

# Hawai'i's Thirty Meter Telescope

*Construction of the World's Largest Telescope on a  
Sacred Temple*

Abby Starr Herhold



Master thesis in Culture, Environment and Sustainability

Centre for Development and Environment

UNIVERSITY OF OSLO

October 2015



© Abby Starr Herhold

October 2015

Hawai'i's Thirty Meter Telescope: Construction of the World's Largest Telescope on a Sacred Temple

<http://www.duo.uio.no/>

Print: Representralen, University of Oslo

# Abstract

Mauna Kea is located on the Big Island of Hawai'i. It is a dormant volcano and the highest mountain in the world measured from sea bottom. Mauna Kea's dry atmosphere, cloud-free skies and distance from city lights attracted astronomers starting in the 1960s. The first telescope was built on the summit in 1970. Since then there has been a total of 13 telescopes built on Mauna Kea, funded by 11 different countries (Astronomy 2014). Mauna Kea is considered to be the preeminent site in the world for ground-based astronomy. On April 12, 2013, the Thirty Meter Telescope Observatory Corporation was granted a Conservation District Use Permit (CDUP) by the Hawai'i Department of Land and Natural Resources (DLNR) to build and operate the US \$1.4 billion Thirty Meter Telescope (TMT) on Mauna Kea. The TMT will have the most advanced technology of any telescope on Earth, far surpassing the orbiting Hubble telescope's capabilities (TMT 2015). The potential for scientific discovery is enormous. Paradoxically, Mauna Kea is also considered to be the most sacred place in all of Hawai'i for Native Hawaiian people. Mauna Kea is the spiritual center of the Native Hawaiian people, connecting them to their *akua* (gods), *kupuna* (ancestors) and *'aina* (land). Mauna Kea is the *piko* (umbilical cord) that connects the Native Hawaiians to their original creators, *Papahānaumoku*, the Earth Mother, and *Wākea*, the Sky Father.

For astronomers, the TMT is a necessary next step for science and, as they see it, the future of humanity itself. For Native Hawaiians, the TMT threatens their sacred mountain and culture. As a result, Mauna Kea has become a “battleground” between TMT proponents and Native Hawaiians—or, as some have framed it, Science vs. Culture. This, I argue, is a shallow interpretation of the deeper issue at hand. Native Hawaiians have been clear that they are not opposing science or the potential for discovery the telescope will enable. Their opposition to the TMT revolves around their culture and connection to the land. They are trying to protect a sacred mountain that is the backbone of their identity as Hawaiians.

The dispute between proponents and opponents of the TMT represents a fundamental difference in philosophy between two disparate views on the TMT—science in general, and the role of history, culture and spirituality in determining the outcome of a difficult and sometimes contentious issue. In this thesis, I will first present a detailed analysis of

the history of Hawai'i, as it provides a background into the importance of Mauna Kea to the Native Hawaiians and why they are standing up to protect their revered "Mauna." I will then examine the subject matter by highlighting the current court cases challenging the legality of the TMT. In doing so, I will investigate the following questions: How and why was Mauna Kea selected for the TMT? What are the actual and perceived benefits of building what will become the world's largest and most powerful telescope on Mauna Kea? What is the nature of the opposition to the TMT? How have the cultural beliefs, practices, and myths of the Native Hawaiian people been treated in the quest to build and operate the TMT? Although the TMT may be instrumental in "unraveling the mysteries of the universe" and "benefitting humankind" (TMT 2015), is it also symbolic of a deeply ingrained disconnect from the Earth? How has the Cartesian separation of the mind and body influenced this apparent disconnect between man and the Earth? How has the TMT been granted a use permit to build when it is clearly violative of not only Hawaiian culture, history and land, but the Native Hawaiians themselves?



# Acknowledgements

To the Protectors of Mauna Kea: Your tireless commitment to protect the Mauna and the Earth is beyond inspiring.

To Mom and Dad: Thank you for your guidance and support.

And to my partner Jarno: Thank you for your patience and endless love.







# Table of contents

- 1 Introduction ..... 1
  - 1.1 Rationale/Motivation for Choice of Topic ..... 5
  - 1.2 Ethical and Methodological Considerations ..... 7
  - 1.3 Outline of Thesis ..... 11
- 2 Historical Background ..... 13
  - 2.1 Polynesian Migration and Settlement of Hawai’i ..... 14
  - 2.2 Arrival of Captain James Cook ..... 17
  - 2.3 Arrival of Missionaries ..... 19
    - 2.3.1 Abolition of the *Kapu* System ..... 20
  - 2.4 The Spread of Christianity ..... 22
    - 2.4.1 Christian Dogma vs. Hawaiian Thought ..... 24
  - 2.5 The *Ahupua’a* System ..... 27
  - 2.6 The Constitutional Monarchy and The *Great Mahele* ..... 30
  - 2.7 Overthrow of the Monarchy and Statehood ..... 34
- 3 Mauna Kea ..... 39
  - 3.1 The Mountain ..... 39
    - 3.1.1 Climate Zones and Ecosystems ..... 41
  - 3.2 The *Mauna* and the Hawaiian Creation Story ..... 43
  - 3.3 State Law Governing Development on the Mountain ..... 47
    - 3.3.1 The Ceded Lands ..... 47
    - 3.3.2 The Mauna Kea Science Reserve ..... 49
- 4 Development of Astronomy on Mauna Kea ..... 55
  - 4.1 Growing Opposition to Astronomical Development on Mauna Kea ..... 61
    - 4.1.1 The Defeat of the Outrigger Telescopes on Mauna Kea ..... 64
  - 4.2 The Thirty Meter Telescope ..... 67
  - 4.3 Environmental Impacts of Telescope Construction ..... 72
    - 4.3.1 Impact on Endemic Species ..... 72
    - 4.3.2 Hazardous Materials and Water Contamination ..... 75
- 5 The Legal Battle Over the TMT ..... 79
  - 5.1 Petitioners vs. DLNR ..... 80
  - 5.2 October 7, 2014 TMT “Groundbreaking” ..... 86

5.3	Current Legal Status of the TMT .....	88
6	TMT and Humanity’s Disconnect From the Earth .....	91
6.1	The Philosophical Debate .....	91
6.2	Humanity’s Disconnect and Construction of the TMT .....	95
6.3	“We are Mauna Kea” .....	97
7	Conclusion .....	101
	References.....	103

# List of Figures

Figure 1: Mauna Kea (Hawai'i 2015).....	1
Figure 2: Polynesian Migration and Settlement Pattern (Wilmhurst 2010).....	15
Figure 3: <i>Ahupua'a</i> Land Division (Mueller-Dombois 2007).....	29
Figure 4: Big Island of Hawai'i Volcanoes by Land Area (Hawaii 2015) .....	40
Figure 5: Hawaiian Ridge-Emperor Seamounts Chain (Hawaii 2015).....	40
Figure 6: Big Island Climate Subzones (Guru 2015).....	42
Figure 7: Mauna Kea Science Reserve and Astronomy Precinct (Hilo 2008; pp. 3).....	52
Figure 8: October 7, 2014 Protests on the summit of Mauna Kea (photo credit: Abby Herhold).....	87

# Acronyms

ABCFM: American Board of Commissioners for Foreign Missions

BLNR: Board of Land and Natural Resources

Caltech: California Institute of Technology

CDP: Complex Development Plan

CDUA: Conservation District Use Application

CDUP: Conservation District Use Permit

DLNR: Department of Land and Natural Resources

EA: Environmental Assessment

EIS: Environmental Impact Statement

HIG: Hawai'i Institute of Geophysics

IfA: Institute for Astronomy

KAHEA: The Hawaiian Environmental Alliance

MKAH: Mauna Kea Anaina Hou

MKSR: Mauna Kea Science Reserve

MKSWCD: Mauna Kea Soil and Water Conservation District

NASA: National Aeronautics and Space Administration

NHPA: National Historical Preservation Act

OHA: Office of Hawaiian Affairs

RDP: Research Development Plan

SWCD: Soil and Water Conservation District

TCPs: Traditional Cultural Properties

TMT: Thirty Meter Telescope

UC: University of California

UH: University of Hawai'i

UHH: University of Hawai'i at Hilo

UHIFA: University of Hawai'i Institute for Astronomy

UK: United Kingdom

US: United States

# List Of Terms

**Big Island:** The State of Hawai'i is comprised of eight main islands (from northwest to the southeast): Ni'ihau, Kaua'i, O'ahu, Moloka'i, Lana'i, Kaho'olawe, Maui and the island of Hawai'i. In this thesis, I will refer to the island of Hawai'i as the Big Island, and the State, comprised of the eight islands, as Hawai'i.

**Hawai'i:** The proper spelling of Hawai'i is with the apostrophe between each "i". In some cases where there is a direct quote, Hawai'i will be spelled without the apostrophe (Hawaii).

**Mauna:** Mauna Kea or "Mauna a Wākea" to the Hawaiians.





# 1 Introduction

**“[By] fixing their gaze on distant stars, the astronomers fail to see what is right before their eyes: the irreplaceable cultural and natural resources of Mauna Kea” (Tytell 2003).**



**Figure 1: Mauna Kea (Hawai'i 2015)**

Mauna Kea is located on the Big Island of Hawai'i, the largest of the eight islands that make up the State of Hawai'i. It is a dormant volcano and the highest mountain in the world, rising at a height of nearly 10,000-m. (33,000-ft.) from the ocean floor to an altitude of 4,205-m. (13,796-ft.) above sea level—significantly taller than Mount Everest which stands at a height of 8,848-m. (29,029-ft.) (Society 2012). Mauna Kea's summit is above 40 percent of the Earth's atmosphere. The volcano is one million years old and last erupted 4,500 years ago (Astronomy 2014).

Mauna Kea's dry atmosphere, cloud-free skies and distance from city lights first attracted astronomers in the 1960s. The first telescope was built on the summit in 1970. Discoveries made by the first 2.2-m. (7.2-in.) telescope astounded scientists. It proved Mauna Kea's potential to be the world's preeminent site for ground-based astronomy. Since 1970, there have been a total of 13 telescopes built on the summit of Mauna Kea, funded by 11 different countries (Astronomy 2014).

Shortly after Hawai'i became a state in 1959, the Department of Land and Natural Resources (DLNR), the Hawai'i state agency that oversees all state-owned lands, leased the summit of Mauna Kea to the University of Hawai'i (UH). The leased land is known as the Mauna Kea Science Reserve (MKSR). With permission from the DLNR, UH is able to sublease portions of the MKSR to institutions and corporations for astronomical purposes. On April 12, 2013, the Thirty Meter Telescope Observatory Corporation was granted a Conservation District Use Permit (CDUP) by the DLNR to build and operate the US \$1.4 billion Thirty Meter Telescope (TMT). The TMT, a massive 18-story high edifice, will have the most advanced technology of any telescope on Earth, far surpassing the orbiting Hubble telescope's capabilities (TMT 2015). The potential for scientific discovery from the TMT is enormous. Astronomers will be able to gaze farther and deeper into space than they ever have before, helping to unlock the origins of our universe and our place in it.

Mauna Kea is also considered to be the most sacred place in all of Hawai'i for Native Hawaiian people. According to Hawaiian mythology, high points or peaks hold immense spiritual significance. Mauna Kea, the highest peak on the Islands, is the most honored and revered place in Hawai'i and has been since the Islands were first inhabited almost 1,500 years ago. Mauna Kea is the spiritual center of the Native Hawaiian people, connecting them to their *akua* (gods), *kupuna* (ancestors) and *'aina* (land) (Byrne 2005; pp. 4). Oral traditions passed through chants, legends, myths and *mo'oku'auhau* (genealogies), trace the origins of the Native Hawaiian people to the life forces of the land (McGregor 2013). According to their *mo'oku'auhau*, Native Hawaiians are the living descendents of *Papahānaumoku*, the Earth Mother, and *Wākea*, the Sky Father. *Papa*, as she is affectionately known, and *Wākea* gave birth to the Big Island. Later in the genealogy came the *kanaka* (the first humans)—the descendants of *Papa*, *Wākea*, and the Big Island. The connection between child and parent is through is the child's *piko* (umbilical cord). Mauna Kea is not just the physical manifestation of the Big Island's *piko*, but more importantly, Mauna Kea takes on the symbolic meaning, "to connect." Mauna Kea connects the *kanaka* back to the their *kupuna* and to their creators, *Papahānaumoku* and *Wākea*.

The TMT will be the 14<sup>th</sup>, and by far the largest, telescope to be built atop Mauna Kea. The 18-story high building will dwarf all of the other existing telescopes and will be

readily visible to the inhabitants of the Big Island. The legality of the TMT has been contested before the DLNR and in two follow-on lawsuits. One lawsuit, filed by the Petitioners—a group of Native Hawaiian cultural practitioners, environmentalists and recreational users of the mountain—challenges the Conservation District Use Permit (CDUP) granted by the DLNR allowing the TMT to be built on Mauna Kea. The Petitioners argue, among other things, that the initial permit granted in 2011 was issued prematurely and that the TMT failed to meet all of the statutory criteria necessary to build on what has been designated by the state as a “Conservation District,” state land meriting the highest cultural, historical and environmental protections (Lind 2015). The Petitioners also argue that the TMT would impermissibly increase the negative environmental impacts already seen on Mauna Kea from the existing 13 telescopes. In addition, they assert that the TMT would greatly impact the historical and cultural resources on Mauna Kea, hindering their ability to conduct cultural practices, ceremonies and *pule* (prayer). The second lawsuit, also filed by the Petitioners, challenges the proposed extension of the lease given to UH for the use of Mauna Kea. The original lease granted to UH by the DLNR was for 65 years and expires in 2033. To accommodate TMT’s demand that the lease be extended, UH applied for an extension of the lease for another 65 years (Deneen 2015).

In May 2014, the Third Circuit Court of Hawai’i sided with the TMT and affirmed the CDUP issued by the DLNR. According to the court, UH and the TMT Corporation had followed the necessary protocols and fulfilled all of the requirements needed to legally obtain the permit to build and operate the TMT. The court claimed to have taken into account the potential environmental, historical and cultural impacts of the TMT, and agreed with UH and the TMT Corporation that they had properly established mitigation measures to reduce the impacts of the project to the point where they would not be considered “substantial” or “significant,” especially in light of the degradation that had already taken place on the mountain (Lind 2015). The Petitioners appealed the decision to the Hawai’i Intermediate Court of Appeals.

Meanwhile, construction of the TMT was permitted to begin. On October 7, 2014, the TMT Corporation had its official “ground breaking” ceremony. Opponents of the TMT (who call themselves “protectors” of the mountain) interrupted the ceremony. In late March 2015, construction was scheduled to begin. The Protectors again demonstrated

and halted the construction, blocking off the access road to the summit of Mauna Kea. On April 2, 2015, construction was attempted for the second time. Again, the Protectors were able to stop it, this time with 31 people arrested. In response to the growing protests against the TMT (reaching a world-wide audience through social media), the Governor of Hawai'i placed a temporary moratorium on all further construction. Protests statewide against the TMT began to expand, as well as nationally and internationally. Construction was attempted a few more times since the moratorium was lifted at the end of April 2015. However, the mass protests stopped any construction from proceeding.

On June 5, 2015, at the request of the Petitioners, the Hawaii Supreme Court—in a highly unusual ruling—ordered the TMT court case to be transferred from the Intermediate Court of Appeals directly to the Supreme Court for review. The case was argued on August 27, 2015 and a ruling is expected sometime in the Fall of 2015 (Gutierrez 2015). One of the core arguments of the Petitioners on appeal is that the DLNR violated due process by issuing the CDUP before it held a contested case hearing. As one Justice of the Supreme Court commented at the hearing, “isn't that like finding the defendant guilty and then having a jury trial?” Meanwhile, construction is legally allowed to resume but no attempts have been made by the TMT Corporation since June 24, 2015—the last time the Protectors effectively halted further construction.

For astronomers, the TMT is important, if not essential, to the exploration of the universe and for the future of humanity. For the Native Hawaiians, the TMT threatens their sacred mountain and culture. As a result, Mauna Kea has become a “battleground” between the TMT and Native Hawaiians—or, as some have framed it, Science vs. Culture. However, this is a shallow interpretation of the deeper issue at hand. Native Hawaiians have been clear that they are not opposing science or the potential for discovery the telescope will enable. Hawaiians have a deep connection to astronomy, having used star navigation throughout their history. The opposition to the TMT concerns their reverence for the *‘aina* (land). “Great science. Wrong mountain,” as many have said (Puhipau 2006). The Hawaiians' concern for the land is quite clear—they do not call themselves protestors of the TMT, but rather, “Protectors” of Mauna Kea. They are trying to protect a mountain that is the backbone of their identity as Hawaiians.

Construction of the TMT on top of what the Hawaiians consider to be their sacred temple raises important scientific, cultural and legal questions. For example, how have the cultural beliefs, practices, myths and stories of the Native Hawaiian people been treated in the quest to build and operate the most powerful telescope in the world? Although the TMT may be instrumental in “unraveling the mysteries of the universe” and “benefitting humankind” (TMT 2015), is it also symbolic of a deeply ingrained disconnect from the Earth? How has the Cartesian separation of the mind and body influenced this apparent disconnect between man and the Earth? How has the TMT been granted a use permit to build when it is clearly violative of not only Hawaiian culture, history and land, but the Native Hawaiians themselves?

In this thesis, I will match the issue of the TMT and Mauna Kea with a detailed analysis of the history of Hawai’i—the arrival of missionaries to Hawai’i in 1820, the changing land use laws of the 1840s, the overthrow of the Monarchy in 1893, and the eventual annexation of Hawai’i to the United States in 1898. The history of Hawai’i is necessary to better understand why the Native Hawaiians are standing up to protect Mauna Kea. I will also discuss the influence of Christianity on the minds of Hawaiians and their relationship to the land. This will lead to an examination of the greater Western disconnect from the Earth, initiated principally by Christianity and other organized religions, molded by Descartes, and perpetuated by the endless pursuit of science, progress and development. I will then attempt to connect this Earthly disconnect to the disconnect exemplified by the TMT.

## **1.1 Rationale/Motivation for Choice of Topic**

Initially, I had no thought or desire to do my research in Hawai’i. It has been my home on and off for my entire life; a place too comfortable and familiar to be of any inspiration for a research project. I started at the Centre for Development and the Environment (SUM) excited about the possibility of going anywhere in the world to indulge my adventurous spirit and to research a subject new and meaningful to the world and to me. Although I am deeply intrigued, touched and impacted by many places and people in the world, the connection I feel to Hawai’i is like no other. I came to realize that in order to produce a meaningful thesis, I needed that connection to be strong. The level of depth I wanted to achieve in this thesis required me to be in a place

where I could have the freedom to investigate and ask deeper questions. Hawai'i was that place.

As I began my research, I thought I understood the culture and environment of Hawai'i relatively well. I grew up engaging in Hawaiian culture through *hula* and music. I have explored its incredible environment, from the ocean to the rain forests to the mountains. Growing up in the small town of Waimea at the base of Mauna Kea, it is nearly impossible not to have any connection to the *Mauna*. It is the epicenter of the island, literally and figuratively; always in front of you and ever present. When the elements align, the mountain becomes illuminated, every crevice and *pu'u* (hill) visible to the naked eye. In the winter months, the summit is covered with a blanket of pearl white snow—an extraordinary and almost surreal site when sitting on the beach basking in the warm tropical sun.

When the sky is clear and the summit is visible, so too are the telescopes. Like little white pimples dotted across the top of the mountain, they are all but impossible to ignore. I have never seen Mauna Kea without them. I always knew Mauna Kea was one of the best places in the world for astronomy and I was actually quite proud to say that my island was world-renowned for not only its great beaches and beautiful landscape, but for its place atop the astronomical world. However, I was unaware of the controversy surrounding the telescopes. I knew Mauna Kea was special, but I did not understand its significance to the Native Hawaiians, their culture and their identity.

I first heard about the proposed TMT in 2011. I did not think much of it at the time and frankly disregarded it. I was not aware of how far into the process of development the TMT actually was. It was not until 2012 that I first started to learn about the opposition to the project and became more interested in the subject. In 2013, when the use permit was granted for the TMT, it became clear to me that the project was not just a dream for astronomers, but was quickly becoming a reality. After seeing and hearing the opposition to the TMT from Native Hawaiians, I realized that Mauna Kea was far more than a mountain. Mauna Kea is the source of their very existence. It is the *piko* (umbilical cord) that connects them to their *akua* (gods) and their *kupuna* (ancestors). Mauna Kea is their sacred temple—a temple that had become damaged and was on the verge of further desecration in the name of astronomy. I could not help but question why this telescope was going to be built when it appeared to clearly violate not only the

elaborate protections enacted by the state to protect conservation lands, but was an affront to the Hawaiian people and their culture. Was the scientific quest for progress and an understanding of humanity's place in the universe somehow more important or valuable than the Hawaiians' sacred land and culture?

What solidified my decision to embark on this research topic was that it covers not only a site-specific issue but also touches upon a similar issue facing many indigenous peoples around the world, many of whom continue to maintain their historical, cultural and spiritual connection to the Earth. We live in a time of constant progress where our appetite for development has become nearly insatiable. This never-ending thirst for "progress" seems to be the leading cause of much of the environmental destruction around the world. It also further distances us from our indigenous roots, where the mountains, rivers and oceans had inherent value and were regarded as sacred. Indigenous peoples are facing the loss of their sacred places and as a result, facing the loss of their culture and identity as a people. At the same time, it is the indigenous peoples that hold the teachings the West needs to re-learn in order to re-balance our Earth. What happens then, if these teachings and understandings can no longer be imparted because the Earth can no longer support humankind? While the ultimate question of man's place in the universe and self-destructive nature cannot be answered in this paper, I do attempt to explore how the tension between our commitment to science and progress on the one hand, and our deeper connection to the Earth on the other, is playing out in my island home.

## **1.2 Ethical and Methodological Considerations**

Although I am not a Native Hawaiian, I understand their viewpoint and why they believe no further construction, including construction of the TMT, should be undertaken on Mauna Kea. I grew up in both Hawai'i and California. My parents, who live in Hawai'i, have been very involved in the opposition movement against the TMT and protecting Mauna Kea. While I have personal feelings about the propriety of building yet another telescope on top of Mauna Kea, I have endeavored in my thesis to take a neutral stance on the issue and present both sides of the argument. The central issue I try to tackle in my thesis is not whether the TMT is a good thing or a bad thing, but how and why we have come to this point. How, given the sacredness of the

mountain to the Native Hawaiians, have 13 telescopes been built on top of what to them is a religious shrine? How, given the sensitive environmental issues surrounding construction on Mauna Kea, can another telescope the size of the TMT be allowed to proceed? What role, if any, has man's disconnect from nature played in the construction of the TMT? Does man's search for the Earth's origins in the stars justify desecration of sacred land at home? Clearly there is value in the TMT. It will be the most powerful and advanced telescope on the planet and its potential for scientific discovery is enormous. But what does it say about humanity and our relationship to our natural environment that we can seemingly disregard a native people's culture and identity in the pursuit of science? The answers to these questions are not easy.

Before conducting my research in Hawai'i, I had a strong understanding of the social interactions among the people and the ways in which to properly conduct myself. This knowledge helped me to gain the most of my researching experience. It cannot be denied that there still exists a divide between Native Hawaiians<sup>1</sup> and so-called "*haoles*." *Haole* is a word that dates back to the first foreign contact with the Islands. Some say the word is derived from "*hā'ole*," literally meaning "without breath." The foreigners who first arrived on the Islands in the late 18<sup>th</sup> Century did not know to use the *honi* (kiss), the common Polynesian way of greeting by touching nose-to-nose and inhaling, or basically sharing each other's breaths. Today, although *haole* is still used to describe those of non-Hawaiian descent, it is more commonly used to label a person with white skin. I am considered to be a *haole*—albeit a "local *haole*"—no matter my connection to Hawai'i or understanding of its culture. Just like any "outsider" conducting research, I had to approach my subjects with respect and humility.

Even though I am very familiar with Hawai'i and have numerous connections there, my research led me to places and people I had never seen or met before. In many cases during my research, I felt I was experiencing and investigating a land and people that I did not know existed. As a result, I believe that I approached my subject matter with the neutrality and impartiality that proper research requires. In many cases, my connection to Hawai'i allowed me access to people and places that resulted in a richer research

---

<sup>1</sup> In this paper I use the term "Native Hawaiians" to describe not only those of pure Hawaiian decent (of which there are very few), but also "locals" who have varying mixtures of Hawaiian, Caucasian, Japanese, Portuguese, and other ethnic blood running through their veins.



experience. Also, knowing about Hawai'i and its history helped me to direct my research and highlight important events connected to the issue of the TMT that may not have been touched upon otherwise. In short, my connection to Hawai'i contributed to a deeper investigation of the TMT and Mauna Kea.

My research topic required a method in which I could participate and engage deeply in a very organic way. Prior to starting the project, I had a general understanding of the scope of my research—the questions I wanted to ask, the places I wanted to visit and the people with whom I wanted to speak. However, there was a large element of the unknown prior to conducting my research. This “not knowing” proved to be quite helpful in allowing me to be more spontaneous, open and curious.

I naturally fell into an ethnographic method of research. In the “Ethnographers Method,” by Alex Stewart, he writes that the first characteristic of an ethnographic study is participant observation, “the up close involvement of the researcher in some form of participative role, in the natural, ‘everyday’ setting...” (Stewart 1998; pp. 6). Although this research did not of course constitute participant observation in the fullest sense, this formed the base from which I conducted my research. My research included the study and analysis of issues directly connect to the TMT and Mauna Kea, as well as issues only tangentially connected but nonetheless vitally important to a fuller understanding of the subject matter. I approached my research in this manner in order to more deeply understand why Native Hawaiians are opposing the TMT and seeking to protect Mauna Kea. For example, I participated in native agricultural practices as a means of understanding the Hawaiians' connection to land. I observed classrooms in schools where Hawaiian culture and history was actively part of the curriculum. I also participated in events that directly pertained to Mauna Kea and the TMT. For example, I participated in a water ceremony conducted on the summit of Mauna Kea. I attended sacred ceremonies conducted by Hawaiian *kumus* (teachers) on the mountain. I observed the protests and demonstrations against the TMT both on Mauna Kea and in the community. I also participated in the *Makahiki* festival, which takes place every year to commemorate *Lono*, the god of storms, harvest and fertility.

As part of my research, I conducted open-ended interviews with key “actors” (Stewart 1998; pp. 6). These actors and participants included representatives from both sides of the issue so as to gain a clearer understanding and perspective. I interviewed Native

Hawaiian participants in the TMT opposition movement, including two Petitioners in the court cases against the TMT: Pua Case and Kealoha Pisciotta. I spoke with many of the protectors both before and after the demonstrations on the mountain. I also interviewed proponents of the telescope: the Moore Foundation, one of the lead funders of the TMT; Sandra Dawson, the Hawaiian Community Affairs Manager for the TMT; and Michael Bolte, Associate Director of the TMT and Professor of Astronomy and Astrophysics at UC Santa Cruz. Finally, I spoke with many members of the community, including those that were in favor of the TMT, those that opposed the TMT, and some who had not reached a final opinion one way or the other.

In addition to my fieldwork, I conducted a detailed study of relevant books, legal documents, reports, historical archives, scientific papers and journals, film documentaries, newspaper articles, interviews and online sources. Although the issue of the TMT and Mauna Kea has been widely discussed and reported, there has been little academic research pertaining to this topic. Therefore, many of my online sources were discussion-based sites where people both involved in and interested by the issue have started a dialogue. While I found these sites helpful, I only used them when appropriate in my own discussion of the issue since many of the online sources were not fully reliable. I was also able to access primary sources in the archives of both the Bishop Museum and the Mission Houses Museum in Honolulu, Hawai'i. There I examined historical documents, including letters, journals, newspaper articles, and reports, pertaining to missionary activity and their interactions with Native Hawaiians beginning with the arrival of the first missionaries in 1820. Other primary sources included: legal documents and statutes for the State of Hawai'i, TMT reports, environmental impact statements, official DLNR papers and correspondence, radio interviews and court hearing transcripts. Secondary sources included books, documentary films and newspaper articles.

I embarked on my fieldwork in Hawai'i in September 2014 for a total of three months. I lived at my parents' home in Kamuela on the Big Island. I returned to Norway in December 2014 where I continued my documentary research. I was able to travel back to Hawai'i in May 2015 for a month and was able to complete my on-site research, including visits to the mountain to observe the Protectors of Mauna Kea who have been living on the mountain since March 2015.

## 1.3 Outline of Thesis

Chapter 2 includes a summary of the history of Hawai'i, beginning with the Polynesian migration to Hawai'i in approximately 1000 AD, the arrival of Captain James Cook in 1778, and the arrival of Christian missionaries from the East Coast of the United States in 1820. In conjunction with the arrival of the missionaries, I will discuss the Hawaiian *Kapu* system (an ever-evolving set of religious and cultural laws) and its abolition just prior to the arrival of the missionaries. I will discuss the spread of Christianity and its teachings in comparison to Hawaiian thought. I will then go on to describe the *ahupua'a* system—the Hawaiian system of land cultivation and a symbol of the peoples' connection to, and respect for, the *'aina* (land). I will analyze how the influence of foreign businessmen and missionaries led to the creation of a Constitutional Monarchy and the Great *Mahele*—the division and privatization of Hawaiian land in 1848 that left the *kanaka* (commoners) with very little. Finally, I will describe the overthrow of the Monarchy by foreign businessmen and missionaries in 1893, the annexation of Hawai'i to the US in 1898, and Hawaiian Statehood in 1959.

