing through the South Pacific in the first half of the nineteenth century and the kidnapping of the majority of islander's on their way to South America. An especially horrific incident in 1862 prompted intervention by the archdiocese of Tahiti, who requested that surviving islander's be sent home. Of the 1,400 islander's that were kidnapped, a mere one hundred or so remained, and these were sent back by the government of Peru. Unfortunately, these last few brought smallpox with them, and upon returning to the island, infected the remaining population. By the end of the nineteenth century, the remaining inhabitants were completely decimated, only a few hundred remaining. According to Peiser, this amounts to genocide.

Peiser feels compelled to state that the *Rapanui* had weathered the environmental degradation of their island, and their population was healthy and stable.⁷⁴ He alleges that most historians have distorted the historical evidence of decline in order to pursue an environmentalist agenda, deny the actions of the Europeans, and imply the white man's racial superiority and Polynesian inability to manage their environment. To defend these serious claims, he points to the fact that the oral traditions of islanders were recorded after the tragedies, and after conversion to Christianity erased most memories of indigenous culture and tradition. He mentions the inaccuracies of Heyerdahl's records of oral traditions, as well as the inaccuracies in oral traditions recorded by

⁷⁴ Ibid.: 536.

Métraux and Routledge. For evidence, he cites contradicting claims of early Europeans who stated that *Rapanui* were physically healthy and had good nutrition. Some early European visitors, such as J.L. Palmer (1870), claim to have seen “boles of large palm trees.”⁷⁵ Further, he claims that the numerous accounts of tribal warfare in oral traditions cannot be dated accurately, and that “recollections of warfare and violent conflict most likely belong to the hostilities in the wake of European attacks on the island... Conflicts that resulted from societal breakdown and the apparent transfer of foreign populations which occurred in the late 1860’s.”⁷⁶

The most notable fault with Peiser’s argument is that he is guilty of the same thing he charges of his opponents, “he consistently selects only the data and interpretations that seem to confirm his conviction,”⁷⁷ a damning charge levied against Diamond, although equally applicable to the oral accounts he presents. He charges Diamond, Ponting, and others of “confirmation bias” for the purposes of environmental campaigning. Since all of the oral traditions recorded are dated after the events of the nineteenth century, and virtually all records of early European contact contradict one another, it is difficult to base one’s hypothesis simply on this evidence alone. He relies entirely on disproving the reliability of oral traditions, rather than providing evidence beyond oral traditions in order to defend his position. His final point emphasizes Rainbird’s conclusion “Whatever may have happened in the past on Easter Island, whatever they did to their island themselves, it totally pales into insignificance compared to the impact that was going to come through Western contact.”⁷⁸

⁷⁵ J.L. Palmer, cited in Ibid.

⁷⁶ Ibid.: 530.

⁷⁷ Ibid.: 535.

⁷⁸ Rainbird, cited in Ibid.: 536.

Without discounting the horrendous tragedies that occurred on the island in the eighteenth and nineteenth centuries, it is important to note that the overwhelming amount of evidence linked to pollen analysis, excavation, and archaeological finds, points to a significant decline of population linked to a drop in the resource base. It may be that *Rapanui* society was experiencing a new wave of population growth when Europeans first discovered the island, but that should not distract from the fact that the environment first encountered by Roggeveen was a completely different one from that first encountered by *Hotu Mota'u* and his tribe. Alternative explanations ranging from natural climatic shifts due to the Little Ice Age, or cultural collapse caused by European contact, are likely possibilities, but on balance, are insufficient to account for all the evidence supporting human induced environmental damage.⁷⁹ However, Rainbird and Peiser's scholarship reminds readers of the various inconsistencies with attempting to piece together *Rapanui's* true history, a history that will probably never be fully known.

