Traditional Knowledge Systems and Crops: Case Studies on the Introduction of Kūmara (*Ipomoea batatas*) and Taewa Māori (*Solanum tuberosum*) to Aotearoa/New Zealand

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Abstract

Kūmara (*Ipomoea batatas*) and taewa Māori, or Māori potato (*Solanum tuberosum*), are arguably the most important Māori traditional crops. Over many centuries, Māori have developed a very intimate relationship to kūmara, and later with taewa, in order to ensure the survival of their people. There are extensive examples of traditional knowledge aligned to kūmara and taewa that strengthen the relationship to the people and acknowledge that relationship as central to the human and crop dispersal from different locations, eventually to Aotearoa / New Zealand.

This project looked at the diverse knowledge systems that exist relative to the relationship of Māori to these two food crops; kūmara and taewa. A mixed methodology was applied and information gained from diverse sources including scientific publications, literature in Spanish and English, and Andean, Pacific and Māori traditional knowledge.

The evidence on the introduction of kūmara to Aotearoa/New Zealand by Māori is indisputable. Mātauranga Māori confirms the association of kūmara as important cargo for the tribes involved, even detailing the purpose for some of the voyages. Less conclusive is the earlier introduction of kūmara to the Pacific from South America. In the case of taewa, both traditional Māori knowledge and early literature confirm the potato as an introduction during the first decade of recorded European contact.

The aim of this thesis was to look to various knowledge sources and determine what can contribute to a discussion around the early introduction of key food crops to Aotearoa / New Zealand and also to understand the most important factors affecting each crop's mode of introduction, assisted or not.

Various key factors which clearly define the Māori relationship to these foods have been identified. These include: the conduit the crops provided in determining and continuing a relationship between cultures across the South Pacific and including the South American continent and cultures; the contribution of scientific knowledge from western science including oceanography, ethnography, ethnobotany and horticulture generally; the perceived importance of these crops as witnessed at the time of European contact, by both the Spanish and Portuguese in the wider Pacific region, and subsequently the British, French, and other peoples including their missionary cohorts in Aotearoa / New Zealand, and; the extended value of these crops to the endurance of Māori culture (physically, socially and spiritually). Both crops retain an importance to Māori society which is beyond doubt.

Acknowledgements

Firstly, I would like to acknowledge all the people who guided me on the mātauranga Māori component of this work. Some are listed at the end of this thesis as mātauranga mentors; however, many others who are not listed have also greatly contributed with their insight and knowledge. I deeply appreciate your trust and the time you shared with me.

Special thanks to Nick Roskruge, who shared with me some of his extensive knowledge on Te Ao Māori. He also introduced me to the people who would be the main source of traditional knowledge for this thesis. This work would not have been done without his immense contribution.

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He kai nā te tangata, he kai tītongitongi kaki;
He kai nā tōna ringa, tino kai, tino mākona noa.
Food from another is little and stings the throat;
Food of a man's own getting, is plentiful, sweet, and satisfying[1]

1.1 Introduction

This thesis aims to investigate the relationship of Māori – as a people – to key food crops, specifically the kūmara and taewa, both seasonal crops which were essential for the survival of communities in pre-colonial times. The relationship is one which has many contributing factors, not least the knowledge base which surrounds each crop; including relationships to a wider community of interest e.g. the Pacific communities. As the influence of contemporary knowledge systems and influences on cultural systems become more entrenched there is a need to consider the opportunity to gather what remnants of traditional knowledge is still evident, alongside that knowledge which is available from other spaces – including other non-Māori cultural sources, and create discussion which can facilitate our understanding of these crops. The aim of this thesis therefore is to look to these various knowledge sources and determine what can contribute to a discussion around the early introduction of key food crops to Aotearoa / New Zealand with a view to understanding the most important factors affecting each crops' mode of introduction, assisted or not. It is also an opportunity to compare or contrast the types of knowledge; traditional, scientific, and/or social science with a view to creating a fully multi-dimensional discussion.

One of the most satisfying aspects of this research is the opportunity it provided to interact with Māori communities around the country and to build relationships with these same communities relative to their relationship with favourite foods. In particular Te Ātiawa, an iwi of the Taranaki region with satellite groupings in the Wellington, Te Tau Ihu (Northern South Island) and Chatham Islands took it upon themselves to support me as an external researcher and the project from their cultural standing. The emphasis on these two foods, traditional knowledge and systems therefore has been drawn together with the natural cultural bias of the Te Ātiawa iwi but is not

[1] Traditional whakataukī or proverb given for this thesis from Te Ātiawa Kaumātua (Taranaki).

limited to them alone. Full acknowledgements of all those involved are given elsewhere in the thesis. The following research question was formed following early conversations with Te Ātiawa in the first instance.

Research Question:

> *What are the key factors influencing the introduction of kūmara and taewa to Aotearoa/ New Zealand?*

1.2 Background

Early Māori, after their migration to Aotearoa / New Zealand lived in a subsistence society. Their food production and management systems were crucial to their survival and were effectively restricted by a very limited suite of plants that were cultivated seasonally supported by other plants sourced from wild populations and foods such as fish and birds, also sourced from the wild. In all cases Māori society relied heavily on a strong set of spiritual beliefs and behaviours to ensure the success of their food production and gathering procedures. Hence much of the retained knowledge around these traditional subsistence foods is encased in spiritual language and mythology, all intended to ensure the generational relationship with these foods forevermore (N. Roskruge, personal communication, 21 September 2014).

As Māori became more influenced by other cultural factors after the early contact period following Cooks 'discovery' of New Zealand in the mid-18th century, so did the food options and systems. Production systems for all cultivated foods moved from an almost stone age system relying on wooden tools and physical labour to one of economic drivers supported by metal tools, beasts of burden and new methods of food preparation. Previously unknown crops such as grains (wheat, corn/maize etc.), stonefruits, cucurbitaceae (pumpkin/paukena; watermelon etc.), and solanaceae (potatoes, tomatoes etc.) became commonplace, as did the processes used to ensure their palatability. Whereas kūmara had previously been the dominant carbohydrate crop – and food type – new introductions including the potato superseded it and became valuable additions to the traditional horticultural inventory and knowledge base.

Among the various crops cultivated in Aotearoa/New Zealand after European contact in the 18th century, the potato (*Solanum tuberosum* L.) was probably the most important. Early varieties of potatoes, variously called *taewa Māori, Peruperu, parareka, Māori potato* or *mahetau* (note the term *riwai* generally refers to the later arrival of modern potatoes) still survive around *marae* grounds unto these days and are generally easily identified because of their distinctive appearance.

Since their introduction, the Māori potato was quickly adopted and recognised as an important asset, with each iwi developing a unique relationship with it. The acquisition of the crop marked a watershed in the history of Māori, as the potato directly or indirectly propitiated the dominance of some iwi and the subordination of others.

Some important elements around the introduction of potatoes into New Zealand have strong parallels to the introduction of recognised traditional crops by Māori, especially kūmara (*Ipomoea batatas*). The kūmara is immersed in the history and whakapapa of Māori. It dominated society as the early crop of choice for both carbohydrate intake and trade. As an element of traditional society that was crucial to the survival of the people, it was also immersed in the world of the sacred thus requiring continuous input through karakia and other spiritual acknowledgements to ensure the on-going survival of the plants/crops themselves and their on-going contribution to the well-being of the community. This relationship with a specific food remains today even though the varieties of the food have changed through more recent introductions of the same plant.

Since its introduction, the potato has been thoroughly intertwined in the social dynamics of different iwi and greatly contributed to the profound change of people-land relationship that would occur in the subsequent centuries. In many ways this mimics the relationship kūmara held with the Māori community until the arrival of the potato. Subsequent impacts through colonisation, political matters and other various circumstances, have meant the cultivation of both kūmara and taewa or Māori potato has markedly decreased and is now usually limited to areas around *marae* and generally with no commercial value (Roskruge, 1999). However, growing these two crops is still considered as an integral part of Māori agricultural heritage and represents an important component of whakapapa and identity.

This thesis therefore aims to review the dissemination and introduction of two recognised traditional Māori crops; kūmara and potato, across the South Pacific and New Zealand. This will include the relationship each crop bears to their botanic centre of origin and the significance they hold for the early Polynesian inhabitants. It will consider published and unpublished traditional knowledge, scientific papers of diverse topics, and early European travel reports, among other sources. In order to gather traditional understanding associated with the traditional crops in New Zealand, interviews will be conducted with keepers of Māori cultural knowledge belonging to a number of iwi, including Te Āti Awa, Ngāti Raukawa, Ngāti Porou, and Ngāi Tūhoe. Integrating these diverse information sources will lead to a discussion which compares and contrasts retained knowledge around the movement and introduction of the two crops to Aotearoa / New Zealand. This will be undertaken with continual reference to the Māori introduction of other traditional food

crops and the present day knowledge systems around traditional horticulture and ethnobotany generally.

1.3 Research objectives:

- To collate and summarise the various types of knowledge relative to kūmara and taewa Māori crops. This will include traditional knowledge and published materials of the wider Pacific, Central and South America and Aotearoa
- To compare and contrast the knowledge offered relative to the origin of that knowledge
- To participate in traditional forum relative to the research discipline and to disseminate the research question in a wide non-academic space, and
- To identify the key factors which have, and continue to, influence the relationship of Māori to kūmara and taewa Māori crops.

1.4 Case studies

Case studies were undertaken based on the following terms of reference which are drawn from a generic interpretation of the subjective considerations applied to case study theory (Hamel, *et al.* 1993):

- Acknowledged crops of importance to Māori – historically and contemporarily
- Both published and unpublished information was apparent
- Historical/whakapapa relationship to the crops was apparent

Furthermore, an information gathering process, which focussed on indigenous (primarily Māori) production systems, was undertaken in support of the case studies. Information was sourced both from primary and secondary written sources and from community (predominantly Māori) and other informants. An awareness of the logistical, time and skill constraints is acknowledged.

Two case studies were undertaken and are focussed on the following:

- *Kūmara* – an example of the pre-European cultivated crop. Kūmara is well recognised as probably the single most important food type for Early Māori and many other Polynesian cultures. There is a wealth of information and traditional knowledge available relating to kūmara at all levels of its existence, including the relationship to humankind through sustenance. The case study was initiated with a view of encapsulating the wider South

American and Pacific cultures and their relationships to the same food product as a form of supporting the knowledge systems around kūmara within New Zealand specifically.

- *Taewa* or *Māori potatoes* – this crop is also well known in the context of being a later introduction to Māori after they had settled in Aotearoa and then usurping the dominance of the kūmara as the primary carbohydrate food in the local diet. Most people believe in an assisted introduction of taewa over time to Māori communities in various locations. This case study takes the same approach as the previous through recognising the wider, global context of potatoes as a food source and its contribution to Māori systems specifically.

1.5 Chapter overview

This thesis is built on a unique set of contributing knowledge bases aligned to kūmara and taewa crops. The format of the thesis intentionally follows science principles in structure and presentation. Where Māori (and other cultural) knowledge is gathered, critiqued and presented, this was undertaken with the full assistance and support of an acknowledged Kaumātua roopu (group) aligned to a National Māori Horticultural Collective: Tahuri Whenua Inc.

1.5.1 Chapters

The thesis is presented in independent chapters, each of which contributes to a discussion relative to the knowledge systems which provide the basis for the argument of the thesis. The presentation takes the following order and approach:

The introduction and background which make up chapter one provide the general introduction to the topic including the Research Question, some background information to the development of the topic and the key objectives of the study.

Chapter two looks at the methodology used which itself was purposefully drawn from several distinct methodologies to seek recognition from two clearly divergent communities under study; Māori and 'Western' Science. This research was undertaken primarily with a 'Kaupapa Māori Research (KMR)' framework supported by aspects of participatory, ethnobotanical, social scientific theory and case study methodologies.

Chapter three gives a very brief overview of the traditional and published knowledge of Polynesian settlement of the Pacific including a wider literature review on accepted theory aligned to sailing routes and technology. Māori migration and settlement is included in the general

Polynesian focus and there is considerable input from literature relative to the Spanish influence in the Pacific.

This is then supported by chapters four, five and six which focus on the mātauranga or traditional knowledge and published information aligned to kūmara, taewa and other prime crops of pre- and post-European contact in Aotearoa/New Zealand. The knowledge accessed ranges from Māori, Andean and Pacific indigenous knowledge contributions, South American pre- and post-colonial knowledge and various inputs from research aligned to the ethnobotany discipline.

Two case studies are given to allow the discussion to be centred on two unique crops for which there are clear differences in their relationship to Māori communities yet the contribution of each crop is equally significant. Each case study is layered with information that is aligned to the crops in a more global context as well as including the Māori specific relationship. Knowledge around production activities and the unique mātauranga (indigenous knowledge) formed with the crop is also included.

Chapter seven is a discussion drawn from all the information presented in the earlier chapters. This discussion aims to highlight the key factors relative to the two crops reviewed which have impacted over time on the relationship of Māori (personal, collective or otherwise) to the crops. The thesis intentionally looks to a wider knowledge system to learn more around the earlier relationship Māori had with these crops and how well the wider external relationships such as other Pacific communities are acknowledged.

This is then followed by a conclusion to the thesis and full list of references and communications relevant to the study.

2 Materials and Methods

E kore e piri te uku ki te rino, ka whitia e te rā
Clay will not cling to iron when the sun shines[2]
(Te Whiti o Rongomai, Parihaka, 1872)

2.1 Introduction

To meet the objectives of this thesis it was deemed necessary to research the origin, associated traditions, dispersal, and introduction of the most important traditional crops in the South Pacific. It was also considered important to establish the intercontinental relationships (Asiatic, Oceanic, and South American) that affected the early Polynesian culture.

Researchers are held accountable for the processes and procedures used in the pursuit of their findings. The 'research design' or 'methodology' ensures accountability for the way that data or information were obtained, how it was managed, analysed and interpreted, and the instructions in order for the results to be replicated and unbiased results obtained (Krippendorff, 1980).

To achieve this it was considered imperative to draw information from a range of disciplines including, ethnographic, ethnobotanic, evolutionary genetics, historic, archaeological, and traditional sources, among others. Central to this is the process of working with traditional knowledge; each culture having its own processes and preferences. For Māori specifically there is an emerging research methodological approach called Kaupapa Māori Research which purposefully aims to assist those researching within a Māori paradigm. When dealing with taonga species, such as kūmara and taewa, the Waitangi Tribunal Flora and Fauna '*Ko Aotearoa Tēnei*' report (2011) clearly identifies and recognises the complex and unique kaitiaki relationships that each iwi, hapū and, whanau has established with a particular taonga, which rely on carefully maintained mātauranga and kōrero (knowledge and dialogue).

The homogenous methodology used in this project was purposefully drawn from several distinct methodologies to respond to the mixed disciplines under study and also to seek recognition from two clearly divergent knowledge systems; Māori and 'Western' Science. This research was undertaken with the 'Kaupapa Māori Research (KMR)' methodological overlay supported by aspects

[2] This whakataukī spoken by Te Whiti is metaphorical, meaning that Māori (clay) and Pākehā (iron) require a common bond which is ostensibly the money focussed society (moisture); without it the bonds would evaporate! – alternatively; 'the old cannot hold with the new without a common link'.

of an ethnobotanical framework, participatory, applied and social scientific theory and case study methodologies. At all times the homogenous methodology was used to acknowledge the traditional knowledge base and ensure the rangatiratanga[3] of Māori as people and as iwi/hapū/whānau was maintained.

2.1.1 Pacific Islands / Pacific Rim

It is important to note for the purposes of this thesis that whilst Māori and Māori knowledge were the crux of the project, other knowledge systems were also accessed to provide a wider context around the research question. Knowledge which had its roots in the Pacific Islands and Pacific Rim was also sought. In some instances the stories from informal conversations with horticultural practitioners (e.g. a Fijian informant and his interpretation of names applied to the kūmara) was gained without any pursuance. Other cultures and communities e.g. those related to the South American Pacific coast, contributed with various stories, many of which had to be translated for uptake into this thesis.

2.2 Kaupapa Māori Research (KMR)

The Kaupapa Māori methodology was deemed to be of primary importance here, as it is seldom included in this type of work. According to Binney (1987), oral traditions in the forms of narrative, waiata, whakataukī, and whakapapa, have been, and still continue to be, the main form for Māori to record history. Williams (as cited in Barton, 1998) indicates that Māori written language was not established until 1820. However, Māori oral traditions are not easy to adapt into modern written history. These traditions represent not only a source of information, but also are the result of significant events that have been culturally amalgamated in time and place in order to instil meaning and validity to them (Binney, 1987).

The typical western-centrism in Polynesian ethnographical studies has resulted in most publications easily dismissing the traditional accounts. Also, political influence has often contributed to denigrate Polynesian traditional knowledge in order to devalue land claims and traditional rights. Nonetheless, Polynesian tradition has at numerous times pointed the direction for scientific endeavours and has provided valuable information that contemporary science is only recently beginning to understand e.g. in the quest for ethno-pharmaceutical knowledge.

[3] Rangātiratanga – literally ‘chieftainship’ or generally ‘self-determination’

Kaupapa Māori Research methodology is based on a growing consensus that research involving Māori knowledge and people needs to be conducted in culturally appropriate ways. These ways must work within Māori cultural preferences, practices and aspirations in order to develop and acknowledge existing culturally appropriate approaches in the method, practice and organisation of research (Durie, 1998a; Durie, 1998b; Bevan-Brown, 1998; Henry, 2000).

The term Kaupapa Māori is essentially used to refer to research driven by Māori aspirations, values and perspectives and that which anticipates 'tikanga Māori' or the distinctive Māori way of doing things (Royal, 2012). Kaupapa Māori Research (KMR) should be undertaken by people with the necessary cultural skills, involve Māori as the community of interest throughout, be accountable to them, and eventually the research findings should be shared in a way that is culturally appropriate and will contribute to their empowerment.

Where Māori values and science come together for the 'creation of knowledge' or practise of scientific processes, the disciplines do not normally meet expectations from a cultural perspective. That is, they do not necessarily incorporate the values or epistemology of Māori – as a people or culture - into the methodology. Depending on the expected outcome or process of research, this may have an important effect on the whole project. The main concern Māori have with a solely Western scientific research approach is that research has often distanced Māori participants from participation in the construction, validation and legitimation of knowledge (Roskruge, 2007). As a result, Māori are increasingly concerned about who will directly gain from the research as traditionally, Western research has utilised an approach where the research has served to advance their own interests (Durie, 1998a; Durie, 1998b; Bevan-Brown, 1998; Henry, 2000).

KMR further challenges the dominance of traditional, individualistic Western research that primarily benefits the researcher. In contrast, KMR is collectivistic and is oriented toward benefiting all the research participants and their collectively determined agendas (Bishop, 1996). Henry (2000:21) adds that kaupapa Māori centred research challenges the status quo in the academic community in New Zealand and calls for (among other things) '*power-sharing in the process of knowledge construction, its dissemination and the consequent ownership and uses of the knowledge produced*', a role in the de-colonisation of Māori .

Three principles are particularly applicable to a KMR centred approach to research. The first principle is enablement, or empowerment of the people. Any research activity should aim to enhance the people, especially through a fuller understanding and interpretation of knowledge. Integration is the second principle, and it recognises the holistic view of life Māori have. The third

principle, Māori control, places importance over research which involves Māori as subjects or which investigates aspects of Māori society, culture or knowledge. Table 1, drawn from Durie (1996), introduces the generally accepted key components of a KMR approach to research.

Table 1: Framework for a Māori Centred Research Framework - Adapted from Durie, 1996

Purpose of research	1. Gains for Māori 2. As Māori 3. To advance positive Māori development
Practice of research	1. Active Māori participation 2. Multiple methodologies 3. Measures relevant to Māori
The Practitioner	1. Māori researchers 2. Interim solutions 3. Competencies
The Politics	1. Treaty of Waitangi 2. Māori and iwi 3. Funding

Furthermore, Roskruge (2007) in work which was both Kaupapa Māori and ethnobotanically centred noted:

> *"If an inappropriate research approach is adopted when working with Māori, serious problems can arise. This includes the reluctance of Māori to divulge information in the future if they believe the knowledge they have shared has been misused or benefited the researchers [solely] instead of themselves. This problem of misuse of indigenous knowledge is prevalent with many indigenous peoples overseas, where for example, grain crops that they have cultivated for thousands of years have recently been patented by Western scientists (Benjamin, 1997). The question of cultural ethics has also been raised as part of the kaupapa Māori approach to research. Primarily these ethics are based on tikanga or good cultural practice including, aroha ki te tangata (respect), kanohi kitea (face to face interactions), titiro, whakarongo, kōrero (look, listen, speak), manaaki ki te tangata (generosity) and more".*

From the time of project inception it was consciously acknowledged that potential informants may not have been able to understand properly if the research approach was too technical. It was imperative that the research used language that all parties could grasp in order to obtain the correct information. Conversation-like, informal interviews may obtain significantly more

useful information than rigid, formal interviews (Royal, 1993). To achieve this, the process of interacting with potential informants was assisted greatly by the interaction with the Māori community through acknowledged experts in the topics under study, primarily accessed through a national collective of Māori practitioners in horticulture and related activities; Tahuri Whenua.

2.2.1 Tahuri Whenua

This research was undertaken with the mentoring and support of kaumātua, kuia and traditional practitioners aligned to plant knowledge and utility through the national Māori horticultural collective *Tahuri Whenua*[4]. This collective has a kaumātua roopu (group) drawn nationally and they were instrumental in the development of this research topic and report. For over 18 months they purposefully identified those with knowledge and other factors to contribute and exercised their prerogative as tikanga experts to organise hui in various forms to elicit conversation relative to the traditional Māori component of the research. Furthermore, they also advised on the opportunity to access Pacific expertise, especially where language and cultural practise needed to be considered. It is important to acknowledge in this forum the value the Kaumātua roopu of Tahuri Whenua gave to the project, including the interpretation of language based information, analysis of metaphorical information and the application of both kawa and tikanga, i.e., the rituals and protocols, applied whenever gatherings were held, both formal and informal.

2.2.2 Ethics approval

As required in projects such as this one, Low Risk Ethics approval was sought from the Massey University Human Ethics Committee relative to the potential interaction between researcher and community of interest. Approval was gained prior to any initiation of information sharing (see Appendix 1).

2.3 Māori knowledge and Māori science

The major difference between the Māori (and other indigenous peoples) and a western approach to 'science' is the inclusion by Māori of a worldview based on spiritual origins in their understanding of knowledge. There are four dimensions within which Māori perceive themselves and all resources; *tinana, wairua, hinengaro* and *whanaungatanga* – physical, spiritual, intellectual

[4] See www.tahuriwhenua.org.nz – Tahuri Whenua Inc. Society

and social/cultural. Through these dimensions it is apparent that Māori science is more than just knowledge as it contributes to all these dimensions.

In attempting to define mātauranga Māori, Royal offers the following:

> *'Mātauranga Māori is a modern term for a body of knowledge that was brought to these islands by Polynesian ancestors of present-day Māori. Here this body of knowledge grew according to life in Aotearoa and Te Wai Pounamu. Despite an initial period of change and growth, the arrival of European populations in the 18th, 19th and 20th centuries brought major impacts to the life of this knowledge, endangering it in many and substantial ways (2012, p. 33).*
>
> *Mātauranga Māori includes a range of concepts which can be considered as views or perspectives on the nature of knowledge and knowing. These views are presented as an introduction to an epistemology of mātauranga Māori and they range from explicit knowledge codified primarily through the use of literacy (mātauranga) through to experiences whereby a notion of explicit knowledge is no longer employed…'(2004:2)*

Durie (1996) argues that the relationship between Māori knowledge and Western science is one of the main contentious issues for scientists. The understanding of Māori views, beliefs, relationships and spirituality bound together is holism and forms the basis of Māori science. It is the joining of the past with the present, physical and metaphysical, people and the environment. Durie then states that while these points may seem to highlight differences between the science practitioners there are several striking similarities as well; the effects of unseen forces, for example *tapu*, in Māori science or the various forces in physics such as gravity or torque; the processes of deduction used to reach conclusions and; the development of systems to retain and retrieve the knowledge.

Marsden (1992) identified the religious, philosophical and metaphysical attitudes inherent in Māori culture as contributors to understanding Māoritanga (and mātauranga) as a whole. He correctly recognises that, for Māori having been brought up in the culture, their values and attitudes are drawn from those experiences, so while the experiences lack objectivity and therefore recognition in an academic forum, Māori (and thus indigenous) knowledge is a thing of experience and existence within a cultural milieu. This insight is apparent in all the Pacific cultures and arguably in all indigenous cultures.

Western science has its origins in the Babylonian, Egyptian and Greek cultures from as far back as 3000 BC (Lindberg, 1992). These cultures were also based on cosmology and cosmological speculation with a strong emphasis on astronomy and the power of unseen forces – not unlike Māori beliefs and values still held today. Western science has evolved in its own way to the

structured practice that it is today and the acknowledgement of its origins from earlier, somewhat simpler times is often overlooked.

2.4 Ethnobotanical framework

This research has its foundation in traditional or indigenous horticultural knowledge; thus it has an ethno-botanical base. This then contributes to a largely applied science approach using the information gained. In early science this discipline was known as 'Applied Botany' (Villamar, 1997 as quoted in De Albuquerque & Hanazaki, 2010), however it is now known as ethnobotany (without the hyphen) and includes ethnobotanical knowledge produced within a framework of western science based on the relationships of people and plants. The discipline of ethnobotany has many interpretations however it can be defined simply as: *The study of the relationship between people and plants.* However, the question arises around 'who' undertakes this study; those belonging to the native (ethno) group, or those non-native researchers with different theoretical orientations and academic backgrounds (de Albuquerque & Hurrell, 2010). A broader definition is: *the study of the uses, technological manipulation, classification, agricultural systems, magico-religious concepts, conservation techniques and general economic and sociological importance of plants in primitive or pre-literate societies* (Schultes, 1994).

Criticism of the various 'ethno-sciences' is becoming more apparent, especially where their application creates 'conceptual noise' – often produced because of a multiplicity of meanings, also called polysemy (de Albuquerque & Hurrell, 2010). Berlin (1992) states that ethnobotanical research, his own discipline, is by its very nature collaborative research and is not undertaken in isolation. Ethnobotany and ethnobiology are seen as disciplines which combine the intuitions, skills and biases of both the anthropologist and biologist (*ibid.* p3). Utilitarian versus intellectual arguments in ethnobotany form part of the dichotomy in anthropological theory (*ibid.*, p11) and can be identified as essentially a focus on one culture in contrast to a generic approach.

Berlin (1992, p. 8) claims that:

> *'[…]human beings everywhere are constrained in essentially the same ways – by nature's basic plan – in their conceptual recognition of the biological diversity of their natural environment. In contrast, social organisation, ritual, religious beliefs… are constructed by human society.'*

Researchers in the discipline of ethnobotany identify their role as targeting at least one of three ideals (Given & Harris, 1994:9):

1. Rescue missions – aligned to a culture near extinction. This includes the systematic recording of ethnobotanic knowledge.
2. Industry investigations – the relationship between plants and commerce, and
3. Cultural enhancement – aligning science and culture where possible.

By their very nature, ethnobiology and ethnobotany must be participatory as they involve both ecology and living cultures. Their science is a combination of studies around people, plants and land: each unique in its own way.

A conceptual approach to ethnoecology was originally presented by Toledo (1992) and refined in 2000 (Toledo, 2002). It was based on three components as a framework for working with indigenous peoples and knowledge. These are: *Kosmos*, the peoples worldview, perceptions and beliefs; *Corpus*, primarily 'local' or indigenous knowledge, and *Praxis*, the practical implementation of the corpus of knowledge (Toledo, 1992). Roskruge (2007) in his thesis reworked this triad to fit with Māori (and arguably Pacific) interpretations in that the indigenous element, including Māori knowledge, is incorporated into the model where *kosmos* is applied as *Te Ao Māori*, *corpus* as *mātauranga Māori* and *praxis* as *tikanga Māori* .