Chapter 3 includes an in-depth look at Mauna Kea. First, I will present Mauna Kea from a scientific lens—its age, composition, climate zones and ecosystems. Then, I will discuss the importance of Mauna Kea to the Native Hawaiian people and their genealogical and spiritual connection to the *Mauna*. I will also highlight the State laws that govern development on Mauna Kea.

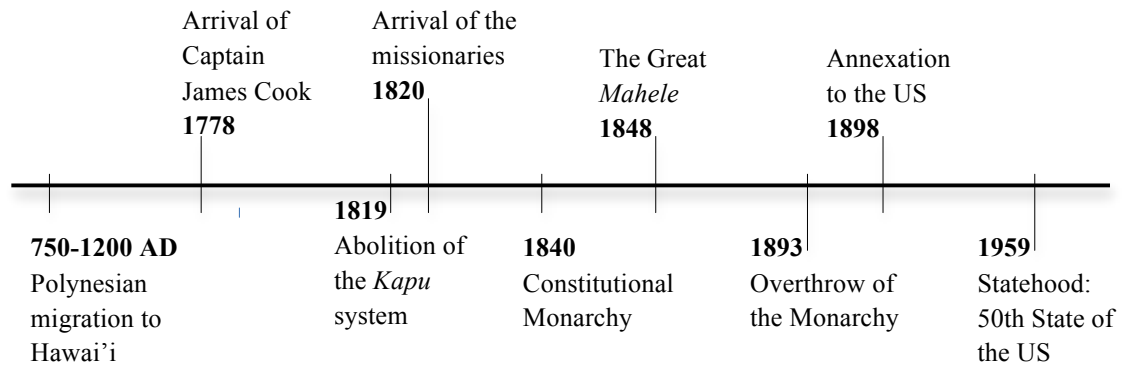
Chapter 4 includes a history of astronomy on Mauna Kea. I will outline the development of astronomy on the mountain starting with the first telescope in 1970. I will then discuss the first noticeable signs of opposition to astronomical development, including the defeat of the Outrigger Telescopes project. I will then present the TMT and its development, and will also highlight the environmental impacts of the project and past projects.

Chapter 5 includes a discussion of the legal issues surrounding construction of the TMT, including a look at the current court cases challenging the legality of the use permit and sublease for the TMT.

Chapter 6 includes a discussion of the environmental and philosophical debate regarding man's connection—or lack thereof—to the Earth. This growing sense of disconnect between man and his environment can be found most prominently in the teachings of Descartes. I will then go on to describe the ways in which the TMT is an example of humanity's disconnect from the Earth and the Native Hawaiians' struggle to protect the most sacred place in Hawai'i.

Finally, in Chapter 7, I will conclude my thesis by discussing the importance of reconnecting to the Earth in order to save it from further destruction.

## 2 Historical Background



The history of Hawai'i is complex and obscure, and often disputed and questioned. Much of what we know about the history of Hawai'i and its people comes from ancient Hawaiian chants, an oral tradition passed down from generation to generation among the Native Hawaiians. Although these chants were not committed to writing until the mid-19<sup>th</sup> Century, we know from archaeological studies and interviews of Native Hawaiians that Hawai'i has a long and rich history, embedded deep in the people and the land. The history of Hawai'i is extremely important and necessary to give context to the current struggle taking place on Mauna Kea.

For most “outsiders,” Hawai'i is known as the 50<sup>th</sup> state of the United States of America. Hawai'i joined the Union in 1959 and is now an easily accessible paradise for a holiday. Hawai'i has been simplified into a place of entertainment, palm trees, sun and luxury hotels; a place to escape from reality and the burdens of everyday life. This surface story of the 50<sup>th</sup> State is well known and believed by most. Unfortunately, this story paints a picture of Hawai'i as a place devoid of history, or at least, without a history worth acknowledging and appreciating. Native Hawaiian academic and activist Huanai-Kay Trask writes that the perpetual overlooking of Hawai'i's history has resulted in the destruction and exploitation of the Native Hawaiian people and their sacred *'aina* (land) (Kay-Trask 2008).

The other story of Hawai'i, unknown by most, is a story of an occupied nation that has been struggling to regain independence for over 100 years. In a hostile and arguably illegal act, the United States assisted in the overthrow of the Hawaiian Monarchy in

1893 and then annexed Hawai'i in 1898. This moment marked the accumulation of years of suppression and abuse of the Hawaiian people and their land by foreign missionaries and businessmen from the time of first contact in 1778. The annexation of Hawai'i also marked the time when Hawai'i's past was forgotten and a new history began to be written. The United States took the land, appropriated the culture and manipulated the people, nearly abolishing what was a fiercely independent, and deeply spiritual and connected people.

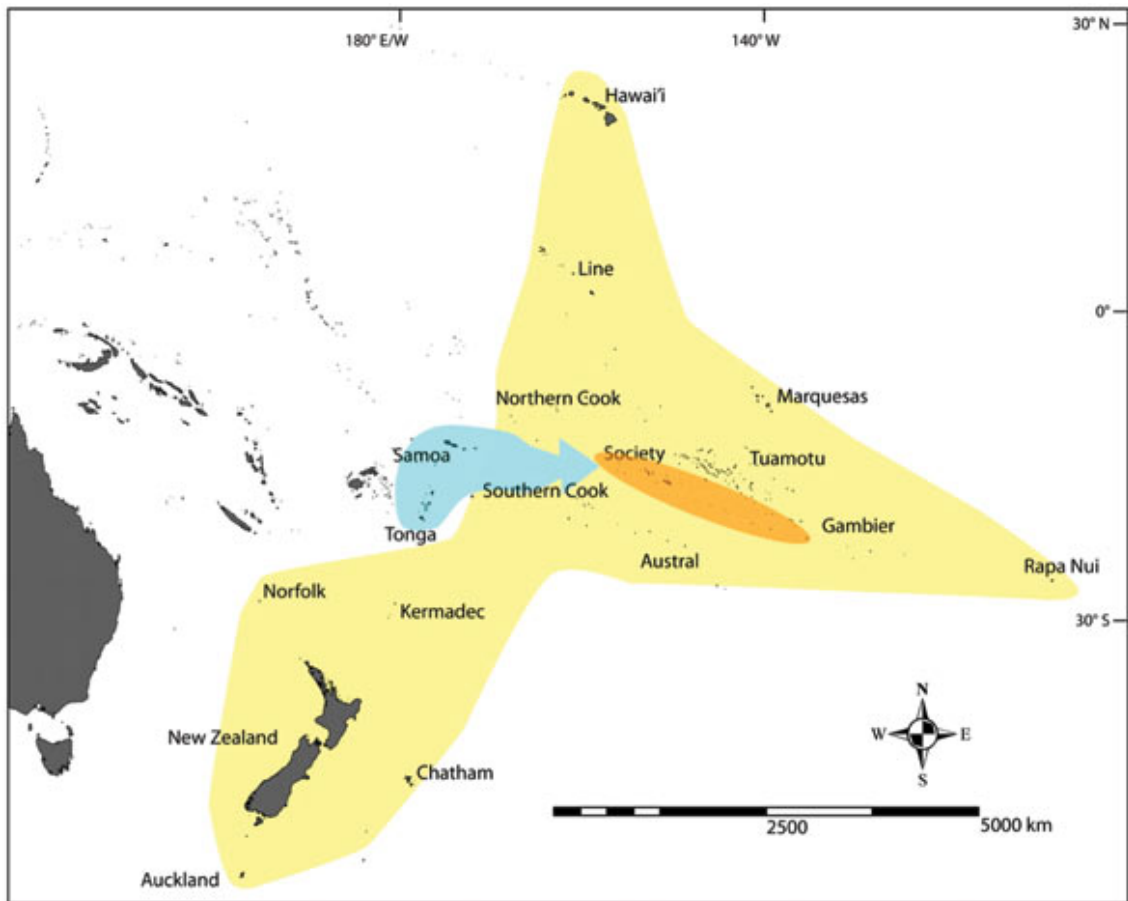
As David Malo writes in "Hawaiian Antiquities," "Memory was the only means possessed by our ancestors of preserving historical knowledge; it served them in place of books and chronicles" (Malo 1903; pp. 328). Because Hawaiians did not write down their history, but instead, retained it in their oral traditions, Hawaiian history, culture and practices can often be vague, contradictory, or even unknown. This does not mean, however, that Hawai'i is without a history. There is a history held within the bodies of all Hawaiian people. It has been a matter of remembering and reinvigorating a spirit that has been suppressed.

The history of Hawai'i is defined by six important events: the abolition of the *Kapu* system in 1819; the arrival of the missionaries in 1820; the Great *Mahele* of 1848; the overthrow of the Monarchy in 1893; the annexation of Hawai'i to the United States in 1898; and statehood in 1959. These events all played a role in destabilizing Hawaiian culture and society, and to a greater extent, disconnecting the Hawaiians from the *'aina*. Many Native Hawaiians see the TMT as a continuation of Hawai'i's repressive history, the manipulation of its people, and the taking of the land for the benefit of the *haloe*. To understand this view, one must first trace the history of Hawai'i back to its beginning.

## **2.1 Polynesian Migration and Settlement of Hawai'i**

The Polynesian migration to Hawai'i was part of the rapid and extensive settlement of the remote and scattered islands of the central Pacific. Polynesia is generally defined as the triangle of islands from Hawai'i to Aotearoa (New Zealand) to Rapa Nui (Easter Island). Although the exact settlement pattern is unknown, archaeological data suggests the settlement of Polynesia began in Samoa around 800 BC. Settlement moved eastward

to the Society Islands between 1000-1120 AD and branched south to Aotearoa, north to Hawai'i, and east to Rapa Nui between 1000-1200 AD (Wilmhurst 2010). Past studies suggested the discovery of Hawai'i to be as early as 300-750 AD. However, with the advancement in radiocarbon dating and archaeology, new models show a more recent and rapid settlement pattern, beginning closer to 1000 AD. (Kirch 2014; pp. 1).



**Figure 2: Polynesian Migration and Settlement Pattern (Wilmhurst 2010)**

The exploration and settlement of Polynesia was done in canoes built from tree trunks. Single and double-hulled canoes were used, with the former better equipped for long distances. Sails were attached to canoes in times of wind and paddles were used in times of calm. The canoes were navigated by experts using traditional knowledge of the patterns of nature and observations in the sky and ocean (Wilmhurst 2010).

Researchers believe that the first settlers of Hawai'i came mostly from Hiva (Marquesas). Linguistic similarities and biological evidence shows a close relationship between Hawai'i and Hiva. 56 percent of the basic words in Hawaiian and Marquesan are the same (Wilmhurst 2010). Another piece of evidence supporting the Marquesan

settlement of Hawai'i is the positioning of the Marquesan islands in relation to Hawai'i. The Islands are closer to Hawai'i and farther east than the Society Islands, the Cook Islands and the Tuamotus Islands. Because of the easterly trade winds, a canoe going north is better off positioning itself as far east of Hawai'i as possible. 80 percent of computer simulated voyages from the Marquesas to Hawai'i reached Hawai'i because of the wind pattern (Wilmhurst 2010). Archaeological evidence such as adzes, fishhooks and pendants also connect Hawai'i to Hiva. Other theories suggest the first settlers to Hawai'i came from Tahiti, as the two languages, much like Marquesan, are extremely similar. The exact period of settlement of Hawai'i and its first inhabitants are still not fully known, although best estimates are around 1000 AD. More archaeological evidence is needed to pin down the exact date.

Hawaiian oral traditions suggest that two-way voyaging initially occurred before permanent settlement of the Islands. In other words, the discoverers of Hawai'i did not stay on the Islands after their discovery, but rather returned to the South Pacific to gather family and supplies, then made a return voyage north. It is not known how many voyages were made or how many people first settled the Islands. Archaeological evidence found in the area of *Ka Lae* (South Point) shows that the Big Island of Hawai'i was potentially the first to be discovered and settled by the early Polynesians (Kirch 2014: pp. 10). However, evidence found on O'ahu, Kaua'i and Moloka'i may dispute this idea.

The discovery and settlement of Hawai'i is recalled by Hawaiian scholars Kamakau and Kepelino in Abraham Fornander's "Collection of Hawaiian Antiquities and Folk-lore" (Fornander 1916; pp. 266). Abraham Fornander was a Swedish immigrant to Hawai'i, arriving in 1843. He was a whaler, coffee grower, surveyor, publisher, journalist, folklorist and historian. He was appointed by Kamehameha V as Inspector General of Schools of the Hawai'i Kingdom and Judge of the Circuit Court, and was also honored as Knight Companion of the Royal Order of Kalākaua. Fornander championed the perpetuation of Hawaiian oral traditions and history, publishing many books on Hawaiian origins and culture.

The discovery of Hawai'i, as told by Kamakau and Kepelino, was attributed to a fisherman named *Hawai'iloa* or *Ke Kowa i Hawai'i*. *Hawai'iloa* was one of four brothers born on a land from the west called *Ka'Aina kai melemele a Kane* (the land of



the yellow sea of Kane). During a long fishing excursion on his *wa'a* (canoe), *Hawai'iloa's* principal navigator, *Makali'i*, decided to steer the *wa'a* in the direction of *Iao* (Eastern Star), also called, *Hoku hikina kiu o na 'aina* (the discoverer of land). Using *Hoku 'ula* (red star) as a guide, *Makali'i* steered the *wa'a* eastward. *Hawai'iloa* arrived at the easternmost island of the Hawaiian chain. *Hawai'iloa* named this island *Hawai'i* after himself. After staying on the island and filling his *wa'a* with supplies, *Hawai'iloa* and his crew returned to their homeland.

In his second voyage, *Hawai'iloa* once again returned to *Hawai'i*. He settled in *Hawai'i* with his wife and children and never returned to his native land. A group of men accompanied *Hawai'iloa* and his family, also settling in *Hawai'i*. *Hawai'iloa* named the others islands after his children: *Mau* after his first born son, *O'ahu* after his daughter, and *Kaua'i* after his younger son. *Hawai'iloa* and his descendants developed a complex society, rich in culture, traditions and belief systems.

*Hawai'iloa* made many journeys to Tahiti to visit his brother *Ki*. He brought back with him *Tu-nui-ai-a-te-Atua*, his brother's oldest son, to marry his daughter *O'ahu*. It is believed that the descendants of *Hawai'iloa* and his brothers *Ki* of Tahiti, *Kana Loa* of the Marquesas, and *Laa-Kapu*, peopled nearly all of the Polynesian islands (Fornander 1916). Voyaging between *Hawai'i* and the South Pacific continued for some time in order to connect families, escape famine, acquire *mana* (power) from the homeland, and for adventure (Kirch 2014). Archeological evidence shows that voyaging between *Hawai'i* and the rest of Polynesia came to a stop around the 14<sup>th</sup> Century (Kirch 2014). The growth in population and food production in *Hawai'i* during this time showed a people more focused on developing their own society and *'aina*, with less ties to families and gods on islands in the South (Kirch 2014).

## **2.2 Arrival of Captain James Cook**

The first known European to arrive to *Hawai'i* was Captain James Cook aboard the HMS *Resolution* in 1778. Cook first encountered the Islands on a journey from Tahiti going north toward the Bering Strait in search of the Northwest Passage (Haley 2014; loc. 275). He happened upon the island of *Kaua'i* on January 18<sup>th</sup>. Cook found a people similar to those in Tahiti, worshipping similar gods and following a similar rule system

called *kapu*, or *tabu* among the Tahitians (Haley 2014; loc. 333). He also observed that there were two distinct classes of people—the *ali'i* (chiefs) and the *kanaka* (commoners) (Haley 2014; loc. 333). Cook sailed to the nearby island of Ni'ihau before leaving for the Northwest Passage.

A year later, Cook returned from his travels in the North Pacific to the islands of Hawai'i, or the “Sandwich Islands” as he called them (in honor of the Earl of Sandwich, his benefactor from England) (Haley 2014; loc. 289). He visited Kaua'i and Ni'ihau again, as well as a new island called O'ahu. He sailed passed the islands of Moloka'i, Lana'i, Kaho'olawe, and finally Maui, before encountering the largest of the islands, Hawai'i (Big Island). For a few weeks, Cook sailed in a clockwise direction around the Big Island.

In a strange coincidence, Cook's trip around the Big Island coincided with the season of *Makahiki*. The *Makahiki* season occurs between October and February each year, celebrating the year's end and harvest. *Lono*, the god of storms, harvest and fertility, is honored and given offerings from the entire island community during *Makahiki*. The ancient story has it that in an act of despair, *Lono* sailed away from Hawai'i on a canoe with giant masts that reached the sky and square white sails (Haley 2014; loc. 407). As Cook sailed the *Resolution* into Kealakekua Bay, the Hawaiians believed him to be the manifestation of *Lono* (Kelly 2011; loc. 75).

After some time, having realized Cook was not the god *Lono*, tensions started to develop between Cook, his crew and the Hawaiians. Cook had arrived at a time when King Kalaniopu'u of the Big Island was planning his takeover of Maui. Kamehameha, King Kalaniopu'u's nephew and future king, tried to negotiate a deal with Cook to obtain guns to conquer Maui. Unfortunately for King Kalaniopu'u and Kamehameha, Cook did not give up any firearms. Things between the men remained civil but Cook sensed tensions starting to ignite. Unbeknown to Cook, during the *Makahiki* season, there was a *kapu* (rule) against warfare. This kept the tensions from igniting into something worse.

Cook tried to sail back to Maui but was forced to return to Kealakekua Bay when his mast broke. On the afternoon of February 13, 1779, a fight broke out between the Hawaiians and Cook's men. The Hawaiians stole a cutter and the British retaliated by

stealing a canoe. On February 14th, Cook ordered the King to board his ship but the King refused. A scuffle broke out. Cook fired two shots, killing one man. A stone was thrown and struck Cook in the head, followed by a dagger into his body. Cook's body was burned at a nearby *heiau* (temple). The *Resolution* eventually set sail again after the crew obtained enough supplies. In one last act of retaliation, Cook's men burned 30 homes and fired a cannon into a cliff that was the site of hundreds of graves (Kelly 2011; loc. 132). Cook's arrival and death in Hawai'i marked the dubious beginning of Western contact and settlement of the Islands.

## 2.3 Arrival of Missionaries

Heeding the request of two Native Hawaiians who were taken back to New England and given a Western education, the first missionaries arrived in Hawai'i aboard the ship *Thaddeus* on March 30, 1820 to spread Christianity to the "heathens." Among the first to arrive were Americans Hiram Bingham and his wife Sybil, and Asa and Lucy Thurston, sent by the American Board of Commissioners for Foreign Missions (ABCFM) headquartered in New England. Their goal was to change Hawaiian culture and society, seen as savage and backwards, into a more acceptable and civilized Christian way of life (Munger 2013). As Dr. Samuel Worcester, Secretary of the Commissioners, said, "You are to aim at nothing short of covering those islands with fruitful and pleasant dwellings, and school and churches; of raising up the people to an elevated state of Christian civilization" (Borreca 1999).

In 1820, soon after the first missionaries arrived, Reverend Bingham established the mission headquarters in Honolulu on the island of O'ahu. In 1823, the second contingent of missionaries from the ABCFM landed in Hawai'i. Throughout the 19<sup>th</sup> Century, 12 ABCFM companies arrived to Hawai'i, the last one arriving in 1848 (Haley 2014). The missionaries established headquarters on all of the islands. They created a written form for the Hawaiian language and set up the first printing press at the Mission Houses in Honolulu where the Bible was printed in Hawaiian.

The missionaries' arrival coincided with a time in Hawaiian society where their own religious system was weakening. The *Kapu* system was a quasi-religious law system that governed Hawaiian life. After nearly one thousand years, the *Kapu* system no

longer had as firm a grip on the Hawaiian people. This left a void to which Christianity fit right in.

### **2.3.1 Abolition of the *Kapu* System**

In 1819, prior to the missionaries' arrival, Liholiho, the new King and son of Kamehameha I, abolished the *Kapu* system. *Kapu* was a concept related to the *tapu* or *tabu* found in other Polynesian cultures. *Kapu* can be translated to "forbidden," "sacred," or "holy" (Pukui and Elbert 1986; pp. 132). It was a system based on beliefs centered around *mana* (spiritual power), and laid down rules and regulations for social conduct. Hawaiians believed that the *akua* (gods) had the ultimate *mana* and made the *kapu* (rules) that governed everyday life. The *ali'i*, the highest of the rank among the Hawaiian society, were considered to be the descendants of the gods. Thus, the *ali'i* had strict *kapus* around them and were not to be touched or contaminated by those of lesser rank. For example, no one was allowed to touch anything that the *ali'i* had touched, except for the lesser chiefs called *kaukaua'ali* who cared for the *ali'i* (Malo 1903). Nearly all of Hawaiian life was governed by *kapus*. The *Kapu* system regulated how men and women could interact, what women could and could not eat, how homes and canoes were built, birth and death ceremonies, and activities such as fishing. Breaking a *kapu* resulted in death by strangulation, clubbing, stoning, burning or drowning. However, if a *kapu* violator was able to reach a *pu'uhonua*, a place of refuge and forgiveness, the *Kahuna* (priest) would offer protection and forgiveness through prayer and rituals, and the *kapu* breaker could eventually re-enter the society (Malo 1903).

When Kamehameha I died on May 5, 1819, Liholiho, who took the name Kamehameha II, became King. Kamehameha I's favorite wife, Ka'ahumanu, took the role as *kahina nui* (co-regent or prime minister). She ruled as Queen Regent during the reigns of both Kamehameha II and III (Kamehameha's second son). Ka'ahumanu and Keopuolani, Kamehameha II's mother, encouraged Kamehameha II to do away with the *Kapu* system (Rhodes 2015). Ka'ahumanu's belief in the *Kapu* system was faltering, having seen foreigners visiting the Islands and breaking *kapus* regularly with no consequences. She was introduced to Christianity during this time where no such *kapus* were necessary. Ka'ahumanu also saw many of her people dying, while Christian foreigners seemed impervious to the new dangers. It is speculated that Ka'ahumanu through it was

Christianity that protected the foreigners against death. Unbeknownst to her, the deaths of the Hawaiian people were caused by diseases such as cholera, measles, the bubonic plague and other illnesses introduced to the Islands by foreigners (David 2000).

In looking back at the overthrow of the *Kapu* system, King David Kalākaua (1874-1891) wrote that in one moment his people's history had changed:

In the smoke of burning heiaus, images and other sacred property, beginning on Hawai'i and ending at Ni'ihau, suddenly passed away a religious system which for fifteen hundred years or more had shaped the faith, commanded the respect and received the profoundest reverence of the Hawaiian people (Borreca 1999).

The end of the *Kapu* system opened up a space in the Hawaiian society for a new belief system. The groundwork for the conversion to Christianity was already in motion by the time the missionaries came to the Islands beginning in 1820.

The reason for the abolition of the *Kapu* system has been questioned and the subject of great speculation. As Historian Diane Lee Rhodes writes, the idea that the Hawaiians voluntarily changed their religion and culture is at odds with other Polynesian societies where religious reformation was instigated and almost forced by foreign traders and missionaries. Also, the overthrow of the *Kapu* system did not come at the demands of the people. Rather, it was initiated by the highest ranking officials whose position was legitimated by the *Kapu* system itself (Rhodes 2015). Anthropologist Alfred L. Kroeber suggests that the reason why those in power—Liholiho, Ka'ahumanu and Keopulani—supported the abolition of the *Kapu* system, was that they were experiencing a time of “cultural fatigue” (Levin 1968; pp. 405). In other words, the tight bounds of the *Kapu* system, spiritually, politically and culturally, became too burdensome.

Following the death of Kamehameha, the newly appointed King Kamehameha II (1819-1824) did not share the same leading spirit as his father. He indulged in many things that broke *kapus* and had a new-found fondness for western trade goods (Rhodes 2015). Due to Kamehameha II's inability to lead, Ka'ahumanu was given great power along with Keopulani. It is speculated that because many of the *kapus* were especially harsh on women, Ka'ahumanu and Keopulani used their new positions of authority to give women more freedom.

Another reason for the abolition of the *Kapu* system was perhaps the unconscious transformation of the Hawaiian society from a tribal to a state based socio-political system. Tribal leaders were gaining more power especially through the acquisition of firearms from European traders. Power increased not through prestige, kinship, or religious reasons, but through trade and military force. The sacredness of being in a position of power was diminishing and there was less need for traditional religious practices. The *Kapu* system became too constraining and time consuming for the new social and political reality (Rhodes 2015).

Lastly, it is speculated that Ka’ahumanu’s goal to maintain the strength of the monarchy also influenced her decision to abolish the *Kapu* system. In the traditional *Kapu* system, priests held great power. If any ruler, including the King, alienated his priests, they could weaken his rule or even strip him of his power. Therefore, removing the *Kapu* system meant removing the status of the priests, and therefore, eliminating any potential for a ruler to be stripped of power (Rhodes 2015).

The abolition of the *Kapu* system was one of the most significant moments in Hawaiian history. It opened the door for foreign traders, settlers and missionaries to influence, change, and ultimately gain control of the Hawaiian people and their land. While many have criticized the missionaries and foreigners—who began arriving to the Islands in greater numbers in the early 19<sup>th</sup> Century—for the gradual disconnect between the Hawaiians and their *‘aina* (land), others have noted that it was the Hawaiians themselves who began the process of discarding their ancient systems and cultural practices in order to “modernize” Hawaiian culture and society. What is clear, however, is that Western influences hastened the process of cultural and spiritual separation that spread through the Islands in the 19<sup>th</sup> Century and continues to the present day.

## **2.4 The Spread of Christianity**

The process of disconnecting Hawaiians from their core belief systems and converting them to Western culture and Christianity was relatively quick and effective. Queen Ka’ahumanu, the Queen Regent and facilitator of ending the *Kapu* system, was a prized convert to Christianity for the missionaries. Ka’ahumanu began to change the laws of the land to reflect her new Christian beliefs. In 1830, she went as far as banning

performances of *hula*. Missionaries saw *hula* as deviant, sexual and idol worshipping. James L. Haley writes in “Captive Paradise,” *hula* was not just a dance but “a physical expression of the national poetry” (Haley 2014; loc. 1692). The oral history and legends of Hawai’i were told through *hula* and its accompanied song and chant. *Hula* was the embodiment of Hawaiian culture and spirituality. To ban *hula* symbolized the power Christian thought was having in Hawai’i at the time. “In what she [Ka’ahumanu] thought was the service to her faith she struck at the heart of Hawaiian culture,” writes Haley (Haley 2014; loc. 1705). Native spiritual practices were banned both as means of conversion to Christianity and as a way to slowly and effectively destabilize the Hawaiian community. The Hawaiians themselves were unknowing participants in the steady degradation of their culture and society.

By the end of the 1830s, the Eighth Company of Missionaries from New England arrived in Hawai’i. Having given the Hawaiians a written language, the missionaries printed over twenty million pages of Biblical texts, sermons and teachings—taking advantage of their “near-monopoly” on distributing the written word (Haley 2014; loc. 1891). The missionaries also established 1,100 schools, teaching 40 percent of the adult population (Haley 2014; loc. 1947). By the mid 1830s, the missionaries turned their attention to the education of Hawaiian children. The missionaries regarded Hawaiian children as “wild and undisciplined,” and the *ali’i* (royal) children even more so (Menton 1992; pp. 219). The missionaries hoped that if they could educate the children of Hawai’i in Christian principals, the future of Hawai’i as a Christian and “civilized” nation would be secure (Menton 1992; pp. 220).

The Chiefs’ Children’s School was established in 1839 at the request of the chiefs themselves, who wanted the *ali’i* to be prepared to rule in the future in the face of growing Western influences. A total of eleven noble children ranging in ages from three to eleven entered the school the first year. Among the eleven children were four future kings, a queen regnant, a queen consort and a *kahina nui* (co-regent or prime minister). The *Polynesian*, an English language newspaper, wrote about the goals of the new school: ‘It is the earnest desire of the leaders that the children of the chiefs committed to their care should ‘seek first the kingdom of God and his righteousness,’ imbibe the spirit of the gospel and avoid sin in all its forms, that they may eventually be qualified to take the lead of a civilized and Christian nation’ (Menton 1992; pp. 226). Schools for

common children were also established. By the end of the 1830s, 12,000-15,000 children were enrolled in schools, using American textbooks translated into Hawaiian and religious texts written by missionaries (Menton 1992; pp. 220). Western education, along with Christianity, were the tools used by the missionaries and other foreigners to strengthen their foothold in the Islands.

### **2.4.1 Christian Dogma vs. Hawaiian Thought**

The introduction of Christianity to Hawai'i ushered in a system of ethical "do's and don't's" that the missionaries attempted to impose on the Hawaiians. These new rules began to replace not only the ancient *Kapu* system but also the Hawaiians' understanding of, and relationship to, their *'aina* (land).

As told in the *Kumulipo*, the Hawaiian creation story, the *Kanaka* (humans-beings), were born from the *Papahānaumoku*, Earth Mother, and *Wākea*, the Sky Father. The first born of the *Papa* and *Wākea* was the *kalo* (taro) plant and the second was the *Kanaka*. The Earth gave the *Kanaka* life. The Earth and the *Kanaka* are not separate entities, but rather are connected as relatives. The Hawaiians' connection to the *'aina* is the foundation of their identity.