3. Models and Theories – The Possible Evolution of Common-pool Resource Institutions on *Rapa Nui*

Historians have struggled to understand why the *Rapanui* were unable to reverse, or at the minimum, halt the environmental damage they were causing. Comparisons to other Polynesian islands are disquieting, since there is clear evidence that on other islands Polynesian societies were able to recognize and reverse population overshoot through some form of preventative checks. Further, Kirch has noted that

⁷⁹ John Flenley, "New Data and New Thoughts About Rapa Nui," in *Easter Island in Pacific Context; South Seas Symposium: Proceedings of the Fourth International Conference on Easter Island and East Polynesia*, ed. Christopher M. Stevenson, Georgia Lee, and F.J. Morin (Los Osos, CA: The Easter Island Foundation, 1998), 127.

on some islands resource use was strictly regulated and controlled by the social institutions.⁸⁰ In addition, Métraux has proven that the hierarchical social structure on *Rapa Nui* enabled top-down institutional control over harvesting of certain flora and fauna. Thus, as per-capita availability of resources dropped and competition increased over fertile soils, sea birds, and remaining trees, why did these types of social institutions not evolve on Easter? Fortunately, research on the matter has come from a new direction, abruptly set in motion by Brander and Taylor's 1998 article "The simple economics of Easter Island: A Ricardo-Malthus model of Renewable Resource Use." Their self-described "simplistic" model generated scholarship on relationships between population and resource use, and given the rich amount of data provided by historians, Easter proved an excellent case study for hypothetical analysis. The new scholarship follows two distinct but interwoven themes. The first theme utilizes econometric models to examine human behaviour, population management, and resource competition. The second theme examines property-rights regimes and the development of common-pool resource governance. Individually, each theme has a limited capacity to provide a holistic theory for deducing what happened on *Rapa Nui*. Together, the theories are excellent tools for arriving at a theory for why the *Rapanui* failed to govern their natural resources. The remainder of this study develops the ideas from previous scholarship, and arrives at just such a theory. The theory aims to answer Diamond's enduring question, "What were they thinking?"

3.1 Complexity and Collapse

In a study that so often mentions collapse, it may be important to define the notion at some point. As Rainbird and Peiser's alternative

⁸⁰ Patrick Vinton Kirch, *The Evolution of the Polynesian Chiefdoms* (Cambridge: Cambridge University Press, 1984).

theory have shown, such a definition is quite subjective, since cultural systems are continuous and ever evolving. To those that argue that the *Rapanui* society collapsed, Peiser would say that they merely evolved and adapted to changing conditions. The notion of collapse is indeed subjective, since the term ‘civilization’ is vague and intuitive.⁸¹

Nevertheless, to help wade through some muddy waters, Tainter’s (1988) definitions for the terms complexity and collapse provide a sufficient base. Complexity is measured on a continuous scale, by degree of social, political, and economic, order. Complexity is the traditions that uphold such orders, and civilizations emerge with complexity.⁸² Collapse, according to Tainter, is “the fall of specific *political* entities,” as well as the “a transformation of the features or behaviours that characterize a cultural entity... (that is, their transformation into some other civilization, defined as new traditions in art, literature, music and philosophy).”⁸³ Within the confines of such a definition, narrow in scope and focused on the political and the cultural, the ‘high-society’ of *Rapa Nui* certainly devolved late in its history.

Tainter’s *Collapse* (1988) elucidates general theories for collapse, and is therefore the foundation for understanding the concept. Of the eleven major themes he discusses, three apply to *Rapa Nui*. The first, “the gradual deterioration or depletion of a resource base (usually agriculture), often due to human mismanagement, and the more rapid loss of resources due to an environmental fluctuation or climatic shift”⁸⁴ relates to *Rapa Nui*’s environment previously discussed.

The second, an insufficient response to circumstances, is the primary topic of this section. The question of “why” is essentially a

⁸¹ Tainter, (1988): 40.

⁸² Ibid., 41.

⁸³ Ibid., 40.

⁸⁴ Ibid., 44.

question of why did they not respond. One link is provided by Janssen and Scheffer (2004), who argue that the role of sunk-costs may have psychologically deterred the *Rapanui* from changing their exploitative behaviour. Sunk-costs constitute investments made in political, social, or economic arrangements, such as the human and resource investment devoted to the carving of the *moai* statues. "We have shown that such a sunk-cost effect will tend to keep societies continuing about their business as usual in periods of stress rather than structurally changing their activities."⁸⁵ Resistance to reform, especially in the face of uncertainty, is a highly destabilizing factor.