2.5 Applied Scientific Theory

Western Science has become the dominant science approach worldwide and is based on investigation, originality, discussion and accessibility. Scientific knowledge is proven knowledge, derived from rigorous observation and experiment, and based on what we can see, hear and touch (Chalmers, 1999). Māori and other indigenous cultures also argue their knowledge base is an applied 'science' as it is also created based on these exact same principles and processes.

The belief that Western scientific knowledge is the only valid form of knowledge is called positivism (Burns, 2000) and is a widely held view. The use of hypotheses to prove scientific theories as right or wrong is also widely undertaken and forms one of the basic tenets of research. Western science however has boundaries and must be repeatable and therefore needs to be undertaken using a methodology to meet all these parameters. The methodology used should always align to the hypothesis. In Western science, research generally draws from a quantitative methodology based on the process and results being quantifiable through accepted processes e.g., statistically or treatment differences.

The application of western science methodologies in isolation of indigenous conceptual approaches in disciplines aligned to ethnobotany or similar studies would be inappropriate, especially if the projects are focussed on obtaining indigenous knowledge. Some value exists however for the credibility which can be drawn from the boundaries, repeatability and quantification of western science and for the value these research factors may bring. As an example, the quality of information provided or its repetitive nature when received from a range of indigenous informants can be quantified in much the same way as survey results are in research seeking public responses.

2.6 Participatory research approaches

The Participatory Action Research model (PAR) has also been applied to the methodology mix in this project. Whyte (1991) defines PAR as a methodology in which the community involved in the study actively participate with the researcher throughout the process, from the initial design to the presentation of results and discussion of their action implications. PAR contrasts sharply with the most common type of applied research in which researchers serve primarily as experts, designing the project, gathering data, interpreting findings and recommending action to the community. Okali, Sumberg, and Farrington (1994:41) elaborate further stating:

> *'[…]underpinning participatory research is a distinction between quantitative and qualitative approaches in applied science. The debate on methods is often reduced to a dichotomy between quantitative versus qualitative studies and techniques, and statistical versus non-statistical approaches. The objective of these discussions is to break the link between what is understood as 'research' and 'positivist science', and they argue for a rejection of any assumption of the neutrality of the scientific method.'*

The 'participatory' or 'participant-observer' methodology is described by Adams & Schvaneveldt (1991) as the methodology best applied in anthropological research, though their experience does not include researching with Māori or for that matter considering the research from the indigenous viewpoint first. The 'observer' in this methodology implies the researcher is located in an intimate relationship with the [research] subjects. Wuest, McCool, Miller, and Veseth (1999) describe the end-user participation in participatory research as that of an 'intellectual partner', involved in establishing objectives, selecting methodologies and interpreting results. The key term is 'partner' which implies some equality around inputs to the project. Regardless of definitions, for all culturally based research there needs to be some form of participatory interaction between researcher and community under study and this relationship is then validated further through the application of a model for cultural values, e.g. KMR.

In the context of researching under a kaupapa Māori methodology, this is a key factor in the successful outcome of applied research and generally a strong relationship between parties develops over time. The relationship evolves through processes recognised as *whakawhiti kōrero* (exchanges of dialogue), *whakawhanaungatanga* (ongoing social interactions), and *kanohi kitea* (visibility) by the Māori community (Durie, 1998a; Bevan-Brown, 1998). A weakness however of the participant-observer type of methodology is the tendency to err toward subjectivity and sympathy in any interpretation due to the personal involvement of the researcher (Adams & Schvaneveldt, 1991).

Data collected under the participant-observer method is often classified as unobtrusive data. The process is recognised as a prolonged period of intense social interaction between researcher and the subject, during which time data may be unobtrusively and systematically collected (Adams & Schvaneveldt, 1991). The primary tools applied consist of watching, asking questions and listening. The interpretation of the data would by necessity be undertaken in a cultural context with the assistance of cultural experts, where and as appropriate.

2.7 Case study methodology

For this project there are two distinct case studies where the information pertaining to two crops of interest is each presented in an independent chapter effectively collating knowledge and other information sources into a story which responds to the hypothesis as stated in the thesis. The case study process here is applied as a form of qualitative research in that the information from which it is based is subjective by nature and encompassed in cultural bias which in itself is the expectation prior to embarking on the data collection process.

The use of a case study has become an accepted qualitative method in certain research disciplines including ethnobotany. Hamel *et al.* (1993) argue that the case study is an approach rather than a method and that as an approach it employs various methods including interviews, participant observation and field studies. In an anthropological study it allows the researcher to undertake a monographic study from which generalised conclusions can be drawn and discussed (*ibid.*).

Yin (2014) defines the case study as: *an empirical inquiry that investigates a contemporary phenomenon within its real life context, especially when the boundaries between phenomenon and the context are not clearly evident* (p12). Furthermore, he notes that multiple case studies can be undertaken and used to compare the similarities and differences between cases (Yin, 2014) and that

evidence drawn from multiple case studies is often considered more compelling and the overall study may therefore be considered more robust (*ibid.*).

The perception of a lack of rigour in this research method often results from the subjective nature of the research based on observations, thoughts, or cultural world-views of both informants and researcher. Chapoulie (1987, p. 276) noted that the comparative approach to case studies:

> *'not only permits field researchers to take an objective point of view toward their activities and thus exercise certain control over them, it also allows them to avoid established representations of the subjects they study, especially those associated with their familiar everyday points of view.'*

2.7.1 Case Study Data collection

Yin (2014) further identified six sources of evidence usually presented in a case study; documentation, archival records, interviews, direct observations, participant observation and physical artefacts. A mix of sources has been applied to the data collection process in the case studies for this thesis. Primarily, informal interviews with various Māori knowledge experts have been undertaken to assist in determining the whakapapa (historical relationship) and cultural alignment of the Māori and Pacific/South American communities to two well-known crops. A significant amount of the knowledge was given formally and informally at hui or traditional gatherings under the umbrella of Tahuri Whenua or related whanau/hapū interests and other occasions where contact has occurred. Where possible they have been referenced as personal communications but often they have been given under the consensus of several people rather than one alone. Culturally, Māori have a strong belief in an intergenerational transmission of knowledge, acknowledging that no single process of learning will provide all the answers for each individual in our community (Pere, 2000). In reference to these traditional processes, Royal (1993) states: *'oral literature was recited continuously until it was carved into the house of the mind'* (p21).

2.7.2 Literature review

Historical (archival) data or 'documents of the past' (Adams & Schvaneveldt, 1991) from both primary (e.g. diaries) and secondary (e.g. collated statistics or newspaper articles) sources have also been drawn from to provide further insight into Māori , Pacific and other knowledge relevant to the origin and dispersal of key crops. Alongside this element of literature work has been the advantage of being able to access and interpret literature or other materials written in Spanish which is the author's mother tongue. This provides a uniqueness which has so far been missed in

previous ethnobotanical work with a Māori emphasis. Thus all six sources of data identified by Yin (2014) have been utilised in these case studies.

A practical approach and application to the discipline of ethnobotany has also been applied as part of the data collection for this thesis. The nature of working within one or more cultural groups based in their traditional knowledge and seeking in part to restore and revive that knowledge in an academic context is a daunting objective in itself.

2.8 Spatial factors

Given the topic of this thesis and the relationship to the Pacific region as a whole, it is not easy to fully appreciate the spatial factors which apply to the relationship between geographical locations and communities, movements across an oceanic continent, and the actual logistics involved in migrations. To support this several maps have been included in the text.

Figure 1 on the following page is a map indicating all the Pacific locations directly mentioned in this thesis and is provided for ease of locating names and their geographical positions relevant to Aotearoa / New Zealand. Figures 2-6, 8-9, 16, 18 and 20 all provide cartographic presentation to support textual information.

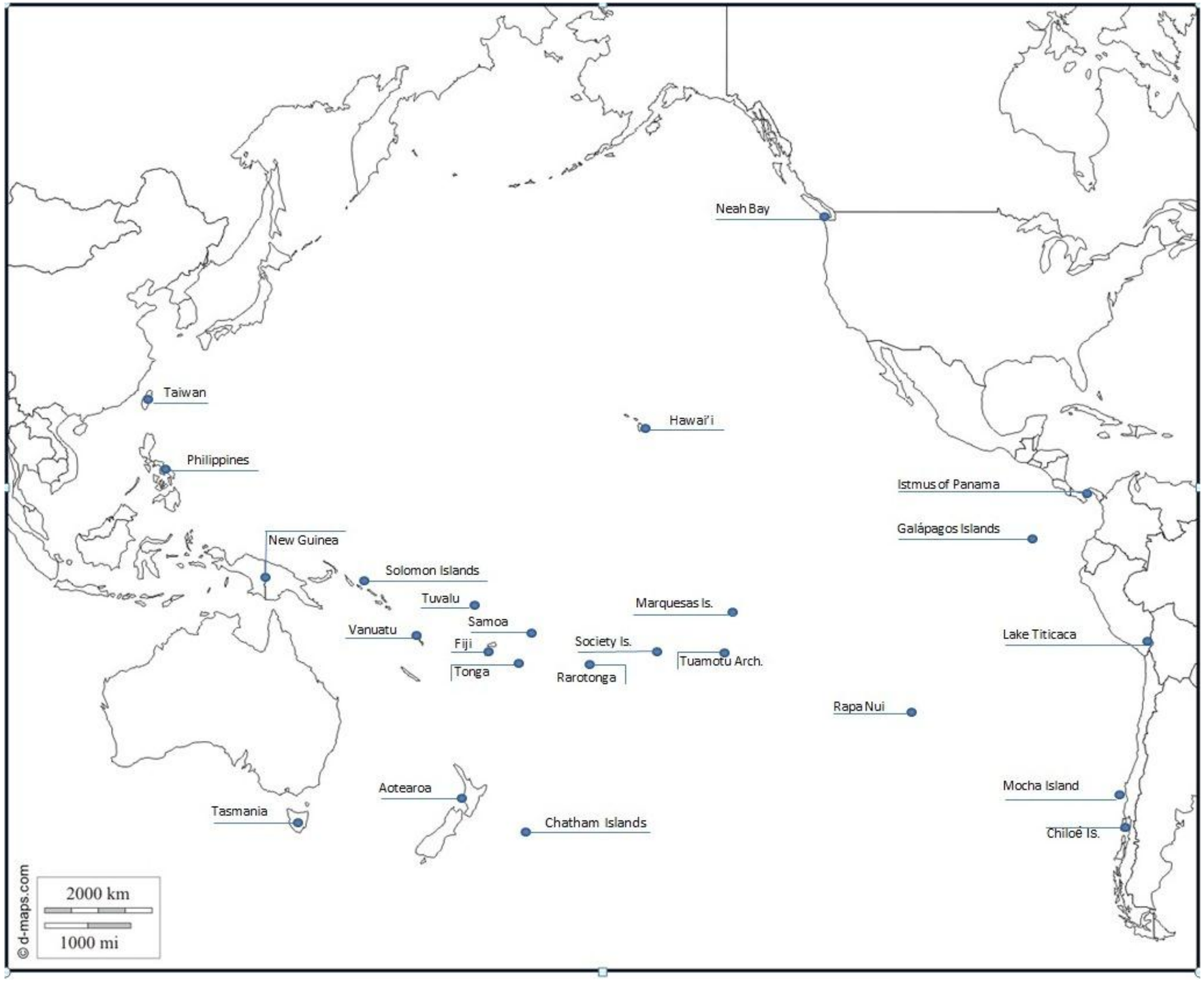


Figure 1: Map of Main Locations Mentioned in this Thesis.

3 Polynesian Settlement and Discovery

Tangaroa ara rau
Tangaroa's hundred pathways[5]

3.1 European Discovery of Polynesia and New Zealand

In 1513, while looking for new riches and domains, Vasco Nuñez de Balboa crossed the Isthmus of Panama. He was the first European to reach the Pacific Ocean, which he named "The South Sea". Subsequently, for more than two centuries the Spanish controlled and sailed almost uncontested the waters of the Pacific, which they even referred to as "Spanish Lake". They discovered numerous island chains and interacted with the ancient local inhabitants, who hint at some of these encounters in their oral accounts and traditions (Mellén, de Lucas, & Luque, 2006).

In 1526 the caravel San Lesmes was travelling from Spain to the Indies following the recently discovered passage between the Atlantic and Pacific Ocean (south of mainland South America) when it was blown from its course and ended in the south coast of Australia. The Portuguese who later seized the vessel in Indonesia interrogated the crew and based on the accounts, were able to map the eastern coast of Australia, as depicted in the Dieppe maps circa 1547, especially the Dauphin Chart (Figure 2) (Hervé, 1983; Wiseman, 1998). Wiseman (1998) points out that these maps present a remarkable similarity with the coastline of New Zealand and Australia. Sir Joseph Banks, at the time of James Cook's first expedition to the Pacific in 1768, had a copy of this map (Mellén *et al*., 2006).

Various maps from the 16th century portrayed a great continent separated by a strait from America. This led numerous geographers to speculate that it was the mythical *Terra Australis Incognita*, a large continent believed since classical times to be located in the antipodes. The Spanish navigator Álvaro de Mendaña mounted an expedition from Perú in 1567 in order to look for the *Terra Australis* and colonise it. On his journey he discovered the Marquesas Islands (named after the viceroy of Perú), Tuvalu, and the Solomon Islands (named after the biblical King Solomon), where his

[5] Māori whakataukī referring to Tangaroa, atua of the sea and fish.

expedition clashed with the natives (see Figure 1). He returned to America after failing to encounter the southern continent and to establish a colony in the Pacific (Mellén *et al*., 2006).

Figure 2: Dauphin or Harleian world map, *1547. Source: British Library, London (n.d.).*

Another expedition to discover the *Terra Australis* was organised in 1605 by Pedro Fernandez de Queirós, who had partaken in Mendaña's failed expedition. According to Kelly (1961), it left from Perú and discovered the Tuamotu Islands, Vanuatu, Kiribati, the Society Islands and the Cook Islands. Luis Váez de Torres, who was commanding a ship on this expedition, discovered the Torres Strait in 1606 (between the island of Papua and Australia). The Dutch navigator Willem Janszoon is the first European to have recorded the discovery of the Australian continent in 1606, just some months before Torres sailed through the strait (Estensen, 2006).

According to Mellén et al. (2006), the discoveries of the Spanish were kept secret in order to protect the Spanish trading routes. It is possible that one or several of these Spanish expeditions managed to reach New Zealand, and there are various reports that seem to suggest this. Esparza, in his book Epic Spain (as cited in Juan Fernández, n.d.), proposes that the Spanish explorer Juan Fernández could have been the first European to reach New Zealand, in 1576. Fernández sailed westward for one month along the 40° South and his expedition found an island that he describes as: "mountainous, fertile, with strong-flowing rivers, inhabited by white peoples, and with all the fruits necessary to live".

Wiseman (1998) writes that the discovery of an iron helmet in the Wellington Harbour (See Figure 3) gave rise to much speculation, and some academics have suggested it was left by Fernández's expedition. While anchored at Ship Cove (Figure 3) in 1777, Captain Cook heard from Tairoa, their Māori liaison, about a foreign ship that had anchored near this harbour some time prior to his visit (Richards, 1993; Wiseman, 1998). According to Richards (1993), Cook was convinced he was not the first European to reach New Zealand and regretted not indicating more about these earlier visitors. The findings of Fernández's expedition were not publicly disclosed as they did not have the approval of the Viceroy of Perú (Juan Fernández, n.d.) and the evidence of a discovery remains inconclusive.

Figure 3: Map of Various Places in New Zealand Mentioned in this Work.

Besides these Spanish expeditions, there are several other hypotheses about the discovery of New Zealand before the traditionally accepted date of 1642, when the Dutch explorer Abel Tasman arrived. The Portuguese apparently had reliable maps of the Australian coastline since the early 16th century and could also have been familiar with the New Zealand waters. Also, a Tamil bronze bell was found in Northland by Reverend William Colenso in 1836. The locals told Colenso that their tribe had been in possession of the bell for many generations, after being found buried amongst the roots of an old tree (Wiseman, 1998). The exact origin of the bell is unknown, but it strongly suggests an early contact with sailors who had been in Southeast Asia, possibly Portuguese. When referring to the discovery of the bell several generations ago, Colenso's Māori informants meant that it occurred earlier than 1750, as, according to Bellwood (1978), a generation in traditional Polynesian time-keeping is usually considered to comprise approximately 25 years.

A bird representation made of dark green serpentine, a rock material unknown in New Zealand, was found in Waikato in 1871. Korotangi, as it was called by the local Māori, has an Asian style and presents features that could only have been achieved with metal tools, unknown in pre-European Polynesia. Several scholars have proposed that Arab sailors, who developed vast mercantile routes around Southeast Asia, could have reached New Zealand's coast several centuries ago (Wiseman, 1998). Eccles (as cited in Miller, 1955) refers to the existing Arabic works from the 13th and 14th century mentioning New Zealand and describing it as a:

> *"Large and very mountainous island in the farthest southern ocean, beyond and far south-east of Borneo, and as being uninhabited by man but by gigantic birds"* (p. 2).

According to Beaglehole and Best (as cited in Richards, 1993) Banks was told by an old Māori about a local tradition of two large vessels that had arrived in the past. According to the tale, the crew were killed and eaten, while the vessels were destroyed. Similarly, many iwi from the South Island to Whanganui in the north held that a vessel known as Rongotute arrived sometime before Cook and was wrecked and its crew eaten after the Māori were mistreated by the navigators. According to most of these stories, a virulent epidemic called *Rewharewha* followed the arrival of the Rongotute, probably indicating an introduction of some foreign disease. Based on James Cook's personal diaries, Richards (1993) suggests that Cook himself suspected that a venereal disease was introduced to New Zealand by some previous visitors.

Mellén *et al*. (2006) noted that in 1911, the Māori tohunga Mohi Turei from Gisborne recorded the old Māori legend about some local fishermen, long before Captain Cook's arrival, who encountered in their fishing waters a ship with pale-skinned men aboard. The ship, according to Mohi Turei, seemed to rise in the sea and appeared to be rowing the air. The ship was to be

encountered in the same place on various occasions. His descriptions seem to indicate that the vessel sailed with different mechanisms to those known to Māori and Polynesians, which suggest a European or Asian origin.

Even though there are numerous hypotheses of a proto-discovery of New Zealand, some presenting strong arguments, the Tasman discovery in 1642 continues to be the first European documented sighting of the islands. The discovery of Polynesia and New Zealand by its first inhabitants, however, remains a much more obscure topic, with many more hypotheses proposed by scholars.

3.2 Original Colonisation of Polynesian

Research in, and on, the Pacific is a relatively recent activity, with most of the archaeological investigations not beginning until the end of World War II. Shutler and Shutler (1975) point out that this is the major reason why there is not much information available about the development of prehistoric Oceania and no meaningful progress had been made into the issue of Polynesian origins. However, the hypothesis about the Lapita culture migrations has gained a strong foothold in the academic field and is constantly being extended by new archaeological and linguistic findings. It is generally understood that the original Polynesian culture developed out of the Lapita, a sea-faring people who migrated from Southeast Asia and introduced new sailing technologies and colonisation approaches. Kirch and Kahn (2007) indicate that the chronology of the dispersal into Eastern Polynesia is increasingly well understood and has been the focus of several recent important researchers.

Modern scholars generally concur that the ancestors of the Polynesians were the Lapitas, who are widely thought to have originated in modern Taiwan (Green, 2005). There are various discrepancies regarding the exact route and the methods of their voyages across the Pacific, but their Lapita origin is seldom questioned in the academic circles. Zeng *et al*. (2014) propose that from the early inhabitants of Taiwan, only a few of the tribes actually migrated to the southeast between 2000-1000 BCE to eventually develop into the Polynesian culture.

Soares *et al*. (2011) suggest that according to studies of mitochondrial DNA, which is inherited only from the mother, an unknown group of Polynesian ancestors migrated from the islands of Southeast Asia to Near Oceania around 4000 BCE. This is much earlier than the presumed Lapita migration from Taiwan to the area, which is traditionally considered the first ancestral lineage of Polynesian in Oceania. However, the study also found that around the time of the migrations from

Taiwan, there was a "voyaging corridor" between Island Southeast Asia and Near Oceania, which concurs with the mainstream hypothesis of Taiwanese migrations (Soares *et al*., 2011). Walter, Jacomb, & Bowron-Muth (2009) indicate that along their migrations through Papua New Guinea and the Solomon Islands, the Lapita settlers interacted, and probably were influenced, with tribes that had inhabited those islands for more than 40,000 years.

Polynesian traditional knowledge has no accounts regarding the Lapita origin, with their oral history not mentioning the place of provenance before settling in Polynesia. Māori generally regard the events prior to the main occupation of Hawaiiki as something retained in their mythology rather than specifically through whakapapa (P. Richardson, personal communication, June 29, 2014). As such, the academic theory about the Lapita origin is neither supported nor contradicted by traditional accounts.

According to archaeological and linguistic data, Garanger (1972) states that it is clear that western Polynesia was settled around 2000 BCE from Fiji or the islands to the west. The first settlers of Polynesia reached Tonga after 1500 BCE (Bellwood, 1978). Various middens (waste mounds or shell deposits) found in the island are thought to be of Lapita origin, associated with the pottery in Fiji at that time, and are dated at 1150 and 800 BCE (Shutler and Shutler, 1975). Lapita pottery dating to 800 BCE was also found in Samoa, suggesting that the colonisation of both Tonga and Samoa took place at almost identical times.

Various scholars, based on different types of evidence, have proposed either Tonga or Samoa as the place where Polynesian culture originated after arriving from Fiji (Shutler and Shutler, 1975). Also, Shutler and Shutler (*ibid*.) indicate the people who populated these islands eventually stopped making pottery at the turn of the current era, possibly indicating a shift in cultural development. The usually accepted time period for the expansion into East Polynesia coincided with this event, probably marking the beginning of modern Polynesian culture as such.

The early stages of East Polynesian migration are characterized by Sinoto (1970) as having a maritime economy emphasizing hook and line fishing, and the manufacturing of a distinctive style of adzes. Before the 1970s, the Society Islands were generally regarded as the most likely centre for these dispersals. Archaeological projects now suggest that the earliest site of occupation in Eastern Polynesia is in the Marquesas Islands, with Sinoto (1970) dating some sites at 300 and 600 CE, and Dickinson and Shutler (1974) dating some pot shards at 300 CE. However, there is still an on-going debate about the nature of the archaeology undertaken, as Bellwood (1970) has indicated major differences in the topographic characteristics and cultural development between the islands.

Bellwood (1970) suggests that it would be much more probable to find well preserved material remains in the relatively undisturbed soil profile of the Marquesas Islands than on the largely interfered agricultural soils on the coast of the Society Islands.

From this centre of dispersal, the Society and/or the Marquesas Islands, Polynesian culture was quickly extended to numerous islands and delineated a region known as the "Polynesian triangle" (See Figure 4). This area, according to Finney (1996), is the largest part of the planet to be inhabited by people sharing a common provenance and ancestral culture.

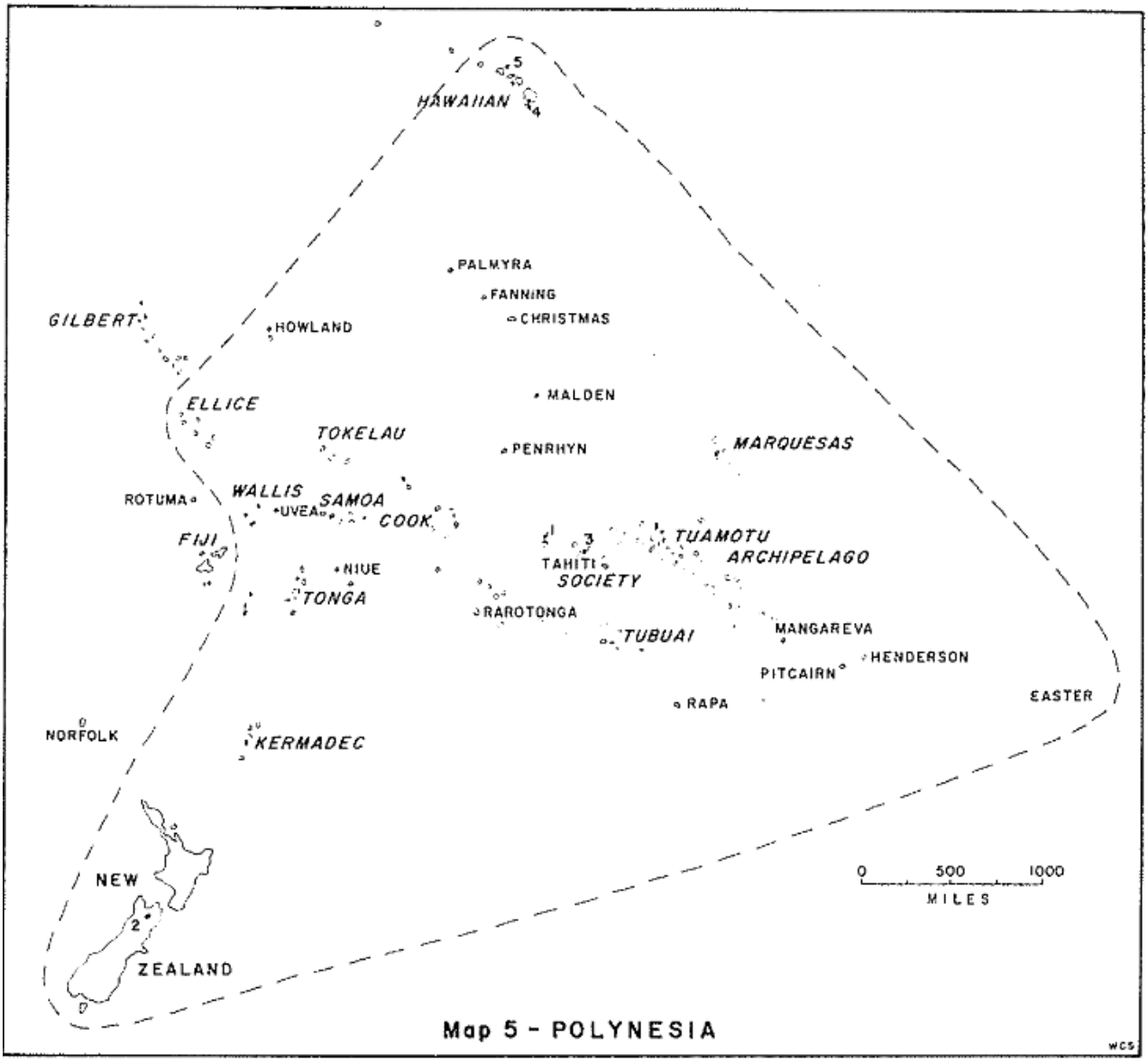


Figure 4: Map of Polynesian Triangle. Source: Shutler and Shutler, 1975.

Far at the eastern point of the triangle, Easter Island is thought to be settled from the Marquesas around 500 CE (Shutler and Shutler, 1975). Heyerdahl (1952) proposed that Easter

Island/Rapanui was originally colonised by the mythological “long-ears” from South America and then by Polynesians at a much later stage. However, Shutler and Shutler (1975) indicate that the lack of archaeological evidence for this proposed early colonisation and the distribution of the idiosyncratic Lapita pottery in Melanesian and early Polynesian settlements sharply reject this hypothesis.

Hawai’i, the northern point of the Polynesian triangle, is also thought to have been settled from the Marquesas around 650 CE (Emory and Sinoto, 1969). The southern point of the triangle, comprised of New Zealand and the Chatham Islands, was colonised at the last stage of Polynesian expansion circa 1000 CE (Walter *et al.*, 2009). Sharp (1957), based on the similarities between artefacts found in early New Zealand sites and Maupiti and Huahine in the Society Islands suggests that Māori culture was directly originated from the Society Islands.

The Marquesas Islands seem to have been the primary origin for migrations on eastern and northern Polynesia. Suggs (1962) suggests that Mangareva, on the eastern part of the Tuamotu Archipelago, was probably settled from these islands around 1200 CE. Also, other islands in eastern Polynesia, such as Henderson Island and Pitcairn Island, seem to have been settled from the Marquesas at 1100-1300 CE (Sinoto, 1974).