In "Man, Gods, and Nature," by Michael Kioni Dudley, Ph.D., he describes the Hawaiian world-view as entirely different from the Western/Christian view. He writes:

To understand Hawaiian thought, one must first realize that the Hawaiian truly experiences the world differently. One who believes that the fish hear, who asks plants for permission before picking their flowers, and who thinks he is related as family to many of the species of nature surrounding him, obviously experiences and reacts to the world differently from one who does not (Dudley 1993; pp. 3).

He goes on further to say, "In the Hawaiian view the world is alive, conscious, and able to be communicated with, and it has to be dealt with that way. Man participates in a community with all the species of nature, a community in which all beings have rights and responsibilities for one another"(Dudley 1993; pp. 3).

Conversely, in the Western/Christian world-view, the communion between nature and human is not honored, but rather it is a relationship of dominance in which nature exists



to be used and exploited by man. Unlike in Christianity where there is a Supreme God who is all-powerful and all-knowing—and fundamentally separate from humans—Hawaiians experience a spirit world where all things—humans, nature and material objects—have the capability of possessing a divine *akua* (spirit). The Hawaiian words *akua* and *'aumakua* are often translated as “god” or “gods.” Dudley prefers to translate these words to “sentient spirit,” “spirit consciousness,” or a “cognizant entity,” as not to confuse the Christian understanding of God with the Hawaiian *akua*. *Akua* dwell in humans both alive and deceased, and in different forms of nature and material objects. *Akua* can also exist as a pure spirit with no physical form (Dudley 1993; pp. 35). Martha Warren Beckwith, an American folklorist and ethnographer, writes:

Thus any object of nature may be a god; so may a dead body or a living person or a made image, if worshiped as a god. Every form of nature has its class god, who may become *aumakua* or guardian god of a family into which an offspring of the god is born, provided the family worship such an offspring with prayer and offerings (Beckwith 1970; pp. 2).

Another fundamental difference between the Western/Christian world-view and the Hawaiian world-view is the designation of who and what has the capability of thinking and willing. In Christianity, God, angels and the souls of humans are all that are able to think and will. Everything else that is not God, angels or souls fall into the realm of matter, and matter does not have the ability to think or will (Dudley 1993; pp. 35). The physical body of a human is devoid of thought; it is the mind and soul of a human that makes us think. Thus, the Earth—the land, the ocean, nature and the sky—is seen as matter and therefore incapable of thinking and willing, as we perceive these concepts.

On the other hand, Hawaiians view all matter as being capable of thinking and willing. The material body of a human has its own consciousness as does all the different parts of the body. “The feet walked,” “the hands picked,” “the ear heard,” are phrases commonly used that express different parts of the body as thinking and willing on its own (Dudley 1993; pp. 37). This way of understanding is also projected into nature. Nature and all its elements are alive and conscious, just like the human and the body. This perception of thought and deed was central to the Hawaiian belief system and their relationship to, and understanding of, the land.

The creation stories of both the Christians and the Hawaiians are a reference point to better understand these two fundamentally different relationships between humans and nature. In the Christian creation story, the opening chapter of the Bible begins, “In the beginning God created the heavens and the earth” (Genesis 1). It then goes on to recite that God created the light, the dark, the sky, the ocean, the land and the animals. It was all done by God’s hand, since only God was capable of thought and deed. Conversely, in the *Kumulipo*, it was not God who created the “material universe,” but rather the material universe developed from within as a conscious and self-acting being (Dudley 1993; pp. 45). Hawaiian historian David Malo writes, “In the genealogy called Kumulipo, it is said that the land grew up of itself, not that it was begotten, nor that it was made by hand” (Dudley 1993; pp. 45). The first two lines of the *Kumulipo* state, as translated by Queen Lili’uokalani, “At the time that turned the heat of the earth. At the time when the heavens turned and changed.” There was no outside force or God that caused the Earth to heat and the heavens to turn. It was the consciousness and will of the Earth and the heavens to change from within (Liliuokalani 1897).

For Hawaiians, man cannot claim to be superior to the Earth because of his conscious ability to think and will. The Earth and nature are equally as conscious and all-powerful as man. By living with this belief system, man and the Earth and all of nature live in union and equality. As Dudley writes, “The Hawaiians’ world was filled with conscious beings which formed an interrelating community with them. They depended upon, cared for, and communicated with the surrounding world of nature, and it depended on, provided for, protected, and communicated with them” (Dudley 1993; pp. 48).

Dudley goes on further to say:

They [Hawaiians] felt a kinship with nature that is not experienced by people who see a break between mankind and the species of nature that have preceded them in the evolutionary advance. In the Western world, where the cleavage is most pronounced, animals are disdained as having senses but no reason; the plant world is recognized as alive, but in no way even aware; and the elements of the cosmos are treated as inert objects that follow mechanical laws. Hawaiians, on the other hand, view all of these beings as sentient ancestral forms which interrelate with them as family (Dudley 1993; pp. 50).

The introduction of Christianity and Western norms to Hawai'i completely altered the way in which the people related to nature and the land. In the film series entitled "Standing on Sacred Ground," Hawaiian historian Davianna Pomaika'i McGregor discusses how Christianity's focus on humans and the afterlife severed the Hawaiians' relationship to the *'aina*. In Christianity, life is centered on procuring a place in heaven for the soul to enter—heaven being an abstract entity completely disconnected from the earth. For the Christian, nurturing a relationship with the Earth is unnecessary, as is protecting and maintaining the health of the Earth. Ultimately, when death occurs, the Christian will be saved and placed in heaven, leaving Earth for eternity (McLeod 2015).

The missionaries in Hawai'i brought with them a completely new creation story. In the words of McGregor, the Christian creation story "cut the umbilical cord of the Hawaiians to the land" (McLeod 2015). It can be compared to removing a child from its mother. The effects of severing the relationship to the land were not immediately felt nor understood by the Hawaiians, as they were convinced that Christianity was a superior belief system to their own. However, because Christianity essentially severed the Hawaiians relationship to, and communion with, the land and spirit of the land, their very identity as Hawaiians became lost (McLeod 2015).

## **2.5 The *Ahupua'a* System**

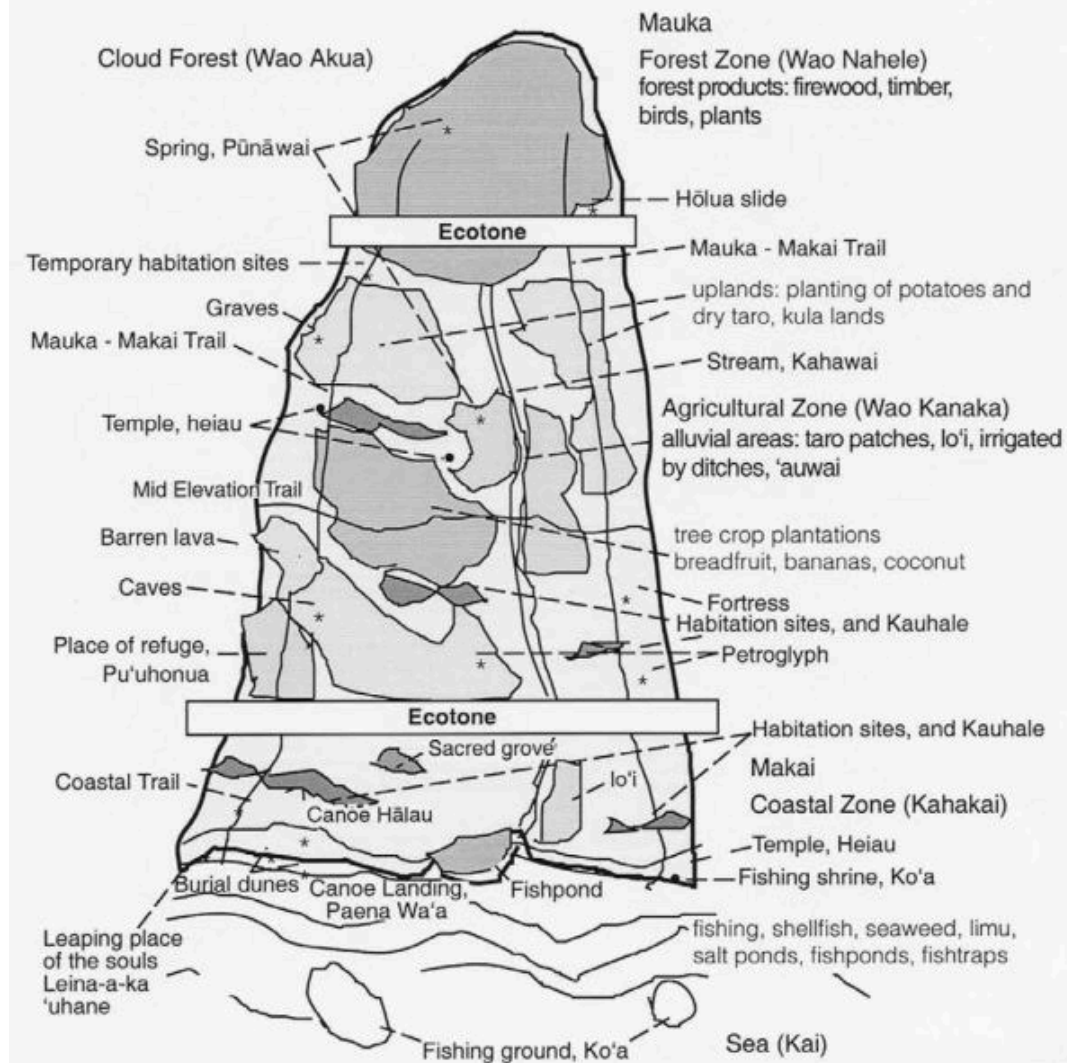
Central to Hawaiian thought and culture was the *ahupua'a* system. It was not only a system of land division and cultivation and but was also central to the Hawaiian belief system at the time of the arrival of the missionaries. The steady process of disconnecting the Hawaiians from their *'aina* as part of the Christianization of the Islands was done most effectively through the abolishing of the *ahupua'a* system.

Prior to contact by foreigners and the introduction of Christianity, the concept of private property was unknown to the Hawaiians. They did not own their own land but rather followed a complex system of land division called the *ahupua'a* system. The *ahupua'a* system served as "a complete life support system for the Hawaiian family groups" (Mueller-Dombois 2007; pp. 27). The land on each island was divided into districts called *moku* and administered by an *ali'i nui* (high chief) who was seen as a representative of the gods. Each *moku* was further divided into *ahupua'a*—wedged

shaped land segments from *mauka* (mountain) to *makai* (sea), and into the ocean as deep as a person could stand (Mueller-Dombois 2007; pp. 23). The word *ahupua'a* comes from combining the word *ahu* (stone altar or mound) and *pua'a* (pig). Stone altars with carved wooden images of a pig's head acted as border markers between *ahupua'a* land divisions. Every *ahupua'a* was ruled by an *ali'i 'ai* (lower chief). A *konohiki* (headman) was responsible for managing the resource use of the *ahupua'a*. The *maka'ainana* (commoners) who worked the land paid weekly labor taxes and annual taxes to the *konohiki* who collected goods and offerings that were given to the high chiefs and the gods, especially to *Lono*, the god of agriculture (Mueller-Dombois 2007; pp. 23)

Each *ahupua'a* followed the natural boundaries of the watershed and contained all the resources needed to sustain the community. The land segments from the mountain to the ocean were based on the five biological resource zones: the upland/inland forest zone called the *wao nahele*, the agricultural zone called the *wao kanaka*, and the coastal zone called the *kaha kai*, the freshwater ecosystem called the *kaha wai*, and the *kai* (ocean) (Mueller-Dombois 2007; pp. 23). The vertical arrangement of the *ahupua'a* was typical of Polynesian volcanic islands, as it maximized the use of biodiversity over short distances. The *ahupua'a* system also acknowledged the interconnectedness of each biological resource zone—what happened to one zone affected the others. Sustainable management of one resource zone was necessary to maintain the health of all the other zones, and in turn, to maintain the health of the community (Mueller-Dombois 2007).

# Ahupua'a (Typical Land Division)



**Figure 3: Ahupua'a Land Division (Mueller-Dombois 2007)**

Resources from each biological zone were distributed between the entire *ahupua'a*. For example, villagers living in a coastal zone traded fish for wood from the forest zone to build canoes and houses. Sophisticated irrigation systems were constructed to direct water from the mountain to the coast to supply water for communities and farmers. The diversity of environments and resources available within the *ahupua'a* allowed the

communities within each land division to be fairly self-sufficient. Large-scale trade between different *ahupua'a* was not a common practice among the Hawaiians.

Stewardship of the land and ocean was formalized through the *Kapu* system. The *konohiki* (headman) and *kahuna* (priest) of each *ahupua'a* placed restrictions and rules on resource extraction in order to maintain the balance of the environment and the community (HawaiiHistory.org 2015). For example, restrictions were placed on fishing certain species during specific seasons, on harvesting and plantings crops, and the use of water. Through sharing resources and understanding the rhythms and changes in the environment, Hawaiians enjoyed a rich and deeply connected life (HawaiiHistory.org 2015). “The ancient *ahupua'a*, the basic self-sustaining unit, extended elements of Hawaiian spirituality into the natural landscape. Amidst a belief system that emphasized the interrelationship of elements and beings, the *ahupua'a* contained those interrelationships in the activities of daily and seasonal life” (HawaiiHistory.org 2015).

As Christianity spread, the Hawaiians' relationship to their land began to recede. It is here that we see the beginnings of the disconnect between man and nature played out in the Hawaiian Islands. The *ahupua'a* system symbolized the Hawaiians' connection to, and respect for, the *'aina*. It was a system that made possible an environmental and spiritual balance for both *ali'i* and *maka'ainana* alike. As will be seen, the influence of Christianity and the West effectively ended the *ahupua'a* system and created a system of land ownership where the native Hawaiians lost the rights to their own land and livelihoods.

## **2.6 The Constitutional Monarchy and The *Great Mahele***

By the end of the 1830s, the missionaries' influence in Hawai'i was stronger than ever. Not only were royal children being educated by the missionaries, so were the King and his chiefs. Certain missionaries became “trusted confidants” of some of the most powerful *ali'i* in the Islands. Strictly forbidden by the ABCFM from engaging in political affairs, the missionaries found it more and more difficult to separate their Christian teachings from political and social matters in the Islands (Menton 1992; pp. 220). In 1838, at the request of the chiefs themselves, missionary William Richards

agreed to take on the role as their teacher. To do so, Richards had to sever his official ties with the ABCFM. Richards became the official instructor of the King and chiefs, teaching them the ins and outs of political economy and government. He used Francis Wayland's "Elements of Political Economy," translated into Hawaiian, as a guide for his teachings (Menton 1992; pp. 221).

With Richards' help, and new insights into political economics and government, King Kamehameha III passed a Declaration of Rights in 1839 stating, "God hath made of one blood all nations of men to dwell on the earth in unity and blessedness. God has also bestowed certain rights alike on all men and all chiefs, and all people of the lands" (Menton 1992; pp. 221). The Declaration of Rights was followed by a Constitution in 1840 outlining the principals of landownership, religious freedom and a governmental system, including executive, legislative and judicial branches. Hawai'i became an official constitutional monarchy with government positions held by both Hawaiians and foreigners (Menton 1992; pp. 221).

The establishment of a Constitution was just the start of a long line of American influence in the Hawaiian political system. One of the biggest issues concerning the Hawaiians, Americans and other foreigners, was the issue of land distribution and ownership. Prior to foreign contact in Hawai'i, land was not owned, nor was it seen as a capital investment. It was ultimately that of the gods and that which gave life to the *kanaka* (people). In his teachings, Richards emphasized the concept of land as capital. "The land where man farms is wealth. The sea, the place where one fishes, is wealth," he stated (theumiverse 2013). Through his teachings and other ongoing Western influences, the spiritual value of the land was slowly but surely transformed into something far more treasured and tangible to the foreigners—economic value.

Americans and Europeans had been pressuring the Hawaiian government to transition to a westernized system of private property, hoping to gain stable land title and long-term leases to facilitate large-scale agriculture (Garovoy 2004; pp. 526). In 1845, acting on the advice of his foreign advisors, Kamehameha III created the Land Commission with William Richards as the president. The Land Commission was responsible for reviewing land claims and term leases (Dyke 2007; pp. 34). In 1847, the newly appointed Land Commission president, Judge William Little Lee, proposed to the *ali'i* the idea of dividing up the land of Hawai'i. In defense of his proposal, Lee stated that

the redistribution of property would ‘emancipate the natives from a state of hereditary servitude, to that of a free and independent right in the soil they cultivate’ (Dyke 2007; pp. 38). In what is known as *Ka Mahele*, also known as The Division of 1848 or “Great Mahele,” the land in Hawai’i was divided between the *Mo’i* (King), the *Ali’i* (Chiefs), the Government and the *maka’ainana* (commoners). After the land division, the *Mo’i* (then King Kamehameha III) held claim to approximately 1 million acres of Hawaiian land (23.8%), known as the King’s Lands and later the Crown lands; the *Ali’i* received 1.6 million acres (39.2%); and the Government received 1.5 million acres (37%), known as the Government Lands. The *maka’ainana* received land from the Government lands but only land that they laid claim to and for which they were able to perfect title before the Land Commission (Dyke 2007; pp. 42). Both the King and *Ali’i* gave up vast holdings of land they held pre-*Mahele* in order to provide sufficient ‘*aina* (land) for the Government and *maka’ainana* (Dyke 2007; pp. 43).

After the *Great Mahele*, many *maka’ainana*, the vast majority of whom had no formal education or understanding of Western land use systems, were unable to maintain legal possession of the lands they had traditionally occupied. In order to help the *maka’ainana* secure title to their land, the Kuleana Act of 1860 was passed. The act encouraged the *maka’ainana* to file claims with the Land Commission for the land they were currently cultivating and living on. The application process was long and confusing and many were unaware that a claim was even needed to secure their land. As a result, very few *maka’ainana* legally filed claims to their land. The concept of private property was unfamiliar to them and many preferred the old system where they had access to all the lands within their *ahupua’a* (Dyke 2007; pp. 46). In total, out of the 1.5 million acres of Governments Lands, only 28,658 acres, or less than 1 percent of Hawai’i’s land, was awarded to the *maka’ainana* at the time of the *Mahele*. The average plot size given to an adult Native Hawaiian male was 2.5 acres, not nearly large enough to maintain an independent and decent livelihood (Dyke 2007; pp. 48). Some have theorized that this is exactly the result Richards, Lee and other foreigners sought when pushing the Hawaiians towards private land ownership. The less land claimed by Native Hawaiians, the more land available to Westerners to seize for themselves.

Another significant change that occurred during the time of the *Great Mahele* was the adoption of the Alien Land Ownership Act of 1850, which enacted into law the right of



foreigners to own land in Hawai'i. Again, Judge William Little Lee was responsible for persuading the government ministers to enact this law. The *maka'ainana* submitted numerous petitions to Kamehameha III urging him not to allow foreign ownership of the *'aina*, but he did so anyway (Dyke 2007; pp. 36). Government lands on each island that were not laid claim to by the *maka'ainana* were available for purchase by both Hawaiians and foreigners. As Van Dyke writes, "their [foreigners] greater familiarity with allodial title and their access to capital gave them a significant advantage" over the *maka'ainana* when it came to purchasing land (Dyke 2007; pp. 51). By 1864, 320,000 acres of Government lands had been sold to 213 foreigners, compared to 90,000 acres of land that were sold to 333 native Hawaiians (Dyke 2007; pp. 57).

It has been disputed whether, at the time the *Great Mahele* was enacted, if Kamehameha III intended the King's (Crown) Lands to be his personal possession and passed down to his heirs, or that of the office of the Crown, to be passed on to the next king or queen in succession. Evidence suggests that Kamehameha III viewed the King's Lands as his personal property and not the property of the Crown. In his will, Kamehameha III elected Liholiho, his son, as the heir to the throne, entitling him to the King's Lands. Liholiho ruled the Kingdom from 1855 until his unexpected death in 1863. Liholiho died with no written will indicating who would take the throne or who would inherit the King's Lands. Both the Queen and the Government agreed to Prince Lot Kapuaiwa, Liholiho's older brother, as the successor to the throne. At that point, who would inherit the King's Lands was still up for debate. The issue was taken to the Supreme Court in 1864, in a case entitled *In the Matter of the Estate of His Majesty Kamehameha IV*. In the case, Queen Emma, the granddaughter of High Chief Kamaunu and High Chiefess Kukaeleiki, argued that the King's Lands had been the private property of her husband and, therefore, she should be entitled to them as his heir. Prince Lot, on the other hand, argued that the lands were attached to the Crown and, therefore, were to be passed on to the next *Mo'i* (king) (Dyke 2007; pp. 71). The Hawai'i Supreme Court concluded that Queen Emma was entitled to a portion of the King's Lands, but in order to ensure clarity in the future, the court decided that, from then on, the King's Lands would be inherited only by the 'successors of the throne' (Proto 2009; pp. 71). The King's Lands, at that point called the Crown Lands, later became managed by the Board of Commissioners of Crown Lands.

The legal nature of the Crown Lands remained unsettled even after the Supreme Court decision, however. The controversial decision granting the King's Lands to the Crown rather than the personal property of the King would later prove detrimental to the Monarchy and the Native Hawaiian people. The *Great Mahele*, like the abolition of the *Kapu* system, was one of the most significant events in Hawai'i's history. The Hawaiians went from a system where the *'aina* was respected and cared for as the life-blood of the society to a system where the land simply became a commodity to be bought, sold and used as the owner wished. This new and emerging view of the role of land (nature) as a thing to be bartered and exploited at will changed not only the system of land ownership in Hawai'i, it completely changed the Hawaiians' way of life and perception of themselves. Whether this was part of a conspiracy by the sons and grandsons of the original missionaries and other foreigners to co-opt the land for themselves or was simply the unintended consequence of a move by the Hawaiians towards modernity is hotly contested and is not likely to be answered anytime soon.

## **2.7 Overthrow of the Monarchy and Statehood**

For a long time, the United States had seen Hawai'i as a strategic location for a military base between Asia and the continental United States. In 1875, in an effort to gain access to the Islands for a military base, the United States presented a sugar treaty to the Hawaiian Kingdom. The Reciprocity Treaty of 1875 was a free-trade agreement between the United States and the Hawaiian Kingdom, which gave free access to the United States market for sugar grown in Hawai'i. In return, the United States gained control of lands on O'ahu for what would eventually become the Peal Harbor Naval Base (Fish 1875). The sugar industry in Hawai'i expanded greatly after the Reciprocity Treaty. A large portion of the Crown Lands, now managed by the government-appointed Board, was leased to sugar plantations, owned in large part by the offspring of the original missionaries, whose Christian roots were morphed and manipulated to accommodate the new capitalist fervor spreading through the Islands.

By the end of the 19<sup>th</sup> Century, despite efforts by the British, Russians, French and Americans to gain control of the Islands, the Hawaiian Kingdom remained a sovereign state, although it continued to struggle immensely. In an effort to curtail the powers of the King, the Reform Party of the Hawaiian Kingdom, also known as the Hawaiian

League, led by sons of missionaries and other businessmen, forced King Kalākaua to sign the Bayonet Constitution under threat of use of force (Katz 2009). Authored by Lorrin Thurston, grandson of the first Christian missionaries in Hawai'i, the Bayonet Constitution greatly reduced the Monarch's power, making him a mere figurehead. It forced the King to form a new cabinet ministry of League members and placed executive power in the hands of the cabinet. The Constitution extended voting rights to non-citizen and foreign residents of European and American background. It also required voters to meet high property ownership and income requirements—excluding two-thirds of the formerly eligible Native Hawaiians from voting (Association 2015). The real purpose for the Bayonet Constitution was to decrease the power of the native vote in order to gradually seize control of the government.

In 1881, King Kalākaua died of kidney disease at the age of 54. His sister, Lili'uokalani, took the oath of office as Monarch and became the Queen. On January 14, 1883, the Queen presented to the Cabinet a new constitution she had written, restoring power to the throne and rights to the native people of Hawai'i (Pitzer 1994). The Cabinet, made up largely of business leaders, refused to sign her new Constitution and persuaded her to postpone action for some future day. Soon after, the Annexation Club—also known, ironically, as the “Committee of Safety”—comprised of members of the Queen's cabinet and the Hawaiian League, sprang into action. On January 16, 1883, backed by 162 fully armed troops from the American warship USS *Boston*, the Committee of Safety overthrew the Monarchy (Pitzer 1994). Sanford B. Dole, the son of missionaries, replaced the Queen as president of the provisional government. Soon after the provisional government was installed, Lorrin Thurston went to Washington hoping the United States president would sign a treaty of annexation. President Cleveland refused to sign the annexation treaty, placing the issue in the hands of Congress. Congress took no action on the matter, neither restoring the Monarchy nor annexing Hawai'i to the United States (Pitzer 1994). With their goal of annexation halted, the leaders of the provisional government decided to form their own republic. The Republic of Hawai'i was officially established on July 4, 1894 with Sanford B. Dole as president (Pitzer 1994).

In January 1895, Hawaiians and other royalists lead a counterrevolution to restore the Monarchy. The Republic quickly struck it down. During the counterrevolution, the

Republic discovered a cache of arms buried in the garden of Queen Lili'uokalani's home. She was arrested and imprisoned on the second story of 'Iolani Palace. She was found guilty of misprision of treason—having knowledge of treason and failing to report it. She was imprisoned for eight months in the palace. She was eventually released and placed under house arrest for a year (Pitzer 1994).

In 1897, the Republic presented another treaty of annexation to US President William McKinley. Under United States Constitutional Law, in order to annex a nation, the people must first be asked if they want to be incorporated or not. If both agree, a treaty of annexation is created and a two-thirds majority of the Senate must approve for it to be legal. The United States bypassed the annexation process because it knew Native Hawaiians did not approve of giving up their land and sovereignty (Sovereign 2013). The Ku'e Petitions of 1897 show 90+ percent of Native Hawaiians opposed annexation. Coincidentally, during the time of the annexation debate, the Spanish-American War broke out in the Philippines. More than ever, the Hawaiian Islands became a strategic military position in the Pacific. President McKinley convinced Congress to enter into a joint resolution in the case of Hawai'i. Joint resolutions cannot lawfully be used to annex foreign nations. However, for Hawai'i, the joint resolution solidified the Islands' annexation to the United States (Sovereign 2013).

In a little over a century, from the time Cook first landed on the Islands to the time of annexation, the Hawaiian people had lost their land, their Monarchy and their independence. They also lost a vast majority of their own people due to foreign disease. In 1778, an officer of Cook's ship estimated the native population to be roughly 400,000. More recent and accurate estimates put the 1778 population at 800,000. In 1831, the first official census counted only 130,000 Native Hawaiian people. In nearly 50 years, the Hawaiian population had declined almost 85 percent. By 1850, the population was less than 85,000. In 1890, it had dropped to 40,000. And by 1900 it was 37,000 (David 2000).

After WWII and the creation of the United Nations, a wave of decolonization occurred. Former colonies in Africa and Asia gained independence and entered the United Nations as free states. In 1959, the United Nations had Hawai'i on the list of places that still needed to be decolonized. Rather than give up Hawai'i, the United States decided to make the Islands look like a state instead of an occupied nation (Sovereign 2013).

The United States government rushed the statehood vote to ballot. They opened the vote to everyone living in Hawai'i. At that point, Native Hawaiians made up less than 20 percent of the population. Settlers from the mainland US, military and Asian immigrants far outnumbered Native Hawaiians and saw no reason not to vote for statehood. Hawai'i officially became the 50<sup>th</sup> state in 1959 (Sovereign 2013).



## 3 Mauna Kea

Mauna Kea played and plays a central role in Hawaiian history, culture and spirituality. It is the *piko* (umbilical cord) that connects the Hawaiians to their *akua* (gods), *kupuna* (ancestors) and *‘aina* (land). Physically and symbolically it is the center point of the life of Native Hawaiians and the most sacred place in all of the Hawaiian Islands. As will be discussed, it is here, on the most revered spot on the Islands, that the disconnect between man and nature—instigated in large part by the growing influence of Christianity and Western culture—is clearly evident. The construction of the TMT on Mauna Kea not only illustrates this separation but it has become the centerpiece of the Hawaiians’ struggle to reconnect to their *‘aina* and their very identity as a native people.

### 3.1 The Mountain

Mauna Kea is a dormant volcano located on the Big Island of Hawai’i. The Big Island itself is composed of five volcanoes connected together: Kohala, Mauna Kea, Mauna Loa, Hualālai and Kīlauea. The Big Island is the southeastern most island of the chain of islands that constitute the State of Hawai’i: Ni’ihau, Kaua’i, O’ahu, Moloka’i, Lana’i, Kaho’olawe, Maui and Hawai’i (Big Island). The Hawaiian Islands are a very small part of the 70 million year old Hawaiian Ridge-Emperor Seamounts chain that extends 6,000-km. (3,728-miles) from the Big Island of Hawai’i to the Aleutian Trench off Alaska (USGS 1999).