Destabilization leads to the third major theme for collapse of the *Rapa Nui*: class conflict and elite mismanagement. *Rapanui* faith in their king as mediator between them and the gods, and his inability to prevent environmental collapse, eroded his power in society. Historical evidence and oral traditions reveal that power was usurped by the warrior class, and the religion based on the *moai* was eventually transformed to the cult of the birdman. Together, destabilization, insufficient response to circumstances, and deterioration of the resource base intertwined to unravel the complexity of *Rapanui* society.

3.2 Speculations on Decline

In their article "Scarcity and Appropriative Competition" (2003), Grossman and Mendoza show that a depression of permanent resources forces individuals to dedicate more time to the allocation and harvesting of remaining resources, further exacerbating the depletion of the resource base.⁸⁶ Their formulation of this commonsensical hypothesis is confirmed

⁸⁵ Marco A. Janssen and Marten Scheffer, "Overexploitation of Renewable Resources by Ancient Societies and the Role of Sunk-Cost Effects," *Ecology and Society* 9, no. 1 (2004): 2.

⁸⁶ Herschel I. Grossman and Juan Mendoza, "Scarcity and Appropriative Competition," *European Journal of Political Economy* 19 (2003).

by Pezzey and Anderies, who apply a similar model to *Rapa Nui* by adjusting the Brander and Taylor model to account for the sudden halt in *moai* building. They argue that at a certain period (estimates suggest the fifteenth or sixteenth century) the *Rapanui* reached a threshold, after which they had to abandon construction of the *moai* in order to dedicate more time to the appropriation of resources.⁸⁷ Since the resource base shrunk, it was no longer feasible for other members of society to provide artisans with food in repayment for their public service. This corroborates with the anthropological record, “The tales are reckoned to indicate that it was a breakdown of the system of distribution, the exchange networks, and the feeding of the craftsmen by the farmers and the fishermen that finally halted the group cooperation that was so vital to the enterprise.”⁸⁸ Most of the evidence still sits in the quarry at *Rano Raraku*. Over half of the statues on the island remain unfinished remnants of *Rapanui* history.

As the focus shifted primarily to subsistence, the culture and traditions shifted accordingly. Unfortunately, the focus on subsistence actually hurt the population as a whole, enabling population overshoot rather than preventing it.⁸⁹ Pezzey and Anderies raise the moral question asked by Koopmans as to society’s well-being.⁹⁰ “Is society’s goal at each time then to maximize current well-being, its long-run steady-state level, or its discounted present value?”⁹¹ Koopmans asked the question, should only a few live with abundant resources, or many at basic subsistence levels? In Polynesian history, it is known that migrations often occurred because of overpopulation. It is likely that because of *Rapa Nui*’s remote

⁸⁷ John C.V. Pezzey and John M. Anderies, "The Effect of Subsistence on Collapse and Institutional Adaptation in Population-Resource Societies," *Journal of Development Economics* 72 (2003).

⁸⁸ Flenley and Bahn, (2003): 157.

⁸⁹ Pezzey and Anderies, (2003).

⁹⁰ See, T.C. Koopmans, "Concepts of Optimality and Their Uses," *American Economic Review* 67, no. 3 (1977).

⁹¹ Pezzey and Anderies, (2003): 311-12.

location the inhabitants did not risk leaving the island and decided to live with the consequences of minimal resources. It is also possible that by the time the *Rapanui* were aware of overpopulation, too few large trees remained, and it was impossible to build canoes capable of long distance travel. The fact remains that the population overshot the resource base, forcing a competition for resources and further aggravating the situation.

In addition, Anderies has shown that a fundamentally destabilizing force in society is the ability of agents to intensify the exploitation of their resource base.⁹² Without the ability to increase the resource base through technology or adequate regulation, the inhabitants of *Rapa Nui* competed for shrinking resources, intensified exploitation, and potentially eroded the social institutions in place to guard against such an occurrence. The historical evidence clearly indicates such destabilization. It is likely that tribal warfare over resources led to the eventual destruction of all the *Moai*. As noted previously, by the time of Captain Cook's expedition in 1774, not a single statue remained standing. The *Rapanui* had abandoned the majority of the island, living together in only one location, and a new religion succeeded the *moai*. Whatever the timeframe in which this happened, it is undeniable that the traditions that survived for a millennium or more were quickly eradicated.