On the other hand, central and southern Polynesia is thought to have been settled from the Society Islands. Duff (1959) proposes that most of the Tuamotu Islands, the Cook Islands, and the Austral Islands had their immediate ancestors in the Society Islands. Also, New Zealand culture is generally believed to be derived from Tahiti or Ra'iātea (Green, 2005).

There are some Polynesian populations inhabiting small islands along eastern Melanesia and Micronesia, well outside of the Polynesian area. They are sometimes referred to as Polynesian outliers, and their settlement in this region has given rise to much speculation about their origin. It was proposed by Capell (1962) that they represent communities that were left behind when Polynesian speakers were migrating from Southeast Asia to Polynesia. In present, due to the general accepted notion of Fiji as the place from which Polynesian culture and language emerged, it is usually accepted that these Polynesian outliers arise from later migrations out of western Polynesia (Green, 1971).

Cultural characteristics of early Polynesian people, such as the wide use of perishable material for construction, present some important difficulties when trying to understand the settlement patterns. The case of New Zealand is unique, as it provides, “in association of an extinct bird fauna, an obvious method of distinguishing older archaeological sites” (Duff, 1956).

The linguistic studies in Polynesia have a longer tradition than the archaeological one and present much fewer controversies. Polynesian is classified in the Austronesian languages family, which includes most of the languages in Southeast Asia, Madagascar, and the Pacific. Polynesian language is divided into two subgroups: Tongic and Nuclear Polynesian. Tongic Polynesian includes Tongan, Uvean, and Niuean; while Nuclear Polynesian includes Samoic and eastern Polynesian. Māori language (Te reo Māori) is classified under the eastern Polynesian division. The language more closely related to Polynesian is Fijian (Pawley, 1972), which strongly validates the general hypothesis of Lapita origin.

3.3 Sailing Routes and Technologies

One of the most controversial themes in Polynesian migrations studies is how the original settlers were able to find their way around the vast Pacific and manage to reach places against the prevailing currents and winds.

In the 1950s, several publications by the Norwegian ethnographer Thor Heyerdahl, even though not ground-breaking, caused a great uproar in the scientific community by suggesting that Polynesia was colonised following a route from the Americas. Heyerdahl (1952 and 1958), as several scholars before him, deduced that even though the Europeans had long been sailing around Southeast Asia, they had never tried to sail eastward against the prevailing winds and currents. It was not until the discovery of America that the Spanish and Portuguese ventured into the Pacific. Following the flow of the trade winds and currents from South America, and on the advice of Inca sailors, they discovered Polynesia, Micronesia and Melanesia. With almost no exception, subsequent expeditions all originated from the east, even Cook's first discovery voyage. In order to return to the American continent, they had to sail north along the Japan Current and catch the North Pacific current. Heyerdahl concludes that more primitive raft or canoes from either Southeast Asia or South America would have had the same if not more limitations that European caravels (Heyerdahl, 1958).

More than a hundred years earlier than Heyerdahl, the British missionary William Ellis had proposed the hypothesis that the ancestors of the Polynesians were Asians who, along with the American Indians, had crossed the Bering Strait. Once in the American continent, they would have sailed back with the prevailing currents and winds into Hawai'i and then onwards to Polynesia. Ellis, as with Heyerdahl, also stressed that it was much more logical to assume that Polynesia was settled from the east (Bellwood, 1978).

The idea that Polynesia was colonised from South America arises not only from the likelihood of the wind and currents, but also from mythological tales and ethnographic/archaeological comparative studies. Artefacts dug up along the coast of Chile, especially from the Mapuche culture in the central coast, present a striking resemblance to Polynesian objects. It was determined that these artefacts date from exactly the same time as those being manufactured in Polynesia (Storey *et al*., 2007). A study by Storey *et al*. (2007) dated a finding of chicken bones at coastal Chile at 1300-1450 CE and gained worldwide attention when published, as chicken are generally considered to be absent in pre-European America. However, this controversial study has been questioned by several scholars, such as Gongora (as cited in Lawler, 2010), about its accuracy and methodology and remains inconclusive.

According to Matisoo-Smith (as cited in Lawler, 2010), numerous human skulls that were recovered from Mocha Island in Chile allegedly present distinctive Polynesian traits. Human genetic comparative studies between Polynesia and South America have been very limited until recently, with most of them focusing on the Easter Island. Matisoo-Smith (as cited in Lawler, 2010), who has extensively researched about early South American-Polynesian contact, holds that if existent, it would be very difficult to find evidence of an early Easter Island-South American DNA association, as the genetic pool was largely altered when numerous Polynesians migrated or were taken to South America after European colonisation. A study by Moreno-Mayar *et al*. (2014) claims to have found evidence that, between 1280 and 1495 CE, Native Americans made a contribution to the Easter Islander's genetic pool.

Nevertheless, at present, most scholars agree that there is insufficient compelling archaeological and genetic evidence to demonstrate that Polynesians ever associated with South Americans. However, both Polynesian and South American traditional knowledge clearly implies contact, at the very least, between the regions.

The account of the long-ears, which has lingered as a traditional indication of a probable early colonisation by people from South America, was researched to a large degree by Heyerdahl during his excavations in Easter Island. In Perú, the conquistador Pedro Pizarro mentioned that some high-ranking people, who were characteristically white-skinned, had modified their ears so that they presented an elongated appearance. This tradition apparently derived from the accounts that Kon-Tiki Viracocha, the creator deity worshipped by a large part of Incan society, was fair skinned and had long-ears. According to local tradition, a group of "long-ears" had migrated on reed boats across the Ocean from Lake Titicaca in highland Perú, to settle a land located far to the west of South America (Heyerdahl, 1958).

Other similar accounts of South American people settling lands across the ocean to the west are profuse in traditions of Chile, Perú, Bolivia, and Ecuador, among other places (Nick Roskruge, personal communication, 20 September, 2014). The tradition of Incan ruler Topa Inca Yupanqui, who arranged and led an expedition of thousands of men to explore the Pacific Ocean for more than 10 months, claims that South Americans made contact with the inhabitants of various islands far to the west. Even though various authors reject the possibility of such voyage to have taken place, diverse traditional account in the Andes assert that there was some contact with Pacific inhabitants (Nick Roskruge, personal communication, 20 September, 2014).

On Easter Island, 3500 km west of mainland South America and 2600 km from Mangareva, Heyerdahl (1958) claims that the local tradition maintains that the practice of elongating the ears was imported. According to the tradition, the first king of Easter Island (Hotu Matua) had elongated ears and arrived accompanied by other "long-ears". It is narrated that the vessel arrived from the east after sailing for sixty days towards the setting sun. Thomson (as cited in Bellwood, 1978) recounts that this chief, called Hotu Matua, arrived in Easter Island 57 generations ago from a scorched land to the east. However, Bellwood (1978), although accepting the possibility of such event, points out that the traditions from the island were not properly recorded until the 1880s, time at which there might have been some contamination caused by European influence may had already occurred.

The unexplained occurrence in Easter Island of a subspecies of the giant bulrush reed or 'totora' (*Schoeneoplectus californicus* ssp. *tatora*), has given rise to speculation that it might have been introduced by humans from its native South America in order to build boats similar to the ones in Lake Titicaca (Vrydaghs, Cocquyt, van de Vijver, & Goetghebeur, 2004). However, recent studies such as Fishcher (2005) have indicated the possibility that totora was introduced by birds more than 30,000 years ago. Beside the totora, Bellwood (1978) indicates that other South American-originated plants, such as knotgrass (*Polygonum acuminatum*) and nutgrass (*Cyperús eragrostis*), were naturalised by unknown means in Easter Island. While Whistler (as cited in Clarke, 2009) indicates that the Polynesian tomato (*Solanum repandum*), which is most likely of South American origin, was probably introduced to the area by Polynesians.

However, the introduction of sweetpotato/kūmara (*Ipomoea batatas*) to Easter Island/Rapanui and Polynesia is definitely the most controversial argument when discussing South American-Polynesian contact. The topic about the occurrence of kūmara in pre-European Polynesia will be further discussed in Chapter 5: Kūmara.

Even though a large number of academics, such as Roland Dixon (as cited in Te Rangi Hīroa, 1935), have doubted the sailing abilities and technologies of ancient South Americans, various indicatives suggest that they possessed advanced navigational skills and could have been capable of reaching Polynesia by following the prevailing winds and ocean currents. Numerous raft centreboards found in pre-Inca graves in coastal Perú attest to their highly developed navigational techniques (Bellwood, 1978).

The precursors of the Incas apparently visited the Galápagos Islands several times, with various artefacts found in the islands usually being attributed to early South American navigators (Bellwood, 1978). While in Ecuador in 1736, the Spanish scientists and explorers Antonio de Ulloa and Jorge Juan reported that the natives were using very advanced sailing balsas, capable of tacking and safely sailing in contrary wind. These scientists deduced that those vessels would have been able to accomplish lengthy trips to the west, and indicated that the local sailors had a deep understanding of the equatorial and Perúvian currents and were aware of their courses (See Figure 5). It would not be a difficult feat for them to sail on those currents and reach eastern Polynesia, around the Marquesas Islands (Hornell, 1945).

Even though the possibility of South Americans reaching Polynesia has been extensively studied by some scholars, it is usually agreed that the Polynesians sailing to South America would have been more probable. The ability to transverse large areas of ocean has been a skill present in the settlers of Oceania for thousands of years. Australia's first habitants reached the continent 50,000 years ago and had to cross almost 150 km of open sea from New Guinea, while the Solomon Islands are almost 170 km away (Sorenson, 2005).

Figure 5: Currents around Galápagos Islands. Source: Ader,2000.

It has been indicated by Scaglion (as cited in Lawler, 2010) that the Polynesian navigators who managed to reach South America would have landed at the southern part of the continent. From here, they would have sailed north on the Humboldt Current to reach the Cañari people in modern Ecuador, who extensively cultivated kūmara. According to Hornell (1945), South American sailors, who were familiar with the run of the currents on the area and the location of the Galápagos Islands, would have been able to advise the Polynesians how to reach the islands to the west. From Ecuador they would have followed the South Equatorial Current and the trade winds, past the Galápagos Islands, to return to their Polynesian homelands (See Figure 6).

The South Equatorial Current, according to Voitov and Tumarking (as cited in Bellwood, 1978) moves at almost 40 km per day in an east-west direction across the South Pacific. This current, paired with the trade winds, could transport a vessel thousands of kilometres in just a couple of weeks. Considering that the Marquesas Islands are 6400 km away from South America, the voyage could have been completed in one month under favourable weather.

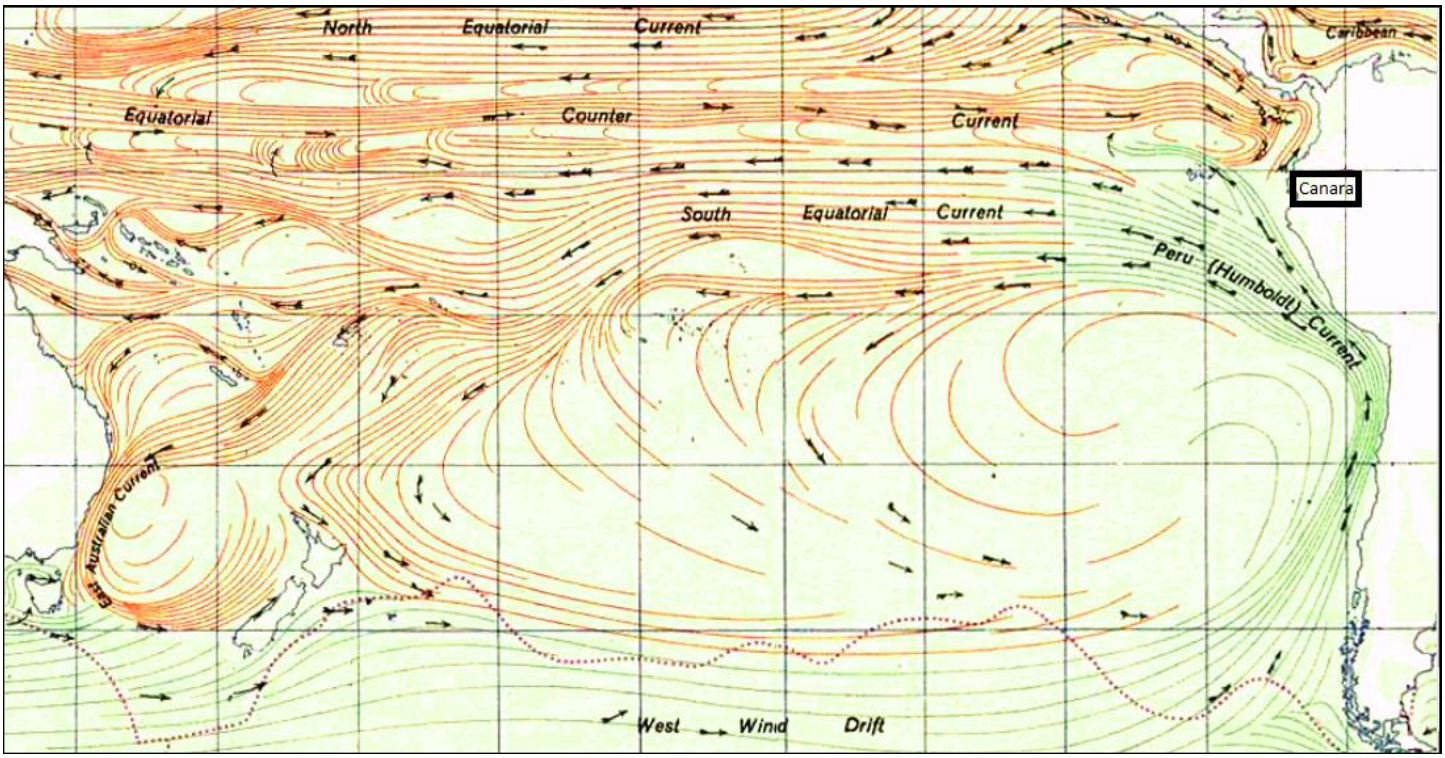


Figure 6: Map of the South Pacific Gyre. Source: United States Army (1943).

There has been an on-going controversy regarding Polynesian settlement strategies as to whether sailing was set to a predetermined location, even against the prevailing winds and currents, or the settlers just drifted along in single "accidental" voyages. The latter hypothesis, which advocates a one-way voyage, was usually accepted by a numerous scholars during the 20th century, with studies such as Sharp (1957) proposing that Polynesian sailors were not capable of tracking their route and were therefore unable to return to their place of departure. He argued that Polynesians did not have the technology to calculate their longitudinal location and couldn't have determined the displacement caused by the winds and currents, rendering their positioning attempts impossible after a couple of days. Kjell Akerblom (as cited in Bellwood, 1978) further added that the Polynesian most probably were also ignorant on how to interpret the zenith stars in order to calculate their latitude positioning.

This strongly contrasts with Polynesian traditional knowledge, which clearly indicates that return inter-Polynesian voyages were relatively frequent during a period a time. Traditional accounts claim that these voyages were motivated by diverse reasons, such as to restock provisions, repopulate an area, among various others (P. Richardson, personal communication, June 29, 2014). Once the Polynesians had a basic understanding of their geographical positioning in regards to other islands, Bellwood (1978) proposes it wouldn't have been long for two-way voyaging to ensue.

Bellwood (1978) indicates that, according to various Polynesian traditions, numerous exploratory voyages were undertaken across the Pacific around 1000 CE, and this concurs with the archaeological findings.

The idea of two-way voyaging, with well-provisioned settlement voyages succeeding an exploratory journey, has increased in prevalence in present day Polynesian studies. A well-known series of models devised by Levison, Ward, and Web (as cited in Bellwood, 1978) back this idea by suggesting that the probability of drifting into Polynesia from any continent is minimal, and it would be practically impossible to passively drift into some of the islands where Polynesians have settled. They concluded that most of the Polynesian islands were purposefully settled after sailing, at least partially, against the prevailing currents and winds. According to this hypothesis, two-way exploratory voyages would have been feasible, as the winds and currents would have facilitated the return to their place of departure.

Green (2005) states it has been proposed that the Polynesians could have travelled east following the short summer intervals when the trade winds are supplanted by strong winds from the west. After sailing east, they would be able to return west downwind once the trade winds returned. This phenomenon would tackle various arguments used in favour of the old theory of east-west settlement of Polynesia.

By the time of European contact, Polynesians were not undertaking long-distance voyages across the Pacific. However, the British missionary John Williams recorded that the inhabitants of the southern Cook Islands, of whom he made the first recorded sighting in 1813, and the Society Islands were at least aware of each other's existence (Bellwood, 1978). Te Rangi Hīroa (1935), based on the markedly different mythology of Samoa to that of east Polynesia, deduces that contact between Samoa and Ra'iatea ceased at a period prior to the establishment of the 'classical' pantheon at the latter.

In 2011, a 6-metre fragment section of an ancient waka, or canoe, made of matai (*Prumnopitys taxifolia)*, a New Zealand endemic tree, was dug out of a river bank in Tasman District, South Island. Ngāti Tama ki Te-Tau- Ihu, mana whenua of northern Tasman District, are the temporary *kaitiaki* for the find. The significant feature of the well-preserved piece was a carved sea turtle, which is seldom depicted in Māori art. It was dated at 1400 CE, and the sea turtle carving (See Figure 7) as well as the style of the waka, with carved ribs according to practice in central and eastern Polynesia, strongly suggests that Polynesians were regularly sailing between Aotearoa and Eastern Polynesia around this time (Rose, 2012; Field, 2014; Bayer, 2014). Jones (as cited in Bayer,

2014) indicated the possibility that canoe builders in New Zealand were using traditional central/eastern Polynesian techniques "passed down through generations long after they lost contact with Polynesia".

Figure 7: Fragment of Waka at Pōhara, Golden Bay. Source: Tim Mackrell (in Khan, 2014).

Experimental science on Polynesian studies was popularised by Thor Heyerdahl and his Kon-Tiki expedition in 1947, where he sailed from the coast of Perú and landed in the Tuamotu Islands 101 days after following the winds and currents (Heyerdahl, 1952). This greatly inspired a series of oceanic voyages using modern replicas of pre-European rafts and canoes, navigating and testing many routes across the Pacific.

In 1974, modern replicas of pre-Columbian rafts sailing from Ecuador reached the coast of Australia, more than 15,000 km distant (Finney, 2003). In 1976, the vessel Hōkūleʻa used traditional Polynesian techniques to sail from Hawai'i to Tahiti and in 1999, from Hawai'i to Easter Island, among other trips. These long-distance voyage canoes and other similar ones, like *Te Aurere* in New Zealand, have demonstrated that the settlement of the Pacific could have occurred as a result of intentional trips guided by the stars, instead of just passive drifting on currents and winds (Finney, 2003). It also provides evidence that, guided by *mātauranga* (traditional knowledge), "primitive" vessels were capable of crossing vast areas of ocean in a relatively short time and reach places thousands of kilometres away.

It should be noted that all of the above arguments have been made on the assumption that the winds in the South Pacific follow their regular modern patterns. Recent paleoclimatic research (Goodwin, Browning, & Anderson, 2014) suggests there might have been a timeframe at 1140-1260 CE when the winds in the area shifted their courses completely. Coincidentally, this interval concurs with the time at which archaeological studies indicate the earliest settlement of Aotearoa by Māori.

This shift in wind patterns proposed by Goodwin *et al*. (2014) would render advanced navigational skills such as tacking and sailing upwind unnecessary, and would allow explaining of the settlement routes for Aotearoa and Easter Island/Rapanui. These models concur with Māori and Polynesian *mātauranga* about return voyages being undertaken in the South Pacific and also suggest that long-distance voyages reduced significantly following the winds' return to their modern patterns after 1300 CE. According to Goodwin *et al*. (2014), the climate patterns at that period would favour a South American settlement of Easter Island.

4 Food Plants and Domestic Animals Dissemination in Polynesia

Ka toi au ki Hawaiiki, ki te kai ra, i rari noa mai, te raweketia e te ringaringa.
Hastily I return to Hawaiiki, where food abounds not prepared by hand[6].

4.1 Polynesia settlement

Polynesia is an exceptional region in the world as most of its important traditional food crops do not originate in the region. Anthropologists and ethnobotanists believe that initially, there were a very limited number of plants in Polynesia that could be used as a food source when humans first arrived in the region. The number of animal and plant species drastically decline across Polynesia the more it is travelled to the east. Te Rangi Hīroa (1935), from Ngāti Mutunga in Northern Taranaki, indicates that the only food plants originally available in the Polynesian volcanic islands were some *"berries, roots, the pith of the tree fern, the curling young shoots of fern, the growing ends and stems of creeping plants, and seaweed"* (p. 313). All of these plants were undoubtedly eaten by the first immigrants prior to the introduction of the other crops that would later become the staple food for the Polynesians, and they have been an important food source in recent famines (Te Rangi Hīroa, 1935).

The degree of development of the Polynesian culture would not have been possible relying only on the native food sources, especially the plants. Numerous fruit and root crops were imported by the settlers at various stages of their expansion into the islands. These introduced crops provided reliable food sources and permitted the settlement of various islands that were previously almost inhospitable. It also hints at the process of discovery that Pacific communities constantly undertook within their geographical region and the opportunistic approach they applied around new foods and settlements.

[6] Whakataukī, as provided by Kaumātua o Tahuri Whenua Inc. hui held at Te Hiiri marae, February 2014.

According to Te Rangi Hīroa (1935), the most important fruits introduced by Polynesians to their islands were: coconut (*Cocos nucifera*), breadfruit (*Artocarpus altilis*), and different cultivars of banana (*Musa spp.*). Of the root crops, the most important were the yam (*Dioscorea alata*), taro (*Colocasia esculenta*), Polynesian arrowroot (*Tacca leontopetaloides*), and sweetpotato (*Ipomoea batatas*). All of these crops, barring the sweetpotato, were first domesticated in the biogeographical region of Malesia (See Figure 8), located between Indochina and Australasia (Wikramanayake, 2002). Nikolai Vavilov classified them in the wider Indo-Malaysian centre of origin (Barrau, 1961).

In Polynesia, the prevalence of root and fruit crops over cereals led to the development of various methods to preserve the short-lived products. In contrast to the long-storing cereals, crops in the region had to be processed and/or dehydrated in order to have a supply in the off-season. It is not clear why the ancestors of the Polynesians did not introduce cereals, such as rice, to the islands. But over time the root crops became the primary carbohydrate foods of these communities.

Yen (1971) proposes that root crops were probably much more popular and well established in Southeast Asia before rice was grown extensively. As there was no environmental obstacle to the dissemination of rice into Polynesia, Yen (1970) suggests it was rather a cultural barrier. Roosman (1970) indicates that a Rarotongan song relates how their ancestors used to live on rice but, after tasting the breadfruit, stopped completely to grow rice.

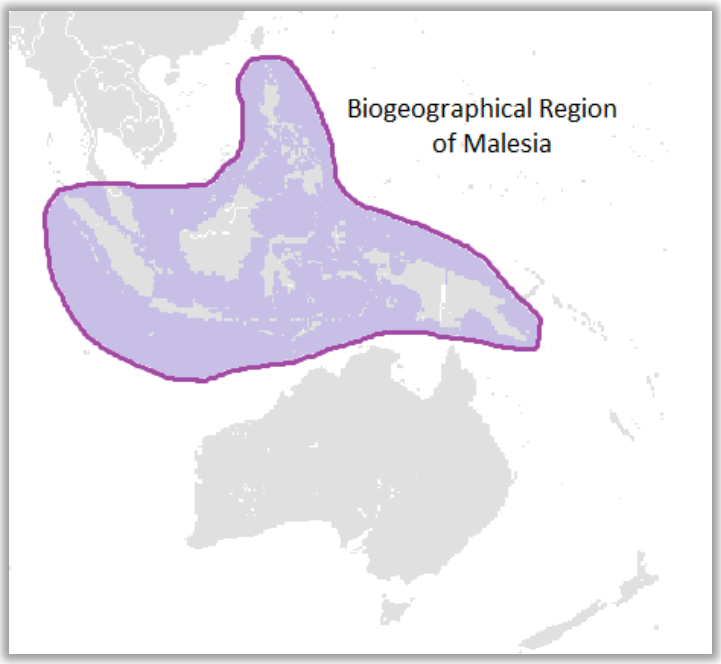


Figure 8: Region of Malesia. Source: Author.

The exact route for the dispersal of the crops by Polynesians has been subject to much debate. As Te Rangi Hīroa (1935) has indicated, the transport of vegetal material across islands on primitive canoes would have been very difficult, as it was exposed to the wind, sun, and salt water, along with the time taken to travel. Upon reaching an island, the food plants would need the adequate soil type to prosper along with suitable conditions generally, not easily achieved in some locations. Almost none of the plants carried by the first settlers, with a few exceptions such as coconut, a coarse taro variety, and possibly the noni (*Morinda citrifolia*), could have survived in the poor coral soils that abound in Micronesia (See Figure 9). All other food crops that were introduced into Polynesia require relatively fertile volcanic soil (Te Rangi Hīroa, 1935).

On that account, it is highly improbable that most of the food plants were introduced through the Micronesian islands, as there are almost no volcanic islands where the crops could have been established before continuing the voyage to Polynesia. Te Rangi Hīroa (1935) claims that a route through Melanesia would have been much more feasible, with most of the crops being carried from Indonesia and New Guinea all the way east to Fiji. From here, the food plants would have been transported to the fertile volcanic islands of Samoa or Tonga, which would serve as the gateway for dispersal into the rest of Polynesia. Gifford (as cited in Te Rangi Hīroa, 1935) favours Samoa as the original gateway, as he indicates that Tongan myths mention that the origin of most of their food crops is connected with Samoa, the skies and *Pulotu*, a mythical land that he claims is "vaguely situated beyond Samoa".

The fact that almost all of the food plants introduced into Polynesia have a vegetative propagation, either as tubers or shoots, is a clear indication that they were necessarily transported by humans and rule out a natural dispersal (Yen, 1973). Considering that these plant parts had no value as sea supplies, but still were carried for thousands of kilometres, it is evident that they were purposefully conveyed by settlers who knew that they would eventually reach islands of volcanic origin. This concurs with several Māori accounts that explain the circumstances under which kūmara was introduced into Aotearoa (See Section 5.3: Kūmara Introduction into New Zealand, Pg.52).

Te Rangi Hīroa (1935) proposes that from the initial gateway in western Polynesia, the crops were transported at an early stage to the Society Islands of Ra'iātea and Tahiti, considered to be the centre of human, domesticated animal, and crop dispersal in Eastern Polynesian.

In the same way as the crops, domestic animals introduced to Polynesia (dogs, pigs, and fowls) were carried from the Indo-Malayan region. These animals were not present in pre-European America, nor were they found in Polynesian coral islands. Te Rangi Hīroa (1935) indicates that the

coral islands or atolls represented an important barrier to the dispersal of domestic animals, further supporting the hypothesis about a Melanesian route of introduction, instead of a Micronesian one (see Figure 9).