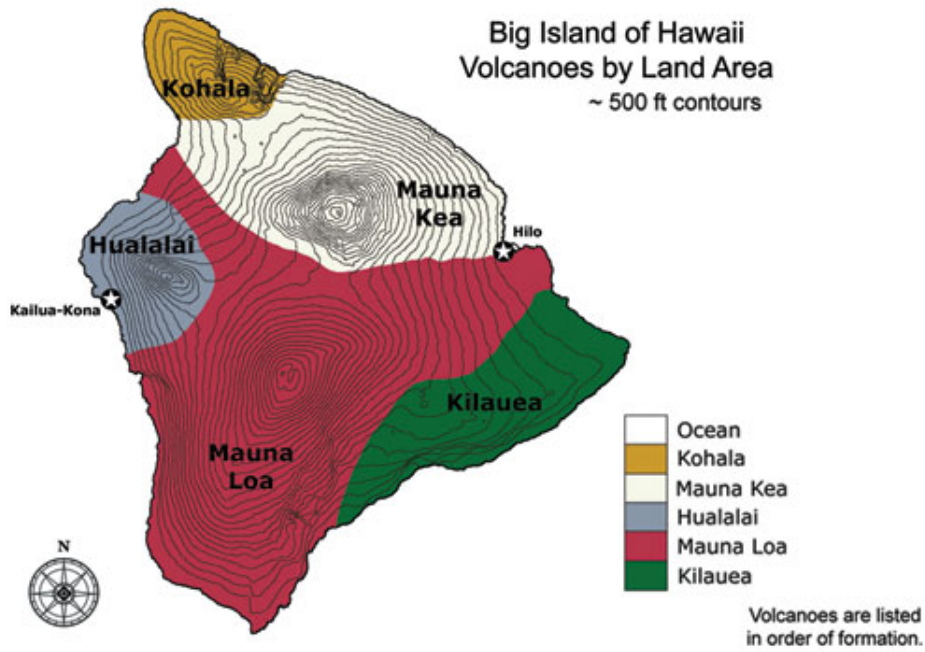


Figure 4: Big Island of Hawai'i Volcanoes by Land Area (Hawaii 2015)

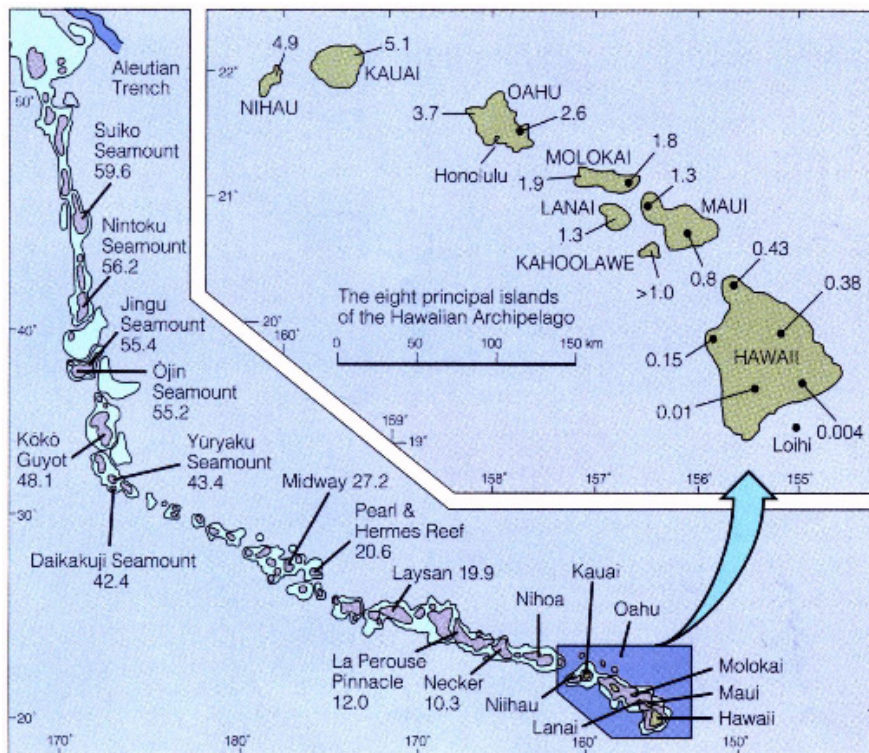


Figure 5: Hawaiian Ridge-Emperor Seamounts Chain (Hawaii 2015)



The Hawaiian Ridge-Emperor Seamounts chain resulted from the Pacific Plate moving over a deep and stationary hotspot. The hotspot is currently beneath the Big Island of Hawai'i, visible in the regular eruptions of Mauna Loa and Kīlauea on the south end of the island. The volcanoes of the Hawaiian chain are older as they move beyond the hotspot. The oldest volcanic rock is found on Kaua'i, the northernmost inhabited island, and is estimated to be 5.5 million years old. On the Big Island, the southeastern most island and positioned almost directly over the hotspot, the oldest rock is 700,000 years old with new rock forming essentially every day as the south end of the island remains active (USGS 1999).

Mauna Kea is estimated to be about one million years old. It is a volcanic mountain characterized by its low eruption rates, steeper and irregular topography and different chemical compositions of lava. Its low profile and large size was the cause of highly fluid lava eruptions forming it into a “shield” shape (Wolfe 1997; pp. 2). Mauna Kea is a dormant volcano, last erupting approximately 4,500 years ago (Wolfe 1997; pp. 15). It stands 4,205-m. (13,796-f.t) above sea level. However, Mauna Kea is built on a sea floor at least 6,000-m. (19,685-ft.) below the surface of the Pacific Ocean, and is therefore calculated to be a over 10,000-m. (32,808-ft.) tall—making it the tallest mountain in the world from base to peak, exceeding mount Everest at 8,848-m. (29,028-ft.) (Society 2012).

### **3.1.1 Climate Zones and Ecosystems**

Hawai'i is one of the most ecologically diverse places on Earth. It is also one of the most geographically isolated places, resulting in the evolution of species found nowhere else in the world. Because of their isolation, species endemic to Hawai'i are very vulnerable to extinction, the effects of human development and invasive species.

Four out of the world's five major climate zones (or 10 of the 13 sub-zones) can be found on the Big Island of Hawaii. On Mauna Kea itself, three subzones exist: tundra, summer dry cool and summer dry warm.

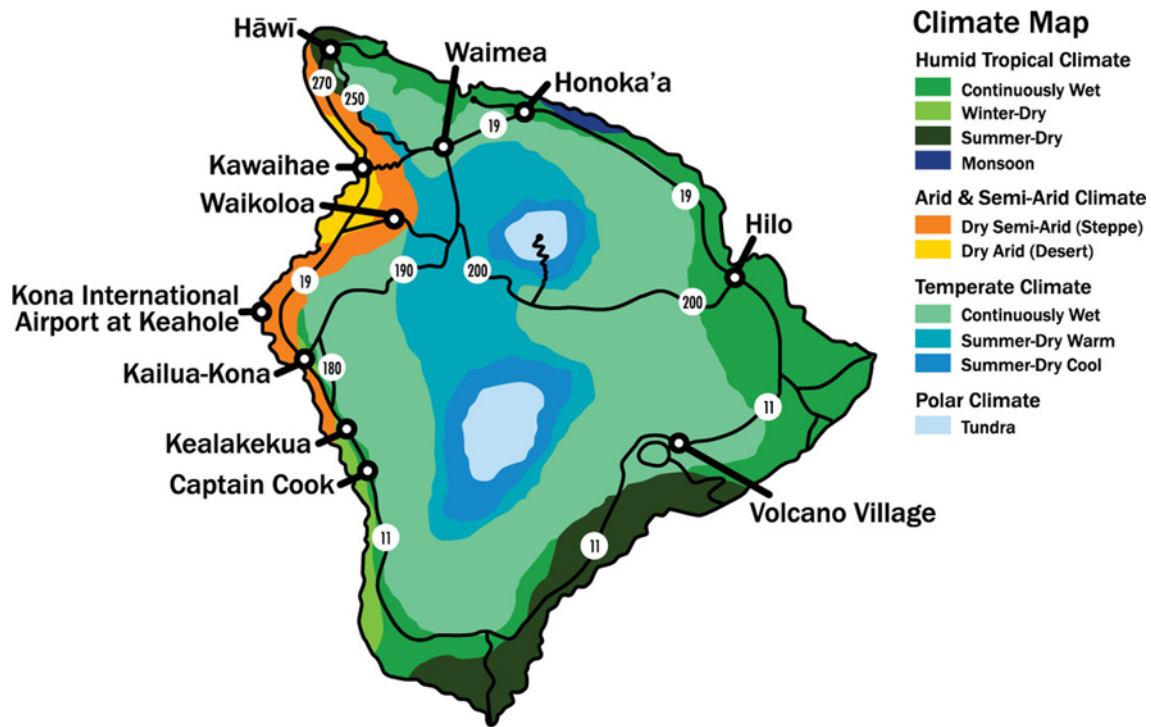


Figure 6: Big Island Climate Subzones (Guru 2015)

Within the tundra subzone is the Alpine Stone Desert, ranging from 3,900-m. (12,800-ft.) to the summit (Hilo 2010; pp. S-4). The Alpine Stone Desert ecosystem is characterized by extremely cold temperatures, under 2.5-cm. (15-in.) of rainfall and snowfall in the winter months (Hartt and Neal 1940; pp. 247). Growth is limited to lichens, mosses and vascular plants such as ferns (Hilo 2010; pp. S-4). The only animals species found in the Alpine Stone Desert ecosystem are arthropods, including 10 indigenous Hawaiian species, the *Wēkiu* bug (*Nysius wekiuicola*) being one of them. The *Wēkiu* bug can be found on cinder cones from 3,566-m. (11,700-ft.) to the summit of Mauna Kea (Hilo 2010; pp. S-4).

From 3,931-m. (12,800-ft.) down to about 2,895-m. (9,500-ft.), the Alpine Shrublands and Grasslands ecosystem exists, straddling the tundra and summer dry cool subzones. Although warmer than the tundra zone, the Alpine Shrublands and Grasslands ecosystem is still cool enough to accumulate frost on the ground and receives only a few more centimeters of rain (Hilo 2010; pp. S-4). The Mauna Kea Silversword (*Argyroxiphium sandwicense*), an endangered species of plant endemic to the Big Island, lives at the lower elevation of this ecosystem (Hilo 2010; pp. S-4)

Below 2,895-m. (9,500-ft.) is the summer dry warm climate subzone. This subzone is warmer than the summer dry cool zone but receives roughly the same annual rainfall. The *Māmane-Naio* Forest dominates the summer dry warm zone. The forest consists of two endemic species of tree called *Māmane* (*Sophora chrysophylla*) and *Naio* (*Myoporum sandwicense*) (International 2015). The *Māmane-Naio* Forest is the habitat of the critically endangered *Palila* bird (*Loxioides bailleui*). The *Palila* bird is a finch-billed species of Hawaiian honeycreeper that can only be found on the upper slopes of Mauna Kea (Hilo 2010; pp. S-5).

### 3.2 The *Mauna* and the Hawaiian Creation Story

According to the Hawaiian creation chant, known as the *Kumulipo*, Mauna Kea is the place where all life originated. Beckwith describes the *Kumulipo* as:

A genealogical prayer chant linking the royal family to which it belonged, not only to primary gods belonging to the whole people and worshiped in common with allied Polynesian groups, not only to deified chiefs born into the living world, the *Ao*, within the family line, but to the stars in the heavens and the plants and animals useful to life on earth, who must also be named within the chain of birth and their representatives in the spirit world thus be brought into the service of their children who live to carry on the line in the world of mankind... (Beckwith 1951; pp. 8).

The *Kumulipo* is commonly referred to as the ‘Hawaiian Song of Creation,’ and can be directly translated to ‘Beginning-(in)-deep-darkness’ (Beckwith 1951; pp. 38). The *Kumulipo* consists of over 2,000 lines and is divided into 16 sections called *wā*, a word used for an interval in time or space (Beckwith 1951; pp. 38). The first seven *wā* describe the period of *pō*, the time of “Night,” “Darkness,” or the “Spirit world.” The last nine *wā* describe the period of *ao*, the time of “Day,” “Light,” or the “World of living men,” the “World of reason” (Beckwith 1951; pp. 38). Born in the time of *pō* was *Kumulipo*, the source of life—the male, and *Po’ele*, night blackness—the female. Also born during this time were plants and animals. Gods and humans did not appear until the time of *ao* (light). As Beckwith describes, over 1,000 lines of the *Kumulipo* are straight genealogy listings by pairs; the male and female branches of the family lines of descent (Beckwith 1951; pp. 38). The genealogy continues through the 18th and 19th centuries with the *Kamehameha* and *Kalākaua* dynasties (Dudley 1993; pp. 8).

Mauna Kea is considered to be the most sacred place in all of Hawai'i. "Mauna Kea is more than a mountain; it is the embodiment of the Hawaiian people" (Ho'akea 2009; pp. 1-1). Mauna Kea literally translates to "White Mountain," referring to its snow covered summit in the winter months. However, Mauna Kea means much more than "White Mountain." Mauna Kea is the shortened version of its original name, *Mauna a Wākea*. *Mauna a Wākea* is the name that connects the mountain to *Wākea*, the Sky Father. *Wākea* means "expansive space" or "heaven." The Sky Father is also referred to as simply *Kea*, which is translated to "white," the color of spiritual enlightenment and male procreative fluid (Ho'akea 2009; pp. i). *Papahānaumoku*, or *Papa*, is the Earth Mother or creator goddess. *Papahānaumoku* literally translates to "broad place who gives birth to islands" (Beckwith 1970; pp. 294).

*Wākea*, the Sky Father, symbolizes the upper regions of air where sunshine and rain descend to fertilize the Earth. *Papa*, the Earth Mother, symbolizes the warm top layer of the Earth which contains the seeds fertilized by the Sky Father (Beckwith 1951; pp. 118). In the "Mo'olelo Hawai'i" by David Malo, *Wākea* and *Papa* are considered to be "the beginning of the Hawaiian people" (Malo 1903; pp. 36).

The intercourse between *Wākea* and *Papa* gave birth to the islands of Hawai'i—the solid foundation for life. The Big Island is their *haipo* or eldest child. Mauna Kea is the child's *piko*, which is translated to umbilical cord, navel, or belly button (Puhipau 2006). The reference to Mauna Kea being the first-born is seen in *mele hānau* (birth chants) like this one for *Kauikeaouli (Kamehameha III)*:

*O hānau ka mauna a Kea, (Born of Kea was the mountain,)*

*‘Ōpu‘u a‘e ka mauna a Kea. (The mountain of Kea budded forth.)*

*‘O Wākea ke kāne, ‘o Papa, (Wākea was the husband, Papa)*

*‘O Walinu‘u ka wahine, (Walinu‘u was the wife.)*

*Hānau Ho ‘ohoku he wahine, (Born was Ho‘ohoku, a daughter,)*

*Hānau Hāloa he ali‘i, (Born was Hāloa, a chief,)*

*Hānau ka mauna, he keiki mauna na Kea...* (Born was the mountain, a mountain-son of Kea...) (Korn 1979)

Mauna Kea is considered to be both female and male. The physical manifestations of soil, ice and rock are its female attributes. Its elevation and close proximity to its father, *Wākea*, represent its male attributes (Ho'akea 2009; pp. i). “The equitability of this female-male distribution establishes Mauna Kea as sacred and creates the *piko kapu* (sacred center) of the island” (Ho'akea 2009; pp.i). Mauna Kea is “*ka piko o ka moku*”—“Mauna Kea is the navel of the island.” In traditional Hawaiian anatomy, there are three physical *piko* that connect the body to the spirit in a concept called *na piko 'ekolu* (three body points):

- (1) *Piko po 'o*, or *Manawa*, at the top of the person's head is the opening that connects the individuals *'uhane* (spirit) or *wailua* (soul) with the spiritual realm beyond, including one's *'aumakua*—departed but always present deified ancestors.
- (2) *Piko waena*, or the navel, represents the person's intrauterine umbilical connection to his/her parents in the present life. The *piko waena* covers the *na 'au* (gut), which is the place of knowledge, wisdom and emotions.
- (3) *Piko ma 'i* is the genitalia that link the person to his/her descendants forever into the future. The *piko ma 'i* is the physical instrument that enables life to continue (Blaisdell 1991).

One of the many cultural practices that occur on Mauna Kea is the burying of a baby's *piko* (umbilical cord) at Lake Waiau and other locations on the summit. Pualani Kanaka'ole Kanahale speaks of the symbolism of this practice:

The *piko* is the part of the child that connected the child back to the past. Connected the child back to the mama. And the mama's *piko* is connected back to her mama and so on. So it takes it back, not only to the *kahiko* [ancient times], but all the way back to *Kumu Lipo*... So it's not only the *piko*, but it is the extension of the whole family that is taken and put up in a particular place, that again connects to the whole family line. And it not only gives *mana* or life to that *piko* and that child, but life again to the whole family (Hilo 2010; pp. 10).

All Hawaiian genealogies stem from *Wākea*, and he is therefore the original *kupuna* (ancestor) of all Hawaiian people. Thus, Mauna Kea, being *Wākea*'s child, is also a *kupuna* (ancestor) of the Hawaiian people (Beckwith 1970; pp. 294).

*Wākea* and *Papa* also gave birth to *Komoawa* and *Ho'ohōkūkalani*. Together with *Wākea*, *Komoawa* and *Ho'ohōkūkalani* helped to establish the *Kapu* system, the ancient code of conduct to regulate human impact on the Islands, which are considered to be the sacred children of *Wākea* and *Papa* (Ho'akea 2009; pp. i).

*Ho'ohōkūkalani*, the daughter of *Wākea* and *Papa*, is the goddess of the stars. Her name can be directly translated to “the heavenly one who made the stars” (Beckwith 1970; pp. 294). As she grew into a beautiful woman, *Wākea*, her father, desired her.

*Ho'ohōkūkalani*, in union with *Wākea*, gave birth to a child. Sadly, the boy was stillborn and was buried on the side of her house. Heartbroken, *Ho'ohōkūkalani* grieved the loss of her son and cried at his grave every day. Over time, a plant with a long stalk grew from the son's grave. The plant, which turned out to be a *kalo* (taro) plant, was named *Hāloa* by *Wākea* because of its long stalk root (Beckwith 1970; pp. 298). The name can also be translated to “long breath”—*hā* meaning “breath” and *loa* meaning “long.”

*Wākea* and *Ho'ohōkūkalani* had another child, this time a healthy baby boy. The boy was also named *Hāloa* after his deceased brother. According to the Hawaiian creation story, the second *Hāloa* is considered to be the first *kanaka* (human being). All Hawaiians descend from the second *Hāloa* and are related to the *kalo* (taro) plant—*Hāloa*'s older brother. Malo calls *Hāloa* the “progenitor of all the peoples of the earth” (Malo 1903).

*Ho'ohōkūkalani* was the “celestial womb” from which the original native being, *Hāloa*, was born. Since *Ho'ohōkūkalani* is the goddess of the stars, Hawaiians themselves are the decedents of the stars. The coming together of *Wākea* and *Ho'ohōkūkalani* is the “primordial union that inserts the Hawai'i native into the sacred parabola of life between the stars and the earth” (Ho'akea 2009; pp. i). Mauna Kea is where the Earth (*Papahānaumoku*), the stars (*Ho'ohōkūkalani*), and heaven (*Wākea*) come together as the sacred *kuahu* (shrine or alter) for the origin of life for the Hawaiian people. The sacred *kuahu* for the origin of life is Mauna Kea (Ho'akea 2009; pp. i).

Cultural historian Kepa Maly describes the close relationship between the Hawaiian people and the islands:

Cultural attachment is demonstrated in the intimate relationship (developed over generations of experiences) that a people of a particular culture share with their landscape—for example, the geographic features, natural phenomena and resources, and traditional sites, etc., that make up their surroundings. This attachment to environment bears direct relationship to the beliefs, practices, cultural evolution, and identity of a people. In Hawai'i, Hawai'i cultural attachment is manifest in the very core of Hawaiian spirituality and attachment to landscape. The creative forces of nature which gave birth to the islands (e.g., Hawai'i), mountains (e.g. Mauna Kea) and all forms of nature, also gave birth to nākānaka kānaka nā kānaka (the people), thus in Hawaiian traditions, island and humankind share the same genealogy (Maly 1999; pp. 27).

### **3.3 State Law Governing Development on the Mountain**

Because of Mauna Kea's sensitive ecosystem and historical and cultural significance to the Hawaiians, it has been designated as "conservation land" under Hawai'i state law. As such, it is given the highest level of protection from development and use of all the state lands. Notwithstanding the stringent legal protections afforded to conservation lands, the Mauna Kea Science Reserve, with its 13 telescopes and related buildings and infrastructure, has become one of the most heavily developed areas on the Islands. To understand how the State of Hawai'i, through the Hawai'i Department of Land and Natural Resources (DLNR), allowed this legal anomaly to happen, one needs to trace the historical background of land use in Hawai'i.

#### **3.3.1 The Ceded Lands**

After the overthrow of the monarchy in 1893, the Republic of Hawai'i joined the Crown Lands and the Government lands together into what was known as the "Public Lands," amounting to nearly 1.8 million acres of land that was not privately held and was essentially "owned" by the government. In 1898, when the United States annexed Hawai'i, the Republic of Hawai'i "ceded" the Public Lands to the United States. These lands were thereafter referred to as the "Ceded Lands." After annexation, the Ceded

Lands were held in a special trust created by the United States government. 200,000 acres were set-aside for the Hawaiian Home Lands Program in 1921. 350,000 acres were retained by the federal government for military bases and national parks, e.g. Pearl Harbor Naval Base (Dyke 2010). The remaining Ceded Lands, as set forth in the Newlands Resolution which annexed the Republic of Hawai'i to the United States in 1898, were to be “used solely for the benefit of the inhabitants of the Hawaiian Islands for educational and other public purposes” (America 1897). In 1959, when Hawai'i became a state, the remaining 1.4 million acres of Ceded Lands were transferred to the new State of Hawai'i to be held in trust for the benefit of Hawaiians. The revenues from these lands were required to be used for public purposes, including, as stated in the 1959 Admission Act, “for the betterment of the conditions of native Hawaiians” (Dyke 2010).

The transfer of the Ceded Lands to the Republic of Hawai'i in 1893 and then to the United States government in 1898 is surrounded by controversy to this day. The United States military and diplomatic officials' involvement in the 1893 overthrow of the Hawaiian Monarchy was recognized as “illegal” and a violation of international law by the United States Congress in the 1993 Apology Resolution, commemorating the 100<sup>th</sup> year of the overthrow. Signed by President Clinton, the Apology Resolution stated that the transfer of the Ceded Lands to the United States government was “without the consent of or compensation to the Native Hawaiian people of Hawai'i or their sovereign government” (America 1993). The Apology Resolution also stated, “the long-range economic and social changes in Hawai'i over the nineteenth and early twentieth centuries have been devastating to the population and to the health and well-being of the Hawaiian people.” In addition to the formal apology issued by the United States government, the Office of the President of the United Church of Christ also offered a public apology to Native Hawaiians for their denomination's historical complicity in the “cultural genocide” of a native people (America 1993).

When the State of Hawai'i tried to sell a portion of Ceded Lands, the Office of Hawaiian Affairs (OHA), the public agency responsible for improving the well-being of Native Hawaiians, filed a lawsuit to prohibit that sale and all further sales of Ceded Lands. OHA receives permanent funding from 20 percent of Ceded Land revenues, mostly through lease agreements. OHA claimed that the 20 percent allocation of revenue gave them the right to veto any sale of Ceded Lands because, if sold, the Ceded



Lands would no longer produce revenue to maintain OHA. In 2008, the Hawai'i Supreme Court ruled in favor of OHA, permanently prohibiting the sale of all Ceded Lands. The Hawai'i Legislature passed Act 176 (2009) stating that none of the public lands in the State—whether Ceded Lands or not—can be transferred or sold without a two-thirds vote by both chambers of the Legislature (Dyke 2010). As Van Dyke states, Hawaiians have powerful claim to these lands. Until that claim can be addressed and resolved, there will be a “virtual moratorium” on any sale or transfer (Dyke 2010).

Mauna Kea is part of the Crown Lands—lands of the Monarchy prior to the 1893 overthrow of the Monarchy. Under the Hawai'i Constitution, Mauna Kea, like all Ceded Lands (which included the former Crown Lands), is held in trust by the State and managed for the benefit of the Native Hawaiian people and the public. Hawai'i State Law 171 requires that fair market rent be charged for all leasing of Ceded Lands (KAHEA 2015). It is noteworthy that those who have historically opposed telescope construction on Mauna Kea argue that the University of Hawai'i is in violation of HRS 171 since they have never paid fair market rent for the use of Mauna Kea. UH pays a symbolic \$1.00 per year for the use of Mauna Kea. UH, in turn, subleases the land on the summit to the various telescope institutions. In exchange for subleasing the land, UH receives compensation for observing time on the telescopes. A single night of viewing time on the Keck Observatory, for example, is valued at \$80,000 (KAHEA 2015). By gaining access to the world's best telescopes, UH greatly benefits from this sublease exchange. In 2001, the value of UH-owned patents resulting from astronomical development on Mauna Keas were estimated to be worth \$14 million (KAHEA 2015). It has been proposed that between \$45 and \$50 million dollars per year would be the fair market rent charged by the State to the international observatories for the use of Mauna Kea (KAHEA 2015).

### **3.3.2 The Mauna Kea Science Reserve**

Following Hawai'i's admission as a State into the United States in 1959, Hawai'i promulgated a new State Constitution for the governance of the State. Under Article XII of the State Constitution, Section 4 (Public Trust), “The lands granted to the State of Hawai'i by Section 5(b) of the Admission Act... shall be held by State as a public trust for native Hawaiians and the general public.” This provision of the State Constitution

has been referred to as the Public Trust Doctrine (Hawai'i 1978). Included within this state land is the Mauna Kea Science Reserve where the 13 telescopes currently reside and construction of the TMT is set to take place.

Shortly after its admission, Hawai'i created the Department of Land and Natural Resources (DLNR) to oversee and govern all state land (formerly "Ceded Lands"). The DLNR is responsible for managing, administering and exercising control over public lands, ocean waters, water resources, navigable streams, coastal areas and minerals. The department's jurisdiction is comprised of 1.3 million acres of state lands, beaches and coastal waters, and 750 miles of coastline. It controls state parks, historical sites, aquatic life and sanctuaries, forests and forest reserves, public fishing areas, boating and ocean recreation, wildlife and wildlife sanctuaries, game management areas, public hunting areas, and natural area reserves (Hawai'i 2015).

In 1968, a year after the University of Hawai'i Institute for Astronomy (UHIFA) was started, the DLNR granted UH a lease to all lands above 3,657-m. (12,000-ft.) elevation on Mauna Kea, a total of 11,288 acres (Group70 1983; pp. 2). UH established the Mauna Kea Science Reserve (MKSR) and was granted full authority for its operation and management. As stated in General Lease No. S-4191, the Reserve was created as a "scientific complex, including without limitation thereof an observatory, and as a scientific reserve being more specifically a buffer zone to prevent the intrusion of activities inimical to said scientific complex" (Group70 1983; pp. 2). The General Lease No. S-4191 was issued on June 21, 1967 with a commencement date of January 1, 1968 and a termination date of December 31, 2033. The University pays \$1.00 in rent to the DLNR for the lease of the MKSR (Resources 1968). The responsibilities and rights of the University of Hawai'i are stated in the lease as:

1. Maintenance of the premises in a clean and orderly fashion.
2. The right to develop improvements upon review and approval by the BLNR.
3. General liability resulting from negligence of UH.
4. Compliance with DLNR regulations and all other federal, state and county laws affecting land or improvement.

5. UH must not damage any cultural or historic site of value.
6. No planting of trees, shrubs or other vegetation except those approved by the Chairman of BLNR (Hawai'i 2000; pp. VIII-1).

A sub-section of the MKSR is the special land use zone called the Astronomy Precinct. The Astronomy Precinct encompasses 525 acres of the summit of Mauna Kea. 12 of the 13 telescopes are located within the Astronomy Precinct. The Very Large Baseline Array sits outside the Precinct at a lower elevation yet still within the Mauna Kea Science Reserve (Affairs 2015).