3.3 The Capacities of Social Institutions

For at least a few centuries, the predominant social institutions on the island were supported by a top down hierarchy supervised by a king. The king had the power to regulate what was *tapu* (forbidden) and when harvest season began. Therefore, common-pool resources were governed according to ritual and tradition. It is likely that traditions evolved as a means of governing overexploitation, and yet those same

⁹² John M. Anderies, "On Modeling Human Behavior and Institutions in Simple Ecological Economic Systems," *Ecological Economics* 35 (2000).

traditions failed. Good and Reuveny (2006) developed a model which “allows the representative agent to have foresight, resource management institutions and the ability to enforce their decision rules,”⁹³ a best-case scenario for the island. They explain that despite best efforts by the *Rapanui* to institute *tapu* and *rahui* regulation, in the long term the society still would have failed. The model *assumes* that the *Rapanui* considered the future – both their own and future generations – in their decision making process. The results of the simulations indicate that without sufficient foresight of upwards of two hundred years, even a best-case scenario of optimal resource management institutions would have proven inadequate to prevent the population boom-bust on the island.⁹⁴

According to the model’s predictions, long-term sustainability was only possible if islanders under utilized resources in order to maintain them for future generations, which still did not guarantee sustainability because there was no guarantee that future generations would utilize them responsibly.⁹⁵ The fact that the regeneration rate on Easter was very low, or possibly zero, made it inevitable that at some point, the resources would be endangered. Models however, have a tendency of being deterministic, if not fatalistic.

In his seminal 1968 article, “The Tragedy of the Commons,” Garrett Hardin warns of the dangers of unimpeded population growth and its impact on common resources.⁹⁶ He warns that sufficient control over common resources must be administered in order to protect them from overuse by all. This requires cooperation and mandate. In *Governing the Commons* (1990), Elinor Ostrom expands Hardin’s theory by formulating

⁹³ David H. Good and Rafael Reuveny, “The Fate of Easter Island: The Limits of Resource Management Institutions,” *Ecological Economics* 58 (2006): 477.

⁹⁴ *Ibid.*: 486.

⁹⁵ A similar model testing technological *hypothetical* technological progress and population management was conducted by Reuveny and Decker (2000). The results of their simulations were inconclusive.

⁹⁶ See, Garrett Hardin, “The Tragedy of the Commons,” *Science* 162, no. 3859 (1968).

the model and illustrating successful examples of self-governing institutions that evolved for the protection of common resources. Her book notes that these institutions arrive because a need exists, but more importantly, success is determined by an accurate identification of the problem.⁹⁷

Ostrom also lists a set of attributes, which increases the likelihood of successful self-government of resources by their appropriators.⁹⁸ This list of attributes (provided in full in Appendix D) provides the fundamental explanation for why the *Rapanui* were motivated to cut down their last trees. Indeed, for the most part the *Rapanui* had sufficient indicators that a problem existed. Given the small size of the island, the ability for islanders to take full and accurate stock of the limits of their resource, and the systematic reduction of resources, there was reasonable predictability to assess the problems of a depressed resource base. Significant evidence exists that they were aware of their growing problems.⁹⁹ Nevertheless, islanders were powerless to solve the problem because they were likely unaware of its cause. Inability to identify the problem led to the logical conclusion that there was no feasible improvement in the condition of the resource. Irrespective of whether or not trees were felled, regeneration of new trees did not occur. Since their culture evolved with a high dependency on the resource system for their livelihood, the *Rapanui* were very slow to change their behaviour. Research by Fernandez and Rodrik (1991) has shown that status quo bias is sufficiently high in the face of uncertainty.¹⁰⁰ This likely applied to the *Rapanui*, who for

⁹⁷ Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge: Cambridge University Press, 1990).

⁹⁸ ———, "Reformulating the Commons," *Ambiente & Sociedade*, no. 10 (2002): 5.

⁹⁹ As soils were leached, islanders resorted to covering seeded plots with small stones in order to contain moisture.