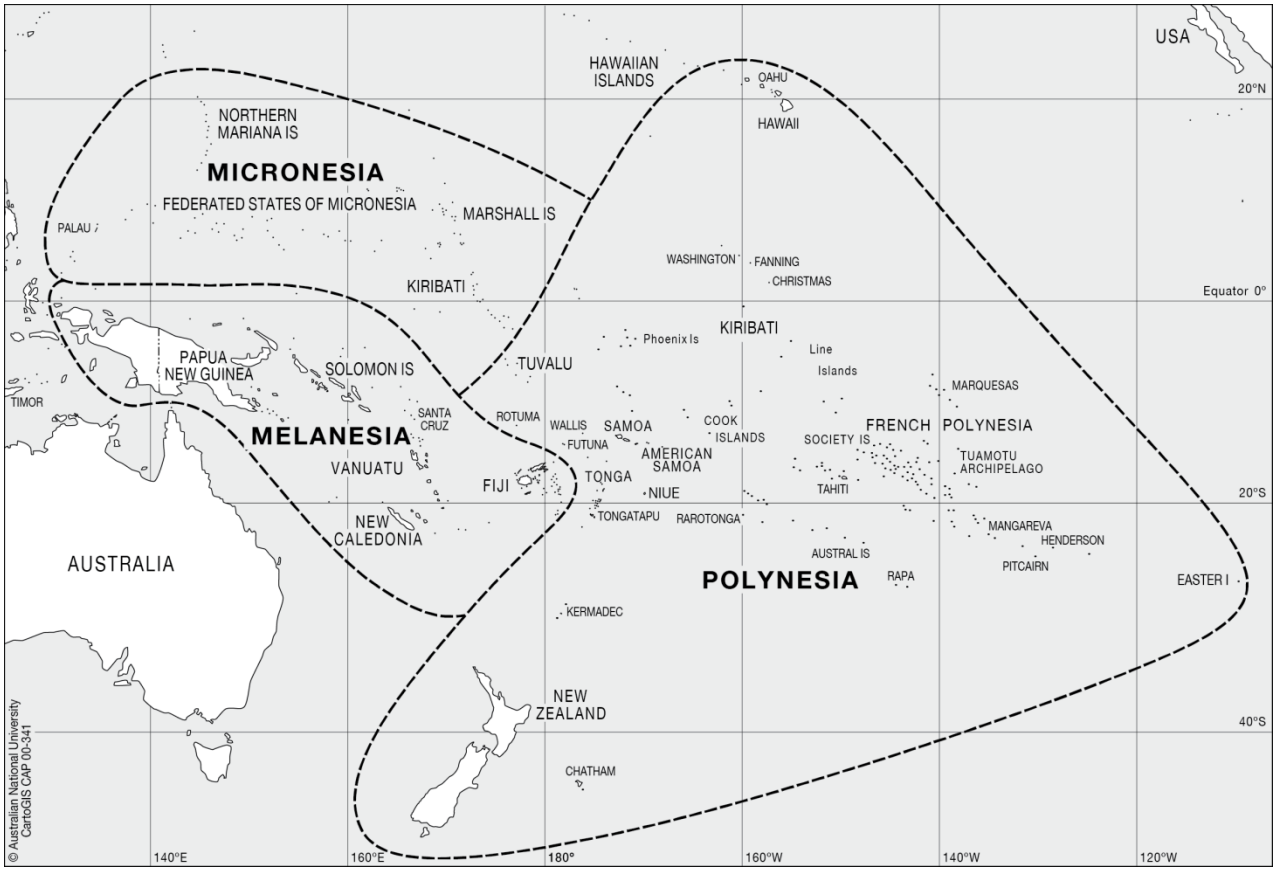


Figure 9: Micronesia, Melanesia, and Polynesia. Source: The Australian National University.

At the time of European contact, the coconut and breadfruit were not present at Easter Island and New Zealand, located at more than 27 and 34°S, respectively. The latitude most probably was the main obstacle against the successful establishment of these tropical crops. However, the fact that there is a Māori word for breadfruit -*kuru*- is indicative that they were at least aware of its existence (N. Roskruge, personal communication, August 10, 2014).

Yen (1960) suggests that kūmara, taro, and yam (all annual root crops) were able to prosper in New Zealand because they did not require as much time as the perennial tree crops, such as breadfruit and coconut, to reach maturity. Regarding the animals introduced by Polynesians, only the Polynesian dog, or *kurī*, was present in New Zealand; while in Easter Island, only the fowl was found by Europeans. In New Zealand, the Polynesian name for the fowl, *moa*, was instead used for the now extinct large flightless bird (Te Rangi Hīroa, 1935).

However, the same as in all Polynesian settlement, the undomesticated Polynesian rat – *kiore* - (*Rattus exulans*), was also introduced to New Zealand (Matisoo-Smith, Allen, Ladefoged, Roberts & Lambert, 1997). It is unclear why the rest of the Polynesian domestic animals were not introduced to these islands. Especially significant is the absence of the pig, which in Oceania usually coincides with horticulture (Shutler and Shutler, 1975), but the large voyage distances and the harsh austral weather may have been crucial factors.

After the initial dispersion of the crops and domesticated animals, Polynesians presumably continued to travel between the islands for a period. Handy (as cited in Te Rangi Hīroa, 1935) recorded a traditional account from the Marquesas Islands that indicates that shoots of breadfruit plants were carried to Rarotonga.

According to Forest Brown (as cited in Te Rangi Hīroa, 1935), such ample diversity of breadfruit varieties present in the Marquesas and of sweetpotato cultivars in Hawai'i is an indication that Eastern Polynesia must have been settled for a particularly long time, much earlier than the usually accepted 300 CE.

4.2 Mātauranga Māori on crop associations

Māori tradition supports the notion that many plants and useful additions to society were introduced during the primary migration period in the 13th century. Some tribes claim that each of the well-known waka – Aotea, Tokomaru, Takitimu, Kurahaupō, Te Arawa, Horouta and Mataatua – all carried significant taonga, including food stores and plants for future establishment in their new homes (A. Heihei, personal communication, February 10, 2015).

Māori are horticulturists, a fact evident from the very origins in whakapapa: the sons of Papatūānuku and Ranginui included Rongo-marae-roa and Haumia-tiketike, manifestations and guardians of the cultivated and uncultivated crops, respectively. Mātauranga in the form of history recalls the importance of key crops during the periods of migration to Aotearoa; taro (*Colocasia* sp.), aute (*Broussonetia papyrifera*), uwhi or yams (*Dioscorea* sp.), hue (*Lagenaria* sp.), kūmara and tii kōuka (*Cordyline* sp. or New Zealand cabbage tree). There are numerous records that reiterate the association of certain crops or plants with their introduction to Aotearoa such as the karaka (*Corynocarpus* sp.) (Hammond, 1924). Māori were also quick to identify useful attributes of many endemic New Zealand plants and the contribution they could make to their society, and thus plants such as harakeke (*Phormium tenax*) were added to their suite of horticulturally managed plants. Prior to the arrival of Europeans, Māori were subsistence horticulturists' dependant on the success

of these crops for matters of survival, hospitality and health. Leach & Stowe (2005) identify pre-European Māori as horticulturists and arboriculturists (including agroforestry) rather than agriculturists. This recognises the domestication and cultivation of food and utility crops in both annual and perennial systems.

4.2.1 Karaka (Corynocarpus laevigatus)

Atherton (2014) focussed on the movement of the karaka (tree) (*Corynocarpus* sp.), which was cultivated for its highly nutritious kernel and in traditional account was introduced to much of the North Island through the migrations of various tribes to Aotearoa and subsequently translocated throughout New Zealand. Her thesis focused on both cultural and evolutionary aspects of the cultivation of karaka. Originally it is thought to have been restricted to the northern North Island, however, its occurrence in the southern North Island, the South Island, Chatham and Kermadec Islands is strongly associated with Māori and Moriori archaeological sites and considered to have resulted from its cultivated production, in other words the tree was purposefully translocated with the movement of the people.

Colenso (1880) described the karaka as '*of inestimable value to the Māori, as a common and useful article of vegetable food, second only to their prized kūmara tuber.'* The tree itself has a number of related species across the Pacific and is therefore well known across many of the islands in its different forms. The collected history of the Aotea waka mentions karaka as one of the cargo of their ocean-going migration (Hammond, 1924; Smith, 1910/1999), said to have been collected at an island known as Rangi-tahua (thought to be the Kermadec Islands, North East of the North Island). Turi, as captain of the Aotea planted these karaka at present day Pātea in a grove called Pou-o-Turi (ibid.). Alternative or variations to this story exist with Smith (1910/1999) also stating there are karaka trees introduced by those on the Kurahaupō waka near Nūhaka in the northern Hawke's Bay. Other informants give Kupe, who made the original voyage to Aotearoa, as one who planted a variety of karaka called *Oturu* at Pātea (Atherton, 2014). Best (1925/1972) gives another account that one Tama-tea-nuku-roa, who captained the Nukutere waka, credits his son Roau with the introduction of the Tii Kouka (cabbage tree), taro and karaka to the East Coast.

4.2.2 Hue (Lagenaria siceraria)

Smith (1910/1999) recorded that hue was the only crop to succeed from the original introductions by Māori prior to the migration phase of the 14th century. Hammond (1924) stated that it was introduced to Aotearoa as seed from the cargo of the Tainui waka during the migrations. It was a dual-purpose plant; the mature fruit was variously used and young immature hue *(kotawa)* were eaten when the skin and flesh of the fruit were soft – generally around January and February (Yen, 1974). Hue have a strong whakapapa in Māori society and are protected by the god or atua Pu-te-hue, a child of Tane (Best, 1924/1995 & 1925/1976), and as such required strict ritual during planting and harvest. Pu-te-hue is quoted as saying: *'the seeds within me shall provide water vessels for my descendants'* as she gave herself to the people, specifically a tribe known as Ngāti Toi, the first to cultivate the hue (Schoon, 1962). Best (*ibid*.) also gives *kowenewene* or *wenewene* as alternative names for the hue in the East Coast Ngāti Porou district.

4.2.3 Uwhi/Uhi (Dioscorea alata)

The uwhi, or yam, is acknowledged as one of the vegetables introduced to Aotearoa during the time of the migration of Māori from Hawaiiki. Several varieties of yam are known to have been cultivated throughout Polynesia and St John (1954) stated:

> *'Such a widespread dispersal implies its esteem by the early Polynesian colonists. Its tubers, of course, were easily carried. When once planted in the forest, they would persist and multiply and maintain a food supply available for residents or occasional voyagers.'*

The traditional variety of yam (*D. alata*) is believed to have been grown extensively in New Zealand in former times but now it is not found anywhere. The journal of Banks from Cook's voyage of 1769 and Cook's later correspondence mentions the yam or uwhi identifying that it was being grown in the Bay of Islands area relatively extensively at that time (Begg & Begg, 1969). Shawcross (1967a) noted it was still a relatively common crop in Northland in the 1820s.

4.2.4 Aute (Broussonetia papyrifera)

The aute, or maro, was said to have been brought to Aotearoa by Māori on the waka Oturereao during the migration from Hawaiiki (Evans, 1997) but it struggled to survive in the cooler, temperate climate. At the time of Cook's visit to this country in 1769 only a few aute shrubs were observed in the Bay of Islands (Hindmarsh, 1999). Banks and Solander – members of Cook's expedition - collected a specimen of aute describing it as *'in parte septentrionalis, culta sed rara' (in northern parts [of the country], cultivated but rare)* (Simpson & De Lange, 1993).

The Marutūahu tribes of Hauraki have a tradition around the aute confirming the existence of the plant in traditional gardens until the early twentieth century. Royal (2007) states:

> *'According to Hauraki tradition, the aute was brought from central Polynesia to Hauraki on the Tainui canoe. However, only a small plantation, Te Uruaute-o-Mārama-tāhanga (Māramas aute grove), was grown. Planted at Waihihi in Western Hauraki, it flourished until the beginning of the 20th century. This gave rise to the saying 'Haere mai ki Hauraki, he aute tē awhea' (Come to Hauraki where the aute tree survived) which refers to the great fertility and mana of Hauraki.'*

4.3 Conclusion

These stories consolidate the understanding in traditional knowledge of the origin and movements of key plants that were important to early Māori society. They provide just an introduction to the conversation on the distribution of these plants (and others) across the Pacific and also provide some insight into the understanding of the migration of Māori across the wider Pacific region. We will pick up this story in subsequent chapters in relation to two key crops; kūmara and taewa.

5 Kūmara

"The unknown Polynesian voyager who brought back the sweetpotato from South America made the greatest individual contribution to the records of the Polynesians"
(Te Rangi Hīroa, 1935)

5.1 Origin and Characteristics

Even though frequently associated with the potato (Solanaceae), kūmara (Convolvulaceae) is not botanically related. The main similarity between these root crops, according to CIP (2014) is the same-size edible 'tuber', used for storing nutrients, which they produce. However, the potato is a thickened modified stem (a botanical or true tuber); whilst the kūmara is a specialised swollen root (not a true tuber, though conventionally referred as one).

Sweetpotato or kūmara (*Ipomoea batatas*) is one of the few species of the tropical-world widely distributed genus *Ipomoea* which develops fleshy and palatable storage roots (Cooley, 1951). Kūmara evolved from a climbing vine and is widely believed to have been domesticated around 6000 BCE, with its botanic centre of origin in the Perúvian highlands (Clarke, 2009; Nuwer, 2013). However, a study by Zhang et al. (as cited in Clarke, 2009) disputes this by indicating that it might have originated in Central America, as the kūmara gene pool is more diverse in this region than in South America and the Caribbean. In any case, as Harrison *et al.* (1985) indicate, the crop probably developed from its diploid ancestor into a 90-chromosome hexaploid.

Kūmara can be grown from sea level up to 2500 mamsl and in the present day is widely grown in the tropical regions of the world where, according to Harrison *et al.* (1985), is usually an important secondary food rather than a staple crop. According to Prance and Nesbitt (2005), kūmara was one of the major crops for the people living thousands of years ago in the lowlands of the Amazon basin, far to the east of the Andes. It contains a very high nutritional value and some varieties, especially the orange-coloured, are significant sources of vitamin A. According to Gibson (1984), the tubers are relatively high in calcium and iron, but have low protein contents. In addition, the abundant foliage produced by the kūmara plants is good livestock fodder, and can also be eaten by people (Harrison *et al.,* 1985).

Kūmara can be grown year-round in the tropics and is normally propagated vegetatively by planting stem cuttings, from which new plants develop. However, in places where kūmara plants

cannot overwinter in the field due to low temperatures, the kūmara tubers are placed under modified conditions in order to grow shoots which can be planted in spring (Harrison *et al*., 1985). The crop requires well-drained soils and high soil nitrogen can be detrimental to the development of the tubers. Once the kūmara plant has established, it is highly tolerant to long periods of drought, although Lewthwaite and Triggs (2012) indicate that the yield and quality might be affected.

In warm and humid tropical zones, where sunlight duration and accumulated temperature is appropriate, kūmara can develop flowers (See Figure 10), though usually they don't set seed. According to Yen (1960), the effectiveness of the plant to propagate from seed without human intervention is unclear. The tubers formed underground range from white to purple in colour, take from 4 to 8 months to reach maturity, and are usually elongated in shape, but can be almost spherical (Harrison *et al*., 1985).

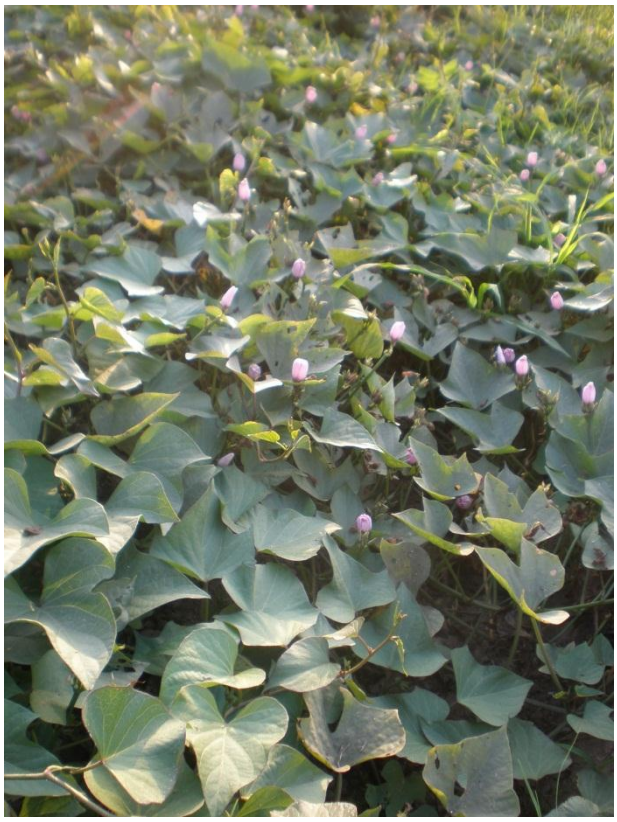


Figure 10: Kūmara in flower, at a kūmara garden in Perú. Source: N. Roskruge.

The main concern in kūmara production is their handling and storage, as the tubers must be cured after harvest and be kept under very strict conditions in order to store well, especially in temperate and frosty areas (Harrison et al., 1985). Gibson (1984) indicates that the tubers' susceptibility to spoil during storage can cause a 33% loss of the total crop. The crop's storage

timeframe can be drastically prolonged by dehydrating and pounding the kūmara, and later can be reconstituted by adding water in order to consume it. Māori still prepare and eat the kūmara in this fashion, known as kao (N. Roskruge, personal communication, 9 November 2014), while Gibson (1984) reports that stored provisions of dehydrated kūmara are used as "typhoon insurance" in Japan and Taiwan.

5.1.1 Traditional Knowledge around Kūmara in the Andean Region

There is little published material accessible to discern a full ethnobotanical history of the Andean communities' relationship with sweetpotato, primarily because of the periodic conquest of cultures in the region over many centuries including the Spanish arrivals in the 16th century. Of the most recent cultures, the Inca people, located in Andean Perú and Bolivia have many myths and legends which allude to the longstanding relationship with their foods. In the present day Perúvian and associated regions the people revere *Pachamama* as the 'Earth Mother' of their legends and the one from whom propitious crops are gained. One of the legends on the origins of the Andean knowledge introduces *Pachacamac* one of the most powerful and feared of their deities. Pachacamac created the first man and woman; however, he did not provide them with food and the man died. In her grief the woman was supported by the sun and gave birth to a son. In his jealousy Pachacamac killed the son and tore him into pieces, burying them in different locations. From each piece different cultivated foods arose. A brother to the deceased son named Vichama was later born. He became the origin of humankind and is remembered for that relationship to this day (Rosas, 2011).

Pachamama however remains the most important of the Andean gods relative to crops and food production. Rosas (2011) states:

> *Pachamama means mother Earth. She is still worshipped in the Andes. She is the goddess of fertility and the provider of food for animals and human beings, she is also seen as the house protector. The planting season in the Andes is in August and it is during this month when Pachamama receives most offerings. Farmers offer her chichi (corn beer), coca leaves, lard or ghee, etc. to make sure they attain good crops…….*(p. 39)

In the entire Andean altiplano region *Pachamama* retains her importance, especially for those subterranean crops such as sweetpotato, potato, oca and mashua. Whilst the detailed history of the crop is somewhat lost through the rise and fall of various cultures, the dependence on this crop and others in a unique climate zone is very valuable to those communities who still grow it.

5.2 Kūmara dissemination in the Pacific

Of the major crops introduced to Polynesia, the kūmara or sweetpotato stands out as the great exception, as its botanic origin lies in the American continent. The nature of the introduction of the sweetpotato to Polynesia has been extensively researched and has given rise to a number of theories and speculation.

Spanish ships carried the kūmara to Spain after the discovery of America, and the crop was eventually introduced to a large number of the recently discovered Spanish domains, such as the Philippines (Gibson, 1984). According to Dixon (1932) and Lawler (2010), numerous scholars in the past have proposed that after introducing the kūmara to Southeast Asia, Spanish and Portuguese sailors then introduced it across Melanesia and Polynesia. However, there are no historical records to suggest the latter and genetic studies have pointed out the direct relation between the South Pacific samples and the South American ones, rejecting Southeast Asia as a midpoint for its introduction (Clarke, 2009). Polynesian traditional knowledge clearly indicates that kūmara was already present before any contact with Europeans.

The most accepted theory in contemporary Polynesian studies, according to Green (as cited in Montenegro et al., 2008) is that some Polynesians voyaged to the east in an exploratory expedition at an unknown date before the 13th century and arrived at South American coasts. According to Green (ibid.), the fact that other more important South American crops, such as maize, were not introduced to Polynesia is a clear indication that it was the Polynesians and not the South Americans who made the transfer. Cohen (as cited in Leach, 1983) indicates that manioc, guavas, capsicums, maize, and melons, along other crops, were available in 200 BCE coastal Perú. Leach (as cited in Montenegro et al., 2008) speculates that the Polynesian explorers appropriated only the kūmara because they associated it with the familiar cultivation and cooking methods of yam, and would have left other unfamiliar-looking crops behind.

Te Rangi Hīroa (1935), based on ethnobotanical analysis, proposes that the Polynesian voyagers embarked from Mangareva or the Marquesas Islands and were forced to continue all the way to South America after failing to find land in the eastern Pacific. Once on the South American coast, the Polynesians somehow managed to acquire some sweetpotato shoots and successfully return them to their homeland, where the crop was quickly dispersed around the region. Irwin (as cited in Fitzpatrick & Callaghan, 2009), based on the relatively low genetic diversity of kūmara, suggests that the Polynesian voyages to South American were probably very infrequent.

It is believed that the Polynesians voyagers would have made landfall at present-day northern Perú, a region where, according to Te Rangi Hīroa (1938), the sweetpotato was called *kumar* in the native Quechuan dialect. It was from this term that the Polynesian name for the sweetpotato, *kūmara* (and all its derivatives), was originated. Table 2 lists some of the vernacular names applied to sweetpotato across the Pacific.

Table 2: Vernacular Names of Sweetpotato in the Pacific. Adapted from Roskruge,2014.

Traditional Name	*Region*
kumar, kumal	Various Quechuan areas
umara, umaa	Tahiti
kumala	Tonga
‘umala	Samoa
‘uala, ‘uwala	Hawai’i
kumaa	Marquesas Islands
ku’a’ra	Mangāia
kūmara	Te Ika-a-Māui (NZ North Island), Rarotonga, Tuamotu Arch., Mangareva & Rapanui
kūmera	Te Waipounamu (NZ South Island)
kumala[7]	Fiji
camote	Spanish speaking communities

Some cultural historians (*cf.* academics) in Perú and related areas believe the kūmara (and possibly the potato at a later date) moved along with displaced peoples from the present day Perú and northern Chile from earlier conquests and initially made their way to Rapanui (Easter Island) before any dissemination into the wider Pacific west[8]. They concur that there are several foods and traditions which contribute to this understanding of which the sweetpotato is the most apparent.

In any case, sweetpotato was already present in Polynesia around the start of the second millennium. Carbonized remains of kūmara tubers found at Mangāia Island, in the Cook Islands, have been dated to 1000-1100 CE and represent the oldest archaeological evidence of kūmara in Polynesia (Green, 2005; Lawler, 2010). Traditional accounts, which in Polynesia date events based in the number of generations passed since, claim that the sweetpotato was present in Hawai’i since at least 1250 CE and in New Zealand by 1350 CE (Te Rangi Hīroa, 1935).

[7] As stated by Mesulame Tora, horticulturist at Nadi, Fiji (January 20, 2015)
[8] (Dr) Pamela Anderson, Ex.Director CIP, Lima, Peru as told to N Roskruge in 2011

Kūmara was rapidly spread from Central Polynesia to every area of Polynesia and, according to Whistler (2009), as far as New Guinea and some Micronesian islands. At the distant vertices of the Polynesian triangle, kūmara quickly became the most important food crop. In Easter Island, both Jacob Roggeveen and James Cook reported that it was the main crop in the island at the time of their arrival in 1722 and 1774, respectively (Bellwood, 1978). It was also the most prominent crop in New Zealand and Hawai'i at the time of Cook's landing in 1769 and 1778, respectively (Gibson, 1984). However, Bellwood (1978) and Montenegro, Avis, and Weaver (2007) state that these early explorers of the South Pacific indicated that the kūmara was actually not as important in the tropical Central Polynesia as it was in the marginal points of the Polynesian triangle. The availability of alternative food sources in tropical Polynesia was most probably the reason why kūmara was not so abundant in those latitudes as opposed to outer Polynesia.

Considering the widespread cultivation of kūmara and its prominence at the farthest corners of Polynesia, and presupposing that the era of extended inter-Polynesian voyages was over after the 14th century, Montenegro et al. (2007) strongly suggest that the crop was introduced in Polynesia at a much earlier stage than usually accepted. This strongly concurs with whakapapa and mātauranga Māori, which claims a very early relationship with kūmara, prior to their migrations from *Hawaiiki* to Aotearoa / New Zealand.

According to recent genetic studies of old specimens of kūmara collected by the early European explorers, it is now believed that the crop was introduced to the South Pacific at three different stages; a model known as the tripartite hypothesis (Clarke, 2009; Denham, 2013). First, the kūmara entered from South America in pre-European times (*kūmara* lineage), then the Spanish introduced it from Mexico to the Philippines (*camote* lineage), and then the Portuguese introduced it from the Caribbean to Indonesia (*batata* lineage). Clarke (2009) indicates that while this model is consistent with current science, there are some elements that present evident irregularities, a case that further research will contribute to.

However, the kūmara is not the only Central or South American plant that was introduced to Polynesia. According to recent genetic studies (Clarke, Burtenshaw, McLenachan, Erickson, & Penny, 2006), the bottle gourd (*Lagenaria siceraria*) and the soapberry (*Sapindus saponaria*) found in pre-European Polynesia may have also originated in the Americas. The soapberry was first reported on Easter Island in 1773 by Captain Cook and was found at various other Eastern Polynesian islands (Langdon, 1996). Green (as cited in Jones, Storey, Matisoo-Smith, & Ramirez-Aliaga, 2011) proposed that the bottle gourd arrived in Central Polynesia along with the kūmara from South America in the

11th or 12th century. This provided ample time for the crops to be dispersed into Hawai'i and New Zealand during the early settlement stage.

In any event, the presence of the kūmara in pre-European Polynesia still remains the most controversial factor in food plant dispersals in Polynesia and represents the most compelling evidence for an early contact with South America.

5.3 Kūmara Introduction into New Zealand

Ethnological literature, according to Yen (1963), often acknowledges the great number of pre-European kūmara varieties in New Zealand. Considering that this crop doesn't set a botanical seed under New Zealand's conditions, the role of natural breeding and genetic recombination is discarded. Saner (as cited in Yen, 1963) suggests that the kūmara diversity in Aotearoa can only be explained by the Māori introduction of a large number of varieties or by vegetative mutations of the original cultivars. However, Yen (1963), after taking into account the extant plant remains and the difficulties inherent to carrying vegetative material across Polynesia, suggests that the actual number of varieties introduced by Māori was probably very small.

5.3.1 Tribal or local knowledge

Many different stories exist around the kūmara; such is its importance in Māori Society. All have a common theme in identifying a local association – through person or place – to the kūmara thus reiterating its importance and direct association to them. There is no doubt from historical discourse / Māori knowledge that the cultural belief remains that kūmara were introduced as cargo through the movements of Māori across the Pacific. The early associations to the mythical homeland *Hawaiiki* and language associations with other Pacific cultures alongside the detailed whakapapa attest to an enduring relationship Māori had with kūmara as a food crop of importance.

In Te Ao Māori, all elements of the natural world have a relationship, whether it is through association, utility or whakapapa; similarly all plants have a relationship with each other and a hierarchy of sorts. As an example it could be considered the kūmara was the most important 'cultivated' food of early settlement times. The plant was affected by many other plants for competition and by other natural elements such as caterpillars which lived upon it. There is an old story that highlights the relationship and also the ethereal origins of common plants:

> *The common (native) convolvulus, Calystegia sepium, known as pōhue is aligned to Toro-i-waho, one of the primal atua, who had responsibility for climbing plants and also for many of*

the smaller insects and reptiles. Toro-i-waho, mated with Paenoa and begat a family of twelve 'aka' or climbing children, including aka pōhue. It is said that pōhue is the bane of kūmara often growing within the crops as punishment for an indiscretion of a woman in mythical times that offended the celestial house: where she planted her kūmara the pōhue grew instead. Some tribal variations associate the aka or climbing plants with kūmara and therefore as descendants of Rongo-marae-roa. (Roskruge, 2014:93)

5.3.2 Whakapapa

The whakapapa for kūmara is strongly defined and well recorded. This is as expected because kūmara was traditionally the most important cultivated crop and therefore Māori sought favour from the spiritual realm to ensure success of the crop for their own survival as well as their ability to provide for mana-related activities such as hospitality and trade.