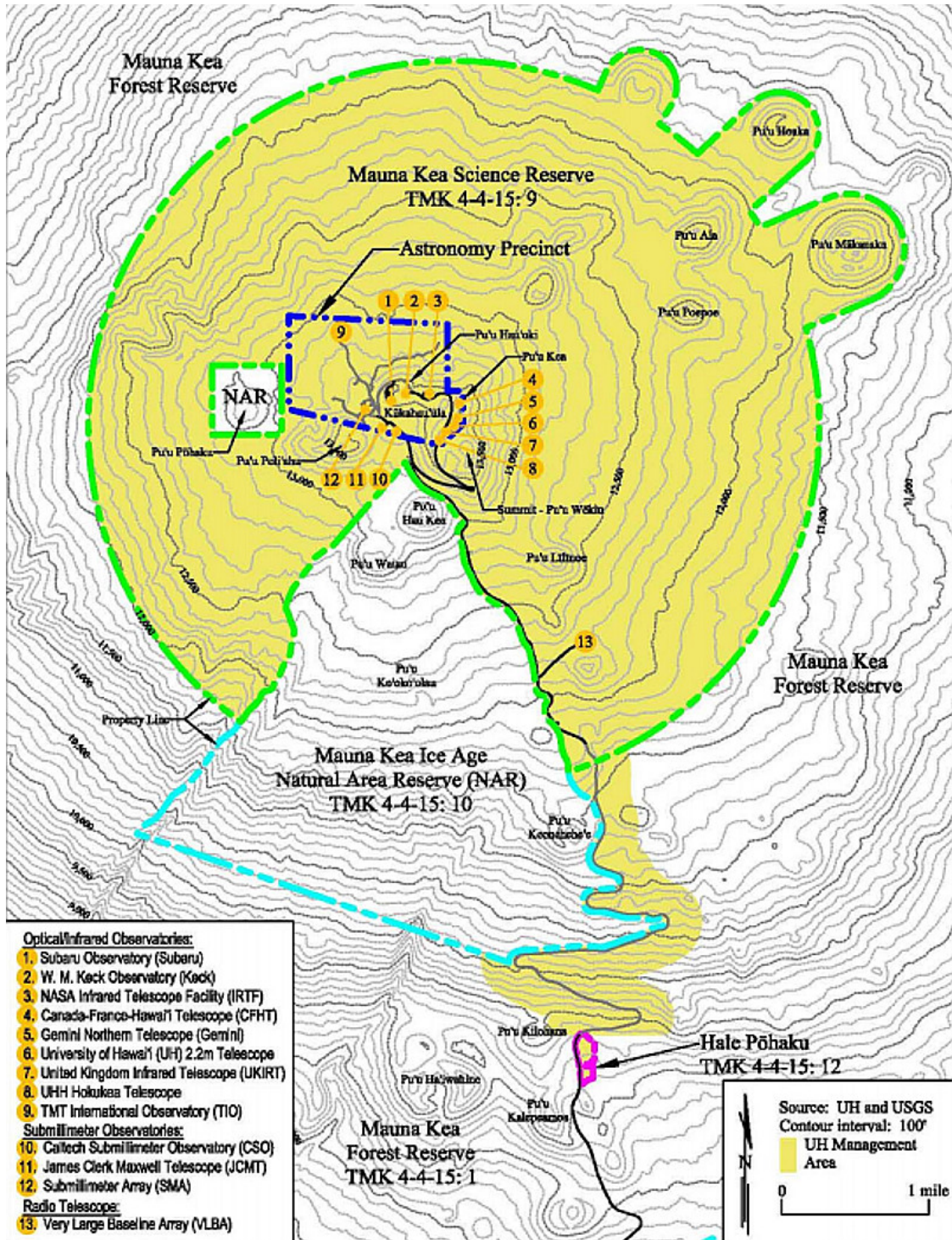


Figure 7: Mauna Kea Science Reserve and Astronomy Precinct (Hilo 2008; pp. 3)

The MKSR is also within a Soil and Water Conservation District (SWCD). Conservation lands are lands in forest and water reserve zones, and areas essential for protecting, such as: watershed and water sources, parks, wilderness, scenic and historical areas, open space, recreational areas, habitats of native plants, fish and wildlife, lands subject to flooding and soil erosion, and all submerged lands seaward of

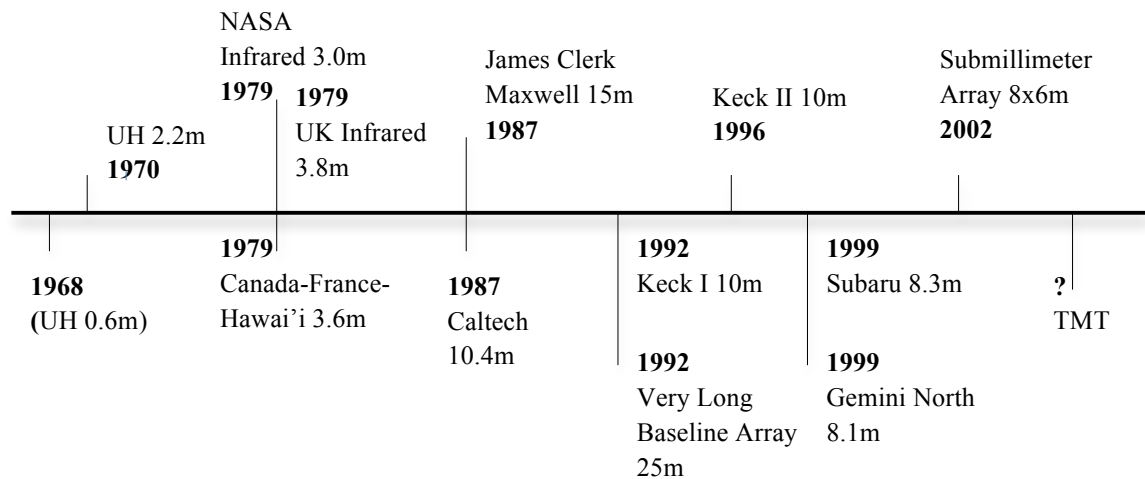
the shoreline (Resources 2015). There are 16 SWCDs in the State of Hawai'i that were formally established under the 1947 Hawai'i Soil and Water Conservation District Law known as Chapter 180 (Resources 2015). The United States Soil and Water Conservation Act of 1935 established the legal groundwork from which Chapter 180 was adopted. The 16 SWCDs in Hawai'i were created between 1948 and 1957, with some expansion of the districts up until 1990 (District 2015). Since 1967, the DLNR has managed and provided funding for the State's SWCDs.

Since 1968, the University of Hawai'i has been responsible for the management of the MKSR. Initially, there was no significant management plan for guiding and controlling development on the MKSR. As development increased, the public became concerned that astronomy interests would completely take over Mauna Kea (Group70 1983; pp. 2). Environmentalists were worried about impacts on the mountain's unique ecosystem, hunters were fearful that their access to the mountain would be limited, and others who used the mountain for recreational activities and cultural practices were concerned that their interests would be compromised (Group70 1983; pp. 2).

The public outcry resulted in the first comprehensive management plan adopted in 1977 called The Mauna Kea Plan. The Mauna Kea Plan was created to "recognize the world-wide significance of Mauna Kea's summit for astronomical research and set a limitation for facilities based on need and environmental concerns" (Group70 1983; pp. 3). The next phase in management plans occurred in 1982 with the adoption of the University of Hawai'i Research Development Plan (RDP). The RDP provided the programmatic plan for astronomy development on the MKSR to the year 2000 (Group70 1983; pp. 2). The RDP specified that a maximum of 13 telescopes could be allowed within the MKSR by the year 2000 (Group70 1983; pp. 9). The most current management plan, called the Mauna Kea Master Plan, was adopted on June 16, 2000. As will be discussed below, the 1998 Audit of the mismanagement of Mauna Kea was instrumental in initiating the Mauna Kea Master Plan. The Mauna Kea Master Plan is the framework for the protection and use of UH leased lands on Mauna Kea to year 2020 (Hawai'i 2000; pp. A-1). The Plan allows for the addition of one large telescope with a 25 to 50 meter mirror—the TMT (Hawai'i 2000; pp. ES-4).



# 4 Development of Astronomy on Mauna Kea



The first astronomers in the Hawaiian Islands were the Hawaiians themselves. The early Polynesians used the stars and land markers to navigate throughout Polynesia and the Pacific. It is believed that the first thing the Polynesian explorers saw when coming to the Hawaiian Islands was Mauna Kea. It was the beacon or “lighthouse” on which they navigated the Islands. Astronomy has always played a central role in Hawaiian history and navigation. As discussed later in this paper, the concept that the Hawaiians are “anti-astronomy,” or “anti-science” is erroneous. But for the Hawaiians, unlike other astronomers, Mauna Kea is not only a telescope to the stars, it is their sacred temple from which their *mana* (power) originates and their connection to the heavens and the *‘aina* (land) exists.

Soon after Hawai’i became a state in 1959, the newly-appointed Governor, John Burns, was encouraged to change the old ways of Hawai’i and push the State forward into the 20<sup>th</sup> Century (Jefferies 2015). Burns believed the University of Hawai’i, established in 1907, was in need of greater strength in order to facilitate this change. He appointed Thomas Hamilton as the new UH president and Bob Hiatt as the vice president. A major focus of UH became geophysics. With help from the federal government, UH established the Hawai’i Institute of Geophysics (Jefferies 2015). Among the first

members of the Institute was Walter Steiger. Steiger had been a part of the Physics Department at the University since receiving his M.S. there in 1950 (Steiger 2015).

Steiger was the first to envision a solar observatory on the summit of one of Hawai'i's many peaks. His dream became a reality in 1963 when the C.E. Kenneth Mees Solar Laboratory was completed on the summit of Haleakalā, a 3,055-m. (10,023-ft.) massive shield volcano on Maui Island. The observatory was named in honor of Dr. Mees, the vice president of the Kodak Company and a believer in the importance of Hawai'i for astronomy (Jefferies 2015). Two other sites for the observatory were considered on the Big Island—Mauna Loa and Mauna Kea. However, both were too remote and too difficult to access. Even though Haleakalā (3,055 m.) was lower than both Mauna Loa (4,169-m.) and Mauna Kea (4,205-m.), it still proved to be a superb site for astronomy (Jefferies 2015). The C.E. Kenneth Mees Solar Laboratory was the first observatory in Hawai'i, with the exception of a small sea-level observatory built at Makapu'u Point on the island of O'ahu in 1957 (Jefferies 2015).

Gerard Kuiper, a renowned astronomer and director of the Lunar and Planetary Laboratory in Tucson, Arizona, arrived to the Islands shortly after the Solar Laboratory was completed on Haleakalā (Group70 1983; pp. 17). Kuiper and his partner, Alike Herring, were in search of a site for their newly-developed 30-cm. (12-in.) telescope. Kuiper and Herring visited Haleakalā but were disappointed by the cloud layer that sometimes engulfed the summit and “spoil observing” (Jefferies 2015). While looking across the ‘Alenuihāhā channel that separates Maui from the Big Island, Kuiper saw the summit of Mauna Kea rising high above the clouds (Jefferies 2015). Kuiper was curious—could Mauna Kea be a better site for astronomy than Haleakalā?

The Hawai'i Chamber of Commerce and Governor Burns agreed to evaluate Mauna Kea as a potential site for astronomy. Governor Burns approved government funding for an access road to the summit of Mauna Kea (Jefferies 2015). Kuiper and Herring set up their 30-cm. (12-in.) telescope on *Pu'u Poliahu*, one of many *pu'u* or hills on the summit. Observations were gathered from the telescope for six months in 1963-64 (Jefferies 2015). Mauna Kea proved not only to be better than Haleakalā, but it was the “finest” astronomical site Dr. Kuiper had ever seen (Jefferies 2015).



With his finding, Dr. Kuiper submitted a proposal to National Aeronautics and Space Administration (NASA) to build a telescope on Mauna Kea. Rather than take Dr. Kuiper's proposal right away, NASA decided to invite UH and Harvard University to also submit their own proposals for a new telescope (Jefferies 2015). NASA was ready to 'exploit the exciting potentialities of the Mauna Kea site for astronomical purposes' (Maly 2005). John T. Jefferies, a theoretical solar physicist at the Hawai'i Institute of Geophysics, had recently arrived to the Islands to fit the new Mees Observatory on Haleakalā with instruments and conduct solar research (Good 2004). With the support of his colleagues, Jefferies decided to draft his own proposal for a new telescope and submitted it to NASA in 1965. The proposal included a 2.1-m. (84-in.) telescope, State provided support buildings, a road and power lines (Jefferies 2015). By submitting a proposal, Jefferies also encouraged the University to establish an astronomy institute at UH separate from the Hawai'i Institute of Geophysics. On July 1, 1965, NASA approved Jefferies' proposal and agreed to fund the project with \$3 million (Jefferies 2015).

Even though Mauna Kea was the chosen site for the new telescope, given its harsh weather conditions, high altitude and lack of infrastructure, sites on Haleakalā were also tested just in case Mauna Kea proved to be too extreme (Jefferies 2015). For six months, Jefferies and his team conducted tests on four sites on Mauna Kea and three on Haleakalā. Mauna Kea still proved to be the best location. However, the high altitude remained a concern. No other telescope in the world had been constructed on a mountain as high as Mauna Kea and the effects of the altitude on astronomers were unknown (Jefferies 2015). After a series of tests and input by experts, the altitude was considered not to be a "fatal hindrance" to the astronomers, as stated by Jefferies. The potential for scientific discovery was too high to be deterred by the hazardous conditions on the summit of Mauna Kea.

In March 1966, with site testing completed, NASA accepted Mauna Kea as the site for the new telescope. Construction on the telescope began in 1967. The project was completed in 1970 after much delay due to harsh weather conditions and difficulties working in the high altitude (Committee 2015). The 2.2-m. (88-in.), a slight expansion from its original 2.1-m. (84-in.), was the first construction on Mauna Kea and the seventh largest optical/infrared telescope in the world at the time (Committee 2015).

“The early results from the UH 2.2-meter telescope demonstrated to the world how good Mauna Kea is for astronomy,” as stated by UH. The telescope made many important discoveries over the years, the most notable being the discovery of the Kuiper Belt in the outer part of the Solar System. Prior to this discovery, Pluto was the only known object beyond the orbit of Neptune. Pluto was also discovered not to be the ninth planet, but instead, the largest known Kuiper Belt Object (Wainscoat 2005). The 2.2-m. (88-in.) telescope established Mauna Kea as the “pre-eminent site for ground based astronomy,” as stated by the Mauna Kea Astronomy Outreach Committee, and paved the way for many more telescopes to come (Committee 2015). During the construction of the 2.2-m. (88-in.) telescope, the United States Air Force submitted a proposal to build a 60-cm. (24-in.) telescope on Mauna Kea to map the sky. Their proposal was granted along with another 60-cm. (24-in.) telescope built by Lowell Observatory (Committee 2015).

In 1967, while the first telescope on Mauna Kea was in its early stages of construction, the Institute for Astronomy (IfA) at UH finally opened. IfA’s first director, John Jefferies, and his colleagues realized the importance of a research institute that could manage both current and future telescopes on Mauna Kea and Haleakalā, and be able to use the information gathered to advance astronomical research to the next level.

In 1971, France contacted IfA with an interest in Mauna Kea as the site for its own national telescope. French representatives visited Mauna Kea and quickly agreed that it was the best site they had ever seen (Jefferies 2015). Initially, the French wanted to build their own independent telescope but lacked the necessary funding to complete the project. Eventually, in 1973, France struck a deal with Canada and went back to Hawai’i to discuss a partnership with the State and the University (Jefferies 2015). Shortly thereafter, an agreement was reached to form the Canada-France-Hawai’i Telescope Corporation. Canada was in charge of polishing the mirror, putting in the control system and constructing the observatory building. France was given the responsibility of constructing certain mechanical parts for the telescope. Hawai’i contributed the site for the telescope, the road to the site and several instruments (Canada 2015). The agreement also allocated certain observing time to be given to each partner. Canada and France were each given 42.5 percent of the available observing time and Hawai’i (the IfA) with 15 percent (Canada 2015). The 3.6-m. (11.8-ft.)

Canada-France-Hawai'i Telescope was completed in 1979 at a cost of \$30 million (Committee 2015). The Canada-France-Hawai'i Telescope became the sixth largest and most powerful telescope in the world until the Hubble Space Telescope was completed in 1994 (Canada 2015). 1979 saw the dedication of two more telescopes on Mauna Kea: the 3.8-m. (12.5-ft.) United Kingdom Infrared Telescope and the NASA funded 3-m. (9.8-ft.) Infrared Telescope Facility operated by UH (Committee 2015).

In 1982, the United Kingdom submitted plans again for a 15-m. (49-ft.) telescope. The Netherlands joined as a partner in the project. An agreement with UH was signed and the telescope was completed in 1987. Named after the Scottish Physicist, the James Clerk Maxwell Telescope became one of the world's best observatories at sub-millimeter wavelengths (Committee 2015). At the same time as the James Clerk Maxwell Telescope was being completed, a 10.4-m. (34-ft.) telescope was also designed and installed in 1987. The 10.4-m. (34-ft.) telescope, called the Caltech Submillimeter Observatory, was designed by the Caltech Physicist Robert Leighton (Committee 2015). In 1989, the National Science Foundation was given a proposal to help fund two large US National telescopes. The proposal envisioned one telescope in the Northern hemisphere and one in the Southern Hemisphere. The National Science Foundation agreed to fund half of the project with \$88 million (Committee 2015). The UK, Argentina, Chile, Canada, Brazil and Australia agreed to split the cost to fund the other half of the project. Called the Gemini North, the 8-m. (26.2-ft.) telescope was built on the site of the Lowell Observatory 60-cm. (24-in.) telescope and completed in 1999. The Southern hemisphere telescope, called the Gemini South, was installed in Chile in 2002 (Committee 2015).

1991 marked an extremely important and transformative time for astronomy. The Keck I telescope, completed in November of 1991, gave astronomers the ability to observe faint objects at a rate that was previously impossible. For the first time, a team of astronomers and engineers at the University of California (UC) and the California Institute of Technology (Caltech) implemented a segmented mirror design for a 10-m. (32.8-ft.) telescope. The 36 hexagon-shaped segments, each 1.8-m. (6-ft.) in diameter, allowed engineers to construct a mirror infinitely lighter and more precise than any other mirror before (Space 2015). With the success of Keck I, the W. M. Keck Foundation donated enough funds to build a second telescope. The 10-m. (32.8-ft.)

Keck II was completed in 1996 using the same segmented mirror design. The Keck telescopes have made many discoveries during their time on Mauna Kea. Among the most significant discoveries have been: the first observation of a planet eclipsing a star, the existence of a black hole with a mass equivalent to 3,600,000 Suns in the Milky Way Galaxy, and the discovery of the largest dwarf planet Eris (DeVorkin 2013). The segmented mirror design of the Keck telescopes changed the way modern telescopes were built. No longer would weight limit the size of the mirror. Bigger telescopes could and would be built.

In 1992, Mauna Kea received one of ten Very Long Baseline Array antennas. The Very Long Baseline Array is a system of ten radio-telescope antennas, each with a 25-m. (82-ft.) diameter. The ten radio dishes are spread across the US from Hawai'i to the US Virgin Islands (Observatory 2015). Data from each antenna is compiled and put together to simulate one giant telescope with an aperture of 8,500-km. (5,281-m.) (Committee 2015). The Very Long Baseline Array has an ability to see fine detail equivalent to standing in New York and reading a newspaper in Los Angeles (Observatory 2015).

At the same time as the Very Long Baseline Array antenna was being installed, Japan began construction of an 8.3-m. (27-ft.) telescope on Mauna Kea. The Japanese National Large Telescope, later called Subaru, was Japan's first national project outside of Japan (Committee 2015). The project was completed in 1999 and to this day remains Japan's most coveted astronomical facility. In 2003, the Smithsonian Astrophysical Observatory and the Institute of Astronomy and Astrophysics in Taiwan collaborated to create the Smithsonian Submillimeter Array, an array of eight 6-m. (19.6-ft.) dishes. The eight dishes are clustered on the summit of Mauna Kea and are routinely moved around with a forklift to maximize resolution and observational distances (Observatory 2015).

In early 2000s, NASA collaborated with the University of Hawai'i Institute for Astronomy (UHIFA) to begin work on a new project on Mauna Kea. The Outrigger Telescopes Project was to be a group of six 1.8-m. (70-in.) telescopes in 11-m. (36-ft.) high domes that would be placed adjacent to the two 10-m. (32.8-in.) Keck Telescopes (Project 2009). The six telescopes were designed to use a technique called interferometry to work in partnership with the Keck telescopes. This technology could produce clearer

images and allow astronomers to look deeper into space (Project 2009). NASA funded \$50 million for the project as part of their Astronomical Search for Origin project (Apgar 2003). However, due to growing opposition to astronomical development on Mauna Kea, as will be discussed below, the Outrigger project was never completed.

Currently, 13 telescopes stand on or near the summit of Mauna Kea. No new telescopes have been built on Mauna Kea since the completion of the Smithsonian Submillimeter Array in 2003. In 2008, UH upgraded one of their observatories. They also decommissioned their 60-cm. (24-in.) telescope and replaced it with a new 91-cm. (36-in.) telescope (Hilo 2012). UH received funding from the National Science Foundation. The telescope is used by both faculty and students from the University (Hilo 2012). As will be seen, as development on Mauna Kea grew, so did the opposition, albeit gradually at first.

## **4.1 Growing Opposition to Astronomical Development on Mauna Kea**

As telescope construction on Mauna Kea increased, so did the first noticeable signs of opposition. Although there had been protests against any sort of development on Mauna Kea from the start, it wasn't until 1975 that enough people organized to oppose and ultimately stop the construction of a telescope. The United Kingdom (UK) proposed to build a 15-m. (49-ft.) sub-millimeter antenna to study short radio wavelengths emitted by vibrating molecules in space. However, because of opposition to more development on Mauna Kea from the Audubon Society, environmentalists and hunters, the UK looked to an alternative site in Spain (Committee 2015). Noticeably absent from the opposition were the Native Hawaiians. Many have theorized that the lack of an organized opposition among the Native Hawaiians to further construction on Mauna Kea during the 1970's and 1980's was the result of more than a hundred years of oppression suffered at the hands of missionaries, business people and a government that considered them to be a second-class society. It was not until the late 1980's and early 1990's that the Hawaiians began to coalesce behind the sovereignty movement and other indigenous rights efforts that the Hawaiians found their voice as a people and began to understand what was happening to their sacred mountain.

As Swanner writes in “Contested Spiritual Landscapes in Modern Astronomy,” “For the first time in the history of the discipline, astronomers were asked to assess the impact of their science on the mountain environment” (Swanner 2015; pp. 153). The impacts of astronomy on Mauna Kea’s unique and fragile ecosystem were unknown in the early days. The Hawai’i Audubon Society was one of the first organizations to question the environmental impacts astronomy was having on the mountain. The Audubon Society was concerned that an increase in activity—both development and use—on Mauna Kea would greatly impact the endangered *Palila* bird and its habitat. The *Palila* was the last of the finch-billed Hawaiian honeycreepers to exist on the Big Island (Gordon 2007; pp. 139). The endangered bird fed exclusively on the *Māmane* tree that grew on the slopes of Mauna Kea between 1,980-m. (6,500-ft.) and 3,048-m. (10,000-ft.) (Gordon 2007; pp. 139). Environmentalists were also concerned about the rare *Wēkiu* bug found only on the summit area of Mauna Kea. By the mid-1990’s, after more two decades of telescope building on the mountain, no in-depth study of the effects of astronomical development on the environment and natural habitat had ever been conducted. That all changed when the State of Hawaii conducted its audit of the MKSR in the late 1990’s.

The growth of astronomy and related development on Mauna Kea resulted in increased scrutiny by the State of Hawaii and raised concerns that UH and the DLNR had failed to abide by their statutory obligations to be good stewards of the *Mauna*. In 1997, as the result of widespread criticism of the ongoing management of Mauna Kea, the Hawai’i State Legislature requested that the State Auditor conduct a comprehensive audit of the management of the MKSR. The audit report stated:

We found that the University of Hawaii’s management of the Mauna Kea Science is inadequate to ensure the protection of natural resources. The university focused primarily on the development of Mauna Kea and tied the benefits gained to its research program. Controls were outlined in the management plans that were often late and weakly implemented. The university’s control over public access was weak and its efforts to protect natural resources were piecemeal. The university neglected historic preservation, and the cultural value of Mauna Kea was largely unrecognized (Higa 1998, pp. I).

It is clear from the state audit that UH and the DLNR had failed to properly manage the MKSR. What had been promised in previous management plans had been significantly

overlooked. Trash was accumulating, old testing equipment had not been removed and permit regulations went routinely unenforced (Higa 1998).

The use of Conservation District lands, which includes the MKSR, is outlined in Chapter 13-5 of the Hawai'i Administrative Rules: "Conservation District" and Chapter 183C of the Hawaii Revised Statutes. In order to use conservation lands, a Conservation District Use Application (CDUA) must be filed and fulfill certain requirements that ensure protection of the natural resources within the District. Once the application is approved, a Conservation District Use Permit is granted (CDUP) (Resources 2015). The State of Hawai'i, through the DLNR, leased the lands on the summit of Mauna Kea to the University for scientific research. Because the lands are in a Conservation District—the Mauna Kea SWCD established in 1955—the University had to abide by all rules and regulations when using lands in a Conservation District. However, as stated in the state audit, UH was far too focused on astronomical development and enhancing its prestige than protecting Mauna Kea's natural resources (Higa 1998).

One of the greatest concerns voiced in the state audit was the University's neglect of historically and culturally significant sites on the mountain. The original lease stated that the University 'shall not damage, remove, excavate, disfigure, deface, or destroy any object of antiquity, prehistoric ruin, or monument of historic value' (Higa 1998; pp. 21). However, due to a lack of proper management and recognition of the cultural significance of the Mauna Kea, damage had occurred to historic sites (Higa 1998; pp. 21). In 1986, when the DLNR proposed to place Mauna Kea's summit on the State and National Register of Historic Places, UH protested. The University was concerned that the designation of Mauna Kea as a Historic Place would threaten astronomic development on the summit (Higa 1998; pp. 22). The University promised it would protect historic sites on the summit equal to the protection given when placed on the National Register (Higa 1998; pp. 22). As made clear in the state audit, UH had failed miserably to abide by its legal obligations to prevent historical, cultural and environmental degradation to Mauna Kea.

The 1998 state audit recommended that UH and the DLNR create a new master management plan and environmental impact statement for the ensuing two decades. The audit required the new plan to clearly identify areas best suited for astronomical development, areas exempt from development and critical habits of rare or endangered

species. It also required the University and the DLNR to develop rules and regulations, hire rangers, remove trash and old equipment, and new methodology to measure the impact of future astronomical projects (Higa 1998). As discussed below, the 13 telescopes currently on Mauna Kea, and the proposed construction of the TMT, present a direct challenge to UH's and the DLNR's management responsibilities on the mountain. By some accounts, UH and the DLNR have not fulfilled their obligations to adequately protect Mauna Kea even after the state audit was highly critical of their efforts to date. The construction of the world's largest telescope on the mountain will only exacerbate the problem further.

Following the State's audit of the MKSR in the late 1990's, awareness of the environmental and cultural impacts on Mauna Kea grew. This coincided with a growing sense of self-identity among the Native Hawaiians, including the emerging sovereignty movement aimed at reestablishing the sovereign Hawaiian Monarchy. More and more, Native Hawaiians organized themselves around protecting their spiritual, historical and cultural roots, including opposing further construction of telescopes on top of their sacred temples.

#### **4.1.1 The Defeat of the Outrigger Telescopes on Mauna Kea**

In 2002, the Office of Hawaiian Affairs (OHA), a public agency responsible for protecting and improving the well-being of Native Hawaiians (Affairs 2015), filed a lawsuit in the United States District Court in Honolulu against NASA and UHIFA forcing both partners to produce a full Environmental Impact Statement (EIS) of the impacts of the Outrigger Telescopes project on the cultural and natural resources on Mauna Kea (Omandam 2002). NASA had consulted with native Hawaiian groups about the development plan as required by the National Historic Preservation Act and produced an Environmental Assessment (EA) finding the Outrigger telescopes to have "no significant impact on Mauna Kea" (Omandam 2002). However, OHA found the prior assessment to be far too brief and accused NASA of ignoring the Native Hawaiian community's voice in opposition to the project. "The Native Hawaiian community has clearly spoken on the issue of Mauna Kea," said OHA Chairwoman Haunani Apoliona. "It is one of our most sacred cultural resources. The community has repeatedly told NASA that its project will have very damaging effects on this treasured resource, but



NASA has simply ignored us” (Omandam 2002). In the lawsuit, OHA also stated, “[By] fixing their gaze on distant stars, the astronomers fail to see what is right before their eyes: the irreplaceable cultural and natural resources of Mauna Kea” (Tytell 2003).

In July 2003, United States District Court Judge Susan Oki Mollway ruled in favor of OHA holding that NASA and UHIFA had failed to adequately examine the overall impact of the construction of the six telescopes. NASA was ordered to complete a thorough Environmental Impact Statement (EIS) before any further construction on the site could take place (Apgar 2003). After months of legal arguments, in November 2003 NASA finally agreed to begin work on an EIS for the Outrigger Telescopes Project. The study for the statement cost an estimated \$1million and took a year to complete. The Outrigger EIS was the first federal impact statement that had been prepared to evaluate the cultural and environmental impacts of astronomy on Mauna Kea (Viotti 2003). NASA began public scoping meetings in January 2004 to provide the public with the opportunity to voice their concerns with the project, which included environmental, social, cultural, religious and economic issues (KAHEA 2003).

In August 2004, a draft of the EIS was released stating that, “From a cumulative perspective, the impact of past, present, and reasonably foreseeable future activities on cultural and biological resources is substantial, adverse and significant. [However] in general, the Outrigger Telescopes Project would add a small incremental impact” (Project 2009). In October 2004, prior to the final completion of the EIS, the DLNR voted to approve a state conditional use permit for construction of the Outrigger Telescopes (Project 2009). By December, a group of opponents to the project consisting of a native activist organization known as Mauna Kea Anaina Hou, the Sierra Club’s Hawai’i Chapter, the Royal Order of Kamehameha I, and a Native Hawaiian with genealogical ties to Mauna Kea, filed a lawsuit against the DLNR and UH. The lawsuit contested the granted use permit, claiming the Outrigger project would exceed the limit of 13 telescopes allowed on the mountain in the DLNR management plan. Mauna Kea already had 13 telescopes—more than any other high peak in the world (Dayton 2004).