¹⁰⁰ Raquel Fernandez and Dani Rodrik, "Resistance to Reform: Status Quo Bias in the Presence of Individual-Specific Uncertainty," *The American Economic Review* 81, no. 5 (1991).

generations prior to the recognition of the problem, depended on timber for the building of canoes, which they depended on for the majority of their protein consumption. In addition, it is probable that as the resource dwindled, group cooperation disintegrated into mutual suspicion and competition. The trust and reciprocity between tribes disintegrated, as did the autonomy of the king to give orders and enforce them. It is also likely that the last generation to cut down trees did not consider conservation for future generations because there was no guarantee that future generations would maintain low saving rates, "in a sense profiting at the expense of the present."¹⁰¹ Indeed, it is likely that knowledge that the resource base did not regenerate served to encourage a faster rate of exploitation, since competition between actors, as well as future actors, meant that whatever could not be utilized by an individual would only be utilized by another. Olson notes, "*Rational, self-interested individuals will not act to achieve their common or group interests*"¹⁰² without some means of coercion such as social custom and behaviour. The likelihood is that social norms crumbled and individuals, or groups of individuals with allegiances only to their tribe, would have autonomy to exploit open-access resources as quickly as possible. If *Rapa Nu*'s trees are analogized to fish in the seas, M. Scott Gordon's prudent explanation serves well. "The fish in the sea are useless to the fishermen, because there is no assurance that they will be there for him tomorrow if they are left behind today."¹⁰³

¹⁰¹ Good and Reuveny, (2006): 487.

¹⁰² Olson, cited in Ostrom, (1991): 6.

¹⁰³ H. Scott Gordon, "The Economic Theory of a Common-Property Resource: The Fishery," *Journal of Political Economy* 62 (1954).

3.4 Rapa Nui's Fate

The predicted chain of events, which assumes individual self-interest, explains the rationale behind hoarding what remains instead of conserving for the future. In the absence of feasible technological or agricultural progress that enabled islanders to harvest and cultivate trees, their fate was unavoidable, irrespective of how much knowledge they had of their environment. In fact, it is likely that a realization that new trees did not grow in place of old ones triggered competition for what little remained. In this context, the answer to the question, "What were they thinking?" is obvious. They knew that whether they saved the remaining trees for one generation or the next, there would be no more. Further, each individual was aware that conservation was not in his interest because competitors would not conserve.¹⁰⁴ Thus, the generation that felled the last trees may certainly have felt some remorse and uncertainty about the future, but it was following generations that surely felt the consequences. *Rapa Nui's* fate was determined by a unique set of circumstances, pitting rats against trees and its inhabitants against one another. Their fate was determined not by action or inaction, but by the few rats that arrived on the very first canoes all those centuries ago.

4. Concluding Remarks – Implications for the Contemporary World

Given the decline of the island's culture, we should consider the parallels between the behaviour of the Easter Islanders in relation to their

¹⁰⁴ Elinor Ostrom, "Collective Action and the Evolution of Social Norms," *The Journal of Economic Perspectives* 14, no. 3 (2000).

*limited resources and our cavalier disregard for our own fragile environment: the Earth itself.*¹⁰⁵

The adage of Easter Island as metaphor for the Earth is ubiquitous. Easter's popularity is attributed to the prominence and distribution of this metaphor. Naturally, such exposure attracts new scholarship. Unabashedly, one motivation of this study was to arrive at some conclusion regarding Easter's implications for the contemporary world. While it is true that Easter Island and the Earth are two very isolated, fragile, and all-important ecosystems, the conclusions of this study are that the similarities stop there. In large part, modern day resource issues such as fresh-water distribution, carbon dioxide waste into the atmosphere, and even food shortages are challenges pertaining to lack of education and collective action problems. The interests of businesses, communities, individuals, and governments are weighed against the short and long-term costs to the environment. Scientists no longer debate the reality of human induced climate change, but debate continues on the future consequences and the best course of action. Easter Island's problems were far smaller in scope. The island's history indicates that collective action was a not a foreign concept to them. For nearly one millennium, they lived a peaceful existence and managed to build a complex society capable of erecting the *moai* statues. They recognized and addressed problems of soil erosion and moisture leaching through means available to them. It is likely that they were aware of the environmental challenges their island faced. The fundamental difference between Earth and Easter Island is that the islanders faced the challenge of a diminishing resource base they could not feasibly improve, while Earth faces problems of collective action and education.