The whakapapa is succinctly given as:

Primarily the atua Rongo-marae-roa [Rongo] *– son of Ranginui and Papatūānuku – takes responsibility for this food as it is a cultivated crop. Rongo represents the front of his father Ranginui and as such is one of the dominant atua, taking precedence over others who also represent various other food sources such as Haumia-tiketike. Taumata-atua or stone representations of Rongo are strategically placed in the gardens to guarantee his protection supported by karakia as appropriate and the relationship of tohunga with specific expertise in the relationship of the plant, crop process and produce to Rongo; he was the conduit between spiritual and physical worlds.*

It was Rongo-marae-roa's daughter Pani-tinaku who sourced the kūmara from the heavens and therefore took responsibility for its maintenance. His sons also have specific responsibilities to kūmara – and to all other crops cultivated and stored. Ihenga represents the kūmara offering made to the gods at various stages of production and storage; Rakiora is the propitious son and his favour increases yield in the paddock and protects crops in storage; Pahaka is the deity of crops whilst they are being stored; and, Matiti the guardian of the door of the pātaka or storehouse – a most valuable role as he keeps other malignant factors from affecting the produce.

The kūmara are planted on the moon nights of O-Tāne and O-Rongo (usually shown as the 26th and 27th nights in the maramataka). These names are self-explanatory and invoke the protection of these gods as appropriate. Crops were harvested on the Maramataka of WHANUI (Star of Vega) and storage pits prepared at this time also. (Roskruge, 2014:19)

Whakapapa, especially when used as a form of transmission of knowledge, can differ considerably between tribes. Broughton (1979, p. 8) writes of a Ngā Rauru whakapapa as given by their tupuna Tautahi in 1897 as stating: *The department assigned to Rongo-tangata-matua* [Syn. Rongo-marae-roa] *was the kūmara and the fern; they were the children of that god. Tamapeke is the ancient name for the fernroot (aruhe) and Tamamore is the kūmara.* These two versions of whakapapa both indicate a strong and direct association between kūmara as an important food

source and the departmental gods of Māori society, indicating the highest value they can attribute to the kūmara directly.

Almost all Māori traditions (often expressed as legends) trace the origin of kūmara back at least to Hawaiiki, the homeland from where Māori people originated (P. Richardson, personal communication, June 29, 2014). In Te Ao Māori, the use of *whakapapa, whakairo, pūrākau, waiata* and *whakataukī* (historical discourse, carvings, legends, songs and proverbs) all serve to retain or contain knowledge that supports the traditional understanding of the origin of kūmara and its relationship to mankind. There are many different and varying stories held by iwi and hapū aligned to the traditional knowledge surrounding the kūmara in Aotearoa. Considering each tribal region or *rohe* would have climatic factors either promoting or limiting kūmara as a primary crop, the intimacy of the information held within tribal knowledge systems varies considerably. The following section introduces a number of iwi stories which contain some commentary relevant to the understanding of the origin and management of kūmara. These stories are presented by tribal and geographic groupings on the assumption that the relationship to kūmara would vary between location, especially in areas where kūmara is not grown but is a tradable commodity e.g. *Murihiku* or Southland in the lower South island – *Te Wai Pounamu.*

5.3.2.1 – Te Tai Tokerau (Northland and environs)

In present-day New Zealand the northern region dominates the commercial production of kūmara, primarily because of the climate zone which is essentially sub-tropical. The history of the introduction of the pre-European varieties to the northern tribes is not widely recorded, either in kōrero or print. At the time of the migrations of Māori from Hawaiiki the Mataatua waka made its primary landfall at the Bay of Plenty near present day Whakatane. After some familial conflict Puhi left that region with some of the crew and headed north. It is believed he made landfall again at Whangape in the Hokianga region and then made further trips around the region. The final resting place of the Mataatua is at Tākou River (Tākou Bay, north of the Bay of Islands)[9]. Local informants state that Puhi settled at Tākou, clearing ground and planting kūmara, taro and hue (gourds) which he had brought on from the Bay of Plenty and which were first grown there following the original ocean voyage from Hawaiiki. Furthermore, local informants also iterated their understanding that each waka in the generally understood migratory period of Māori settlement brought a taonga or important element to the new society. The Mataatua they are told, brought the 'gift of cultivated food' – including the kūmara.

[9] Various informants including A. Heihei, Local resident and regional Historic Places Trust Māori Heritage Advisor (February 2015).

I te wa o mua, in days long past, the Māori cultivated kūmara in large areas all over New Zealand. It was one of their principal foods, and could be eaten either raw or cooked.

It was thought much of because of its tapu origin, as it was brought from the heavens. All work done in connection with growing it up to the time of taking it from the ground and storing it in pits was done with karakia and great ceremonial. It was an old belief, told me by my old people, that although the kūmara was produced by Whanui, the star Vega, it was through Rongonui-maui and his wife Pani-tinaku that we have it on this earth. But when the kūmara tuber is planted in its mound of earth, it is from Whanui that it receives help in growing

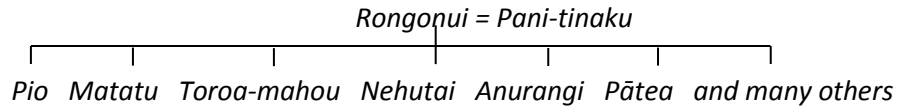
Rongonui-maui, when he heard of the kūmara, thought he would visit his elder brother Whanui who lived in the heavens, and ask him to let him have some to bring back to earth. So he ascended to the heavens, and repeated this karakia:

"E Para E! Tukua atu au kia puta ki tawhangawhanga nui no Rangi, no Papa; he aio."

This was a karakia asking for help to enable him to ascend through the great spaces in safety to the heavens on his way to see his elder brother Whanui.

When Rongo arrived, he made known his reason for coming, saying to Whanui, "I haere mai au ki tetahi o ta taua whanau kia riro ia au ki Raro, ki Mataroa," I have come to ask you to let me take one of our family below with me to Mataroa". And Whanui replied, "Kaore au e whakaae kia riro atu tetahi o wa taua tamariki ia koe," I will not agree that you should take any of our children with you.

So Rongo turned as if to go away, but hid behind a whare, and then approached the family of kūmara unknown to Whanui, and took some of the seed with him. This seed he hid in his body (huna e Rongo ki roto i tona ure), and then returned to Mataroa and slept with his wife Pani-tinaku, who became hapū (pregnant) and brought forth the kūmara.



So from Rongonui-maui and Pani-tinaku came all the varieties of kūmara which were used by the people of old, and which have now almost disappeared. When the kūmara family were born to Pani, her husband Rongo asked her to prepare te umu tapu (a sacred oven) in which to cook them, so that the tapu might be removed. This is the beginning of the tapu ceremonial cooking oven on this earth, and thus we have Waharoa, Kirikahu, and Kohu-kohu used for priests, chiefs, and the people. Through Rongo taking the kūmara seed in secret and without the permission of Whanui in whose care it was, theft was started in this world.

When Whanui found that Rongo had taken the kūmara against his wishes, he was very angry, and as a punishment, he sent pests to destroy the growing kūmara, in the shape of anuhe, the caterpillar, and thus made it difficult to grow. This is why there is so much difficulty in growing it, and why the large caterpillar swarms to eat it, and gives the people so much trouble. Rongo was the god of the kūmara, and also the god of peace.

Source: *Johannes Andersen, 1907: Māori life in Ao-Tea*

5.3.2.2 – Te Tai Hauāuru (west and southwest of the North Island)

E hine! Tangihia te rae haumātao
Heoi ko Pou i tangohia e ikaroa
Ki Te Muriwai-o-Hawaiiki.
Whakahokia mai 'no e Manunui-a-Ruakapanga
Ki tona hau kainga…..
Extract from a Waiata Tangi of the Taranaki tribes (Ngata, 1990)[10]

As with other districts, there are also stories from the Taranaki region that claim an association to the acquisition of kūmara through Pourangahua. Ngata (2006: 532-533) Here Pourangahua was taken to Muriwai-o-Hawaiiki by a sea monster called Ikaroa. There a council was taken on whether the journey was justified, and the determination was that it was wrong, thereupon the chiefs of Hawaiiki gave Pourangahua the bird Ruakapanga to return home, ostensibly carrying valuable cargo with him.

Hammond (1924) and Te Rangi Hīroa (as cited in Shutler and Shutler, 1975) relate the tradition of the Aotea waka, which claims that Turi, fleeing from Hawaiiki after killing the son of Uenuku, took with him a variety of kūmara known as *kakau.* Rongorongo, the wife of Turi, wrapped some of these kūmara tubers in a double belt around her waist in order to keep them warm against her body and protect them from the effects of the southern cold. This event gave rise to the kūmara sobriquet of the 'Belt of Rongorongo'. After reaching Aotearoa and anchoring for a short time in Aotea Harbour, Turi and his crew eventually arrived and settled near the fresh water springs or puna-wai near the southern bank of the Pātea river mouth (now known as Wai-o-Turi – see figures 11 and 12), south Taranaki. At this site, they planted extensive kūmara gardens, from where the crop began to spread around the country. The introduction of kūmara to Aotearoa by Turi is one of the main reasons why the voyage is often referred to as Aotea utanga nui, or Aotea of the important freight (Hammond, 1924; Best, 1925/1976). From Turi descend the Ngā Rauru and Ngāti Ruanui tribes of South Taranaki. A further consolidation of this particular history can be found in the Ngā Rauru whakataukī or proverb *'Te oneone ī hongia e Turi,* literally, 'the soil that Turi smelled'. The action by Turi, eponymous ancestor for Ngā Rauru, of determining the fertility of the soil by smelling it and thus determining the location of their new settlement is remembered forever in this proverb (Roskruge, 1999). It should also be noted that Rongorongo was the sister of Rongomaiwahine, wife of Kahungunu of Heretaunga fame and there is often quoted some alignment at the sharing of kūmara between these peoples through the close relationship that ensued.

[10] Translated as: *Oh maid! Weep over the cold forehead, There was Pou grasped by the monster Ikaroa, Carried off to Te Muriwai-o-Hawaiiki. He was returned upon the great bird of Ruakapanga, To his home village …*

Figure 11: Spring at Wai-o-Turi, Pātea, South Taranaki. Source: Author.

Figure 12: Commemorative plate at Wai-o-Turi. It reads: "Pararakite Uru, puna wai matara a Turi me Rongo Rongo." Source: Author.

Tautuhi *et al*. (1900) further elaborate this settlement noting:

> *After this he* [Turi] *made his cultivation near Rangi-tawhi and named it Hekeheke-i-papa. Turi's spade was named Tupu-i-whenua. When the field was planted with kūmara's, there were eight hillocks in each was set a seed kūmara. When autumn came and the food was harvested, there were eight hundred baskets of kūmara s*. (Pg. 227).

In the Northern Taranaki region the occupants of the Tokomaru waka landed at Mōhakatino and after mingling with the existing tribes, known to them as Te Kāhui Tu, Te Kāhui Ao and Te Kāhui Maunga settled as the Te Āti Awa confederation (Te Ātiawa nui tonu), contemporarily known as Ngāti Tama-ariki, Ngāti Mutunga, Ngāti Maru and Te Ātiawa. Whilst the Tokomaru is not known for its role in translocating kūmara from the Hawaiiki homeland, it was renowned for having brought forebears of equal mana (to whom each of the four iwi of the confederation can whakapapa) to the region and they in turn set about ensuring the necessary means of survival were available to their people. Kūmara were thus introduced to the region through their relationship to others of the same status such as Turi of the Aotea and a priest called Raumati who travelled east to the Bay of Plenty.

The importance of the crop was such that the Ngāti Rāhiri hapū of Te Ātiawa have a whakataukī – ***'Ehara tenei i te ope rahi, e kore e pau nga kūmara a tonga'*** This is an old and important whakataukī or proverb for Ngāti Rāhiri ki Taranaki. It refers to the cultivated crops for which they were renowned and emphasises the bounty of their crops. Translated it means '.....they will not be able to eat all the kūmara crops grown at Tonga (a location off Turangi Road, Motunui)'. Kūmara is a crop better suited to the warmer northern regions of New Zealand yet Ngāti Rāhiri had a reputation for the production of this crop in the cooler Taranaki region. (Kaumātua o Ngāti Rāhiri , and N. Roskruge, personal communication, November 12, 2014). These crops were to serve them well in their future alliances with northern tribes.

5.3.2.3 – Waikato-Bay of Plenty (Tainui, Te Arawa and Mataatua Waka)

The following excerpt as provided by a Ngāti Porou informant aligns to the waka Horouta from whom they descend, however this karakia relates specifically to the planting of kūmara at a Coromandel location prior to reaching the Te Tai Rāwhiti district.

> *In the tradition of the voyage of the vessel named Horouta from Eastern Polynesia to these isles, occurs a variant form of one of the above ceremonial changes: "When Pawa came hither from Tawhiti on his canoe Horouta, the kūmara, and the dogs, and other things were placed on board. The chiefs were Pawa, Hika-tapua, and Makawa; the principal women were Hine-manuhiri and Hine-kauirangi. On landing at Ahuahu* [Mercury Island] *the kūmara was planted at that place, and this ritual was recited over it:*

Ahuahu ana ra te whenua i tipu ai te kai - - e
I ri taua i te ngaru - - e
To tau mua, tau roto
He wai rotoroto, he wai rotoroto
He whakatotohutanga wai renga, wai renga
Kia hua kuru ki tenei māra
Kia hua kakano ki tenei māra
E Pani E! Ringitia to rahu ki waenga ki tenei māra

Various Māori traditions, such as one of Ngāi Tūhoe (T. Haare, personal communication, September 23, 2015) claim that the early inhabitants of Aotearoa already cultivated the kūmara before the arrival of the modern Māori. This, according to Green (2005), contradicts with the usually accepted theory that pre-Fleet people did not practice agriculture. Golson (as cited in Wellman, 1961) reported that structures in Coromandel thought to be kūmara storage pits may be from earlier than 1300 AD, which would suggest the crop was grown prior to the scholarly-estimated time of Māori settlement of Aotearoa. Ngāi Tūhoe were not generally located in an area that suited kūmara production and are known to have established gardens with utmost caution including tikanga or practices such as planting under scrub that allowed them to initiate kūmara in cooler weather. The tribe was better known for the forest foods for which they could trade for kūmara.

According to another tradition in the Bay of Plenty, Taukata and Hoaki, two men from Hawaiiki that either visited or were wrecked near that region, convinced Toi[4] to sail back with them on board Te Ara-tawhao and bring the kūmara to Aotearoa. Pourangahua from Turanga in Gisborne heard about this enterprise and set off to take part in it. However, he was too late to board the vessel and instead had to build his own waka from bark and albatross skins and set sail on his own. Upon reaching Hawaiiki he was gifted two baskets with kūmara and made his return to Aotearoa flying on the back of Tane's great bird, Ruakapanga (Orbell, 1985). Smith (1910/1999) indicates that the bird Ruakapanga also appears on various Rarotongan traditions.

Another story involving Pourangahua and his immediate whanau as retold by Tepene Mamaku (Kaumātua o Ngāi Tamaoki, hapū o Ngāti Awa)[11]:

> *Pourangahua and his wife Kanioro lived at Kirikino in the East Coast, where their twins were born, one of whom was critically ill at birth. Pourangahua and his wife returned to the home of the hapū of Kanioro, at Mataora on Mauke in the Cook Islands. Pou left the other baby with his kaitiaki and took the unhealthy one. At this stage, Kanioro had not seen either of her offspring, and with the father of Kanioro, Chief Rongoatua of Mataora, spent the whole night performing rituals. By morning, the baby had recovered. Later, the kaitiaki arrived with the other twin, and, for the first time, Kanioro saw her babies.*

[11] http://www.ngaitamaoki.Māori .nz/history.aspx - accessed 1 December 2014

Now, Ruakapanga had a wife Nuiho, and they had two children. One was called Manu, the other Nuake. Although Manu was in her senior years, she was still untouched by man. Through karakia, she was transformed into a bird,'ka tangohia te ira wahine, ka whakatongia ki te ira tāne'.

When the bird landed beside Ruakapanga, he, through karakia, presented it with names, ie, 'Te Manunui a Ruakapanga', 'Te Manu tioriori a Tāne tiketike o te rangi', and the bird grew to a size enabling it to carry Pou.

Pourangahua came back on Te Manunui o Ruakapanga with the sacred stems (Kura) of Taininihi (Atua Wairua). One stem was to smooth the elements ahead of the waka Takitimu and Mataatua, and to be plunged into the place where the migrants would plant the first kūmara plot. This spot, we know today as Matirerau, is in the vicinity of Te Whare o Toroa marae at Wairaka, Whakatane. The second stem, 'the mauri of the kūmara ', was to be conveyed to the East Coast.

The first kūmara was red, signalling the arrival of Mataatua when the pohutukawa was in bloom. The second kūmara was white, the purity of the mauri of the famed kūmara still famous today on the East Coast.

Kanioro, the wife of Pourangahua, and their lucky to be alive daughter named Mahanga i te Rangi, husband Ruaihona and their son Tahinga-o-te-ra, came on the Mataatua waka. The other twin, name unknown, remained with his grandfather Rongoatau.

Ka moe a Ruakapanga i a Nuiho, ka puta ko Nuake. Na Nuake ko Manunui tuarua, na Manunui ko Wekanui. Ka moe a Wekanui i a Irakewa, ka puta ko Muriwai, ko Toroa, ko Puhi Moana Ariki.

5.3.2.4 – Te Tai Rāwhiti (East Coast of the North Island)

He mara tautane, he mara tapu
Toto ti hiki Raukatauri, Raukatamea
Mahitihiti marekareka
Tenei te hapai ka hapi
Ko te hapai na wai?
Ko te hapai na Rongo
Rongo uakina, rongo te kainga
Te kainga ki rangi nui, ki rangi roa
Ki rangi te rakahia
Mai taku kete nei
Ko mananea taku kete nei
Totoro tahu, totoro te hua i waenganui
Kia kawitiwiti, kia katoatoa
Haere te kakano
Ko te kura mai i whea?
Ko te kura mai i Mata-te-ra
He harurutanga, he ngatorotanga.

Ancient Ngāti Porou karakia to support the planting of kūmara

The tradition of Pourangahua and Ruakapanga has numerous variations and is a very celebrated history on the East Coast. The tradition is captured in many ways and remembered through the association to various iwi and hapū . As an example, In Uawa (Tolaga Bay) the wharenui at Hauiti marae is named Ruakapanga. According to one tradition, Ruakapanga was a kūmara tohunga living in Hawaiiki who commissioned an expedition led by Pourangahua to find land suitable for growing kūmara in Aotearoa. Upon finding the perfect location on the East Coast, Pourangahua returned to Ruakapanga in Hawaiiki. After reporting to him and describing his successful quest, Pourangahua was given some kūmara tipu or shoots to plant at the designated place and send back to Aotearoa on the back of Ruakapanga's pet birds, Harongarangi and Tuingarangi. Upon reaching Aotearoa, Pourangahua rushed to his wife and rejoiced with his friends, while forgetting to praise the gods. Ruakapanga's pet birds were visibly troubled by his negligence, and on their return flight to Hawaiiki were nearly killed by a hawk. When Ruakapanga witnessed the disastrous effects of Pourangahua's forgetfulness, he exploded in anger and summoned the anuhe, mokoroato and mokowhiti to consume the roots, young shoots, and leaves of the kūmara of Aotearoa (Hamer, Macpherson, Taiapa, & New Zealand Learning Media, 1992).[12]

At the Whakatō Marae, in Manutuke, Gisborne, there are some internal and external carvings (Figure 13, Pg. 62) that relate how Pourangahua, while navigating on his waka, was blown adrift and eventually, after being helped by a sea monster, reached his uncle Ruakapanga in Hawaiiki. Pourangahua asked for some kūmara tubers to replace the failed kūmara crop at his home place. Ruakapanga also acquiesced to Pourangahua's petition to lend him a bird to transport him back, under the condition not to get too close to Mount Hikurangi, where a fierce taniwha dwelt. Neglecting these instructions, Pourangahua flew close to Hikurangi and, although he survived the trip, got the bird killed. Ruakapanga decided to punish his negligence by sending the aruhe (a yellow grub), mokura (a round red grub) and mokowhiti (a green grub) to ravage the kūmara[13].

Orbell (1985) also recounts the Ngāti Porou tradition which claims that Toi's visitors and informants from Hawaiiki were named Kahukura and Rongo-i-amo. According to this tradition, the Horouta then set sail to Hawaiiki, where the cliffs were actually made up of kūmara. Upon reaching the place, Kahukura recited a karakia and the kūmara cliffs plunged into the waka, filling it with the precious taonga. After returning to Aotearoa with the crop, kūmara was distributed at the various sites where the Horouta landed.

[12] According to Smith (1999), it was Tama-ki-Hikurangi, a descendant of Toi.

[13] As related by Barry Brown of Manutuke (since deceased) to N. Roskruge.

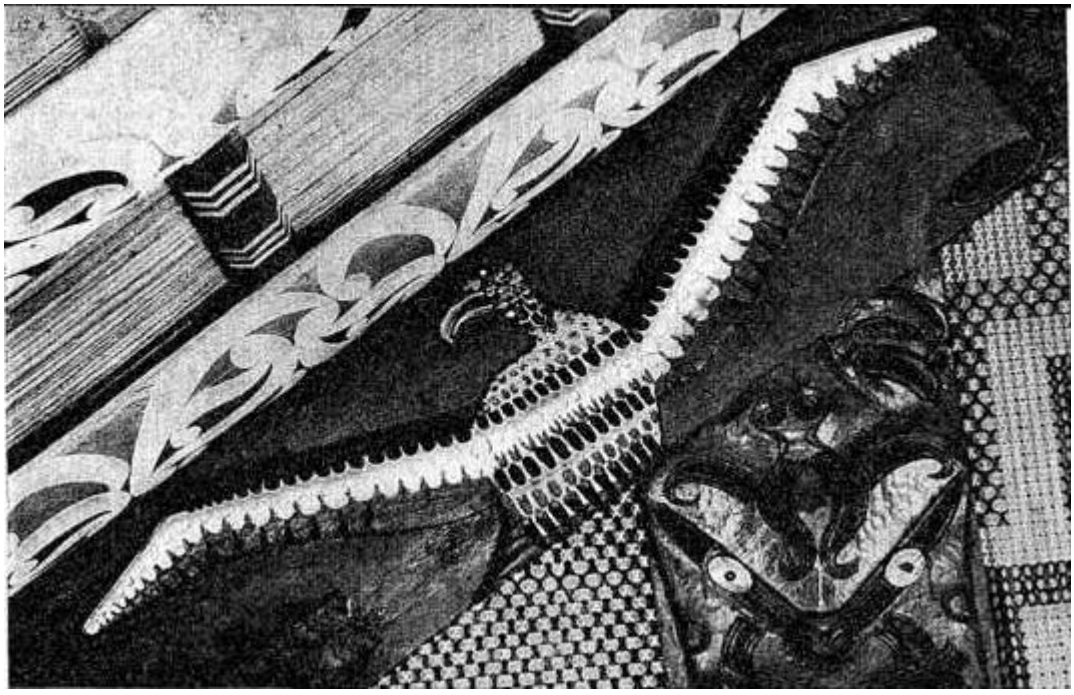


Figure 13: Depiction of the great bird on which Pourangahua rode back to Aotearoa. Carving at the meeting-house at Manutuke, Gisborne. Source: "How the Kūmara Came to Aotearoa", 1962.

Yet another local version of knowledge explaining the origin can be found in a Waiata oriori (lullaby) by Enoka Te Pakaru of Te Aitanga-ā-Mahaki of the East Coast. This version recalls the pou returned to Hawaiiki on a whale supported by incantations from Tangaroa, God of the oceans. He recovered kūmara from the overhanging cliffs there known as Parinuitera and then returned to Aotearoa on the bird Te Manunui-a-Ruakapanga to plant them at Manawaru and Araiteuru. This was apparently at the same time as the arrival of the Horouta waka (Ngata, 2005). This portion of the lullaby recalls this story (*ibid.* p. 218-219):

> *Pō, Pō!, e tangi ana tama ki te kai māna!*
> *Waiho, me tiki ake ki te Pou-a-hao-kai,*
> *Hei a mai te pakake ki uta rā, he waiū mō tama;*
> *Kia hōmai e tō tupuna e Uenuku.*
> *Whakaronga! Ko te kūmara ko Parinuitera.*
> *Ka hikimata te tapuae o Tangaroa,*
> *Ka whaimata te tapuae o Tangaroa. Tangaroa! Ka haruru!*
>
> Pō, Pō!, My son, Tama, is crying for food!
> Wait until it is fetched from the pillars-of-the-netted-food.
> And the whale is driven ashore, to give milk to you my son.
> Verily, your ancestor Uenuku will give freely.
> Now listen! The kūmara is from the overhanging cliff-of-the-sun;
> Lo, striding to and fro is Tangaroa, Tangaroa, listen to his resounding roar!

5.3.2.5 – Heretaunga (Hawke's Bay and Wairarapa)

The Takitimu waka brought the ancestors of Ngāti Kahungunu to Heretaunga. This waka was, according to Mitchell (1972), stocked with dried kūmara and sailed from Tahiti en route to Aotearoa, accompanied by other canoes. After stopping at Northland, it continued along the East Coast, where it introduced the kūmara to the region.

Buchanan (1973) writes of the Takitimu as it landed at several locations along the Heretaunga coast. The Chief tohunga of the Takitimu was *Ruawharo*. One of his grandsons was a man known as Taewha who established a *whare-maire* (School of sorcery) at Waimarama known as Paewhenua. Mahu, another grandson of Ruawharo, was subjected to pilfering of his stored kūmara (at Omahu) after a lean season. He consulted his brother-in-law Taewha to identify the culprits and then entered the whare-maire, was taught in the arts of sorcery, and utilised it to obtain retribution for the loss of his stored kūmara. This reinforces the introduction of kūmara through Ruawharo and the reliance on this food by the new settlements after their migrations.

5.3.2.6 – Te Wai Pounamu (South Island excluding the very south)

> *The Waitaha people, said to pre-date the later Māori arrivals, Ngāti Mamoe and Ngāi Tahu, left their ancestral home of Patu-nui-o-Aio because of war. After travelling through many Hawaiiki [*islands*], they finally landed on the South Island of what is now New Zealand. Their canoe was called Uruao, and their leader was Rakaihautu. Their arrival is set at about the year 840 AD by whakapapa (genealogical record) and carbon dating. Uruao was tied in tandem with another canoe, which brought the Rapuwai people. One tribe was expert in the ways of all water, and the other was expert with food cultivation and gathering. The Rapuwai canoe, called Arai-te-Uru, was wrecked in a tempest at what is now Shag Point. Its hull became the hill and peninsula, and its captain turned into the highest rock. This may have been the canoe that brought kūmara (sweetpotato) from Hawaiiki. When the canoe was destroyed, the kūmara scattered, and turned into irregular boulders along the shore. The food baskets that held the kūmara became the round Moeraki boulders* (Roskruge, 2014).

The following excerpt from a karakia is attributed to Pakauwera of Ngāti Kuia (Northern South Island or Te Tau Ihu o te waka a Māui), and was termed by him as a *koko kūmara* to support planting of the crop[14]:

Papa te whititiri i runga
Ki taua tini, ko taua mano
Te wai o Huru-makaka
Te toe atu ki te wai o Tu-tauarai
Ka whiwhia te kakara o Tai-porohe-nui i taku aro
Whiua ki te whakarua koia.

[14] As provided by kaumātua of Tahuri Whenua Inc. Soc.

This indicates a strong association to kūmara production in their region and along with the well-recognised amended soils of the Nelson region indicates a reliance on this food type. The history of this region tells of the original peoples prior to the Māori migrations and subsequent displacement of tribes such as Ngāti Tumatakōkiri through to the early 19th century and the settlement of the incumbent tribes.

5.3.2.7 – Te Tai Tonga – (Southland and Murihiku)

A Māori informant (as cited in Beattie, 1920/2009) in *Murihiku* -Southland- indicated that kūmara, or *kūmera* as it is known in some parts of the South Island, came from Hawaiiki. This informant claims that when the *Horouta* and *Manuka* waka returned to Hawaiiki to fetch kūmara supplies, they only managed to bring back a small-sized kūmara variety. He also informed that a large variety had been introduced comparatively lately, though it was less sweet than the small ones introduced over twenty generations ago. He says that the kūmara variety known as *Hapū* , which was originally a man in Hawaiiki, is the proper kūmara (Beattie, 1920/2009). Recognising that kūmara did not generally grow south of about Kaikoura or Banks Peninsula in the South Island because of the climate, then this information needs to be read in context.