The lawsuit lasted in court for two years. Native Hawaiians, local residents, and cultural and environmental experts testified in the opponents’ favor, stressing the cultural and environmental damage already inflicted on Mauna Kea and the struggle to prevent further damage (Project 2009).

In early 2006, with the lawsuit still ongoing, NASA published a draft of its 2007 budget. To the surprise of many, no money was included in the draft to complete the Outrigger Telescopes project. The federal government had already spent \$20 million on the project and it would take another \$25 million to complete (Dayton 2006). By June, NASA had officially cut funding for the project. UH and Keck began searching for alternative funding from private sources but it became increasingly difficult to replace the funds previously promised by NASA (Dayton 2006). The Outrigger project faced another setback on August 3, 2006 when Judge Glen Hara of the Hawai'i Circuit Court revoked the land use permit for the project stating that the management plan for the project was not comprehensive enough. 'The resource that needs to be conserved, protected and preserved is the summit area of Mauna Kea, not just the area of the project,' said Judge Hara (Young 2006).

The ruling to reverse the permit was a victory for the opponents of the Outrigger Telescopes project. It set a new precedent for the way in which future development on Mauna Kea would be approached. 'The decision has potentially major implications on the future of development of astronomy on Hawai'i,' said Lea Hong, who represented the opponents of the Outrigger Telescopes. 'Resource management has been ignored for a long time,' she said (Young 2006). Up until this point, the UHIFA has sole responsibility for the management of Mauna Kea's astronomy sites. Opponents of the telescopes used this decision to voice their desire to see a group separate from the UH that would oversee resource management on Mauna Kea (Young 2006). Although an alternative site in the Canary Islands was proposed for the project, the Outrigger Telescopes still have yet to be fully funded. Rolf Kudritzki, director of the UHIFA, said the cut for funding for the Outrigger project by NASA was a 'loss for science,' and he is fearful that the United States is falling behind in research and science (Dayton 2006). 'That's shameful as a nation, that in the 21<sup>st</sup> Century, when science is crucial to our very existence... this is the way we have chosen to move forward. It's more than a shame – it's a disgrace, really,' said Kudritzki (Dayton 2006).

The Native Hawaiians, needless to say, saw this development very differently. Although not uniform in their views of astronomy on Mauna Kea, the many Native Hawaiians who opposed further development on Mauna Kea saw this as a vindication of their rights as an indigenous people to protect their sacred lands and prevent further

desecration of their spiritual and cultural heritage. As will be seen, however, the proposed construction of the TMT dashed any hopes the Hawaiians had that the State of Hawai'i would work to protect their interests.

## **4.2 The Thirty Meter Telescope**

The TMT is slated to be the “most advanced and powerful optical telescope on Earth” (TMT 2015). The Gordon and Betty Moore Foundation, the head funders of the project, state that the TMT will enable astronomers to “unlock mysteries about the nature of the universe” and “holds the potential for discoveries that will benefit not just the international science community, but all of humankind” (Foundation 2015). The TMT is scheduled to be fully operable by 2021. How the TMT project came into being is crucial to an understanding of how it embodies and exemplifies the disconnect between man and nature in Hawai'i.

Before telescopes, people just looked up at the stars with their eyes and only imagined what was out there. It wasn't until Galileo that the potential for discovery was realized. In 1609, with his tiny one-inch (2.5-cm.) telescope, Galileo discovered the moons going around Jupiter and the phases of Venus. Earth was no longer at the center of the universe but rather the Sun, reaffirming Copernicus' model of a helio-centric solar system. “That kind of magnitude of re-understanding has been going on every time you build bigger telescopes. So that's why we build bigger telescopes” said Michael Bolte, UC Astronomer and TMT Board Representative, in an interview conducted on December 8, 2014 (Bolte 2014).

As described by Bolte, telescopes require big pieces of glass to focus the light. However, as glass gets bigger and bigger, it starts to wobble and loses the stiffness necessary for proper focus. In the late 1800s, engineers and astronomers started to develop telescopes with mirrors as the primary optical element. Mirrors could be supported from the back, which allowed for bigger telescopes to be built. In 1948, using the most modern and advanced construction techniques, the Hale Telescope, located at the Palomar Observatory in San Diego, California, became largest telescope to be built. The Hale's primary mirror was 5.1-m. (200-in.) in diameter and used a piece of glass that weighted 14.5 tons, with a thickness ranging from 49.8-cm. (19.6-in.) at the center

to 59.7-cm. (23.5-in.) at the edge (Observatory 2014). Because glass is not perfectly stiff, as the telescope tilts, gravity causes the mirror to deform. In order to stop the mirror on the Hale telescope from deforming, the glass had to be of sufficient magnitude. According to Bolte, many thought the Hale would be the biggest telescope and biggest mirror ever to be built because of the “self-weight problem” (Bolte 2014).

The Hale telescope was the biggest telescope for nearly 40 years. The first attempt at surpassing the 5.1-m. (200-in.) mirror barrier occurred in the 1980s. Engineers developed a computer-controlled mirror that was made from a series of glass hexagon segments with sensors around the edge to detect and correct any slight movement. By breaking the glass into segments, bigger mirrors could be built. The first telescope to use the new mirror system was the Keck I telescope built on Mauna Kea in 1993, with a primary mirror of 10-m. (32.8-ft.) in diameter and 36 hexagonal segments. The Keck I was a success. This led to the development and completion of Keck II in 1996 (Observatory 2015). “Keck I and Keck II changed the way people thought about big telescopes,” said Bolte (Bolte 2014).

After 15 years, the developers of the Keck telescopes were approached about how to take the segmented mirror concept to build a really big telescope (Bolte 2014). Bolte, along with Jerry Nelson and Terry Mast of UC Observatories, worked to figure out how big the next generation giant telescope could be. “We decided 30-meters was about right for sciences’ leap forward, cost and risk,” said Bolte, and, ‘An attractive and achievable scientific ‘sweet spot,’” as stated by the TMT creators (TMT 2015).

The 2001 publication “Astronomy and Astrophysics in the New Millennium” by the Astronomy and Astrophysics Survey Committee of the National Academy of Sciences was very influential in helping Bolte and his team decide on the size and structure of the new telescope. The Survey Committee was created out of the growing need in the astronomy and astrophysics community to develop new ground and space-based programs for the coming decade 2000 to 2010 (Council 2001; pp. XV). Nine panels were arranged with over 100 members ranging from National Academy of Sciences Astronomy Section, members of astronomy departments in US universities and other leading astronomers (Council 2001; pp. XVI). Each panel submitted reports that identified key scientific goals in the respective areas, new initiatives to fulfill these goals and recommendations for technology development (Council 2001; pp. XVII).

The Survey Committee's number one ground-based suggestion and second priority overall was a 30-m. (98.5-ft.) telescope powerful enough to study the evolution of intergalactic medium and to trace the history of star and planet formation in differing galaxies (TMT 2015). As stated in the publication, a telescope of this magnitude would be necessary to fulfill the long-term goal of the 21st Century to “develop a comprehensive understanding of the formation, evolution, and destiny of the universe and its constituent galaxies, stars, and planets—including the Milky Way, the Sun, and Earth” (Council 2001; pp. 52).

In 2003, three partners founded the nonprofit TMT Observatory Corporation: the Association of Canadian Universities for Research in Astronomy, the University of California (UC) and the California Institute of Technology (Caltech). The TMT project combined three already existing large-telescope projects: California Extremely Large Telescope, a partnership between Caltech and UC; Very Large Optical Telescope, led by Association of Canadian Universities for Research in Astronomy; and the Giant Segmented Mirror Telescope, a partnership between the National Optical Astronomical Observatory and the Gemini Observatory (TMT 2015). The three earlier projects and the TMT had almost identical goals—“to marshal lessons-learned from today's leading observatories and use that foundation to push the frontiers of technology thereby enabling astronomy research that has proven to be beyond the current generation of frontline facilities”—making the merge both practical and necessary to achieve the goals laid out (TMT 2015).

A Science Advisory Committee was created by the TMT Corporation made up of representatives from the partner institutions and the larger science community. The Committee convened to discuss how to pair the demands of the scientific community and the future of astronomy with the technical capabilities of the TMT (TMT 2015). As a result of the meetings, the Committee created the Detailed Science Case for TMT. The Detailed Science Case for TMT presented big questions that the Committee believed the TMT could address in the coming decades, which included: What is the nature and composition of the Universe? When did the first galaxies form and how did they evolve? What is the relationship between black holes and galaxies? How do stars and planets form? What is the nature of extra-solar planets? Is there life elsewhere in the Universe? (Committee 2007; pp. 7-8).

Between 2005 and 2006, the TMT partners dedicated \$17.5 million to the project. The official design and development of the observatory and the telescope also took place (TMT 2015). By 2009, with \$77.1 million funded by the Gordon and Betty Moore Foundation, the Association of Canadian Universities for Research in Astronomy, and the Association of Universities for Research in Astronomy, TMT completed the five-year Design Development Phase. In April 2009, with an additional \$30 million of a \$200 million commitment by the Moore Foundation, TMT completed its Early Construction Phase. By the end of 2014, the TMT Master Agreement was signed by all partners. The Agreement defined the project goals, created a governance structure, and outlined member party rights and obligations (TMT 2015). The signing members were: Association of Canadian Universities for Research in Astronomy, The California Institute of Technology (Caltech), The Indian Institute of Astrophysics, The National Astronomical Observatories of the Chinese Academy of Sciences, The National Optical Astronomy Observatory of Japan, and the University of California (UC) (TMT 2015).

The TMT Corporation tested sites all over the world in order to find the best location for the project. The site selection process started in 2001 with a collaboration between New Initiatives Office of The Association of Universities for Research in Astronomy and the California Extremely Large Telescope. Five sites were initially selected as candidates for the TMT: Cerro Tolmar in Chile, Cerro Armazones in Chile, Cerro Tolonchar in Chile, San Pedro Martir in Mexico and Mauna Kea in Hawai'i (Team 2008; pp. 9-12). Each site was tested in accordance with a series of requirements outlined by the TMT Corporation and its partners. As stated in the TMT Site Testing Final Report, "The TMT site needs to be suited for producing astronomical data of superb quality and for building and operating an observatory of the size and complexity of TMT" (Team 2008; pp. 6). "The site selection process involves measuring and predicting both the technical and programmatic properties of the sites and balancing them as to determine the site that best meets the TMT needs" (Team 2008; pp. 6). Science-based requirements included: a high fraction of clear nights, high altitude, low perceptible water vapor, low typical temperatures and low wind speed. Cost related requirements included easy physical access for minimizing construction costs and good human access for minimizing operating costs. Other issues taken into account in the site selection process included: cultural, environmental and land issues, obtaining legal

possession of the site, construction schedule, proximity to astronomers and astronomy infrastructure, and economic impacts (Team 2008; pp. 7-8).

All five candidate sites went through extensive on and off site testing. In 2008, the TMT Observatory Corporation board of directors selected two sites for final consideration, the northern hemisphere site of Mauna Kea on the Big Island of Hawai'i and the southern hemisphere site of Cerro Armazones in the Atacama Desert of Chile (Nadin 2008). Finally, in 2009, the TMT Observatory Corporation selected Mauna Kea as the preferred site for the TMT (TMT 2015). As Bolte stated in an interview with the author in 2014:

We tested sites all over the world. We had two sites that were obviously outstanding; one was Mauna Kea, one was in Chile on a Mountain called Armazones in the Atacam Desert. So, we had to decide. We went back and forth. One of the reasons we liked Mauna Kea is because the Kecks are up there. One of our partners, Japan, also has a big telescope, Subaru. The idea of having a northern hemisphere best observing site in the world where we could use all these telescopes synergistically, that was a pretty powerful motivator. Plus it's on US soil. And it's an absolutely spectacular site. We like to say it's the best window to the universe on earth (Bolte 2014).

“The atmospheric conditions, low average temperatures, and very low humidity will open an exciting new discovery space using adaptive optics and infrared observations. Working in concert with partners' existing facilities on Mauna Kea will further expand the opportunities for discoveries,” said Edward Stone, Caltech's Morrisroe Professor of Physics and vice chairman of the TMT board (TMT 2009).

The proper atmospheric conditions, low temperatures and humidity along with Mauna Kea already being the home to many of the world's top telescopes, made Mauna Kea the best fit for the TMT (TMT 2015)—“Because the TMT partners operate existing observatories at Mauna Kea, it will be possible to integrate our planning much better in terms of scientific programs, the instruments we build, and possibly even sharing key technical staff,” said Bolte (McNulty 2009). With the site selected, the TMT partners got down to work on actually building the telescope. First, they needed the permission of the State of Hawai'i (DLNR), which would require a complete assessment of the

environmental and cultural impacts of building a mammoth telescope on top of a fragile and sacred temple.

## 4.3 Environmental Impacts of Telescope Construction

Although astronomy is considered to be a relatively “clean” industry, the construction of telescopes on Mauna Kea has caused considerable damage to the mountain environment. As stated in the 2010 TMT Environmental Impact Statement (EIS), the impact of past and present telescope construction on the Mauna Kea environment has been “substantial, significant, and adverse” (Hilo 2010; pp. S-8). The greatest cause for concern has been the loss of suitable habitat for endemic species found only on the summit and slopes of Mauna Kea. Other concerns include the use of hazardous materials and the contamination of the Mauna Kea freshwater aquifer. Mauna Kea’s unique and fragile ecosystems make it very vulnerable to the disturbances caused by telescope construction and use. There is great concern that the TMT will continue to exacerbate the damage that has already occurred.

### 4.3.1 Impact on Endemic Species

The *Wēkiu* bug is endemic to the summit area of Mauna Kea. *Wēkiu* is the Hawaiian word for “summit” (Pukui and Elbert 1986). It is an insect predator-scavenger that can tolerate the extreme low temperatures on the summit (L.L.C. 2000; pp. 4). It feasts exclusively on low-elevation insects that are deposited on the summit by wind or immobilized by the cold. It lives in cinder cones above 3,505-m. (11,500-ft.), ranging in size from 3.5 to 5-mm. long (L.L.C. 2000; pp. 4). The *Wēkiu* bug has specific compounds in its blood that allows it to continue normal activities at sub-freezing temperatures (L.L.C. 2000; pp. 5). The *Wēkiu* bug spends most of its time below the surface of loose volcanic cinder on the inner slopes of *pu’u* craters (L.L.C. 2000; pp. 5).

From 1982 to 1996, the *Wēkiu* bug experienced a significant decline in population. The exact cause of the drastic decline was unknown. From the results of a 1999 arthropod study, it was hypothesized that habitat loss due to construction of telescopes, competition from introduced species, climate change, downward trend in winter snowpack depth and



persistence, and environmental contaminants from human activity, all played a role in the decline of the *Wēkiu* bug population (Howarth 1999). The summit of Mauna Kea is made up of three cinder cones, *Pu'u Hau 'Oki*, *Pu'u Wēkiu* and *Pu'u Kea*, all of which are *Wēkiu* bug habitat. Studies from 1982 revealed that *Pu'u Hau 'Oki* had the highest population of the *Wēkiu* bug. The study recommended limiting construction on the cinder cone because any disturbance to the area would impact the *Wēkiu* population (Higa 1998; pp. 24). Unfortunately, the construction of the twin Keck and Subaru observatories filled and cut in the *Pu'u Hau 'Oki* crater walls, destroying critical *Wēkiu* bug habitat (Higa 1998; pp. 24).

Currently, the *Wēkiu* bug is a candidate for listing as “Threatened” under the Endangered Species Act (Hilo 2010; pp. S-4). Habitat restoration efforts have helped to increase the population but there is great concern that the TMT project will disrupt any progress that has been made. The final Environmental Impact Statement (EIS) for the TMT outlined the ways in which the project will help to mitigate destruction of *Wēkiu* bug habitat. According to the EIS, the location of the TMT, called 13N in Area E, was chosen because it not only provided suitable observation conditions but also minimized impact on the *Wēkiu* bug (Hilo 2010; pp. S-1). In a 2009 sampling study, no *Wēkiu* bugs were found in Area E but were found in the cinder along the Access Way (Hilo 2010; pp. 3-63). The TMT Observatory and Access Way will disturb roughly 8.7 to 9 acres of land in the Mauna Kea Science Reserve, of which 2.5 acres have previously been disturbed by existing roads (Hilo 2010; pp. S-6). Nearly 6 acres of *Wēkiu* bug habitat will be newly disturbed. However, most of the newly disturbed acreage is not considered optimal for *Wēkiu* bugs, and therefore, according to the EIS, construction of the TMT and Access Road will not have a significant impact on the *Wēkiu* bug (Hilo 2010; pp. 3-72).

The results of the 2010 EIS findings have been highly disputed by environmentalists and others opposed to the TMT. Deborah J. Ward, retired faculty member of the UH Department of Natural Resources and Environmental Management and petitioner against the TMT, has been a long-time advocate for the *Wēkiu* bug. According to Ward, construction of the TMT and related infrastructure including a new access road will act as barriers impeding *Wēkiu* bug movement around the summit. “Further,” she writes, “habitat degraded by human impact such as dust, compaction, foot traffic, run-off and

pollution from organic and inorganic sources can alter the physical environment for the species. Isolated populations may thrive or suffer losses independently, and barriers to expansion into nearby habitat may hinder repopulation” (Ward 2011).

The Mauna Kea Silversword is a plant endemic to the alpine areas of Mauna Kea. This subspecies of plant was added to the federal list of endangered species without critical habitat in 1986. Its Hawaiian name, ‘*Āhinahina*, translates to “very gray” (Powell 1994; pp. 2) The Mauna Kea Silversword has dagger like leaves that grow in bunches called rosettes and are covered in layers of silvery hairs. The rosettes can grow to be anywhere from 76 to 152-cm. (30 to 60-in.) in diameter. Mature Silverswords produce a flowering stalk up to 300-cm. (118-in.) tall with hundreds of flowers. Silverswords can live from 3 to 50 years before flowering. After flowering, the entire plant dies (Powell 1994; pp. 3). The Silversword was abundant on all slopes of Mauna Kea between 2,600 and 3,800-m. (8528 and 12,464-ft.). In the late 18<sup>th</sup> Century, sheep and goats were introduced to the Big Island by ship captains. By 1930s, the population of sheep and goats reached around 40,000 on Mauna Kea. Browsing of these animals attributed to the drastic decline in Silversword populations. In 1991, the total populations of naturally occurring Silversword on Mauna Kea was 38 individuals (Powell 1994; pp. 1). Starting in the 1980s, the federal government ordered the removal of sheep and goats from Mauna Kea. These efforts have been somewhat helpful in the recovery of the Silversword. Reintroduced Silverswords have helped to raise the population to the 1,000s, although natural occurring plants still remain drastically low.

Construction of the TMT on the summit of Mauna Kea does not directly affect the Silversword because its habitat does not occur at such a high elevation. However, as part of the TMT Project, an accompanying Mid-Level Facility will be built at the Hale Pōhaku Visitors Center at 2,804-m. (9,200 ft.). The 19.3-acre Hale Pōhaku is part of a State of Hawai’i Conservation District recourse subzone and is leased by University of Hawai’i. Facilities at Hale Pōhaku include: food and lodging structures for scientists working at the summit observatories, the Visitor Information Station, and storage for equipment needed for road maintenance and snow removal (Hilo 2010; pp. S-5). The lower part of Hale Pōhaku is also used for the staging of telescope construction on the summit. The area of Hale Pōhaku is critical habitat for the Mauna Kea Silversword. Construction at Hale Pōhaku has resulted in the removal of *Māmane* forest and

Silversword habitat. However, as stated in the EIS, the cumulative impact of current facilities has been less than significant (Hilo 2010; pp. 3-217). All significant impacts on Hale Pōhaku ecosystems were from past mismanagement of the sheep and goat populations (Hilo 2010; pp. 3-217). There are currently no wild Silversword individuals at Hale Pōhaku. However, there has been a few Silverswords planted within an enclosure behind the Visitor Information Station as part of recovery efforts (Hilo 2010; pp. 3-67).

Hale Pōhaku is also the critical habitat of the endangered *Palila* bird. The *Palila* bird is another endemic species to Hawai'i. It is found only on the upper slopes of Mauna Kea. The bird depends on the *Māmāne* tree for over 90 percent of its food (Farmer 2014; pp. 3). Destruction of the *Māmāne-Naio* forest from browsing sheep, goats and cattle has been the greatest factor in the decline of *Palila* bird populations. Severe drought conditions have also attributed to the decline. The *Palila* Restoration Research project from 1996-2012, initiated by the U.S. Geological Survey, revealed that the bird is found in only 5 percent of its historical range on the upper slopes of Mauna Kea (Farmer 2014; pp. 1). From 1998-2012, the *Palila* bird population was estimated to be at its peak in 2003 with 6,463 individuals (Farmer 2014; pp. 2). The population sharply declined to 1,263 in 2011. Currently, the population hovers around 2,100 individuals (Farmer 2014; pp. 124). The TMT EIS stated that the Mid-Level Facility will not disturb any previously undisturbed areas of Hale Pōhaku. There will, however, be some removal of *Māmāne* trees for construction. No *Palila* have been detected at Hale Pōhaku in recent surveys, therefore, according to the EIS, removal of the *Māmāne* trees for construction of the Mid-Level Facility will not impact the *Palila* (Hilo 2010; pp. 3-73).

#### **4.3.2 Hazardous Materials and Water Contamination**

There are a number of hazardous materials stored and used at the telescope facilities on Mauna Kea. Materials include: hydrochloric-acid, potassium hydroxide, hydraulic oil, motor oil, pesticides, insecticides, sulfuric acid, calcium carbonate, ethylene glycol, kerosene, carbon disulfide and elemental mercury (Hou 2002; pp. 34). Nearly all of the 13 telescope facilities store and use these materials. The materials are used for operating and cleaning the telescopes (Hilo 2010; pp. 3-124). The use of elemental mercury has been the cause of great concern. According to the Material Safety Data Sheets, six

observatory facilities use elemental mercury in their telescopes: The University of Hawai'i 2.2-m. (88-in.) Observatory, the Canada-France-Hawai'i Telescope, the William M. Keck Observatory I and II, the NASA Infrared Telescope Facility and the United Kingdom Infrared Telescope (Hou 2002; pp. 34). There has been three mercury spills reported at the William M. Keck I Telescope: August 10, 1995, September 15, 1995, and November 6, 1995 (Hou 2002; pp. 34). Since the adoption of the Mauna Kea Master Plan in 2000, no mercury spills have occurred. According to the EIS, the amount of hazardous waste produced by the TMT will remain small and periodically transported to proper treatment and disposal facilities (Hilo 2010; pp. 3-125).

Drainage of waste material and sewage has also been of great concern on the summit. All telescope facilities use a combination of septic tank/cesspool/leach field systems to deal with sewage. Approximately 48,750 gallons of sewage is generated per month by telescope facilities. Proper maintenance of sewage systems has been an issue. During the 1997 *Wēkiu* bug survey, it was discovered that a large amount of sewage had escaped from a vent pipe below the Subaru telescope (Hou 2002; pp. 37). At the William M. Keck telescopes, mirror washing liquids drained directly into the ground under the telescopes. It wasn't until 2004 that sump pumps were installed to collect mirror washing wastewater (Hou 2002; pp. 35).

Telescope waste material and sewage pose a threat to the contamination of water sources on Mauna Kea. Lake Waiau is the only surface water regularly present on the summit of Mauna Kea. Located at 3,968-m. (13,020-ft.), it is one of the highest alpine lakes in the US. Lake Waiau is a perched aquifer held in an impermeable layer of silty clay, ash and permafrost within the *Pu'u Waiau* cinder cone. The Lake's water comes from snow melt and precipitation within the watershed (Hilo 2010; pp. 3-115). At full capacity, the lake reaches 91-m. (300-ft.) in diameter and 2.3-m. (7.5-ft.) deep. Prior to 2010, the lake surface area was between 5,000-7,000-sq m. (1.2-1.7 acres). In early 2010, the lake surface began to shrink. By September of 2013, Lake Waiau had declined to 115-sq m. (.03 acres) and less than 30-cm. (1- ft.) deep (USGS 2013). The ongoing drought in Hawai'i that began in 2008 was one of the reasons for the Lake's decline. Another was the change in the permafrost that surrounds the Lake, although studies cannot confirm this (USGS 2013). As of 2014, Lake Waiau had partly returned to its pre 2010 size. Lake Waiau is roughly 2.4-km. (1.5-miles) south of the TMT site. According

to the EIS, the TMT's distance from Lake Waiau makes contamination nearly impossible and therefore is of no danger to the Lake's health (Hilo 2010; pp. 3-115).

Another environmental concern is the contamination of the Mauna Kea freshwater aquifer. Ground water provides 99 percent of Hawai'i's domestic water and 50 percent of all freshwater used in the State. The Mauna Kea has two main aquifer sector areas, East Mauna Kea and West Mauna Kea (Fukunaga & Associates 2010). There are a total of nine aquifer sector areas on the Big Island. The remaining seven aquifer sector areas are fed by the four other volcanoes on the island. The East Mauna Kea aquifer sector area includes the northern and eastern slopes of Mauna Kea, covering most of the northeastern coast of the Big Island from Waipio to Hilo Bay (Fukunaga & Associates 2010; pp. 802-1). The West Mauna Kea aquifer sector area includes the western slopes of Mauna Kea. It supplies water for the premier resort area of South Kohala, the agricultural town of Waimea, and Parker Ranch, one of the nation's largest ranches, spanning over 175,000 acres of land (Fukunaga & Associates 2010; pp. 803-1). The Mauna Kea Science Reserve is also located within the West Mauna Kea aquifer sector area (Fukunaga & Associates 2010; pp. 803-1).

According to the EIS, the TMT and the existing 13 telescopes pose no danger to the Mauna Kea aquifer sector areas. With only 38-50-cm. (15-20-in.) per year, the summit of Mauna Kea receives far too little rain to add any significant amount of water recharge to the aquifer. Instead, the aquifer recharge areas for Mauna Kea occur at lower elevations where rainfall is higher (Resources 2011; pp. 27). In an interview via email with Don Thomas, director of the Center for the Study of Active Volcanoes at UHH, he stated that a majority of the precipitation on the summit is in the form of snow and because of the extremely dry conditions, most of it ends up evaporating. The amount of moisture that actually permeates into the ground is quite small. In a recent study, Professor Thomas identified dikes as the dominating system for trapping water on Mauna Kea. Dikes are formed from magma emplaced underground, usually in very vertical and tabular bodies. According to Thomas, the permeability of dikes is similar to concrete. Thomas even found trapped water on Mauna Kea nearly 10,000 years old (Thomas 2015). Thus, "It would likely take several thousand years for any contaminant spill at the summit to make its way, in very diluted form, into the aquifers on the lower slopes of Mauna Kea" (Deneen 2015).

Whether the TMT and the existing 13 telescopes pose a threat the Mauna Kea aquifer is still up for debate. There has been very little monitoring of the aquifer since telescope construction began in 1968. No extensive studies have been conducted to determine if waste materials or sewage from the telescopes have actually impacted the aquifer.

While the environmental impacts of the TMT are numerous and potentially far-reaching, they appear to be falling on deaf ears in the legal process for issuing and ultimately approving a use permit for the construction of the TMT.

## 5 The Legal Battle Over the TMT

Development on Mauna Kea has caused great concern among Native Hawaiians, environmentalists and the local community since the first telescope was built in 1970. While the opposition was weak and scattered during the early years of development, it has grown since then and become more organized with the passing of time. Opposition concerning the environment, endemic species, historical sites and cultural practices successfully stopped two projects from proceeding in 1975 and 2003. However, most of the opposition has been too weak and unorganized to cause any significant changes on the mountain. Subjugation of the Native Hawaiians by missionaries and foreigners caused a sense of complacency among the native people. The influence of Christianity and other organized Western religions caused the Native Hawaiians to look down upon their own beliefs, practices and spirituality. The 13 telescopes currently on Mauna Kea are the result, at least in part, of the years of cultural suppression and disconnect from the *‘aina* (land) felt among the Native Hawaiian people. Prior to the 2003 Outrigger Telescopes project and the TMT, the Hawaiians did not have the self-respect or resolve to protect their sacred *Mauna*. Many carried the fear that if they stood up for their *Mauna*'s cultural and spiritual importance, they would be seen as somehow “anti-progress” or “backward thinking”—reminiscent of how the missionaries and other foreigners viewed the Native Hawaiians when they landed on the shores of Hawai'i in 1820.

Out of this sense of complacency and malaise felt by the Hawaiians for more than 100 years of occupation, arose, beginning in the 1980s, a renewed sense of self-respect and unification, which, in many cases led to action by the Hawaiians. Increasingly, since then, the Hawaiians have begun to find their voice, especially when their sacred *‘aina* is at risk. The Hawaiian “cultural renaissance,” as some have called it, has focused its attention on environmental issues and concerns, including the impacts of years of mismanagement on Mauna Kea. Included in these efforts are legal actions filed by Native Hawaiians and cultural practitioners aimed at stopping the TMT altogether. While those in favor of the TMT seek to find “common ground” with these Native Hawaiians and cultural practitioners, for the Hawaiians common ground means further desecration of their sacred temple; compromise is therefore not possible.