¹⁰⁵ Flenley and Bahn, (2003): *ix*.

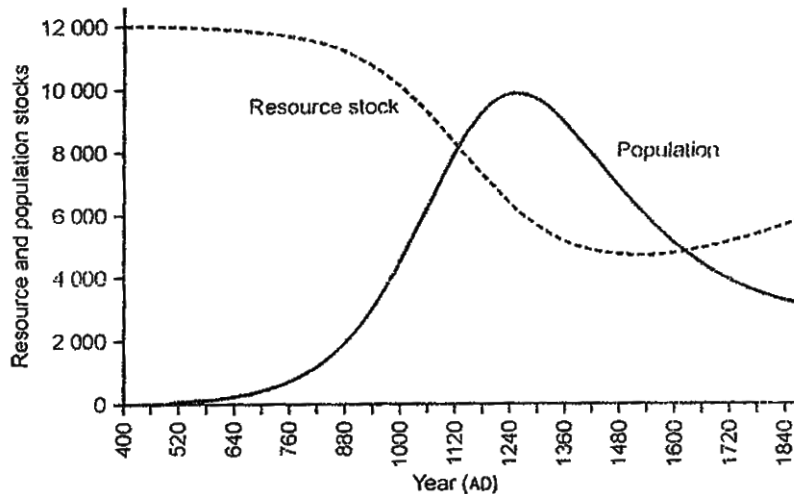
A bit controversially perhaps, the conclusion of this study is that the adage of Easter as metaphor is far too simplistic for anything beyond superficial value, in lieu of the fact that Easter Island was a highly simplistic ecosystem that was overwhelmed with only a few variables capable of disturbing its equilibrium. The scope of the *Rapanui* to correctly identify and fix the problem of their diminishing tree cover was limited. Technological advancement and substitution of resources were unavailable to the *Rapanui*, as was knowledge from other places. This amounts to significant differences when comparing Easter Island to a highly complex and interrelated ecosystem such as that of the globe.

By addressing Jared Diamond's question of "why," this study adds to the evolving literature pertaining to the governance of common-pool resources, and illustrates the effects of what can happen when rational individuals cannot find an effective means for addressing a common problem. They can exacerbate the situation by adopting a selfish and corrosive attitude, eroding social structures, and contributing to destabilization, tending toward conflict over resources. It is most interesting to predict normative behaviours in times of crisis or uncertainty, and align such predictions to the historical evidence available. The specific combination of factors that led to eventual collapse may never be fully known, and it is more unlikely that we will ever be able to pinpoint the moment decline started. At best, such notions remain subjective. Nevertheless, the behaviour and rationale of individuals facing uncertainty and competition for resources is predictable for those with the benefit of hindsight, and can in turn, help to identify potential warnings and predict future problems.

Arrival at such an answer required insight into the problems arising from collective action dilemmas and the attributes necessary to address them. The *Rapa Nui* had most of these attributes, but the fundamental attribute of feasible solutions eluded them. For problems in dealing with

Earth's more complex issues pertaining to the environment and human induced climate change, feasible solutions exist. To date, what is lacking is cooperation and common understanding. For successful alleviation of modern problems, these two attributes must be sought.