5.3.2.8 – Chatham Islands (Rekohu [Moriori dialect]; Wharekauri (Māori))

The Chatham Islands (680 km southeast of mainland New Zealand) are not renowned for their association to kūmara however they do have a recorded mention of the crop to the early migration of the Moriori people to the islands. Seymour (1924) wrote:

> *Moriori narrators have it that very far back, in the time of Te Akarora, a discoverer called Kahu came to the Chathams – a very long time before the Rangimata people arrived, but they can only give meagre particulars about him and cannot say where they derived their information. He is supposed to have first touched at the south-west corner of the island, named Tuku or in full Tuku-a-Tamatea, which was the name of his lieutenant. Setting out on a journey of discovery, with or without companions is not known, he followed round the cliffs – an almost impossible task for, rough as they are now, they would at that time be rendered almost impregnable by the thickly growing bush. He continued along the coast as far as Whangaroa – there he is said to have found parts of the island 'drifting and floating' – joining these together he signalled by means of fires for a boat which then came to Whangaroa or Tei-kohuru (quiet or still tide)* [Tai-kohuru]. *Thence he departed to Waitangi or Waiteka, its old name, but finding it unsuitable for kūmara, owing to the coldness of the climate, he returned to Hawaiiki.* (p. 25)

Whilst there are other important Māori traditions about the introduction of kūmara to Aotearoa / New Zealand, almost all of them indicate that the crop was brought over as cargo from Hawaiiki, and once established in Aotearoa, it became the most valued and venerated food plant for Māori and strict procedures were developed for its production.

5.4 Kūmara Production in New Zealand

5.4.1 Kūmara Production before European Contact

The kūmara can be grown at latitudes much further from the equator than most other Polynesian food crops. Although the uwhi or yam (*Dioscorea esculenta*) is also considerably tolerant to exceptional latitudes, it is not as resistant as kūmara. In New Zealand, yam cultivation was limited to the sub-tropical areas of the northern North Island (Best, 1925/1976).

Before European contact, kūmara was widely cultivated across the coastal areas of Aotearoa's North Island. The crop was also grown, although with significant limitations, in the northern and eastern warm coastal areas of the South Island. It is usually considered that the southernmost limit for growing kūmara in New Zealand is Taumutu, on the southern shores of Lake Ellesmere, on Banks Peninsula (Beattie, 1920/2009; Bassett *et al*., 2004).

Māori had to develop some unique adaptations and techniques, as well as increase labouring, in order to achieve decent kūmara yields in the more inhospitable weather of New Zealand. As Best (1925/1976) proposes, some agricultural techniques developed for tropical Polynesia, such as mulching, mounding, and ditch construction, were used for completely opposite effects in Aotearoa. According to Bellwood (1978), kūmara production was rigorously seasonal, with the planting done in springtime and the harvest at autumn, before the frosts. During wintertime, when the value of the stored crop would highest, the kūmara tubers were kept in specialised storage structures. As Yen (1988) indicated, by developing storage methods, the Māori turned an essentially tropical perennial crop into a temperate annual.

The implementation of the different storage methods was, according to Yen (1988), the highest agricultural achievement by Māori. These methods were contrived not only for kūmara 'seed' stock (not botanical seed but 'tuber') to be carried over through winter, but also for kūmara for consumption. After being harvested, sometimes with the help of a *kō* -foot plough-, kūmara tubers were diligently sorted according to their use, left for as many days as required to be cured under direct exposure to sunlight, and meticulously laid in store pits or storehouses (Bellwood, 1978).

The store pit -*rua-kūmara*- was, according to Best (1974), partially or completely subterranean and was built with dry porous soil, which contributed to maintaining relatively constant conditions. The interior of these subterranean structures, according to Crawford (1993), was frequently lined with stones and had a single tunnel entrance. Some villages had elaborated

storehouses - *pātaka*, which were usually made of wood and further isolated the kūmara from the exterior (see Figure 15). Yen (1988) indicates that the development of storage, especially the construction of the *pātaka*, was the single most important element that enabled the Māori to cultivate kūmara at a latitude as far as 45° S. Archdeacon Walsh (as cited in Best, 1916/1974) indicates that the *pātaka* were adapted to the different local conditions throughout Aotearoa and their main purpose was to maintain a stable and relatively dry environment. According to Becket (1953), it was not until the European introduction of the pig that Māori had to modify their storage structures in order to keep the harvest safe from the animals. Māori eventually incorporated a storage platform, or *timanga*, which rose above the ground and was lined with *aruhe* or bracken fern to better isolate the kūmara.

No effort was spared to create storage systems that both created the appropriate climatic conditions and manifested reverence for the spiritual association with the crops, especially with kūmara. Elaborately carved panels such as those recently returned to Ngāti Rāhiri of Taranaki are prime examples (See Figure 14) (Radio Waatea, 2015).

Figure 14: Carved Panels that decorated the interior of a pātaka in Motunui, Taranaki.
Source: Motunui taonga back with Te Ātiawa, 2015.

Figure 15: Contemporary pātaka at Pipiriki, Wanganui River. Source: Author.

Walsh (as cited in Best, 1916/1974) records that the storage of kūmara tubers entailed "the greatest care and judgement", and even with all the appropriate measures taken, it was nearly impossible to preserve the tubers until the next planting season. Walsh (*ibid*.) points out the kūmara tubers' extreme sensitivity to handling, as even minor bruising would rapidly encourage decomposition among the whole stock. In addition, the crop was highly susceptible to changes in weather, since even momentary exposure to moist or cool air could damage the kūmara. This is the reason why Māori would only harvest the kūmara from dry ground (N. Roskruge, personal communication, 15 June, 2014).

According to Bellwood (1978) considerable research provides evidence of the modification of soils by Māori, especially the addition of gravel. This was done in order to improve soil drainage and structure, and to enhance heat retention. Yen (1988) emphasises the importance of the use of gravel as insulating mulch in order to deal with the decreasing soil temperatures associated with the transition into the autumnal climate, effectively extending the crop window. Bellwood (1978) calculates that thousands of hectares of the predominantly heavy soils in the Waikato area had to be amended by adding great quantities of gravel and sand. Also, extensive gravel pits, such as ones found in northern Christchurch, mark the location of ancient kūmara gardens (Beattie, 1920/2009). Some archaeologists also claim the addition of sands and gravels was to encourage the kūmara root

to produce a better sized product through free spaces as against dense, packed soil types (N. Roskruge, personal communication, November 13, 2014).

One of the main agricultural reasons why kūmara was so important for Māori, beside its relative tolerance to temperate climate, is the crop's low fertility soil requirements. Bellwood (1978) considers this is the principal reason why kūmara could be cultivated in such a wide variety of soil types and topographic characteristics. Jones (1986) points out that, in the same manner as the fern root, the other important partially-cultivated staple crop in Aotearoa, kūmara prospered in light well-drained soils. Unusual among cultivated crops, high fertility levels were not indispensable and the crop could be planted in relatively unproductive areas and in the easily accessible coastline. It was not until the European introduction of other crops, such as pumpkin (*Cucurbita pepo*), maize (*Zea mays*), and potato (*Solanum tuberosum*) that highly fertile alluvial soils would become paramount for agriculture (Jones, 1986).

Shifting cultivation was widespread due to the decline in soil productivity caused by continuous cultivation of kūmara. Vast previously uncultivated areas, even in steep terrain, were frequently cleared of vegetation and burned in order to lay the ground for planting kūmara. McGlone (as cited in Jones, 1989), based in pollen sequence samples, proposes that extensive forest fires occurred in various regions of Aotearoa around 1400 CE, soon after Māori settlement.

In contrast to Central Polynesian practices of using the same soil for extended time due to land scarcity, Jones (1989) indicates that Māori had access to larger areas for cultivation. Because soil regeneration under this slash and burn regime was much slower in New Zealand as compared to tropical climates, fallow periods of more than ten years could be required (Bellwood, 1978).

The bracken fern or *aruhe* (*Pteridium esculentum*) was frequently chosen as a fallow crop after kūmara cultivation because the continuous harvest of the fern's rhizomes was much slower in depleting the soil's nutrients than the other Polynesian food crops. However, kūmara was considered a much higher-grade crop than fern because of its better taste and quality, even though it was much more difficult to grow (Bellwood, 1978). In addition, Leach (1989) points out that kūmara were one of the few foods available in Aotearoa which had a sweet flavour and low fibre content.

Various arrangements were made in preparation for the selected planting ground. Cook (as cited in Thomson, 1922) remarked that the kūmara gardens in Anaura Bay, in Gisborne, were so well tilled that he had "seldom seen land better broken up". Usually, Māori would use a *kō* to build

mounded rows, which according to Best (1925/1976), were aligned towards the east so that the morning sunlight would dry the soil and the plants would receive more sunlight hours.

After the tubers were encouraged to sprout, usually by being placed in warm and sandy beds, they were cut into pieces. These portions, which contained a piece of kūmara flesh and one or more shoots, were then planted on the previously prepared mounds, generally circular rather than rows (N. Roskruge, personal communication, 23 November, 2014). Beattie (1920/2009) was told that in Canterbury, the kūmara tubers or *purapura* were directly laid on the ground and covered with soil and sand, or were grown under a cover of mānuka (*Leptospermum scoparium*) twigs. The shoots were irrigated only once, at transplanting (Beattie, 1920/2009).

The transplant of shoots -*tipu*- had a strong ritualistic significance and was conducted by one or various priests, who would recite *karakia* - prayers (Bellwood, 1978). Gaimard (as cited in Wright, 1950), a sailor in D'Urville's expedition in 1827, records that it was generally forbidden, under penalty of death, for anyone to approach the fields on which the young kūmara was growing, as it was considered *tapu* -under restriction. In the Banks Peninsula, Beattie (1920/2009) indicates that Māori planted the kūmara one day before or one day after the full moon, depending on the arrangement of particular stars. In some other areas of Canterbury, Beattie (1920/2009) reports that kūmara *tipu* were planted at full moon or between first quarter and last quarter. Additionally, Beattie (1920/2009) indicates that in Nelson the kūmara was grown in stacks and the runners were maintained cleanly cut as the Māori tohunga considered it indispensable for a good crop.

Despite not having access to new kūmara cultivars, Māori had the advantage that various important pests that affect kūmara production in other parts of the world were not present in Aotearoa. The only major pest for kūmara growers was, according to Best (as cited in Hargreaves, 1963) a large caterpillar, which Māori used to control by crushing it by hand. Best (1925/1976) also reported that some tribes kept tame seagulls around their crops to control this insect. This caterpillar is referred variously as Anuhe, Mokowhiti, and Mokoroa in the whakapapa of kūmara and the Māori tradition of Ruakapanga (Hauiti Marae Trustees, 2004).

The sweetpotato weevil, which in periods of drought often causes losses of 60%-100% in worldwide sweetpotato production, was unknown to Māori and is still not present in New Zealand (CIP, 2014). The main concern for early Māori kūmara producers was, according to Lewthwaite and Triggs (2012), avoiding water retention or, on the other hand, inundation of the crop.

5.4.2 Kūmara Cultivations before European Contact

According to most tribal traditions the threat of crop infestation by the pests (caterpillars), Anuhe, mokowhiti and mokorua remained the most common issue. Drainage channels and wind-breaks were constructed on the kūmara plots if it was considered necessary. Best (as cited in Barber, 1989) indicates that stone rows along kūmara cultivations were sometimes used as borderlines for cultivated plots (*paenga mā ra kūmara*). Also, according to Best (as cited in Ongley, 1931), extensive terraces for kūmara cultivation were built into the landscape, such as the ones found in Titahi Bay, close to Wellington.

Even while cultivating the same heirloom or old kūmara stock, and being affected by various plant diseases, Māori still managed to maintain a continuous thriving production for many centuries. Leach (1989) points out that the ability of Māori to adapt immediately to the introduction of new crops by the Europeans was a testament to their high level of horticultural development.

The cultivation of kūmara was widespread at the time of European arrival, with Reverend Marsden (as cited in McNab, 1908) recording that more than 80 hectares of kūmara were grown in Waimate North, Bay of Islands on his arrival in the early 19th century.

Kūmara is also of major importance for modern archaeological studies in New Zealand, as Bellwood (1978) indicates that the numerous surviving structures associated with its cultivation provide insight into the pre-European Māori lifestyle. Additionally, Green and Law (as cited in Jones, 1989) point out that the distribution and characteristics of storage pits illustrate the kūmara adaptation in New Zealand. Also, these pits could demonstrate garden localities and indicate the extent of importance that kūmara production had in a particular area (Jones, 1989).

In the present day, kūmara is mostly associated with the Northland and the East Coast. However, kūmara was arguably the most widespread crop in pre-European New Zealand, and was also of exceptional importance in the South Island. Nevertheless, Beattie (1920/2009) indicates that kūmara's place in the South Island was almost completely taken over by the potato, and by the 20th century, most Māori had never seen kūmara growing in the island and were convinced it only thrived at the North Island.

5.4.3 Kūmara Production in Recent Times

Since its introduction and up to the present, kūmara production has thrived in the free draining and fertile alluvial soils of the warmer Northland region (Bellwood, 1978). Currently, the

vast majority of commercial kūmara production in Aotearoa / New Zealand is centred in the areas around Dargaville and Ruawai in Northland (see Figure 16, next page) (Lewthwaite and Triggs, 2012).

Figure 16: Map of Northland, New Zealand. Source: Anon., 2015.

5.5 Kūmara Varieties in New Zealand

Just after European contact, Beattie (1920/2009) indicates Māori categorised kūmara varieties into two groups: kūmara, which were the traditional Māori cultivars, and *waina*, which were introduced by Europeans. Due to the unavailability of new kūmara germplasm in pre-European New Zealand, natural vegetative mutations were particularly important in originating new varieties.

The traditional varieties were selected and developed with important traits, such as resistance to pests, drought tolerance, good yields, and rapid maturation, among others (Yen, 1963).

Makereti (1938) reported that traditional kūmara varieties such as: *toromahoe, kokorangi, matakauri, moio, kirikaraka, kawakawa, papahaua, taratamata*, and p*okerekahu*, were still planted, although infrequently, in some parts of the North Island at the end of the 19th century. However, the new kūmara varieties introduced by Europeans in the early 19th century quickly displaced the traditional varieties, as Māori recognised the superior yields and characteristics of the new ones. The old kūmara cultivations were neglected and eventually disappeared (Makereti, 1938; Jones, 1989). Names given by Māori to the new varieties, such as *merikana* (derived from American), allude to the history that surrounded its introduction (H. Cunningham, personal communication, 14 May, 2014).

In the mid 1800's, when Colenso attempted to catalogue the kūmara varieties present in New Zealand, major obstacles hampered his work. Different names for the same variety, same name for different varieties, and high variability of names depending on the iwi/hapū consulted, were some of the most common issues he had to face (Yen, 1960). Additionally, Beattie (1920/2009) records that his Māori informants in the South Island claimed that older generations of Māori were wary about bestowing personal names on important crops, such as kūmara, as these were considered *tapu*. A short period of time after European contact, which involved a swift spread and exchange of the introduced varieties, it was no longer known if a variety was a traditional or an introduced one (Yen, 1960).

Attempting to investigate pre-contact Māori kūmara production has resulted in highly speculative studies, as various key aspects are unknown. As an example, Burtenshaw and Harris (2007) suggested that the yield of the 'pre-European' kūmara variety *taputini* was not significantly lower than modern cultivars. However, according to genetic studies, Clarke (2009) indicates that *taputini* is more likely an early European introduction and is phylogenetically not closely related to the traditional cultivars, which are most likely extinct in New Zealand. Lewthwaite (as cited in Clarke, 2009) indicates that the original kūmara specimen collected in New Zealand by Banks and Solander[15] has different leaf morphology than any other contemporary variety in New Zealand and also implies it is probably extinct. The old traditional *kūmara Māori* was, according to Williams (1935), white-fleshed and floury, with tubers smaller than 3 cm in diameter.

In the present day, the three varieties that dominate the market in New Zealand are relatively modern varieties. These are the yellow-skinned Tokatoka, purple skinned Owairaka

[15] Specimen kept at the Herbarium of The Museum of New Zealand: Te Papa Tongarewa (See Appendix 2).

(believed to be a descendant of the old Waina cultivar), and the orange-skinned Beauregard. However, some relict cultivars (taputini, hutihuti, rekamauroa and others), most likely dating to the early contact period, are still present in New Zealand and represent an important part of the agricultural heritage of Māori , who up to this day officiate as *kaitiaki* of these varieties.

5.6 Conclusion

The evidence on the introduction of kūmara to Aotearoa/New Zealand by Māori is indisputable. Mātauranga Māori for this epoch of migration confirms the association of kūmara as important cargo for the tribes involved, even detailing the purpose for some of the voyages. Less conclusive is the earlier introduction of kūmara to the Pacific from South America. Science has not yet been able to provide a definitive answer to this issue; however, mātauranga and various sources of traditional knowledge clearly suggest there is a direct intercontinental association, presenting some compelling evidence worth considering further.

6 Potato

"The potato was the greatest gift of the European to the Māori agriculturist"
(Hargreaves, 1963, p. 103)

6.1 Origin and characteristics

The cultivated potato plant (*Solanum tuberosum*) is described by Harrison, Masefield, and Wallis (1985) as a perennial herb that grows from 0.3 to 0.9 m high and has white, pink, red, blue, or purple flowers that eventually form tomato-like berries. The tip of the fibrous roots and rhizomes swell up after flowering and develop into five to 20 edible tubers containing almost 78% water, which are the potatoes (CIP, 2014). The tubers, after the stems and leaves wither in autumn, remain underground and carry the plant through winter (Gibson, 1984). According to Cheeseman (1925), that is the reason why the potato usually reappears in sites where it has previously been grown. Potato plants are usually propagated vegetatively by planting the tubers referred to as 'seed potatoes', although they are not botanical seeds. The 'seed potato', which is a genetic clone to the parent plant, provides the nutrients necessary for shoots to develop from the depressions, or "eyes", of the tuber once the conditions are adequate. Unlike the kūmara leaves, which are edible, all the green parts of the potato plant contain the poisonous alkaloid solanine (Delaplace, Brostaux, Fauconnier & Jardin, 2008).

Potatoes can be produced in practically any region of the world, with some exceptions such as low tropical areas. According to CIP (2014), nowadays the crop is grown from sea level up to 4600 metres above sea level and extends as far as Greenland to the north, with most of the production occurring in countries with temperate climate. With adequate conditions, potatoes have a higher food-value yield per hectare than any cereal crop and are significantly more efficient in using water. The main disadvantage compared to cereals is the potato's high water content, which increases transportation costs and greatly reduces their storage life (Harrison *et al*., 1985).

The genus *Solanum* is present throughout almost 10,000 km of the American continent, from SE North America to the Archipiélago de los Chonos, in Chile (Contreras, 2008). In this region, Estrada (2000) indicates that there are 226 wild species and 8 cultivated species of *Solanum*.

The genetic studies about the pattern of distribution of potatoes (*Solanum tuberosum*) suggest that this crop originated in the highland plateaus, or *altiplano*, in the central Andean region.

Other similar Andean root crops such as ulluco (*Ullucus tuberosus*), mashua (*Tropaeolum tuberosum*), and oca (*Oxalis tuberosa*) also originated in the same mountainous region and under similar conditions. The location between mountain valleys and very high altitudes contributed in limiting the natural pest pressure on these crops (See Figure 17).

Figure 17: Typical Andean highland landscape, near Pisac, Perú. Source: N. Roskruge.

A study by Spooner, McLean, Ramsay, Waugh, and Bryan (2005) identifies a single centre of origin for the potato in the surrounding areas of Lake Titicaca, on the border of present day Bolivia and Perú. Hosaka (2002), based on chloroplast DNA sequencing, suggests that all the cultivated and wild species of potatoes have a common maternal ancestry and also implies a single centre of origin. Some archaeological findings around this region have uncovered remains of early potatoes that date from around 4000 BCE (Hawkes, 1990). However, research conducted by *Centro Internacional de la Papa* [CIP] (2014) suggests that the potato might have been first domesticated as early as 6000 BCE.

Archaeologists have uncovered remains of *Solanum maglia,* a wild species closely related to *S. tuberosum*, in a human occupation site at Monte Verde (in Southern Chile) from around 11,000 BCE. It constitutes the earliest known specimen of any species of potato, wild or domesticated, and

is an indicator that Southern Chile might have been one of the centres of origin for the cultivated *Solanum tuberosum* (Ugent, Dillehay, & Ramirez, 1987; Universidad Austral de Chile, 2010;).

According to CIP (2014), there are between 100 and 180 species of wild potato. Even though there is great potential for interbreeding the cultivated potato (*Solanum tuberosum*) with other *Solanum*, Contreras (2008) indicates that plant breeders in general concur that the genetic pool used up to the present has been not been properly exploited. According to "The World Catalogue of Potato Varieties 2007" (as cited in Universidad Austral de Chile, 2010), there are more than 4,200 varieties. More than 98% of these varieties are derived from 'Rough Purple Chili', a native of Chile. In addition, it is estimated that there are almost 4500 landraces, or local varieties of domesticated plant species, of potato in the Andean region. Of these, more than half are native to Perú (CIP, 2014).

Solanum tuberosum is sometimes divided into the subspecies *S. tuberosum andigena*, which is considered to have originated in the Andean highlands, and *S. tuberosum tuberosum*, which is thought to have been domesticated in Southern Chile (see Figure 18). However, this classification is not universally accepted and some confusion has arisen regarding infraspecific taxonomy for the potato. Spooner *et al*. (2007), whilst supporting the classification of *Solanum tuberosum* into two cultivars based on their geographic distribution and susceptibility to different day-lengths, indicate that cultivar groups merely denote certain traits that are desirable for agriculturalists. Almost all of the cultivated potatoes are tetraploid, but there are some varieties that present a diploid, triploid, or pentaploid arrangement (Contreras, 2008).

For millennia, potato has been the most important source of energy for inhabitants of the Andean highlands and Central-Southern Chile. The Incans, who arose in the 13th century in the highland plateaus of South America, and their precursors, depended on potatoes as their staple food. It was one of the most reliable and high yielding crops that could grow in such a harsh environment. The surplus of the harvest was often exposed to the icy nights and sundried above 3000 m altitude to convert it into a starchy produce known as *chuño* (Global Facilitation Unit for Underutilized Species, n.d.). *Chuño* could be preserved for years inside highly specialised storehouses, which were adapted to the local environmental differences, such as altitude and humidity (Murra, 1984). Potatoes were also ground and fermented to prepare an alcoholic beverage called *chicha* (Gibson, 1984). These applications are still undertaken by some Andean communities.

In coastal Southern-Central Chile, where maize struggled to reach maturity because of insufficient sunlight and temperature throughout the year, the Mapuche culture relied on long-day

potato cultivars as their staple food (Bengoa, 2003). The Mapuche have become one of the mainstays of potato cultivation in the temperate climate of southern Chile with considerable recent research being targeted at their collection of landrace potatoes by the local *Universidad Austral de Chile* research campus at Valdivia.

At present day, the main challenge for potato breeders is the improvement of production in suboptimal climatic conditions and the effects of climatic change, along with a better efficiency in the water and agrochemical use. Germplasm evaluations are continually conducted in order to identify desirable genetic traits such as resistance to pests, antioxidant properties, rusticity, tolerance to water stress, increased yield, high quality starch, and cooking qualities, among others (Contreras, 2008).

6.1.1 Traditional knowledge around the Potato in the Andean Region

A cacique or chief, Curaca, lived on the shore and was in love with an island goddess. The island was prohibited for mortals since only gods could live there. Nonetheless, the dark skinned chief swam there to surprise the gods. However, they surprised him and thus punished him for his indiscretion. When they discovered his forbidden love with the goddess they hid him in the soil, condemning him to be eaten by the rest of the mortals, covering his body with blind eyes: they had made him into a potato!

Traditional Incan myth[16]

The myth of Mama Rayguana of the central region of the Perúvian Andes, describes the origin of potatoes. According to this myth, a long time ago, during a period of starvation, people asked a *chihuanco* or thrush (*Turdus albicollis*) for help. Moved by their pleas, the *chihuanco* gathered the other birds and using a stratagem, kidnapped Conopa, the young son of the Goddess Rayguana. Left devastated, Rayguana negotiated the return of her son and consequently gave the potatoes and other Andean root vegetables to the people living in the Andes and the sweetpotatoes to the ones living by the coast (Rosas, 2011).

According to the Chilean legend of the Treasure of Coicoi-vilu, the man Tempilcahue waited hidden until midnight, when the sea god Coicoi-vilu had retreated with the low tide. The earth goddess, Tenten-vilu, had told him to stealthily go into the low tide and find an eight-pointed starfish, which would point him to the places where Coicoi-vilu had hidden his treasure. He had to search the four cardinal directions: north, east, south and west, and dig from the sand a potato in each place. Just after he had successfully finished his mission, the sea god began to raise the tide, which would reach it highest at the morning. The hero Tempilcahue swiftly ran away with his stolen

[16] See Espinar La Torre (2009) for this and other Inca myths on Andean foods

treasure and retreated to the top of a hill, where he slept under the protection of the earth-goddess. Following her instructions, he buried the potatoes each in a different cardinal direction. After some time embraced by the warmth of the soil, the plants began to sprout. However, Tenten-vilu warned him that the potatoes would not survive in that feeble state, so she ordered him to return again to the sea to capture three dancing sea urchins in order to further strengthen the crop. The hero waited for midnight and went again into the sea, proclaiming the incantations taught to him by the goddess, until he found the urchins and eventually retrieved them to firm land. After grounding the sea urchins, he threw them unto the sprouting potatoes, giving the plants the required strength to complete their growth and provide its generous yields. The potato would eventually become one of the most important foods for men of the region (Gajardo, 1982).

Another legend states that a chieftain of the Chiloe Island, in Southern Chile (See Figure 18), wanted to make love the same way as the gods. It was believed that when the gods embraced, the earth trembled and the sea raged. Eager to surprise them, the chieftain swam to an island populated by gods, where he only managed to catch a glimpse of a giant lizard with a fire-tongue. The gods, discovering the man and offended by his imprudence, buried him and doomed him to be eaten by the rest of humanity. His curiosity was punished by covering his body with blind eyes, a reference to the potato's depressions (Galeano, 1997).

In Chiloé traditional potato production, a *machi* or witchdoctor used to ritually bury a potato in each of the four corners of the planting site in order to protect the crop. A substance made up of sea urchins, along with their burnt shells, would later be added into the paddock. During planting, it was prohibited for any mourning person to come close. During the crop's growing period the *machi* would keep protecting the paddock by pronouncing incantations and checking that the four original protecting potatoes have not been replaced by stones, as some evildoers tended to do. Any out of place element would be quickly removed and taken into the cemetery, where it was properly buried to ensure the safety of the crop (Quintana, 1987).

In Argentina it was discouraged to plant potatoes in the first quarter moon, as the plant would develop too many roots. Additionally, dogs were banned from planting sites as their trampling would be reflected on the shape of the new potatoes (Equipo Naya, 2014).