## 5.1 Petitioners vs. DLNR

The TMT went through an extensive legal process in order to build on Mauna Kea. As required by the Hawai'i Administrative Rules for building on a Conservation District (HAR-13-5), the TMT completed an Environmental Impact Statement (EIS) as part of the Conservation District Use Application (CDUA). The EIS was submitted in May 2010 and signed by the Governor of Hawai'i (TMT 2009). On September 2, 2010, University of Hawai'i Hilo (UHH), as the applicant for the Conservation District Use Permit for the TMT project, submitted its CDUA to the DLNR.

Soon after the application was submitted, a group of petitioners challenged the legality of the project. The petitioners consisted of: The Hawaiian Environmental Alliance (KAHEA), a nonprofit Hawai'i environmental organization; Mauna Kea Anaina Hou, an unincorporated association represented by Native Hawaiian cultural practitioner Kealoha Pisciotta; Clarence Kukauakahi Ching ("Ching"), a Hawaiian cultural practitioner; Flores-Case 'Ohana ("Flores-Case 'Ohana"), an unincorporated association consisting of E. Kalani Flores and B. Pualani Case, who are Native Hawaiian cultural practitioners; Deborah Ward ("Ward"), a recreational user of Mauna Kea lands; and Paul K. Neves ("Neves"), a Native Hawaiian cultural practitioner (Resources 2013; pp. 2). The six petitioners are collectively known as the "Petitioners." In December 2010, DLNR held extensive public informational hearings on the CDUA in Hilo and Kona where all six petitioners testified along with approximately 80 members of the public. Opposition to the TMT project at the hearings centered on environmental, legal, cultural and spiritual concerns (Hilo 2011; pp. 37).

On February 25, 2011, UHH's CDUA was presented to the BLNR at its regular meeting in Honolulu. After extensive testimony by the Petitioners and the public, the Board voted unanimously to grant Conservation District Use Permit (CDUP) HA-3568 for the TMT Project to UHH (Resources 2013; pp. 3). At the same time the Permit was granted, the BLNR also voted to hold a contested case hearing. A contested case hearing is a semi-judicial administrative hearing governed by Hawai'i Revised Statute Chapter 91. Any State agency, such as the BLNR, which decides on actions that could affect people's rights, duties and privileges, must hold a contested case hearing. The purpose of the hearing is to provide the State agency with the most clear and relevant



information they need to make a fair decision (Shelley 2011). The contested case hearing is broken down into three parts. The first part is the pre-hearing where any persons who think they may be affected by the decision can submit a petition to become a “party” in the hearing. One must have a unique interest in the decision that is somehow different from the general public. The second part of the contest case hearing is where witnesses are called to testify and evidence is submitted by parties. The third part is the post-hearing; after all the evidence is presented and witnesses have testified, all parties are given the opportunity to propose a decision for the decision-makers. After the three parts of the hearing are complete, the decision-makers, DLNR in this case, approve, deny, or approve with conditions what is being proposed. The decision is either made at the hearing or a later public meeting (Shelley 2011).

After the approval of the CDUA HA-3568 for the TMT, all the Petitioners submitted formal written requests for a contested case hearing. All requests were submitted individually, but, as stated in the requests, all the Petitioners collectively had an interest in the management of cultural and natural resources (Resources 2013; pp .5). On April 7, 2011, the DLNR selected Mr. Paul Aoki as the Hearing Officer in the contested case hearing and scheduled a pre-hearing conference. The pre-hearing occurred on May 13, 2011, where extensive discussion and arguments were held regarding the timing and procedures for the contested case hearing. The issue to be decided in the contested case hearing was whether UHH’s proposed land use—building the TMT in the Mauna Kea Science Reserve—was consistent with the criteria set forth in Hawai’i Administrative Rules 13-5-30: Permit for building on Conservation District lands (Resources 2013; pp. 9).

The contested case hearing started on August 15, 2011. Evidence was submitted and testimony was taken in a total of seven hearing days, August 15, 16, 17, 18 and 25, and September 26 and 30 (Resources 2013; pp. 12). Experts in botany, archeology, anthropology, hydrology, entomology, Hawaiian history and cultural practices were examined and cross-examined by the Petitioners and UHH at the hearings.

A major issue touched upon in the contested case hearing was whether the proposed TMT satisfied the eight criteria to build on a Conservation District. Found in Section 13-5-30(c) of the Administrative Rules for building on a Conservation District, it states

that, “In evaluating the merits of a proposed land use, the department or board shall apply the following criteria:

- (1) The proposed land use is consistent with the purpose of the conservation district;
- (2) The proposed land use is consistent with the objectives of the subzone of the land on which the use will occur;
- (3) The proposed land use complies with provisions and guidelines contained in Chapter 205A, HRS, entitled “Coastal Zone Management”, where applicable;
- (4) The proposed land use will not cause substantial adverse impact to existing natural resources within the surrounding area, community, or region;
- (5) The proposed land use, including buildings, structures, and facilities, shall be compatible with the locality and surrounding areas, appropriate to the physical conditions and capabilities of the specific parcel or parcels;
- (6) The existing physical and environmental aspects of the land, such as natural beauty and open space characteristics, will be preserved or improved upon, whichever is applicable;
- (7) Subdivision of land will not be utilized to increase the intensity of land uses in the conservation district; and
- (8) The proposed land use will not be materially detrimental to the public health, safety, and welfare.

The applicant shall have the burden of demonstrating that a proposed land use is consistent with the above criteria (Resources 1994; pp. 5-34).”

Nowhere is it addressed whether a proposed land use must satisfy every one of the eight criteria, or the relative weight that is given to the different criteria. The Hearing officer and the BLNR made it clear that nothing about the language of Section 13-5-30(c) compels one to assume all eight criteria must be satisfied for the project to be granted a permit, or that all the criteria are of equal weight. Non the less, in the case of the TMT, UHH and the Petitioners took the view that all eight criteria must be satisfied.

Petitioners presented evidence of the negative impacts of past telescopes by sighting Exhibit A-309 at 3-214, 3-217-219 from the 1998 Audit:

“The past construction of these observatories has had cumulative impacts on cultural, archaeological, and historic resources that are substantial, significant, and adverse.” Exhibit A-309 at 3-214

“Overall, the existing level of the cumulative visual impact from past projects at the summit is considered to be substantial, significant, and adverse.” Exhibit A-309 at 3-217 – 218

“Consequently, the existing level of cumulative impact on geology, soils, and slope stability is considered to be substantial, significant, and adverse.” Exhibit A-309 at 3-218 – 219 (Resources 2013; pp. 18)

It was also noted that in the 2005 federal EIS on the Keck Telescopes, NASA wrote:

Future activities on the summit of Mauna Kea would continue the substantial adverse impact on cultural resources. No area at or near the summit is assumed to be devoid of archaeological properties... Grading and removal of earth for new structures or roads, infrastructural redevelopment, or other observatory projects could adversely affect these resources.

Even with mitigation measures, NASA concluded that future projects, particularly those proposed for previously undisturbed areas, such as the TMT, would have unavoidable adverse impact on cultural resources (Tamanaha 2010; pp. 2).

Given the findings from previous environmental reviews, the TMT organization could not avoid concluding that the project will cause great impacts to the resources in the astronomy precinct on Mauna Kea. As stated in the final EIS:

From a cumulative perspective, the impact of past and present actions on cultural, archaeological, and historic resources is substantial, significant, and adverse; these impacts would continue to be substantial, significant, and adverse with the consideration of the Project and other reasonably foreseeable future actions (Hilo 2010; pp. S-8).

The same was said about the geologic resources, the alpine shrublands and grasslands, and *Māmane* subalpine woodlands (Hilo 2010; pp. S-8).

The Petitioners argued that, given the conclusions made in the EIS regarding the “substantial, significant, and adverse” impacts of the TMT, the DLNR could not legally grant the TMT a permit to build because it does not fulfill criteria number four: “The proposed land use will not cause substantial adverse impact to existing natural resources within the surrounding area, community, or region” (Resources 1994; pp. 5-34). The Petitioners argued that four other criteria were also not fulfilled and therefore a conservation district use permit cannot be granted. The four criteria include (5), (6), (7) and (8) (Resources 1994; pp. 5-34).

The Mauna Kea Summit Region Historic District (the land eligible for inclusion in National Register of Historic Places) comprises 17,820-acres of land on the summit of Mauna Kea. Nearly the entire Mauna Kea Science Reserve (MKSR) and all of the 263 Historic Properties are within the Mauna Kea Summit Region Historic District. Many of the Historic Properties are designated as Traditional Cultural Properties (TCPs) because of their association with cultural beliefs and practices that are deeply connected to the history of the community, and are necessary to maintain the community’s beliefs and practices (Hilo 2010; pp. 3-20). One of the most significant TCPs is *Kukahau’ula*, the 480-acre collective of summit cinder cones. The cinder cones are also referred to separately as *Pu’u Wēkiu*, *Pu’u Kea* and *Pu’u Hau’oki*. Currently, 8 of the 13 observatories reside in *Kukahau’ula* (Hilo 2010; pp. 3-20). The cultural practices and beliefs associated with *Kukahau’ula* and the entire summit region of Mauna Kea include: performance of prayer, collection of water from Lake Waiau for healing and ritual uses, shrine erection, deposition of *piko*, use of the summit for human burial grounds, burial blessings to honor ancestors, belief that the upper mountain region of Mauna Kea is a sacred landscape, solstice and equinox ceremonies, and many more (Hilo 2010; pp. 3-21).

For Native Hawaiian cultural practitioners, the existing observatories have affected the quality of cultural practices and have even forced some practitioners to find alternative places to conduct their practices. As stated in the TMT CDUA, “The approximately 5-acre area to be occupied by the TMT Observatory structure would not be available for future cultural practices of this nature. To some individuals, the Project could represent a significant impact on the suitability of the northern plateau area for spiritual observances and offerings.” The TMT will be another barrier in the way for Native

Hawaiians to properly conduct their traditional practices on Mauna Kea. Thus, the TMT would be in direct violation of Article XII, section 7 of the Hawai'i State Constitution, which affirms that the State “shall protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by ahupua'a tenants who are descendents of native Hawaiians who inhabited the Hawaiian Islands prior to 1778” (Hawai'i 1978).

The TMT CDUA countered these concerns by stating that, even though certain practices have been affected, there is no evidence suggesting that the existing observatories have prevented any practices from occurring. Further, as stated in the CDUA, the TMT project is not anticipated to significantly impact the resources on Mauna Kea used for cultural practices involving pilgrimage, prayer, shrine construction and offerings (Hilo 2011; pp. 4-7).

UHH also presented evidence of the changes to the management of the Mauna Kea Science Reserve and the steps the University has taken to insure the protection of cultural and natural resources on Mauna Kea, the most significant being the implementation of the Mauna Kea Master Plan in 2000. “Astronomy is an environmentally responsible and economically sustainable use that does not extract a large amount of resources, and does not consume significant natural resources once constructed” (Resources 2013; pp. 41). UHH showed that the TMT Organization took all the necessary steps to legally obtain the permit to construct on Mauna Kea, including completing and submitting an EIS.

As stated by UHH in the hearings, the TMT will contribute greatly to the advancement in astronomy. Working in collaboration with the existing telescopes, the TMT will be able to carry out cutting-edge astronomical research that was previously unimaginable (Resources 2013; pp. 34). The TMT will also benefit the local community of the Big Island by providing nearly 140 jobs—although the jobs require specialized skills that the local community may or may not have (Resources 2013; pp. 33-34). As stated at the hearing,

Implemented in accordance with its plans, the TMT project will not consume significant natural resources; will not pollute; will not harm species of concern or the environment generally; will not interfere with customary and traditional cultural practices; will not impede recreational

uses; will not threaten the public health, safety, or welfare (Resources 2013; pp. 43).

After the contested case hearing, the DLNR confirmed the CDUP for the construction of the TMT. The Petitioners appealed this decision to the Third Circuit Court of the State of Hawai'i located in Hilo on the Big Island in 2013. The Petitioners challenged the DLNR's constitutional and statutory interpretation of the rules governing development on Mauna Kea, a conservation district deserving of the highest protections under state law. In April 2014, Judge Greg Nakamura of the Third Circuit Court affirmed the DLNR's granting of the CDUP paving the way for the TMT Corporation to begin construction on Mauna Kea.

## **5.2 October 7, 2014 TMT “Groundbreaking”**

While the legal proceedings discussed above were still pending, the TMT Corporation made known its intention to proceed with construction of the TMT, including groundwork and construction of access roads. Even this limited work, according to the Hawaiians, would have irreversible effects on the Mountain.

October 7, 2014 marked the day of the official TMT Groundbreaking Ceremony. For the Protectors of Mauna Kea, it marked the day they first stood together on the mountain, in solidarity, face to face with the astronomers, funders and builders of the TMT.



**Figure 8: October 7, 2014 Protests on the summit of Mauna Kea (photo credit: Abby Herhold)**

At *Pu'u Huluhulu*, the base of Mauna Kea, nearly 200 people gathered, old, young, Native Hawaiian, non-Hawaiian, locals from the island and visitors from neighboring islands. The purpose of the gathering was to hold light for Mauna Kea by chanting, singing and meditating. For many, it was to protect the *Mauna* from the potential harm that was about to occur.

Nearly half way up Mauna Kea, at the 2,804-m. (9,200-ft.) Visitors Center, another gathering took place with people waving signs and chanting. Eventually, those attending the TMT groundbreaking ceremony arrived, including: astronomers, funders, partner Corporations, UH representatives, the Big Island Mayor and other special guests. Their intention was to ascend to the summit of Mauna Kea to conduct a “groundbreaking” ceremony to mark the start of construction of the TMT.

The protestors at the Visitors Center ascended to the summit of Mauna Kea before the TMT ceremony guests and placed themselves in a blockade, cutting off road access to the TMT site. For nearly four hours, the protestors held off the ceremony guests from making their way to the site. Some guests got out of their cars and walked to the site. The few TMT representatives that made it to the site attempted a small groundbreaking

ceremony. At the end of the day, the TMT protestors were successful in interrupting the groundbreaking ceremony. The TMT Corporation and their affiliates were completely caught off guard. In an interview conducted with Sandra Dawson, the Hawai'i Community Affairs Manager for the TMT, she said they [guests and participants in the groundbreaking ceremony] had no clue the protestors were going to do what they did (Dawson 2014).

October 7, 2014 marked a very important day for the Protectors of Mauna Kea and more importantly, for the Native Hawaiian people. It was a day that reconnected the Native Hawaiian people back to their sacred *Mauna*. It re-inspired and reinvigorated the people to stand up for themselves, their *'aina* and their culture. After this day, the movement to protect Mauna Kea grew significantly.

### **5.3 Current Legal Status of the TMT**

In May 2014, the Petitioners appealed the Third Circuit Court's ruling to the Hawai'i Intermediate Court of Appeals. On June 5, 2015, in an unexpected ruling by the Hawai'i Supreme Court, the high court granted the Petitioners' request to side step the Intermediate Court of Appeals and have the case heard directly by the Hawai'i Supreme Court (Gutierrez 2015). On August 27, 2015, the Supreme Court heard oral argument from the parties. A decision is expected sometime in the Fall of 2015. Some expect that the Supreme Court will remand the case back to the DLNR for further proceedings and require the DLNR to hold a new contested case hearing to determine the propriety of a CDUP for construction of the TMT. While this is not the ultimate victory that the Protectors of Mauna Kea seek, it may afford them another opportunity to contest construction of the TMT, this time before a wider audience.

There have been numerous attempts to start construction since March 2015. All attempts so far have been interrupted by the Protectors of Mauna Kea. After an April 2<sup>nd</sup> attempt where 31 people were arrested, the Governor of the State of Hawai'i put a temporary moratorium on all construction. The moratorium was in place until the end of April. The latest attempt at construction occurred on June 24, 2015. Protectors were again successful in stopping it.



In the meantime, although technically construction of the TMT may proceed based on the CDUP already granted by the DLNR, construction on the mountain has been halted for the time being pending the outcome of the proceedings before the Supreme Court. The Petitioners and other parties opposed to the TMT have stated their intention to block any further efforts to begin construction on Mauna Kea until at least the legal process is finally completed.

While the Petitioners are contesting the TMT through the courts on legal grounds—asserting that the eight criteria have not been met by the DLNR and UH—more importantly they seek to protect the *Mauna* and their connection to *Papahānaumoku* and *Wākea*, Earth Mother and Sky Father, as they have since their first arrival to the Islands more than one thousand years ago. It is this deeper connection to the *‘aina* that truly propels the Hawaiians to prevent any further desecration of their sacred temple. It is evident that the Native Hawaiians’ opposition to the TMT in Hawai’i is part of a larger movement in which indigenous peoples all over the world are seeking to reestablish their historical, cultural and spiritual connections to their land. The disconnect between Western society and indigenous peoples, science and culture, Christianity and mythology, and, ultimately, man and nature, is playing out on the micro scale in places like Hawai’i, but it is also manifest in the world at large.



# 6 TMT and Humanity's Disconnect From the Earth

The central question presented in this thesis is how and why construction of what is slated to be the largest telescope in the world could take place on top of the most sacred place in all of the Islands for the native people of Hawai'i? It can hardly be contested that science and the exploration of the stars is a noble cause. Trying to understand the origins of the universe and man's place in it has been part of man's undertaking since he first looked skyward. The potential rewards and benefits of scientific exploration are profound. The question, however, is at what price? While affording astronomers one of the best platforms in the world to view the stars, Mauna Kea is also the Hawaiians' birthplace and sacred temple. No one would seriously entertain the idea of building a giant telescope on top of the Sistine Chapel. Why, then, would astronomers consider building a giant telescope on the Hawaiians' house of worship? To understand how this could take place, it is important to first trace the philosophical debate that has taken place in the past few decades regarding man's disconnect from his environment. Once placed in this context, it is readily understandable why scientists and governments would feel entitled to pursue their goals at the expense of indigenous peoples and their core beliefs.

## 6.1 The Philosophical Debate

"How, that is, have we [Westerns] become so deaf and so blind to the vital existence of other species, and the animate landscapes they inhabit, that we now so casually bring about their destruction?" (Abram 1997; pp. 28).

The disconnect from the Earth exemplified in the Western way of thinking is a profoundly strong, yet a relatively new, phenomenon. Prior to the 17th Century, as discussed by Dudley, "most Western men of learning thought that nature was alive and, at least loosely speaking, conscious" (Dudley 1993; pp. 53). The idea that man 'participates in' and 'is of the same nature' as his surrounding cosmos, was common to a majority of people of the ancient world (Dudley 1993; pp. 53). It was not until the

17th Century and the influence of Rene Descartes that this way of thinking began to change.

The disconnect from nature cannot be solely attributed to Descartes, since humans had already begun to physically separate themselves from nature by living in structures off the Earth and manipulating nature through agriculture. Yet, many believe that it was Descartes' philosophy that began to separate the Western mind from his natural surroundings. Starting with man, Descartes wrote that it is the soul (or mind or spirit or ego) alone which thinks. Man's material body is incapable of thinking, knowing or sensing (Dudley 1993; pp. 53). Also known as Cartesianism or Cartesian dualism, Descartes teachings emphasized the mind as being completely separate from the body. This idea was then applied to the whole universe, completely separating the thinking mind from the material world of nature, things and objects (Abram 1997; pp. 32). Since only the human mind is capable of thinking, nature, considered to be of the material world, does not think or know and therefore is unconscious (Dudley 1993; pp. 53). As Dudley writes, Descartes' ideas "destroyed the thought foundation that supported the mutually protective, consciously interacting relationship between Western man and the non-human beings of the cosmos," and "created a cleavage between man and nature which has never since been bridged" (Dudley 1993; pp. 53).

Descartes' well-known phrase, "I think therefore I am," is very telling of the value he placed on the mind. If there is no mind, then there is no being. The mind is the mechanism that gives the human consciousness. Nature, on the other hand, is a "determinate object," written in the language of mathematics, void of emotions or any subjective experience of its own (Abram 1997; pp. 32-33). A hierarchy is created with man and his mind on top, and the passive, unintelligent nature below. This hierarchy is the main culprit in the separation between man and nature, culminating in the current environmental crises confronting us today.

The Cartesian separation of the mind and body has become instilled in Western thought and has resulted in man turning inwards and completely detaching from the greater environment which surrounds him. Rather than living "in" the Earth, we think of ourselves as living "on" the Earth. The mere act of saying we live "on" the Earth instantly creates a separation between the Earth and ourselves. The Earth is no longer viewed as a body, of which we are a part of, but rather, as an objective, passive and

mechanical thing. The Earth, then, is not something to be cared for as if it were an extension of our own bodies. Instead, it is an object meant to serve and be exploited.

When man disconnects from the Earth, he is disconnecting from a part of himself. In “How Shall I Live My Life” by David Jensen, Kathleen Dean Moore discusses the importance of the Earth in relation to our own identities. First, she writes, that people are made up of the Earth; minerals in bones are strengthened by eroding mountains, river water flows through veins, sun transforms fat into vitamins—“Calcified by gravity, wrinkled by wind” (Jensen 2008; pp. 189). Not only are we physically constructed from the Earth, but, as Moore writes, so too are our minds; “our ideas, our emotions, our characters, our personal identities” are shaped by places in the Earth (Jensen 2008; pp. 190). Memories of these places form the core of who we are; “people are made of memories” (Jensen 2008; pp. 191). The trees we climbed as kids, the paths on which we walked our dogs, the oceans in which we swam, are all places that contain memories that define who we are, where we came from and the feelings we experienced.

Moore then poses the question: If people are defined by memories of places, then what happens to us if these places are destroyed? What effect does the escalating ecological crisis—the destruction of the Earth that contains places that define who we are—have on the mind, spirit and “wholeness” as living beings? (Jensen 2008; pp. 192).

“Environmental destruction is a kind of forgetting, and so it’s a kind of self-destruction. If we go around systematically destroying the places that hold meaning for us—the places that hold our memories—then why would we be surprised that we become fragmented, that we no longer have a sense of who we are?” (Jensen 2008; pp. 193). In a society ruled by modernity, our cultural understanding and felt experience of places have become increasingly disconnected from the Earth. “We lead lives of relentless separation—comings and goings, airport embraces, loneliness, locked doors, notes left by the phone—and the deepest of all those divides is the one that separates us from the places we inhabit,” writes-Kathleen Dean Moore (Jensen 2008; pp. 182). We have physically separated from the Earth by living in structures far removed from the soil. We rarely feel the dirt between our toes, the wind on our cheeks, or let the rain soak our bodies. We have lost the ability to see nature in its whole and purest form. Our felt experience of the Earth has been manipulated in large part due to technology. We seek

to “connect” through technology, all while completely disconnecting from Earth that we call home. If we do not connect to places in the Earth, we have less of a desire to protect these places. We do not see these places as being sacred, holding memories, or being pieces of our own inner bodies.

As places get destroyed under the pressures of the escalating ecological problems or through the push for development, memories get lost. Since memories form the foundation of who we are, when memories are lost, we too lose parts of ourselves. We respond to this loss with feelings of confusion, despair and disconnect. In our modern society, however, feeling a sense of loss is often not connected to the loss of the environment. We often try to heal our own turmoil by turning inwards, to the “private interior” of our minds (Abram 2011; pp. 155). As David Abram states:

In truth, it’s likely that our solitary sense of inwardness is born of the forgetting, or sublimation, of a much more ancient interiority that was once our common birthright—the ancestral sense of the surrounding earthly cosmos as the voluminous inside of an immense Body, or Tent, or Temple (Abram 2011; pp. 154).

It is this turning inwards that further disconnects us from the larger body in which we reside—the Earth.

When we view ourselves as living “in” the Earth as opposed to “on” the Earth we reconnect to the ways of our ancestors (*kupuna*)—to a pre-Copernican understanding of the universe where the Earth was at the center. As Abram writes, “there was great intimacy to this vision to the cosmos, with its invisible but ordered spheres enveloping the earth, cradling this world in their grand embrace” (Abram 2011; pp. 155). When the Earth is viewed as a body in which we reside, the space between ourselves and the Earth, and our own minds and bodies, becomes whole. Being in the Earth rather than on the Earth shifts our center out of the mind and back into the Earth. The disconnect that existed between the Earth and ourselves no longer remains. This way of being can have profound impacts on the ways we treat the Earth and all the beings that it contains.

As stated by Patrick Curry, “Gaia [Earth] and its inhabitants co-evolve together in a web of relationships of which symbiosis is the dominant kind” (Curry 2006; pp. 69). James Lovelock, the father of the Gaia theory, recognized that biotic life does not adapt to the environment but instead alters the environment to make it appropriate for living

(Lovelock 2007). In other words, all living and non-living parts of the Earth work in conjunction with each other to make the Earth livable. This reiterates the deep connection we have with the Earth. According to Lovelock, all creatures, from humans to whales to bacteria are part of Gaia and play a role in her health and wellbeing. The Earth is not just a provider for all else to live, but is alive itself and equally as reliant on us as we are on it. The Earth is in constant motion and is therefore vulnerable. We cannot clear a forest or drill into a mountain without affecting the balance of the Earth and our own balance as humans living in the Earth. The realization that the destruction of the Earth does indeed deeply impact us can help us to heal the Earth, and in turn, heal ourselves. This disconnect, and the emerging effort to reconnect, is readily apparent in Hawai'i on top of the tallest mountain in the world.

## **6.2 Humanity's Disconnect and Construction of the TMT**

Unless stopped through legal proceedings and/or other actions of the Protectors of Mauna Kea, construction of the TMT will commence in the near future. Within a few short years, astronomers will be gazing into space further than they ever have before. At the same time, Earth is being threatened by famine, war, mass displacement of millions of refugees, climate change and other environmental threats. These “earthly” dangers, it can be argued, pose a more significant and immediate threat to mankind. In the middle of this larger philosophical debate is the TMT. This technological marvel will either prove to be man's panacea from his own destructive path, or it may turn out to be yet another step in the inexorable march towards his ultimate disconnect and demise.

Although the TMT is fraught with environmental dangers and poses a direct threat to the Native Hawaiians' efforts to reconnect to their sacred '*aina*, the State of Hawai'i, backed by its own state courts, has seemingly ignored these threats in permitting the TMT to move forward. As stated in the TMT EIS:

From a cumulative perspective, the impact of past and present actions on cultural, archaeological, and historic resources is substantial, significant, and adverse, these impacts would continue to be substantial, significant, and adverse with the consideration of the Project (TMT) and other reasonably foreseeable actions (Hilo 2010; pp. S-8)

The cumulative impact of past and present actions to geologic resources in the astronomy precinct has been substantial, significant, and adverse, primarily due to the reshaping of the summit cinder cones. The cumulative impact to the alpine shrublands and grasslands and mamane subalpine woodlands as also been substantial, significant, and adverse. These impacts would continue to be substantial, significant, and adverse with the consideration of the Project [TMT] and other reasonably foreseeable future actions. (Hilo 2010; pp. S-8)

According to the TMT EIS, the TMT will continue to accelerate the cultural and environmental destruction of Mauna Kea. And as a result, it will greatly impact the Hawaiian people and their livelihoods. How can this project still be implemented knowing it will hurt a people, their culture and the environment? Is the TMT yet another example of man's disconnect from the Earth?

Astronomy is a noble science. At its core, it is the pursuit to gather knowledge and answer some of our most pressing questions: where do we come from?; what are we made of?; is their life beyond this Earth? Astronomy is not necessarily seeking to “fix” anything—i.e., to find a cure for cancer or solve world hunger. In an interview conducted with Michael Bolte, Associate Director of the TMT and Professor of Astronomy and Astrophysics at UC Santa Cruz, he made clear that astronomy is purely an “intellectual pursuit;” it taps into our fundamental desire as humans to know the unknown (Bolte 2014). In this pursuit, however, astronomy disconnects itself from the place in which it operates—the Earth. There is both a literal disconnect—as the telescopes point away from Earth and up to space—and a figurative disconnect—when the place and its people become less important than the newest scientific discovery. Astronomers have failed to recognize, or as some would say, do not care, how their pursuit is impacting Mauna Kea and the people who stand to protect it.

Astronomers have maintained that they are not trying to “subjugate Native beliefs to scientific inquiry,” nor are they casually destroying the environment, as discussed by Swanner. Mauna Kea simply offers the best platform—the highest peak and clearest sky—for the TMT (Swanner 2015; pp. 158-159). The TMT Corporation is not purposefully trying to harm the Native Hawaiian people or their sacred mountain. However, there is a carelessness embedded in their actions—a carelessness or devaluing of Native Hawaiian spirituality in connection to their sacred mountain. Mauna Kea has



become too valuable to science both economically and intellectually to simply leave it alone. To the supporters of the TMT, Mauna Kea has no inherent value, but rather, is only valuable when a telescope is built on its summit. Mauna Kea becomes a passive object for the astronomers' taking.

According to astronomers, leaving Mauna Kea alone would be doing humanity a disservice—imagine the scientific knowledge that would be lost. In the Mauna Kea Master Plan, by invoking Hawaiian culture, the astronomical community stated that Mauna Kea is their “scientific *piko* (umbilical cord) to the mysteries of the universe” (Hawai'i 2000). The 45 year-old “scientific umbilical cord” is paired against the 1,500 year-old “cultural umbilical cord” of the Hawaiian people. Can the very short, yet highly successful, years of astronomy on Mauna Kea be compared to the Hawaiians' long historical, cultural and spiritual connection to the mountain? For the astronomical community and the TMT, it is quite clear as proof in their actions, that Mauna Kea is more valuable as a scientific *piko* than as a historical, cultural and spiritual *piko*.