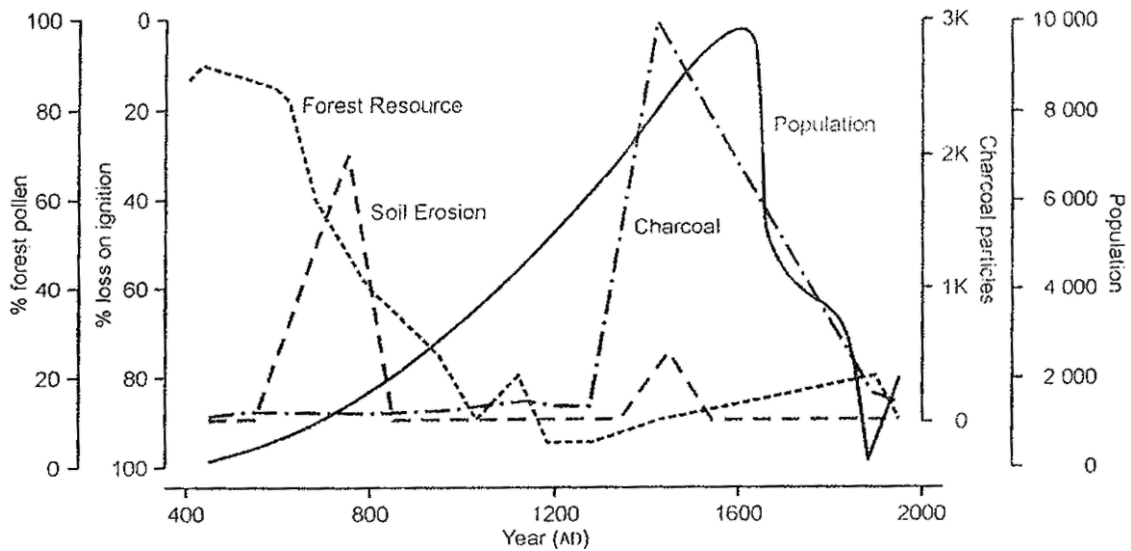
Appendix A



A Copy of Brander and Taylor's "Ricardo-Malthus" Model for Easter Island. The estimate indicates that in the twelfth century population overshoots an already declining resource base, and peaks at roughly 10,000. Afterward the boom cycle the ensuing bust cycle enables the resource base to recover slightly. The carrying capacity of the resource stock is set by Brander and Taylor at 12,000. According to them, "It is convenient for the resource stock to be similar in magnitude to the population... This is the starting value of the stock when Polynesian colonization first occurred."¹⁰⁶ Their reasoning suggests that peak population could only go as high as peak resource use allows.

¹⁰⁶ Brander and Taylor, (1998): 128.