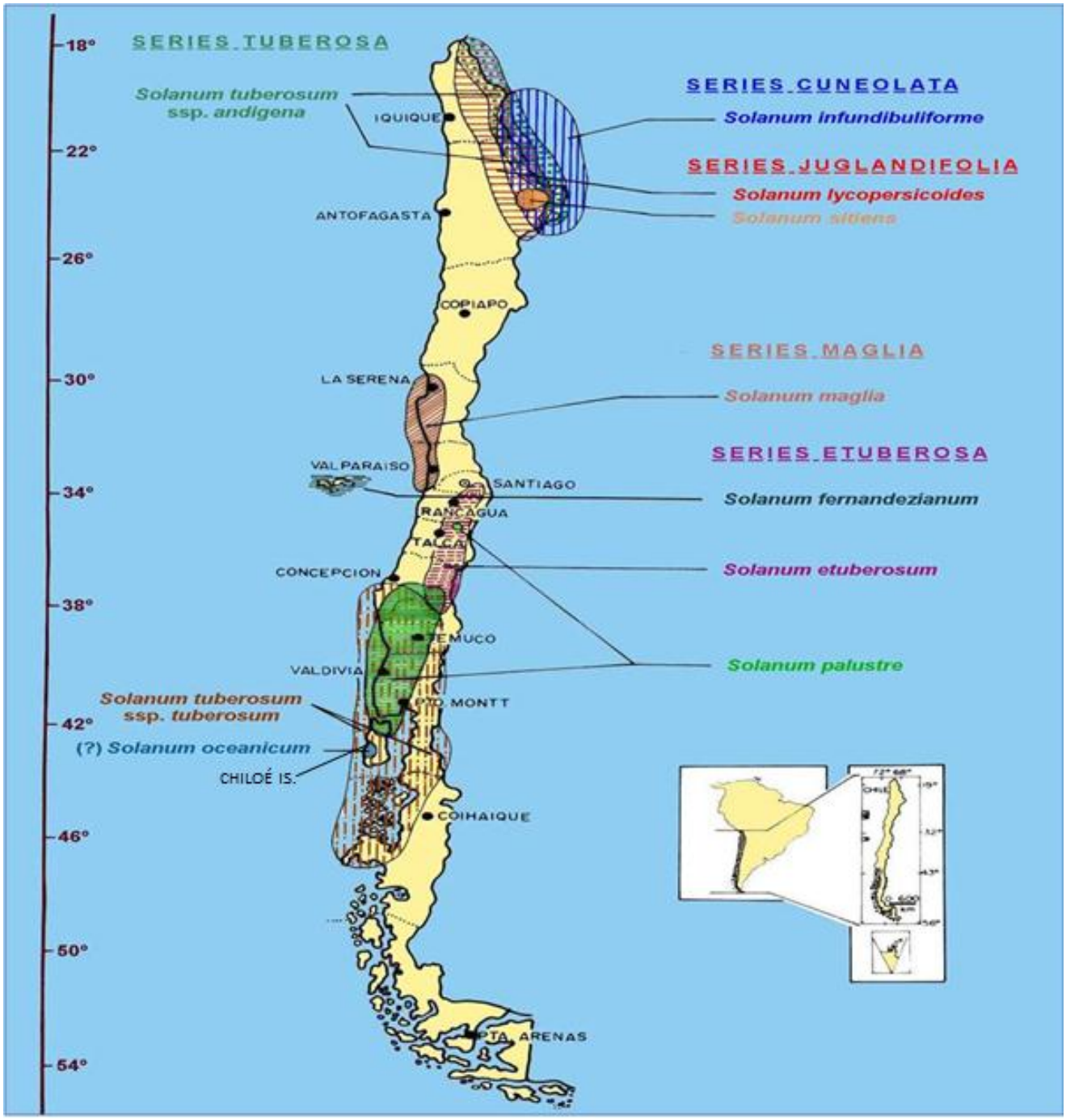


Figure 18: Map of Chile and distribution of Solanum species. Source: Contreras & Castro (2008).

6.2 Potato dissemination

According to Luján (as cited in Contreras, 2008) the first written reference to potatoes was made in 1537 by Jiménez de Quesada in Valle de la Grita, Vélez Province, Colombia. Juan Castellanos, a member of Quesada's expedition, describes them as:

> *"Rounded roots that are planted and produce a stalk with its branches and leaves and some strange flowers of pale purple colour; and the roots of this herb that might be of three hands of height, are held over the soil, the size of an egg, more or less, some rounded and other elongated; they are white and purple and yellow, floury roots of good taste, well received gift of the Indians and sweeties for the Spanish." (*Contreras, 2008, p. 116*)*

The first Spanish conquistadores who went into South America, after the subjugation of Central America in the 1520s, encountered a completely new crop to them. The only plant they were familiar with that presented a close resemblance to the potato was the sweetpotato (*Ipomoea batatas*), which they had encountered in the Caribbean some decades earlier. This in fact led to some confusion over its name, as the term *batata* (Spanish for sweetpotato) was modified to *patata* for the potato.

After their early acquaintance with the potato, the Spanish seemed not to rate the potatoes very highly (Harrison *et al*., 1985). Laufer (1938) indicates that Spain and Portugal, after coming into contact with the potato, were not quick to adopt it and were particularly inactive in propagating it to their other territories. Their main contribution was its introduction to Europe, where soon the British and Dutch would rely on it as one of the most important food crops for their colonies.

The Spanish were most likely the first to introduce the potato to Europe. Hawkes (1967) describes that in 1565 some potatoes were sent from Cuzco, in present day Perú, to mainland Spain. A later study by Hawkes and Francisco-Ortega (1993) suggests that the potato was first introduced to the Canary Islands (a present day autonomous community of Spain) in 1562 and did not reach mainland Spain until 1573. There are some sources that attribute the introduction of the crop to England to the British sailors Sir Francis Drake and Sir Walter Raleigh in the 1570-1580s (Laufer, 1938), portraying a two-point entry to Europe. A receipt gives evidence that there was a delivery of potatoes from the Canary Islands to Antwerp (a Belgian port) in 1567 (Pitrat & Foury, 2003).

Some potato specimens eventually reached the renowned Flemish botanist Clusius in the 16th century, who along with the French Parmentier in the 18th century, were instrumental in popularising the potato as an important food crop in Europe (Laufer, 1938). Potato varieties were extremely limited at that time, with Contreras (2008) claiming that all varieties were bred from only two sources for more than 250 years after the introduction of the crop to Europe. The potato

brought from Perú, which was practically the only one planted in Europe before the mid-19th century, was adapted to short tropical days and was not optimal for the conditions of the northern continent. However, after decades of adaptation to the new environment, it became a reliable crop and began to be widely grown across Europe, where it was an important part of the diet of peasants and workers (Harrison, Masefield, & Wallis, 1985).

In Ireland, the potato eventually gained exceptional importance, to the point where their whole economy and subsistence became precariously reliant on a single variety known as Irish Lumper. Since the potatoes were propagated asexually, the crop was made up of clones with no genetic diversity. The late blight (*Phytophthora infestans*) outbreak in 1845 exposed this dependency and caused the Great Irish Famine, which decimated Ireland's population and led to massive emigration to North America. This event, according to Contreras (2008), was the main catalyst for potato breeders to expand the genetic pool for potato varieties.

According to Zhang et al (2009), the first potatoes were introduced to North America in the early 1620s as a gift to the governor of Virginia from his homeland in the Bahamas. However, the crop was not distributed around the country and it was not until the early 18th century when potatoes, brought from England, became an important crop for the British colonies in North America (Laufer, 1935). However, recent studies by Zhang *et al*. (2009) have found that old potato cultivars currently grown by indigenous inhabitants in north-western USA are more closely related to Mexican or Chilean group potatoes than to the old European varieties that were introduced by the British. This contradicts the generally accepted version of a single European introduction and suggests alternative multiple introduction routes for potatoes in North America, possibly from Polynesia, as suggested in some local traditions. The Makah people[17] of Northwest America (Neah Bay, Washington State) state that potatoes were introduced to their region and tribe when the Spanish established Fort Nuñez Gaona at Neah Bay in 1792. The Neah Bay was a strategic position for the Spanish empire during this time (Brown, n.d., Mendoza, n.d.). The antiquarian cultivar *Ozette* (see Figure 19) is believed to have arrived at Neah Bay in this way.

[17] Darryl Markishtum, Member of Makah Nation, Washington, USA as told to N Roskruge in 2010

Figure 19: Ozette cultivar grown by the Makah people, at Neah Bay, Washington, USA. Source: N Roskruge.

6.3 Potato Introduction into New Zealand

The date of introduction of the potato into the South Pacific is subject to much speculation and varies greatly depending on the location. Early European navigators gradually introduced the potatoes to the Pacific islands where they arrived. However, this process does not seem to have followed any sequence.

Hornell (1945) indicates that while Mendaña introduced maize upon the discovery of the Marquesas Islands in 1595, no records exist about the potato being introduced. Laufer (1936) states that in other Pacific islands colonised by the Spanish and Portuguese, such as the Philippines, the potato was reported as early as the late 17th century. At some other Pacific islands, on the other hand, the potatoes were not introduced until the English and Dutch explorers arrived in the region, almost 200 years later. Zoller (as cited in Laufer, 1936) indicates that the potato was not introduced to northern Papua New Guinea until the Germans had colonised the region in the 1880s. As such, the introduction of the potato to the Pacific region is highly variable and is a topic better suited to study on a specific case basis. For Aotearoa, there exists an abundance of different beliefs and positions regarding the origin of potato, including taewa Māori, and the route of its introduction into the country.

There exist various Māori accounts that claim numerous varieties of taewa were already being cultivated in Aotearoa before the arrival of Europeans in 1769 (H. Cunningham, personal communication, July 13, 2014). Even though it is generally accepted that taewa were not introduced

during the early Māori migrations to Aotearoa around 1200 AD, some believe that early (pre-Cook) unrecorded voyages of vessels which originated, or had made contact in South America, are to be credited for the introduction of taewa.

The accounts of a Captain Stivers, an unknown sailor sometime before Captain James Cook's arrival (1769), attribute to him the introduction of the taewa to the Bay of Islands and New Zealand (Williams, 1935; Richards, 1993). It has been proposed that the term 'taewa' is actually a Māori transliteration of his name, 'Stivers'. Williams (as cited in Richards, 1993) describes that in Māori the term taewa can refer to a foreigner, a cold (a flu-like sickness), or the potato. Regarding this, Richards (1993) points out that both the cold and the potato were introduced to Aotearoa by foreigners, so all the connotations refer to the over-seas nature of the term.

Some iwi and hapū claim that taewa were originated in their territories and, after the crop's discovery by their people, started to be cultivated in gardens. For example, several persons around Maungapōhatu in Te Urewera believe that their tupuna found the taewa in the bush, after which they began to spread it in the region (T. Haare, personal communication, September 23, 2014). Also, there is a tradition in Ngā Rauru of South Taranaki that recounts how their tupuna Te Reke Tātairongo fetched from the underworld a variety of taewa known as Tātairongo (Hammond, 1924).

Best (1925/1976) strictly questions most of these affirmations and points out that the cause for such notions is undoubtedly the fact that most groups, after acquiring the potato from coastal iwi, had no information regarding the crop's origins and the people who had introduced it into the country. As an example, he states that supposing the potatoes introduced by Captain James Cook, the British explorer and navigator, in Queen Charlotte Sound in 1773 were successfully perpetuated, the local Māori would have been growing the crop for almost fifty years before it was introduced into most other regions. Thus, some of these iwi, especially in non-coastal New Zealand, developed different stories that tried to explain the crop's background.

Captain James Cook is generally credited to have introduced the potatoes to New Zealand. Heaphy and White (as cited in Richards, 1993) propose that Cook, during his first voyage to New Zealand, left behind some potatoes at Mercury Bay, and possibly even in Bay of Islands, in 1769. Regarding this first voyage, with Cook captaining the HMS *Endeavour*, the Māori Horeta Te Taniwha of Ngāti Whanaunga of the Coromandel district recalls:

> *"Cook then gave two handfuls of potatoes to the old chief [Toiawa], a gift of profound importance to the Māori s. By tradition these potatoes were planted at Hunua where, after cultivation for 3 years, a feast was held and a general distribution made"* (Begg & Begg, 1969, p. 36).

White (1888) provides a much longer and more detailed version of this story relating to the first gift of potatoes to Māori. He refers to Cook as *Pene Kuku* and wrote:

> *"… took some of his own things and went with them to our old chief, and gave him two handfuls of what we now know were seed-potatoes. At that time we thought they were para-reka (sweet Marattia salicina), and we called them by this name, as the things he gave to the old man were not unlike the bulb of the Marattia salicina, or like the lower end of that fern, at the part where it holds to the stem of the ferntree. The old chief took the gift and planted it, and we have partaken of potatoes every year since that time. These things were first planted at a place in the Wairoa called the Hunua (double canoe), half-way between Drury and the Taupō Settlement, east of the entrance of the River Wairoa, opposite the Island of Wai-heke (descending water); and the old chief to whom the potatoes were given was of the Nga-ti-pou Tribe who occupied the Drury district at that time. After these para-reka had been planted for three years, and there was a good quantity of them, a feast was given, at which some of the potatoes were eaten, and then a general distribution of seed para-reka was made amongst the tribes of Wai-kato and Hau-raki (the Thames). The Nga-puhi tribes say they had the potato before any other tribes of New Zealand. This assertion is a fiction : we, the tribes of the Thames, first had potatoes, as we can show that even at this day the potato grows of its own accord in the Hunua district, from the fact that in the days of old the pa at the Hunua was attacked by a war-party, the pa was taken, all the people killed and eaten, their bones were broken and knocked like nails into the posts of the storehouses at their own home, and the place was sacred for a long time, not any one daring to go there, and was quite forsaken for years, but potatoes continued to grow there of their own accord on the banks of the streams, where the soil is carried by the freshes in the creeks, and potatoes are to be obtained there at this day."* (p. 125-126).

However, various sources ("Sir Joseph Banks", 1905; Miller, 1955) contradict this claim by indicating that potatoes were not introduced to New Zealand during Cook's first voyage. Cook himself, who was particularly meticulous about recording any introduction made, doesn't mention anything concerning the potato in his first voyage. References about Cook introducing the potato point out that this did not happen until his second voyage to New Zealand in 1773, some years after several European sailors could have already introduce the crop.

Many early explorers, as well as whalers and sealers, used to establish potato crops at the locations they reached in order to have supplies available on their return. This means that there are various possibilities, some probably unrecorded, regarding the introduction of the crop to New Zealand. According to various scholars (Best, 1925/1976; Laufer, 1936), De Surville was likely the first to introduce the potatoes to the country in 1769, just some weeks after Cook's rediscovery of New Zealand. However, no definitive information confirming the introduction of potatoes by De Surville has been found. See Figure 20 (page 92) for a representation of New Zealand drawn from information and sketches by Cook and others.

In 1772 Marion du Fresne and his crew planted some potatoes at Motuaro in the Bay of Islands and explained to the local Māori the value of the crop. This is often regarded as the first confirmed case, beyond any doubt, of introduction of potatoes to New Zealand, according to Laufer (1936). Roux, who was a lieutenant on board, recorded in the journal:

> *"As the natives are extremely intelligent, we were able to make them understand that the plantations we had made on Marion Island of wheat, maize, potatoes, and various kinds of nuts, might be very useful to them. All these plants had grown very well, although it was winter."* (Best, 1925/1976, p. 149)

The HMS *Adventure*, captained by Furneaux, was participating along the HMS *Resolution* in the Cook's second exploratory voyage. Upon reaching the rendezvous point at Queen Charlotte Sound in 1773, the crew of the *Adventure* planted some potatoes brought from the Dutch Cape of Good Hope, in modern South Africa. Cook, aboard the *Resolution,* arrived just a couple of weeks later. To this joint expedition is credited the introduction of various plants and animals, such as pig, goat, and possibly fowl, motived by the lack of fresh supplies encountered during Cook's first exploratory voyage four years earlier (Thomson, 1922). According to Thomson (1922), Cook possibly also introduced potatoes earlier that year at Dusky Sound, where he and his crew cleared some land and planted a vegetable garden.

Forster, who replaced Joseph Banks as the chief botanist on board after the latter did not participate in the voyage, alludes to the potato crops at Queen Charlotte Sound in 1773:

> "*Captain Cook, who was determined to omit nothing which might tend to the preservation of European garden plants in this country, prepared the soil, sowed seeds, and transplanted the young plants in four or five different parts of this Sound. ... He chiefly endeavoured to raise such vegetables as have useful and nutritive roots, and among them particularly potatoes, of which he had been able to preserve but few in a state of vegetation. He had likewise sown corn of several sorts, beans, kidney beans, and peas, and devoted the later part of his stay in great measure to these occupations*." (Laufer, 1936, p. 19).

According to Forster (as cited in Best, 1925/1976), Cook meticulously showed Teiratu, their Māori liaison during their stay, the location of the five gardens recently planted around the area and explained their purpose and means of propagation. According to Cook's entries (as cited in Thomson, 1922):

> "*…the man was so well pleased with them, that he, of his own accord, began to hoe the earth about the plants.*"

Forster, in his journals, indicates that Teiratu was particularly interested in the potatoes and manifested knowledge about the crop, evidently due to the similarity with the sweetpotato. After

departing, Cook made Teiratu promise him that he would not remove the crops, but perpetuate them. However, according to Best (1925/1976), it cannot be confidently affirmed that these potatoes planted on Cook's second voyage were maintained by the local Māori.

On his return to Queen Charlotte Sound in 1777, after discovering that the locations where the gardens used to be were overrun by weeds or destroyed in order to erect buildings, Cook notes:

> *"... at all the other gardens then planted by Captain Furneaux, although now wholly over-run with the weeds of the country, we found cabbages, onions, leeks, purslain, radishes, mustard, etc., and a few potatoes. These potatoes, which were first brought from the Cape of Good Hope, had been greatly improved by change of soil; and, with proper cultivation, would be superior to those produced in most other countries. Though the New Zealanders are fond of this root, it was evident that they had not taken the trouble to plant a single one (much less any other of the articles which we had introduced); and if it were not for the difficulty of clearing ground where potatoes had once been planted, there would not have been any now remaining."* (Laufer, 1936, p. 17)

However, Roskruge (2007) indicates that various iwi of Queen Charlotte Sound make mention of a variety called Te Winiharete which they attribute to Capt. Cook's introduction. This would suggest that local Māori actually valued the crop and kept growing it, though probably on other locations. Anderson (1998) also points out that some Otago scholars consider that Ngāi Tahu originally acquired potatoes from Queen Charlotte Sound sometime in the 1770s, which would have most probably been introduced by Cook.

Shawcross (as cited in Roskruge, 2007) states that Lieutenant King, Governor of Norfolk Island, is usually credited with the introduction in 1793 of the 'white' or European potato, which is reputed to have been quickly accepted by Māori of the region. However, it is unclear how this European potato differs from the taewa varieties other than a smooth skin (fewer eyes).

Elder (as cited in Cameron, 1964) indicates that in 1814 Rev. Samuel Marsden, on his first visit to New Zealand, remarked that the introduction of potatoes to New Zealand was most probably unrecorded and attributed the crop to one of the various ships visiting the country during the 1770s. However, Marsden also stated that the potato's 'official' introduction was credited to Lieutenant King in 1793.

The Russian explorer Bellingshausen, visiting New Zealand in 1820, credits Cook for introducing the potatoes to the Māori in 1773. Gaimard, an official on D'Urville's expedition in 1826, attributed the introduction of the crop either to Surville in 1769 or particularly to Marion du Fresne in 1782 (Wright, 1950). Captain Hamilton, who was killed at the battle of Gate Pa in 1864 and whom

the city in Waikato was named after, attributes the introduction of the potato to the North Island and the northern part of the South Island to De Surville and Cook (Thomson, 1922).

In 1813, during the first documented visit of a ship to the region, the sighting of a potato crop more than 40 hectares in extension in Bluff was recorded. This indicates the possibility that potatoes introduced by Cook during his second voyage may have been successfully perpetuated in the region (Cameron, 1964). It is also well known that whalers and sealers had a habit of establishing food-stores on remote islands as a form of 'food insurance' if they needed it during their later expeditions. This is accredited to many of the plant introductions including potatoes to the southern, sub-Antarctic islands and Stewart Island. These varieties would have come primarily from the Australian settlements and no doubt originally from the direction of Europe or the Cape of Good Hope (Southern Africa) (N. Roskruge, personal communication, November 11, 2014).

Once established in the country, the potato was swiftly appropriated by various coastal iwi and spread among iwi across Aotearoa. As Best points out (as cited in Hargreaves, 1963), the potato reached distant mountainous areas such as Taupō, Te Urewera, Tararua and Ruahine Ranges, among others, long before any European set foot on these places. Colenso, the first recorded European to venture into Mōkai Pātea in the upper Rangitīkei, found extensive and tidy potato cultivations near Taoroa at the nearby confluence of the Rangitīkei river (as cited in Thomson, 1922). Makereti (1938), who acknowledged Cook or de Surville for the introduction of the potato to New Zealand, remarked that the crop was introduced to Te Arawa of the Bay of Plenty district in the early 19th century.

It may never be known with certainty who was the first person to introduce the potato to New Zealand, but Darwin (as cited in Hargreaves, 1963) indicates the crop definitely was brought into the country "during the first year or so" after New Zealand's rediscovery in 1769. Best (as cited in Cameron, 1964) considered that, although impossible to know unequivocally, it is highly probable that at least one of these introductions succeeded.

The first 'formal' potato garden in New Zealand, according to the Sydney Gazette (as cited in Richards, 1993), was recorded in 1801 at the Firth of Thames, where some Pākehā had settled. It is unknown if the potatoes grown by these settlers were brought from Sydney or if the crop was already present in the area upon their arrival. The first export of potatoes in New Zealand was, according to the Sydney Gazette (*ibid*.), a shipment taken to Sydney from the Bay of Islands in 1803.

Te Rauparaha, according to Boast (as cited in Roskruge, 2007), is credited with the introduction of the potato, among other European crops, to the Kapiti coast and the Wellington region circa 1820. Additionally, some Māori in the southern part of Cook Strait also attribute Te

Rauparaha with the introduction of the crop (JPS, 1912). Presumably, the potatoes were acquired in Waikato and brought south during Te Heke Tahu Tahu ahi, the great migration of Ngāti Toa-Rangatira led by Te Rauparaha.

Kehu, the renowned guide from Ngāti Tumatakōkiri of the Nelson district, is usually associated with the introduction of the potato to various regions of the South Island in the 1840s. It was recorded, according to Host (1974), that while guiding European explorers such as Brunner, Heaphy, and Fox, Kehu planted potatoes at strategic locations in anticipation for a potential return to the area.

The Chatham Islands or Rekohu – 680 km southeast of mainland New Zealand – had their first contact with Europeans when the ship Chatham was blown off course and landed there in 1791. The local tribe (Moriori) were subsequently introduced to new plants and crops through the periodic contact with sealers and whalers thereafter (Seymour, 1924). In 1835 the marauding tribes Ngāti Mutunga and Ngāti Tama invaded the islands and brought with them their seed potato stock to ensure future gardens (*ibid*.). These islands became known for their potato crops which were exported to Australia during the mid-nineteenth century (Roskruge, 1999).

It is clear the taewa was introduced to New Zealand several times, with largely differing dates between some regions. However, it was quickly adopted and highly valued as a food crop and trading asset in all the regions where it was introduced. For almost the next century after the introduction of potato, Māori agriculture would blossom to heights previously unseen and irreversible changes in Māori society would be set in motion. To consolidate this relationship between food crop and people Māori now have a number of whakataukī which draw on the value of taewa to their lives. Examples include: *E kore e piri te uku ki te rino, ka whitia e te ra,* (Clay will not cling to iron when the sun shines*)* spoken by Te Whiti-o-Rongomai in 1872 as a metaphor, meaning that Māori (clay) and Pākehā (iron) require a common bond which is ostensibly the money focussed society (moisture); without it the bonds would evaporate!

6.4 Potato Production in New Zealand

6.4.1 Potato Production during Early Contact

Charles Darwin (as cited in Hargreaves, 1963), on the voyage of the HMS Beagle, recorded that by 1835 the potato in New Zealand was more widely cultivated than any native vegetable and preferred by the Māori s above all the traditional crops. Considering the relatively short time since

its introduction, it is evident that Māori quickly adopted and developed a strong understanding of the crop. Undoubtedly, the similarities between kūmara and potato production systems greatly contributed to its favourable adoption as a staple crop.

Blue-flowering plants were very uncommon in New Zealand before the arrival of Europeans, except for the poroporo (*Solanum aviculare* and *S. laciniatum)* and some shrubs from the genera *Hebe* (Glenn, 1950; Allan, 1961; Martin, 1961). The potato presented some similarities to the highly valued poroporo (Roskruge, 2012), which might have contributed to the appeal of potato to Māori and its rapid acceptance.

There is a report from the Missionary Register (as cited in Hargreaves, 1963) that one missionary remarked that Māori did not immediately accept the potato after its introduction because they were eating it raw. However, this is an isolated remark, as Best (1925/1976) indicates that the vast majority of observers at the time mention the very rapid and successful adoption of the crop by Māori all across the country. The familiarity with the kūmara meant they would have been fully aware of the attributes of the potato as a cooked food.

In the mountainous and cold areas of New Zealand, such as Te Urewera, and also the Chatham Islands and other inhospitable places, the taewa provided Māori the possibility to improve their diet by having a food supply that was relatively dependable. According to Best (1925/1976), the crop was a welcomed complement to less reliable food sources that required hunting and snaring. In warmer areas, it was possible to grow two crops each year. Laufer (1936) indicates that the potato was also very rapidly accepted by Māori in the southern half of the South Island. Due to cold, the local Māori were unable to grow the tropical food plants brought by Māori from Polynesia but potatoes allowed them to readily resume their long neglected agricultural practice and produce extensive potato crops.

Different methods were developed by Māori in adaptation to their local environment and some techniques unknown to the European were conceived. For example, Ngāi Tūhoe planted in June the seed tubers in light brush, which was eventually felled and burned. During the early stages, the scrub sheltered the new growth from the exposure to frosts (Laufer, 1936; Firth, 1972). Beattie (1920/2009) recounts that Ngāi Tahu in the South Island planted potatoes only at full moon, a practice that was still in use at the time of his publication in 1920. Like the kūmara, continues Beattie (1920/2009), the potato was harvested around April, before the leaves were burned or “eaten” by the frosts. In almost every tribe, the potato was grown according to the Maramataka, or Māori lunar

calendar, which dictated each activity around the crop (H. Cunningham, personal communication, July 13, 2014).

The main advantages of the potato over the traditional crops were that, besides having characteristics familiar to the Māori growers, it had a high tolerance for colder climates, which allowed it to be grown throughout all of New Zealand and generally with an improved yield by area under production. Yam cultivation, which was very limited and confined to northern New Zealand, was neglected and completely disappeared not too long after the introduction of potatoes (Oliver, 1950). Compared to the kūmara, the potato had vastly superior returns for the labour input and could be stored with much less difficulties and for much longer (Hargreaves, 1963). For all the root crops cultivated, Māori practised a form of stale-seedbed preparation, clearing land before the winter and letting the flush of regrowth happen before planting in the spring (Roskruge, 2014).

Some authors, such as Cameron (1964), claim that potatoes required less labour and could be grown more easily than kūmara. However, Firth (1972) remarks that although the taewa crops actually required more labour than the kūmara, Māori at the time could effectively deal with this issue by involving the whole community for the tasks of weeding, tending, and harvesting. Another factor worth noting was the association of the crop to deities and the spiritual favouritism deemed necessary to encourage success. Kūmara have a very strong religious association, ostensibly because of their shortcomings in production and storage, thus gaining extra favour to ensure cropping success. Conversely, potatoes and taewa effectively had an almost non-existent association to the spiritual realm. They were automatically rendered as belonging to Rongo-marae-roa through their status as a cultivated food. They did not however require all the additional ritual which kūmara had as their success was seemingly apparent without it. These crops were easier to grow across a wider geographical region and produced a better yield overall, thus giving better returns and also impacting on the need for trade between tribes where kūmara were marginal or non-existent crops.