### **6.3 “We are Mauna Kea”**

The influence of Christianity and Western Culture had profound effects on the Hawaiian people throughout the 19<sup>th</sup> Century. It led directly to events such as the *Great Mahele*, in which the land was no longer property of the gods but became a commodity to be bought and sold, and ultimately to the overthrow of the Hawaiian Monarchy in 1893. These Western influences played a large part in severing the long-standing relationship the Hawaiians had not only to their sacred *'aina*, but to their very souls. Instead of saving souls, Christianity played a large part in destroying them. As the United Church of Christ admitted in its 1993 Apology regarding the church's historic complicities in the illegal overthrow of the Hawaiian Monarchy, “Native Hawaiians were devastated not only by foreign diseases but by the total disruption of their culture, traditions and economy as well as their government” (McCollough 2015; pp. 2).

Certainly, these Western influences did not enable the Hawaiians to keep, nurture and honor their relationship to the land and the spirit of the land. As McGregor states, “It is Hawai'i we are related, are born out of, and we descend from” (McLeod 2015). The relationship to the *'aina* was and continues to be the heart of Hawaiian culture and their identity as a people. By taking their land and decimating their culture, the missionaries

and their offspring succeeded in effectively severing the Hawaiians' connection to the Earth. For a people who believe in the forces of the *'aina* and who rely on it for their health and well-being, to be stripped of their land was like being stripped of air—the essence of life.

The construction of the TMT on Mauna Kea is but another example of Western society trumping Hawaiian culture. It symbolizes the dominance of Western thought over the belief system of indigenous peoples. The TMT has become a “threatening symbol of cultural genocide” (Swanner 158-9). By placing what will be the largest telescope in the world on the Hawaiians' sacred mountain temple, the scientific community, supported by Western powerbrokers, is effectively saying that their values and belief systems are more important than those of the Hawaiians. This egoistic worldview has pushed the Hawaiians farther away from their history and culture, a culture that has already suffered to the point where very few even speak their native language. The history of Hawai'i parallels the history of much of the world—Western colonial powers, fueled in large part by Christian zeal, subjugating a native people and their traditions to further their own political and capitalist goals. The TMT is but the latest chapter in that long and tortured history.

As much as the West and Christianity have impacted Hawai'i and its people, it has not completely severed the Hawaiians' relationship to the Earth and themselves. While many Hawaiians today do not follow the traditional way of life like their ancestors, there are still a few who have held onto the ways of their *kupuna*. These ancient traditions and practices run too deep in their souls to ever be completely forgotten. As Dudley writes:

The Hawaiian who aches for the land as he watched Westerners—and now the Asians—buy it up and pave it over may not be able to say how he is related to the land, but he knows that he is in his bones. The Hawaiian who puts his life on the line standing in front of a bulldozer may not know why he must defend the land in this way, but he cannot run away. With or without the philosophical tradition, the Hawaiian knows that he forms a community with nature around him. Nature constantly and faithfully consciously provides for and protects him. And he is compelled from deep within to protect nature in turn. And he does this with the same courage and bravery a non-Hawaiian summons to defend his family and community from an aggressor (Dudley 1993; pp. 52).

The years of cultural suppression at the hands of Western influences has led to a community of Hawaiians today where many do not practice their traditional religion, speak their native language, or engage in traditional cultural practices. However, their connection to Mauna Kea is like the connection we have to our parents—as much as we separate ourselves, the fact remains, we are made from them. There is no doubt that the TMT presents an obstacle to the Hawaiians’ traditional way of life. But it also presents an opportunity for Native Hawaiians to reconnect to their identity as people of the *‘aina*. Thousands have gathered on Mauna Kea willing to put their lives on the line to protect the most culturally significant and sacred place in all of the Islands. As the number of Protectors continues to grow, it is evident that Mauna Kea is reawakening a spirit in the people that is reconnecting them to their past and their land. The Hawaiian activists’ cry, “We are Mauna Kea,” is a declaration of fact regarding how the Hawaiians see their connection to the land. While the West has been in a never-ending spiral of separation from the Earth, a growing group of Hawaiians continue to hold onto their connection to their sacred *‘aina*, resisting the powers of science and “progress.”

Kealoha Pisciotta, Petitioner and Native Hawaiian activist, stated:

Mauna Kea in every respect represents the zenith of the Native Hawaiian people’s ancestral ties to Creation itself. When the land, the waters, the life forms suffer, we feel this suffering, the process of creation begins to unravel and de-creation begins. The law, the *kanawai*, is broken. We lose our place in time and space and then we are lost (Kaplan 2015).

If Mauna Kea continues to suffer under the pressures of the astronomical industry, so too will the Native Hawaiian people. The movement to protect Mauna Kea is not just a movement to protect a sacred mountain, it is also a crusade to protect a people. The Protectors of Mauna Kea do not stand in opposition to the TMT and its potential for scientific discovery. Instead, they stand as protectors of a temple from which they originate, the place that connects them to their *kupuna*—the Earth, the Sky and the Stars. Although not all of the Protectors are of Native Hawaiian descent, their movement is grounded in ancient Hawaiian wisdom and is led by those with deep cultural and spiritual connection to Mauna Kea.

“We are Mauna Kea” symbolizes the Native Hawaiians’ ancestral connection to Mauna Kea, the sacred womb of the first Hawaiians. “We are Mauna Kea” also symbolizes the

energy and strength of Mauna Kea that is reflected in the Protectors themselves. From the West's first contact with the Islands in 1778, Native Hawaiians have found themselves under siege—their land stolen, their language banned and their Monarchy overthrown (Puhipau 2006). *Mauna a Wākea*, their sacred mountain, has also been under siege—manipulated and desecrated in the name of science (Puhipau 2006). The Protectors stand to protect Mauna Kea and to protect themselves; no longer will their *'aina*, their culture and their spirit be destroyed. “We are Mauna Kea” signifies a struggle for recognition and reconnection to the Earth. It is a reawakening of the ancient spirit that guided them for a thousand years. This is the lesson the West could learn from a people they nearly destroyed.

## 7 Conclusion

We find ourselves at a critical juncture in our human history. Scientists, environmentalists and a growing number of politicians tell us that the Earth is at a saturation point. The climate is changing, species are dying, and the land and oceans are becoming more and more polluted. In the endless pursuit to develop and exploit the Earth, humanity has disconnected itself from the very body that gave us life. We are treating our Earth Mother and Sky Father as if they were mere objects to be conquered and used for our own selfish purposes. We have forgotten that the Earth is alive and can only withstand so much exploitation. Hawaiians and other indigenous peoples, by and large, have not forgotten. They understand that they are directly connected to, and indistinguishable from, nature. The thought of destroying that which gave them life is anathema to indigenous peoples everywhere. Many in the West are just now beginning to see what indigenous peoples have always seen and understood.

As the world is on the precipice of awakening to the environmental crisis that is occurring, there has been a great push to develop technology that will help to prevent further destruction. Whether it is alternative energy, electric cars, recycling, sustainable development, or any number of other recent technological advancements, all are necessary and important in counteracting the destruction that has occurred. However, the ecological crisis we are experiencing is much deeper than any electric car or solar panel can fix. There has been a severing of a mental, physical and spiritual connection to the Earth when man decided that the Earth was no longer alive and conscious. This disconnect has hastened man's exploitation of the Earth and its resources, and has put us in the environmental tailspin we find ourselves today. In order to prevent further deterioration of our environment, humanity is called upon to reawaken to our true nature, which is to live in harmony with, and respect for, the Earth. Many believe that this is the only way mankind can rediscover the balance that once existed between man and his environment.

Science and technology have afforded mankind tremendous benefits. Through science, we have made new discoveries, cured diseases and otherwise made life more comfortable for many people. Many believe, however, that science and technology have brought about far more harm than good. A growing number of people, including many

scientists and technologists, believe that climate change and other environmental calamities are the direct result of man's endless pursuit of knowledge and progress.

The TMT is a by-product of a deeply disconnected and unbalanced relationship between mankind and nature. It is also symbolic of a deeper spiritual disconnect between mind and body—i.e., the schism between the physical and the metaphysical. For the Native Hawaiians and many other indigenous peoples, their spiritual connection to the *'aina* is paramount and guides their everyday relationship to the Earth. It brings an equilibrium to their lives and protects them from known and unknown adversities. It is through this basic understanding of man's relationship to the Earth and his place in the universe that indigenous peoples have lived in harmony with nature, rather than seek to conquer it. For the Protectors of Mauna Kea, the TMT has reawakened their connection not only to Mauna Kea and Hawai'i, but also to their place as *maka'ainana* (people of the land). The West is only now beginning to reawaken to this fundamental truth and understanding. Whether mankind can wake up in time to save the Earth remains to be seen.

# References

- Abram, D. (1997). The Spell of the Sensuous. New York, NY, Vintage Books.
- Abram, D. (2011). Becoming Animal: An Earthly Cosmology. New York, New York, Vintage.
- Affairs, T. O. o. H. (2015). "About." Retrieved 15/2, 2015, from <http://www.oha.org/about/>.
- America, C. o. t. U. S. o. (1993). 103d Congress Joint Resolution 19. U. S. o. America. Washington D.C.
- America, F.-F. C. o. t. U. S. o. (1897). Joint Resolution to provide annexing the Hawaiian Islands to the United States. Washington D.C.
- Apgar, S. (2003). Telescopes' impact to be studied: OHA hails the move by NASA to evaluate environmental effects atop Mauna Kea. Honolulu Star-Bulletin. Honolulu, Hawaii.
- Association, T. N. H. B. (2015). "The Bayonet Consitution." 2015, from <http://hawaiianbar.org/wp-content/uploads/2012/09/Bayonet-Con.pdf>.
- Astronomy, I. f. (2014). "About Mauna Kea Observatories." Retrieved 2/9, 2015, from <https://www.ifa.hawaii.edu/mko/>.
- Beckwith, M. (1970). Hawaiian Mythology. Honolulu, Hawaii, University of Hawai'i Press.
- Beckwith, M. W. (1951). The Kumulipo: A Hawaiian Creation Chant. Chicago, Chicago University Press.
- Blaisdell, K. (1991). Traditional Kanaka Maoli Healing Practices.
- Bohte, M. (2014). The TMT A. S. Herhold.
- Borrecia, R. (1999). Kamehameha dynasty confronts world of change. Honolulu Star Bulletin. Honolulu, Hawaii.
- Byrne, L. L. D. A. (2005). Mauna Kea: A Guide to Hawaii's Sacred Mountain. Honolulu, Hawaii, Watermark Publishing.
- Callis, T. (2015). Lawsuit seeks injunction to block TMT. Hawaii Tribune-Herald. Honolulu, Hawaii.
- Canada, V. M. (2015). "The Canada-France-Hawaii Observatory." Retrieved 2/2, 2015, from <http://astro-canada.ca/en/a2110.php>.
- Committee, M. K. A. O. (2015). "History." Retrieved 29/1, 2015, from <http://www.mkaoc.org/history>.
- Committee, T. S. A. (2007). Thirty Meter Telescope Detailed Science Case: 2007. Pasadena, California, TMT Observatory Corporation.
- Council, N. R. (2001). Astronomy and Astrophysics in the New Millenium. Washington D.C., National Academy Press.
- Curry, P. (2006). Ecological Ethics: An Introduction. Cambridge, Polity Press.
- David, S. E. (2000). "The Hawaiians: Health, Justice, and Sovereignty." Cultural Survival **24.1**.
- Dayton, K. (2004). Critics sue after panel OKs NASA project. Honolulu Advisor. Honolulu, Hawaii.
- Dayton, K. (2006). NASA budget cut imperils Mauna Kea project. Honolulu Advisor. Honolulu, Hawaii.
- Dayton, K. (2006). Telescope plan loses funding. Honolulu Advertiser. Honolulu, Hawaii.
- Deneen, K. (2015). Protectors of Mauna Kea raise awareness on the new Thiry Meter Telescope. Kaleo: The Voice. Honolulu, Hawai'i

- Deneen, K. (2015). UH pursues extending leases at Mauna Kea astronomy facilities. Kaleo: the Voice. Honolulu, Hawaii.
- DeVorkin, D. H. (2013). Keck Observatory. Encyclopædia Britannica Online.
- District, M. K. S. a. W. C. (2015). "Mauna Kea Soil and Water Conservation District." Retrieved 4/4, 2015, from <http://www.maunakeaswcd.org/>.
- Dudley, M. K. (1993). Hawaiian Nation: Man, Gods, and Nature. Honolulu, Hawaii, Na Kane O Ka Malo Press.
- Dyke, J. M. V. (2007). Who Owns the Crown Lands. Honolulu, Hawaii, University of Hawaii Press.
- Dyke, J. V. (2010). "What the the 'Ceded Lands' of Hawaii?" Civil Beat.
- Farmer, P. B. a. C. (2014). Palila Restoration Research, 1996-2012. Hilo, Hawai'i, University of Hawai'i at Hilo.
- Fish, H., , Elisha H. Allen, Henry A.P. Carter (1875). Hawaiian-American Treaty of Reciprocity, 1875. Washington D.C.
- Fornander, A. (1916). Collection of Hawaiian Antiquities and Folk-lore. Honolulu, Hawaii, Bishop Museum Press.
- Foundation, G. a. B. M. (2015). "Thirty Meter Telescope." Retrieved 15/1, 2015, from <http://www.moore.org/programs/science/thirty-meter-telescope>.
- Fukunaga & Associates, I. (2010). Hawaii County Water Use And Development Plan Update.
- Garovoy, J. B. (2004). "'Ua Koe Ke Kuleana O Na Kanaka"." Harvard Law Law Review **29**.
- Good, L. (2004). "Fouding Director John T. Jefferies Recounts Institute for Astronomy Beginnings." Na Kilo Hoku: The Ones Who Look To The Stars 13. Retrieved 29/1, 2015, from <http://www2.ifa.hawaii.edu/newsletters/article.cfm?a=190&n=1>.
- Gordon, M. (2007). Recollections of "Tucson Operations": The Millimeter-Wave Observatory of the National Radio Astronomy Observatory. Dordrecht, The Netherlands, Springer Netherlands.
- Government, U. (1996). National Historic Preservation Act of 1996. Washington D.C.
- Government, U. (2015). "National Conference of State Historic Preservation Officers." Retrieved 4/4, 2015, from <http://ncshpo.org/aboutus.shtml>.
- Group70. (1983). "Mauna Kea Science Reserve complex development plan, Mauna Kea, Hamakua, Hawaii. 1983." Mauna Kea Retrieved 21/3, 2015, from [http://oeqc.doh.hawaii.gov/Shared%20Documents/EA\\_and\\_EIS\\_Online\\_Library/Hawaii/1980s/1983-01-HA-FEIS-MAUNA-KEA-SCIENCE-RESERVE-COMPLEX-DEVELOPMENT-PLAN.pdf](http://oeqc.doh.hawaii.gov/Shared%20Documents/EA_and_EIS_Online_Library/Hawaii/1980s/1983-01-HA-FEIS-MAUNA-KEA-SCIENCE-RESERVE-COMPLEX-DEVELOPMENT-PLAN.pdf).
- Guru, B. I. (2015). "Big Island Weather." Retrieved 5/5, 2015, from <http://www.bigislandguru.com/weather.html>.
- Gutierrez, B. (2015). State Supreme Court agrees to hear case against TMT. Hawaii News Now. Honolulu, Hawaii.
- Haley, J. L. (2014). Captive Paradise: A History of Hawai'i (Kindle Edition), St. Martin's Press.
- Hartt, C. E. and M. C. Neal (1940). "The Plant Ecology of Mauna Kea, Hawaii." Ecology **21**(2): 237-266.
- Hawai'i, S. o. (1978). The Constitution of the State of Hawai'i H. L. R. Bureau.
- Hawai'i, S. o. (2015). "About DLNR." Retrieved 15/2, 2015, from <http://dlnr.hawaii.gov/about-dlnr/>.
- Hawai'i, U. o. (2000). Mauna Kea Science Reserve Master Plan, Univeristy of Hawai'i.
- Hawai'i, U. o. (2015). Thirty Meter Telescope update and background.



- Hawaii, G. o. (2015). "Hawaii Geology and Geography." Retrieved 5/5, 2015, from [http://www.hawaii-guide.com/content/posts/hawaii\\_geology\\_and\\_geography#](http://www.hawaii-guide.com/content/posts/hawaii_geology_and_geography#).
- HawaiiHistory.org. (2015). "Ahupua'a." Retrieved 5/7, 2015, from <http://www.hawaiihistory.org/index.cfm?fuseaction=ig.page&CategoryID=299>.
- Higa, M. M. (1998). Audit of the Management of Mauna Kea and the Mauna Kea Science Reserve. Honolulu, Hawaii, State of Hawai'i.
- Hilo, U. o. H. i. (2008). Environmental Impact Preparation Notice/Environmental Assessment. Hilo, Hawai'i University of Hawai'i Hilo.
- Hilo, U. o. H. i. (2011). Conservation District Use Application Permit: Thirty Meter Telescope Project. Hawai'i, Hawai'i
- Hilo, U. o. H. i. a. (2010). Final Environmental Impact Statement Volume 1. Hilo, Hawai'i University of Hawai'i at Hilo. 1.
- Hilo, U. o. H. i. a. (2012). "UH Hilo Educational Telescope." Retrieved 25/2, 2015, from <http://www.astro.uhh.hawaii.edu/neweducationaltelescope.php>.
- Ho'akea (2009). Mauna Kea Comprehensive Management Plan, University of Hawai'i.
- Hou, M. K. A. (2002). Contested Case Hearing DLNR File No. HA-02-06 Proposed Findings of Fact, Conclusions of Law, Decision and Order.
- Howarth, F. G., G. J. Brenner, and D.J. Preston (1999). An anthropod assessment within selected areas of the Mauna Kea Science Reserve. Honolulu, Hawaii, University of Hawai'i Institute for Astronomy.
- International, B. (2015). "Important Bird Areas Factsheet: Mauna Kea, Hawaii (Mauna Kea Mamane-Naio Forest IBA)." Retrieved 16/4, 2015, from <http://www.birdlife.org/datazone/sitefactsheet.php?id=26105>.
- Jefferies, J. T. (2015). "Astronomy in Hawai'i 1964-1970." Retrieved 29/1, 2015, from <http://www.ifa.hawaii.edu/users/jefferies/Preface.htm>.
- Jensen, D. (2008). *How Shall I Live My Life?* Oakland, California, PM Press.
- KAHEA (2003). Input Needed: Mauna Kea EIS process begins, KAHEA.
- KAHEA. (2015). "Legal Protections." Retrieved 5/7, 2015, from <http://kahea.org/issues/sacred-summits/legal-protections>.
- Kaplan, S. (2015). How a Hawaiian mountaintop became a battleground between native activists and astronomers. *The Washington Post*.
- Katz, M. M. (2009). "Overthrow of the Hawaiian Kingdom: The Bayonet Consitution." Retrieved 5/7, 2015, from <http://www.mtholyoke.edu/~katz20m/classweb/The%20Bayonet%20Constitution.html>.
- Kay-Trask, H. (2008). *Lovely Hula Hands: Corporate Tourism and the Prostitution of Hawaiian Culture*. *Law and Society*. Berkeley, California.
- Kelly, J. (2011). *The True Story of the Death of Captain James Cook (Kindle Edition)*, The Kiwa's Society.
- Kirch, P. V. (2014). *When Did the Polynesians Settle Hawai'i?* Berkeley, California, University of California Berkeley.
- Korn, M. K. P. a. A. L. (1979). *The Echo of Our Songs: Chants and Poems of the Hawaiians*. Honolulu, Hawai'i University of Hawai'i Press.
- L.L.C., P. A. (2000). *Wēkiu Bug Mitigation Report*, California Institute of Technology.
- Levin, S. S. (1968). "The Overthrow of the Kapu System in Hawaii." *The Journal of the Polynesian Society* 77(4): 29.
- Liliuokalani, Q. (1897). "The Kumulipo." Retrieved 5/7, 2015, from <http://www.sacred-texts.com/pac/lku/>.
- Lind, I. (2015). The Legal Challenge to the Thirty Meter Telescope. *Civil Beat*. Honolulu, Hawaii.

- Lovelock, J. (2007). The Revenge of Gaia: Earth's Climate Crisis and the Fate of Humanity. New York, New York, Basic Books.
- Malo, D. (1903). Hawaiian Antiquities (Mo'olelo Hawai'i). Honolulu, Hawaii, Hawaii Gazette Co., Ltd.
- Maly, K. (1999). Appendix I: 1999 Mauna Kea Science Reserve and Hale Pohaku Complex Development Plan Update: Oral History and Consultation Study, and Archival Literature Research, University of Hawai'i
- Maly, K. M. a. O. (2005). Mauna Kea-- Ka Piko Kaulana O Ka Aina (Mauna Kea-- The Famous Summit of the Land). Hilo, Hawaii, The Office of Mauna Kea Management (University of Hawaii--Hilo).
- McCoy, P. C. (1976). The Mauna Kea Adz Quarry Complex, Hawaii: A First Analysis. Honolulu, Hawaii, Bishop Museum.
- McCollough, Charles (2015). "Why our church apologized to Hawai'i." United Church of Christ.  
[http://d3n8a8pro7vhm.cloudfront.net/unitedchurchofchrist/legacy\\_url/11261/mccollough.pdf?1418437063](http://d3n8a8pro7vhm.cloudfront.net/unitedchurchofchrist/legacy_url/11261/mccollough.pdf?1418437063)
- McGregor, N. E. A. P. i. (2013). "'Aina K Ola O Na Kanaka 'Oiwi/Land: The Health of Native Hawaiians." UH Press.
- McLeod, C. (2015). Standing on Sacred Ground.
- McNulty, J. (2009). UC astronomer cheers Mauna Kea selection as site for Thirty-Meter Telescope. Santa Cruz, California.
- Menton, L. K. (1992). "A Christian and "Civilized" Education: The Hawaiian Chiefs' Children's School. 1839-50." History of Education Quarterly **32**(2).
- Mueller-Dombois, D. (2007). "The Hawaiian Ahupua'a Land Use System: Its Biological Zones and Challenge for Silvicultural Restoration." Bishop Museum Bulletin in Cultural and Environmental Studies **3**.
- Munger, S. (2013). "Civilizers or conquerors? The first missionaries to Hawaii." Retrieved 6/5, 2015, from <http://seanmunger.com/2013/12/03/civilizers-or-conquerors-the-first-missionaries-to-hawaii/>.
- Nadin, E. (2008). Thirty Meter Telescope Focuses on Two Candidate Sites. Padadena, California. **2015**.
- Observatory, N. R. A. (2015). "Very Long Baseline Array." Retrieved 2/2, 2015, from <https://science.nrao.edu/facilities/vlba>.
- Observatory, P. (2014, 27/12/14). "The 200-inch (5.1-meter) Hale Telescope." Retrieved 15/1, 2015, from <http://www.astro.caltech.edu/palomar/about/telescopes/hale.html>.
- Observatory, S. A. (2015). "The Submillimeter Array." Retrieved 15/2, 2015, from <https://www.cfa.harvard.edu/sma/>.
- Observatory, W. M. K. (2015). "Keck Observatory." Retrieved 15/1, 2015, from <http://www.keckobservatory.org/about>.
- Omandam, P. (2002). OHA sues for environmental report on Mauna Kea project. Honolulu Star-Bulletin. Honolulu, Hawaii.
- Pitzer, P. (1994). The Overthrow of the Monarchy. Spirit of Aloha. Honolulu, Hawaii.
- Powell, E. (1994). Recovery Plan: Mauna Kea Silversword. Portland, Oregon.
- Project, T. P. (2009). Mauna Kea, HI (Native Hawaiian) (2009). Research Reports. Cambridge, Massachusetts, Harvard University.
- Proto, N. T. (2009). The Rights of My People: Liliuokalani's Enduring Battle with the United States 1893-1917. New York, NY, Algora Publishing.
- Puhipau, J. L. (2006). Mauna Kea: Temple Under Siege: 57 min.

- Pukui, M. K. and S. H. Elbert (1986). Hawaiian Dictionary: Hawaiian-English, English-Hawaiian, University of Hawaii Press.
- Resources, B. o. L. a. N. (2011). Conservation District Use Application HA-3568 Thirty Meter Telescope. Honolulu, Hawaii.
- Resources, B. o. L. a. N. (2013). Findings of Fact, Conclusions of Law and Decision and Order, State Of Hawaii.
- Resources, D. o. L. a. N. (1994). Hawaii Administrative Rules: Conservation District, State of Hawaii
- Resources, D. o. L. a. N. (2015). Hawaii Administrative Rules Title 13. D. o. L. a. N. Resources. Honolulu, Hawaii.
- Resources, D. o. L. a. N. (2015). "Soil and Water Conservation Districts." Retrieved 4/4, 2015, from <http://dlnr.hawaii.gov/swcd/>.
- Resources, H. i. D. o. L. a. N. (1968). General Lease No. S-4191. Honolulu, Hawaii: 9.
- Rhodes, D. L. (2015). "Overview of Hawaiian History." Retrieved 20/7, 2015, from [http://www.nps.gov/parkhistory/online\\_books/kona/history5.htm](http://www.nps.gov/parkhistory/online_books/kona/history5.htm).
- Shelley. (2011). "What is a Contested Case Hearing?" Retrieved 25/4, 2015, from <http://kahea.org/blog/what-is-a-contested-case-hearing>.
- Society, N. G. (2012). Mauna Kea: The World's Tallest Mountain. National Geographic. Washington D.C., National Geographic Society.
- Sovereign, H. i. I. a. (2013). Part 3: Hawaii vs. U.S. Imperialism.
- Space, A. (2015). "The Keck Telescopes." Retrieved 2/2, 2015, from <http://amazing-space.stsci.edu/resources/explorations/groundup/lesson/scopes/keck/index.php>.
- Steiger, W. (2015). "Origins of Astronomy in Hawai'i." Retrieved 29/1, 2015, from <http://ifa.hawaii.edu/users/steiger/introduction.html>.
- Stewart, A. (1998). The Ethnographer's Method. California, Sage Publications.
- Swanner, L. (2015). "Contested Spiritual Landscapes in Modern American Astronomy." Journal of Religion & Society(Supplement 11): pp. 149-162.
- Tamanaha, M. (2010). CDUA HA 3568 for the Thirty Meter Telescope. Honolulu, Hawaii, KAHEA.
- Team, T. S. S. (2008). TMT Site Testing Final Report.
- theumiverse. (2013). "The Inner circle: An Annotated Biography of the Architects of the post 1845 Political Economy." Retrieved 5/7, 2015, from <https://theumiverse.wordpress.com/tag/william-richards/>.
- TMT (2009). Thirty Meter Telescope Selects Mauna kea. Pasadena, California.
- TMT. (2015). "About TMT." Retrieved 10/1, 2015, from <http://tmt.org/about-tmt>.
- TMT. (2015). "Why Thirty Meters." Retrieved 15/1, 2015, from <http://tmt.org/observatory/why-thirty-meters>.
- Tytell, D. (2003). "Tensions Erupt on Mauna Kea." Sky and Telescope. <http://www.skyandtelescope.com/astronomy-news/tensions-erupt-on-mauna-kea/>
- USGS. (1999). ""Hotspots": Mantle thermal plumes." Retrieved 2/4, 2015, from <http://pubs.usgs.gov/gip/dynamic/hotspots.html#anchor19620979>.
- USGS. (1999). "The long trail of the Hawaiian hotspot." Retrieved 2/4, 2015, from <http://pubs.usgs.gov/gip/dynamic/Hawaiian.html>.
- USGS. (2013, 7/11/13). "Lake Waiiau is shrinking fast." Retrieved 20/4, 2015, from <http://hvo.wr.usgs.gov/volcanowatch/view.php?id=201>.
- Viotti, K. D. a. V. (2003). NASA to prepare impact statement for Mauna Kea telescope project. Honolulu Advertiser. Honolulu, Hawaii.
- Wainscoat, R. J. (2005, 2005). "University of Hawaii 2.2-meter Telescope." Retrieved 2/2, 2015, from <http://www.ifa.hawaii.edu/88inch/>.

- Ward, D. J. (2011, 14/8/11). "Meet the Mauna Kea Hui." Retrieved 20/4, 2015, from <http://kahea.org/blog/mk-vignette-deborah-j.-ward>.
- Webb, D. A. (1976). 25-Meter Millimeter Telescope Memo No. 69. Tucson, Arizona, National Radio Astronomy Observatory: pp. 1-80.
- Wilmhurst, J. M., , Terry L. Hunt, Carl P. Lipo, Atholl J. Anderson (2010). "High-precision radiocarbon dating shows recent and rapid initial human colonization of East Polynesia." Proceedings of the National Academy of Sciences of the United States of America.
- Wolfe, E. W. (1997). The Geology and Petrology of Mauna Kea Volcano, Hawaii--- A Study of Postshield Volcanism. U. S. D. o. t. Interior. Washington D.C., United States Government Printing Office.
- Young, K. (2006). Judge reverses permit for new Hawaiian telescopes. New Scientist.

## Interviews

- Thomas, D. (2015). Email Interview about the Mauna Kea Aquifer. A. Herhold. 25/4/15.
- Dawson, S. (2014). Interview about the TMT. A. Herhold. 14/10/14.
- Bolte, M. (2014). Interview about the TMT. A. Herhold. 8/12/14.