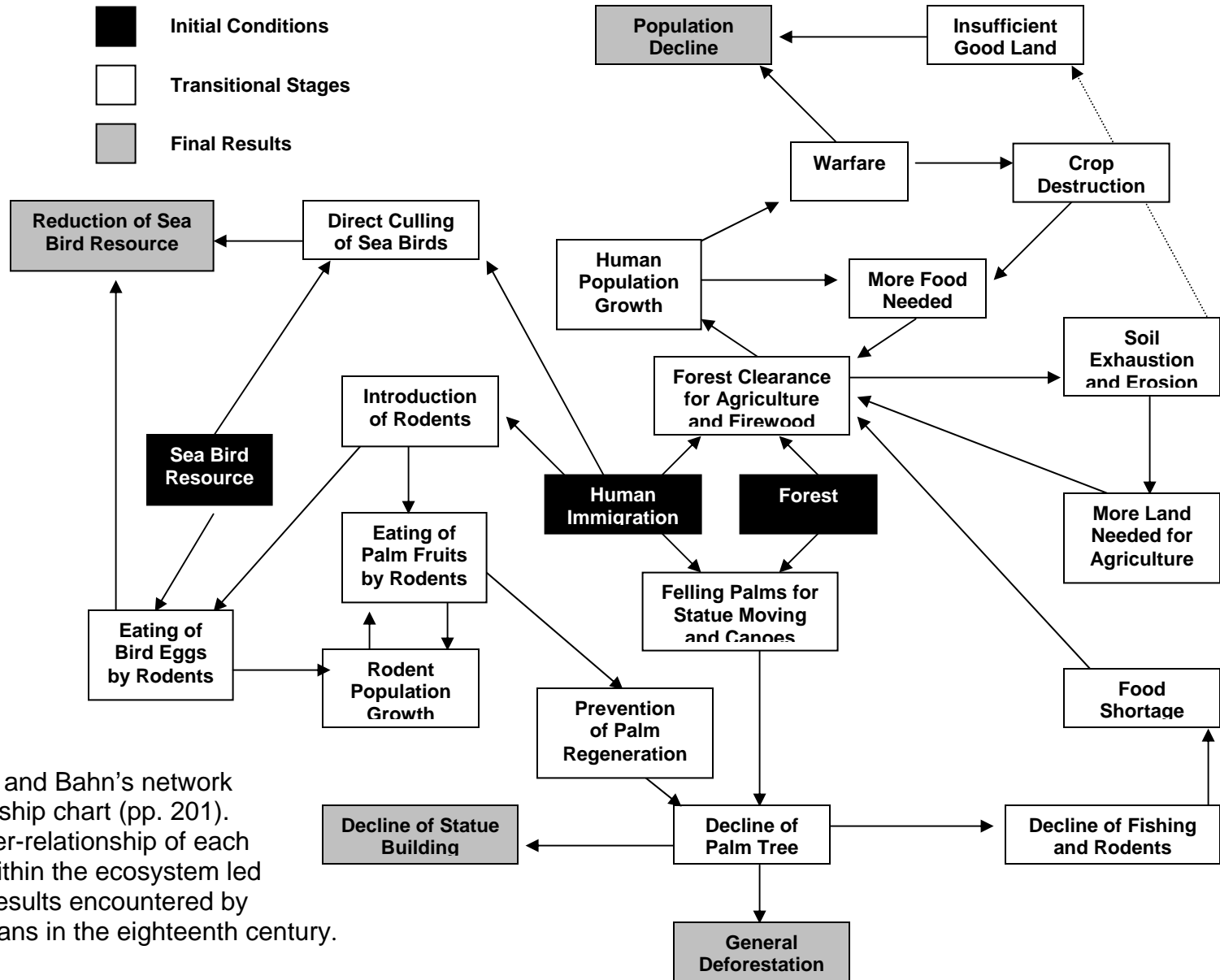
Appendix B



A copy of Flenley and Bahn's (2003) resource graph.¹⁰⁷ Forest resource, soil erosion, charcoal, and population size are modelled simultaneously to illustrate the relationship between each. As forest resource declines, there is a sharp spike in soil erosion, and then a subsequent drop in erosion after most topsoil has already disappeared. There is a sudden, dramatic spike in charcoal after CE 1200, which corresponds to research by Orliac and Orliac and Mann *et. al.* The causes for this are guessed to be rising need for arable land fertilised by ash, a consequence of declining good agricultural lands and increased population. Population rises gradually, and peaks at roughly 10,000, a likely result of diminished resources on the island leading to precipitous decline after 1600.

¹⁰⁷ Flenley and Bahn, (2003): 199.

Appendix C



Flenley and Bahn's network relationship chart (pp. 201). The inter-relationship of each actor within the ecosystem led to the results encountered by Europeans in the eighteenth century.

Appendix D

Copy of Ostrom's list of attributes for resource and attributes for appropriators. The contents of this list likely explain the causes for why the *Rapa Nui* continued to exploit their resource stock even after a problem was recognized.

Attributes of Resource:

R1. Feasible improvement: Resource conditions are not at a point of deterioration such that it is useless to organize or so underutilized that little advantage results from organizing.

R2. Indicators: Reliable and valid indicators of the condition of the resource system are frequently available at a relatively low cost.

R3. Predictability: The flow of resource units is relatively predictable.

R4. Spatial extern: The resource system is sufficiently small, given the transportation and communication technology in use, that appropriators can develop accurate knowledge of external boundaries and internal microenvironments.

Attributes of the Appropriators:

A1. Saliency: Appropriators are dependant on the resource system for a major portion of their livelihood.

A2. Common understanding: Appropriators have a shared image of how the resource system operates (attributes R1, 2, 3, and 4 above) and how their actions affect each other and the resource system.

A3. Low discount rate: Appropriators use a sufficiently low discount rate in relation to future benefits to be achieved from the resource.

A4. Trust and Reciprocity: Appropriators trust one another to keep promises and relate to one another with reciprocity.

A5. Autonomy: Appropriators are able to determine access and harvesting rules without external authorities countermanding them.

A6. Prior organizational experience and local leadership: Appropriators have learned at least minimal skills of organization and leadership through participation in other local associations or learning about ways that neighbouring groups have organized.¹⁰⁸

¹⁰⁸ Ostrom, (2002) 5.

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