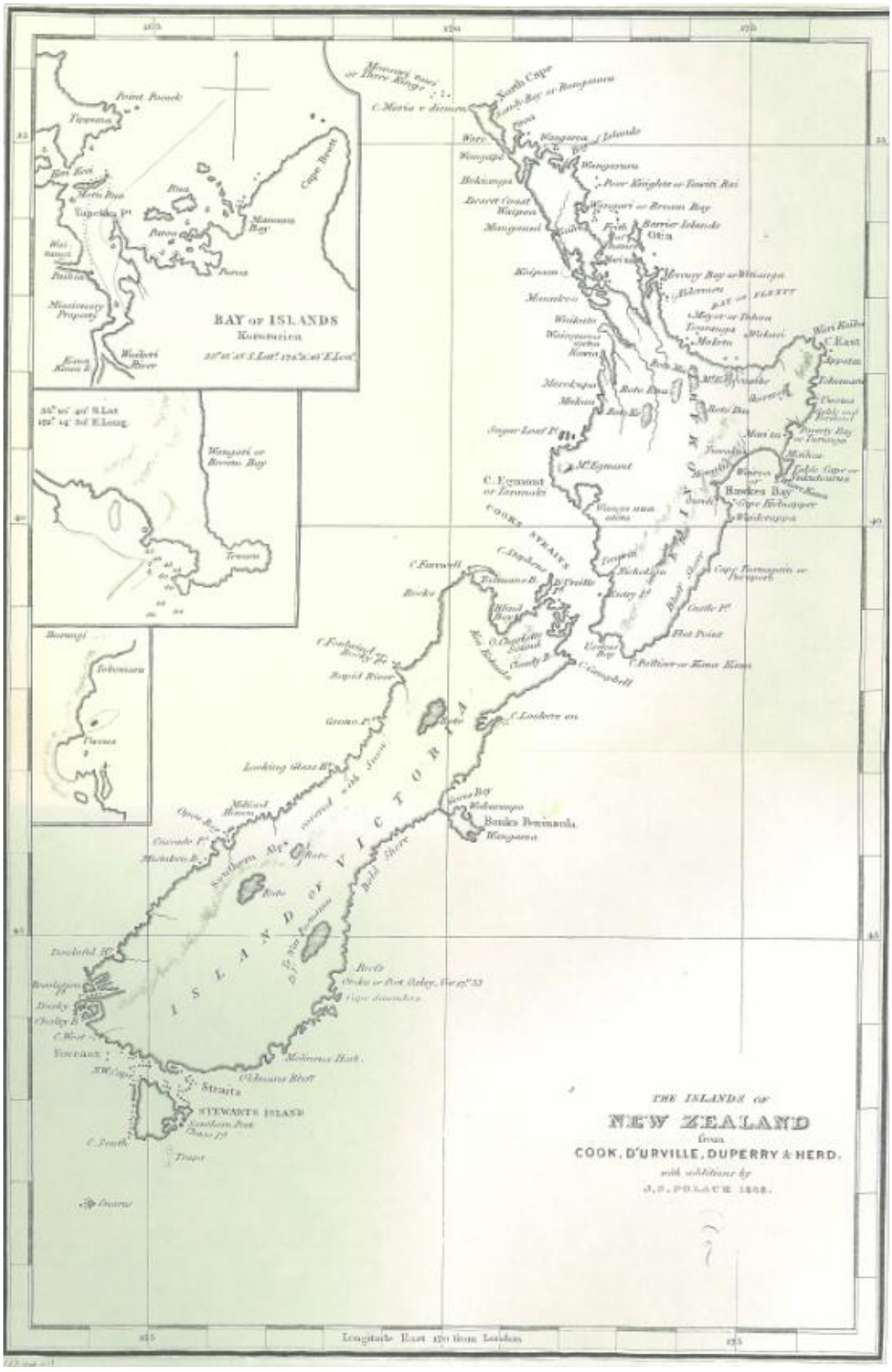


Figure 20: Map of New Zealand from Cook, D'Urville, Duperry & Herd, with additions by Polack, 1848. Source: Polack, 1976.

According to various authors, the production of potatoes by Māori entailed nothing new or more complicated than the systems they already used to grow traditional crops. Begg and Begg (as cited in Leach, 1983), based on early records, remark that potatoes were grown according to the traditional kūmara practices. Beattie (1920/2009) indicates that the potatoes were planted in mounded rows facing east, a practice undoubtedly derived from mātauranga Māori regarding kūmara production. Montefiore describes Māori potato production as:

> *"...their system of planting, is very simple, ... a small hole dug with a piece of hard wood, at a distance of a foot each way, with a small potato thrown into it, is their usual method, the surrounding area is cleared of weeds, but never loosened."* (Montefiore, 1837, p. 3).

Best refers that the journals from the voyage of the *Venus* describe the methods that Māori were using to cultivate potatoes in the Bay of Islands in the late 1830s as:

> *"[…]they made use of a small piece of straight iron, something like an elongated nail, with which they scooped a hole for everyone. They then returned the earth on top so that each tuber was surmounted by a little cone something like those made by the moles in their earth-works. This arrangement, observed with great exactitude, gave to the plantations an appearance of very finished culture."* (Laufer, 1936, p. 99).

However, contrary to the assumption made by Best and other authors that Māori merely adapted techniques used for kūmara production to the potato, Cameron (1964) points out that there were significant differences. The requirements for the crops are notably dissimilar, with kūmara thriving in soils with good heat retention, good drainage, and excellent aeration; potatoes would flourish in moist and highly fertile soils. Thus, potato crops were much more nutrient intensive and it was necessary for faster shift to new cultivating grounds. Considering that the Māori seldom used organic matter to replenish the soil's nutrients, Cameron (1964) argues that it would not have been viable to obtain decent potato yields by growing them using traditional kūmara cultivation methods. As such, the introduction of potatoes also entailed an accelerated reduction in forest coverage in Aotearoa. One factor that did remain relatively constant was the use of the Maramataka or Māori lunar calendar for all land and crop management processes (Roskruge, 2007).

The extent of forest clearances performed by Māori growers and the effect of European introductions in this topic has often been debated. Cameron (1964) pointed out that many of the writers that commented on early Māori potato production noted that there were no large forests in areas where a strong iwi population was present. Johnson (as cited in Cameron, 1964) also commented on various fires started by Māori growers in order to prepare and burn the ground for the planting of potatoes that accidentally went out of control and consumed the forest far beyond the planting site.

Best (as cited in Cameron, 1964) proposed that the European introduction of iron tools and more sophisticated methods for starting a fire led to a large scale forest clearance by Māori. In contrast, the stone-age tools used by Māori before European contact limited the options for ground preparation and vegetation clearance, resulting in a much slower expansion of the agricultural frontier. Added to the great incentive for Māori to cultivate large tracts of land with potatoes in order to trade with Europeans, Cameron (1964) indicates that it resulted in substantial forest areas being scorched.

According to Cameron (1964), most writers detail how the Māori prepared the lands by burning off all the vegetation, with bracken covered areas usually being preferred for taewa cultivation. Only recently cleared ground would be used for potato growing. In 1835 Reverend Yates (as cited in Cameron, 1964) indicated that after a site was selected, then the trees and branches were burnt down and the potatoes were planted among the tree's roots. Dieffenbach (as cited in Thomson, 1922) observed that patches of potatoes were planted between piles of partially burned haulms.

Rev. Yates (as cited in Cameron, 1964) explained the location for potato crops was chosen based on the soil composition, preferring places with rotten leaves and branches, which greatly contributed to the flourishing of the potato. Savage (as cited in Hargreaves, 1963) refers to some Māori cutting up a seed potato in pieces and planting them separately, similar to the traditional practice with kūmara. Best (1925/1976) indicates that once planted, the cultivated land would be placed under strict tapu. Stone representations of deities, usually Rongo-marae-roa (see Figure 21), would frequently be strategically placed around the cultivations in order to look after the crops.

The production and trade of taewa was one of the most important activities for Māori in the early 19th century, as it enabled them to enter a new economy and acquire several European products such as tools and muskets. As reports of the time suggest, there was a buzzing commerce of potato in many parts of the country, which propitiated mostly cordial relations between Māori and Europeans (Cameron, 1964).

6.4.2 Potato Cultivations and Trade during Early Contact

Savage and Morrell (as cited in Hargreaves, 1963) observed that the potatoes grown by Māori in the early 19th century were of excellent quality, large-sized tubers and good storage properties. McNab (as cited in Hargreaves, 1963) recorded that, due to the high quality of the crop, Māori grown potatoes in the Bay of Islands were being exported to Sydney as early as 1806.

Figure 21: Stone representation of Rongo-marae-roa, from Te Ātiawa. Source: N. Roskruge.

In 1805 at the Bay of Islands, where potatoes had become well established, Savage remarked about the crop:

> *"[…] I never met with that root of a better quality; they keep remarkably well, and we provided a stock of them sufficient to supply the whole ship's company for several months…"* (as cited in Laufer, 1936, p. 99).

The potato rapidly began to displace traditional crops such as *aruh*e (fernroot) and kūmara as the main source of carbohydrates in the Māori diet (Makereti, 1938; Yen, 1961). Savage (as cited in Williams, 1935) commented that in some areas in the north, the potato was already more widely grown than *aruhe* as early as 1805. By 1810, large potato cultivations by Māori were reported at locations ranging from the North Cape at the tip of Northland to the Foveaux Strait in Southland. Captain Edwardson (as cited in Thomson, 1922), referring to the Māori around the Foveaux Strait, recorded that they preserved the potatoes during winter "by the same process as that employed by the Irish; either by ground storage or the familiar rua and timanga options."

Figure 22: Depiction of Potatoes at Te Rau Aroha o Te Waipounamu wharenui, Ōmaka marae, Blenheim. Source: N. Roskruge.

In 1813 Captain Williams (as cited in Thomson, 1922), on the first recorded European visit to Bluff, stated that he observed a potato cultivation of more than 40 hectares in extension, which had well-cultivated beds and crops at different stages, with some recently planted and some ready for harvest. William's report, according to Laufer (1936), was the first documented potato cultivation grounds in southern New Zealand. Captain Fowler also accounted that he acquired some potatoes from the Māori at Otago harbour in 1813, while other sailors report that by 1817, Māori were able to provide sizeable quantities to whalers for trade (Thomson, 1922).

Rev. Marsden commented about Māori potato crops in 1814 at Bay of Islands:

> *"Their potato plantations are all very neatly fenced in, and were in as high condition as the gardens in and near London, as they do not suffer a single weed to remain that would injure the growing crops. The flat where the natives were encamped might contain somewhat about a hundred acres or more, part of which was enclosed and planted with potatoes."* (as cited in Laufer, 1936, p. 99).

Savage (as cited in Williams, 1935) remarked that, even though Māori were very fond of potatoes, they did not eat them very frequently in order to have enough stock for trade with the

European sailors. Contrary to most sailors and traders of the time, Bellingshausen in 1820 commented that although Māori at Queen Charlotte Sound had sufficient quantities of potatoes, which were "as good as the English species", they were unwilling to part with them and only grew potatoes for their own consumption (Williams, 1935). However, Laufer (1936) indicates that Bellingshausen's experience was atypical, as there are numerous records that indicate an extensive trade between New Zealand and Australia including regular shipments of more than eight tons of potatoes each being sent to Australia.

Gaimard (as cited in Wright, 1950), in 1826, commented that the value of the potatoes was so quickly realized by Māori that he observed potato cultivations everywhere around their settlements. By 1839 the potato was so widely established that Thomson recorded Bidwell (as cited Laufer, 1936) stating:

> *". . . the potato might be taken for an indigenous plant, as it is impossible to go anywhere without finding it growing wild."* (Laufer, 1936, p. 100).

During his crossing of the Ruahine range in 1845, the first incursion of a European into the area, Colenso mentioned (as cited in Thomson, 1922) that he came across a Māori centre of extensive potato cultivations along the Rangitīkei River.

Unlike the wheat, which started to fall out of favour because of the rapid decline in prices, Māori continued to extensively grow potatoes and maize. The potato widely replaced the kūmara, which according to Williams (1935) continued to be grown only because of the introduction of new varieties such as *waina*, which had significantly better yields than traditional varieties.

As Harris (2006) pointed out, at the time of the Irish Great Famine in the late 1840s, Māori agricultural production was flourishing. Shipments carrying crop provisions were frequently dispatched by Māori themselves from ports all around the country, including the Chatham Islands and Stewart Island (Williams, 1935). Between 1830 and 1860, the rapidly developing and expanding towns of Auckland and Nelson were heavily reliant on potatoes produced by the Māori (Roskruge, 2007). By 1858, at least 53 Māori -owned ships were registered in the port of Auckland, most of which were doing regular export voyages of potato and maize to Australia (Williams, 1935).

However, due to varied circumstances, Māori agriculture had declined significantly by 1860 and was never to recover to the levels of the early 1800s (Hargreaves, 1959). One of the main reasons for this abrupt decline was the profound alteration of the Māori traditional system caused mainly by the expansion of pastoralism and the Māori Wars, which put an end to Māori trade and production and would permanently compromise their access to the cultivation grounds.

6.4.3 Potato Production in Recent Times

New Zealand proved to be a very suitable country to grow potatoes, not only because of the soil characteristics and climatic conditions, but because of the initial lack of major pests. Even though some of the insects that affected the kūmara crops were also a problem for the potatoes, the damage was usually localised and could be dealt with by the same traditional methods that Māori had been practising for centuries on the kūmara (Best, 1925/1976). The value of potatoes cannot be underestimated and an example can be found in carvings, a traditional mode of knowledge dissemination for Māori, which contain references to potatoes (see Figure 22).

However, due to the complete lack of border controls regarding imported produce, highly damaging pests eventually found their way into New Zealand, According to the report of the Agricultural Department for 1906 (as cited in Thomson, 1922), the lined click beetle (*Agriotes lineatus*) was widely distributed across New Zealand by that year, and was causing major damage to the potato crops.

Harris (2006) claims that particularly violent outbreak of late blight (*Phytophthora infestans*) destroyed the potato crops of numerous Māori communities during 1905-1907. According to Harris (ibid.), this epidemic had devastating effects on Māori, who were heavily reliant on the potato as their staple crop, and was one of the main drivers behind the introduction of new potato varieties and a diversification in crops. However, Māori agricultural production by then was nowhere near the levels and importance that it had in the first half of the 19th century, so the extent of the damage caused by this event is arguable.

The potato tuber moth (*Phthorimaea operculella*), which can devastate tubers exposed before being harvested and also stored potatoes, entered New Zealand via infested potatoes imported from Australia in the late 19th century (Thomson, 1922). According to Thomson (1922), it is a very destructive pest for potato crops throughout the country, with a more limited presence in Southland. It was usually controlled by burning the haulms and clearing the remaining tubers by feeding them to the pigs; also, the larvae of two native hoverflies (*Melangyna novaezelandiae* and *Melanostoma fasciatum*) prey on this insect (Thomson, 1922).

More recently, in 2006, the tomato/potato psyllid (*Bactericera cockerelli*) was detected in New Zealand. This major pest can significantly reduce the yield of the potato crops by transmitting the Zebra Chip Disease (*Candidatus Liberibacter solanacearum syn. psyllaurous*), which also renders the crop unmarketable (Puketapu, 2011). At present, considerable research continues on suitable control mechanisms for the psyllid.

6.5 Taewa and Potato Varieties in New Zealand

The taewa or Māori potato, which were the first varieties introduced to New Zealand, is known by a number of generic names which vary according to tribe and dialect around the country. Most of these names reflect the circumstances under which the crop was introduced or became known in the region. Roskruge (1999) lists some of the most common names: taewa, Peruperu or periperi [Northland], parareka [Ngāti Porou], mahetau [Ngāi Tahu], and riwai, among others. However, since the recent general resurgent interest in Māori potatoes, taewa has been the most frequently used term throughout the country.

Since the early contact period, numerous varieties of potatoes have been kept by Māori and still continue to be grown in private gardens and around marae grounds (Roskruge, 1999). These Taewa Māori usually have a conspicuously different appearance than the commercially grown potatoes and possess unique traits, such as a high number and significant depth of the "eyes" of the tuber, irregular shapes, and particular flavours and consistency. Roskruge and Anderson (2010), as well as Harris and Niha (1999), also indicate that taewa are usually smaller in size and generally are significantly less productive than the modern commercial potatoes, which have been purposefully bred to improve their yields and resistances, as well as to develop desirable characteristics for the industry.

Taewa strongly resemble the so called "native potatoes" of the Andean region, to which they are closely related. Although some taewa Māori are sometimes classified as *Solanum tuberosum* subsp. a*ndigena (*Roskruge and Anderson, 2010*)*, there is no general consensus as to their defining traits against the *tuberosum* subspecies.

Taewa Māori also present some important characteristics regarding the nutritional value. CIP (2014) indicate that yellow taewa varieties are high in vitamin C, while red and purple varieties contain significant levels of antioxidants. Polack (1973) points out that during the early 19th century, the antiscorbutic properties present in Māori taewa saved countless lives of seamen.

According to Thomson (1922), by 1820 Māori already possessed several named varieties of taewa. Kendall (as cited in Leach, 1983) indicates that seven vernacular names for potatoes were listed in 1820. These names reflected the association that Māori made between the crop and elements they were familiar with, such as the varieties *uwhi* and *ngangarangi*, which were Māori terms previously used for the yam.

Taewa Māori were widely grown and traded throughout New Zealand, and constituted an essential commodity in the early economy before and after the European foundation of the country

in 1840. However, after the Māori agricultural and commercial decline around 1860, taewa Māori were largely forgotten by European New Zealanders for the next 150 years and the crop was almost exclusively perpetuated by Māori during that time.

White (1913) reports that in Canterbury in 1855 he came across a taewa variety which used to be called "Māori mungamunga" by the Pākehā. Although he never saw it again, White (1913) describes it as waxy and not floury when cooked, and presenting a purplish black colour throughout. Roberts (1913) claims that the potato described by White was the same "Kapana mungamunga" grown in Southland. He described it as "rough, dark-brown skin, and purple flesh, with occasional whitish streak" and indicated that it thrived in soils previously occupied by bush. The name "Kapana" most probably is the Māori rendition of the English word "Captain", referring to an unknown captain who introduced the variety into the area.

According to Skinner (1913), there was a variety grown in Wairau in the Marlborough Region called puna-karewau, which had a stalk approximately 15 cm long and produced around half a dozen tubers. This variety, which had ceased to be grown locally around 1860, was considered by local Māori to have been cultivated before Cook's visit to the country. Skinner (1913), while indicating that there is not much information about the early potatoes, also lists the varieties Tātai-rangu, rapae, and raramu. The name Tātairangi from South Taranaki as a pre-European variety closely resembles the name Tatai-rangu applied by these informants.

Beattie (1920/2009) reports that on the West Coast of the South Island Māori grew the varieties: *karaponia* (California), *waitaha* (White Rock), and *katote*, the latter being quite popular. Beattie (1920/2009) indicates that, according to one of his Māori informants in the region, the *waitaha* variety was especially suited to the bushy soil of the region (without explaining the definition of the term 'bushy soil').

According to Thomson (1922), around 1920 some taewa were found growing on a waste ground in Otago Peninsula. Thomson (1922) continues by saying that although the Māori had practically disappeared from the area, which used to have a large native population, and only a few "half-castes" remained, wild Māori potatoes still persisted. This taewa is described as having "a very firm tuber, rather bluish in colour, and very solid when cooked" (Thomson, 1922). More recently, locals of Otākou (Otago Heads) have recovered old taewa cultivars from ancient garden sites (N. Roskruge, personal communication, December 8, 2014).

Best (1925/1976) reported that at the beginning of the 20th century some varieties of taewa could still be found growing in the bush in the North Island, at places which used to be Māori

clearings for potato cultivations in the mid-19th century. Best further described these potatoes, even while being tangled with blackberries and completely neglected, as producing high quality firm tubers (*ibid.*). This was particularly evident in Te Urewera where isolated occupation sites were frequent and informants state they could still find examples of these varieties in the mid-twentieth century (N. Roskruge, personal communication, November 13, 2014). Similarly, the variety *Rakiura* provided to the Massey University collection from a landowner in Stewart Island in 2005 was claimed as a self-perpetuating variety that was growing down a bank decades after occupation of the general area by a settler family[18].

During almost the entirety of the 20th century, a very limited number of potato varieties were grown for commerce. Clark (1949) stated that in 1941 more than 80 per cent of the potato production in New Zealand came from six commercial varieties. There was a breeding programme initiated in the 1960s with one or two success such as the *Rua* and *Iwa* varieties (Genet, 1983). Subsequent to that has been the change in the commercial demands for potato crops, from one of bulk commodity type produce for family consumption to one where processing options are more prominent and consumers are more discerning, looking for varieties by name for their cooking characteristics ahead of their family bulk needs.

However, the start of the 21st century has brought resurgence in the interest and awareness on taewa Māori in New Zealand (McFarlane, 2007). New market opportunities and a Māori cultural affirmation movement have driven the gradual expansion of taewa cultivations and increased the availability of several varieties as seed potatoes and as "novelty" vegetables in restaurants and grower markets (Fandika, Kemp, Millner & Horne, 2010; Roskruge & Anderson, 2010). According to McFarlane (2007), the newly developed niche domestic market and its premium prices could potentially compensate for the inferior yields of most taewa varieties and turn it into a commercially viable produce.

Even though there is very little information regarding the performance of taewa varieties, some seem to possess a superior natural resistance to late blight (*P. infestans*) than several other common commercial varieties (Roskruge & Anderson, 2010). Trials by Fandika *et al*. (2010) suggest that the taewa variety "moemoe" actually has similar yields and resource use efficiency compared to other important commercial varieties and, with the adequate management, might be a commercially viable variety. At present day, taewa are grown using the same production systems as commercial potatoes (Roskruge, 2007).

[18] As per records kept with the collection on accessions provided by the New Zealand public.

Figure 23: Selection of taewa varieties. Source: N. Roskruge

Currently the most popular and available varieties of Taewa are: *huakaroro, pawhero, karuparera, raupi, tutaekuri* (also widely known as *urenika), wherowhero, and waiporoporo* (see Figure 23). Various growers associated to Tahuri Whenua, the National Māori Vegetable Growers Collective, have been propagating and perpetuating several of these varieties, as well as making them available for other growers.

6.5 Conclusion

As compared to kūmara, taewa are a relatively recent introduction to New Zealand; however, their contribution to Māori economy is unsurpassed. Both traditional Māori knowledge and early literature confirm the potato as an introduction during the first decade of recorded European contact. In this instance the varieties are most likely aligned to those taken to Europe directly from South America.

Secondary information hints at the possibility of European contact earlier than Tasman and Cook, ostensibly across the Pacific and potentially capable of introducing potato cultivars directly from South America. This scenario has numerous limitations and is not supported by Māori and Polynesian traditional knowledge, as potatoes are not depicted or mentioned in traditional waiata, carvings, or pūrākau which pre-date European contact.

7 Discussion

E kore au e ngaro; te kākano i ruia mai i Rangiātea
I will not be lost; the seed is planted at Rangiātea
Māori whakataukī of the Aotea tribes

As Bellwood (1978) suggests, studies about the Pacific region as a whole have been historically appropriated by English-speaking academics to the point that many scholars, as well as the general public, are convinced that the history of the Pacific Ocean and New Zealand in particular started with the voyage of Captain Cook (with a slight mention to Abel Tasman). However, most of them fail to acknowledge the impact that Spanish and Portuguese sailors had on the history of the Pacific, who were navigating through the region almost 250 years earlier than Cook.

It is important to emphasise that kūmara and taewa, arguably the two most important crops in Māori history, originated in South America. A relationship, even though practically unacquainted, has long existed between the regions. In the case of kūmara, it is becoming increasingly certain that there was pre-European contact between Polynesians and South Americans. In the case of taewa, through the European introduction of one of the most important crops of the Andes to Aotearoa, a second relationship was also formed. It might be argued then that this is an overstatement, as any country in the world which grows potatoes has established a relationship with South America. However, it might be accurate to say that no other people besides Māori regarded the crop as so spiritually important that they developed, during the span of a few decades, a relatively complete religious and cultural system around the potato, quickly adopting it as traditional crop and incorporating it into their *kaitiaki* or guardianship responsibilities.

The whakapapa for kūmara is very extensive and numerous Māori traditions account for the early introduction to Aotearoa. There is ample evidence to confirm that kūmara moved around as cargo with the people of Polynesia, who were the agents for the dispersal of the crop outside of its native South America. Even though there are substantial references to the kūmara provenance from Hawaiiki, there exists an evident threshold where the crop's whakapapa simply ceases and the past of the crop is then shrouded in the realm of mythology.

Extensive whakapapa concerning the origin and introduction of kūmara attest the importance and long-standing association that Māori had established with this crop. Alongside the *whakapapa* are the traditions expressed as *kawa* (ritual) and *tikanga* (best practise) which align to

all facets of the kūmara life-cycle; from production, harvest, storage to cooking. Supporting these factors are the other forms of knowledge transmission which identify as Māori systems; expression through waiata, carving, pūrākau (legends) and occupation. These traditions and practises have all evolved over generations prior to European contact and form a core knowledge system which Māori still draw upon today. This attests to the relationship of the people to the crop and of the value of the crop to their sustainability.

It is interesting to note the predominance of some names in Māori mythology aligned to the origin of the kūmara, and the importance each tribe subscribes to this level of knowledge. Tribes of many regions including; Ngāti Porou, Te Aitanga-ā-Mahaki (both Te Tai Rāwhiti), Ngāti Awa of the Mataatua waka (Bay of Plenty) and, Taranaki Tūturu iwi of Te Tai Hauāuru are all examples given in this thesis where they claim the role of an ancestor Pourangahua who, in his own way, acquired the kūmara and utilised the fabulous bird Ruakapanga to return it to his homeland. This story in its various forms sits alongside the very mythical knowledge of Pani-Tinaku who acquired the original kūmara from the celestial realm and then brought it to the mortal world. Both stories and their versions indicate a temporal relationship back to a time when detail was forgiven and the myth captured sufficient information to satisfy the enquiring mind of the present generation. Mythology is well known to evolve in many cases from a true story which, over time, and often in isolation, evolves into a fantastic version, designed to appeal to the imagination of successive generations of a community and therefore be remembered forever.

South American traditional knowledge can contribute by pointing out some of the hazy circumstances under which the kūmara was introduced to the South Pacific. However, it would be presumptuous to claim that different sets of traditional knowledge, such as Māori and Quechua groups, can complement each other. They are independent systems with different cosmologies and ways to understand and interpret the world and should be treated as such. But with discernment, it might be possible to draw important elements regarding the relationships to kūmara, as well as the taewa.

Of particular relevance is the analogy between the storage methods devised respectively for their principal crops. The inhabitants of the Andean highlands had to develop very precise methods to preserve the potato in the icy mountainous weather, an environment where very few crops would grow. Storehouses were meticulously designed and built, each one of them adapted to the unique local conditions along the vast Andean highlands. Intimate knowledge of the environment was required to ensure that the provision of potatoes would endure until it was needed.

Māori had to develop equivalent methods, although thousands of years later, in order to establish kūmara in Aotearoa. It would most probably have taken the early settlers various failed attempts in order to develop successful methods to perpetuate kūmara. Since Māori were limited in alternatives, a deep understanding of the kūmara and their new environment was imperative to have any chance of success. Whakapapa hints at this learning process and emphasizes the importance that the mastery of kūmara entailed for the survival of Māori.

Regarding the Māori relationship to taewa, which at a superficial level might appear to be very similar to their connection with kūmara, it presents several crucial differences. Kūmara has a complete mythos that has been imbued into Polynesian culture for a significant stretch of their history. In essence the two crops have a true *tuakana:teina* relationship (senior:junior) in that kūmara is the senior of the two. By virtue of this cultural interpretation of the relationship, the kūmara is subject to a senior role and protected accordingly alongside having extra responsibilities.

Even though it is easy, for the sake of simplicity, to regard kūmara and potatoes as corresponding crops, it important to remember their highly-different attributes, storage requirements, and the conditions of the locations where they originally developed. The geographic features of their areas of origin and their growing characteristics had a remarkable influence on the divergent distribution of the crops throughout the Pacific for more than 500 years. Considering that kūmara was widely grown at the Perúvian lowlands while the potato thrived in the mountainous regions, it would have been easier for hypothetical Polynesian voyagers to acquire the kūmara in the coastal strip. However, even assuming that the Polynesians voyagers would have also acquired the potato, most likely it would not have been successfully established in the tropical islands to where they returned and the crop would not be present in Polynesia until introduced by Europeans several centuries later. As Māori did not travel directly to and from the South American Continent to New Zealand, the interlude where they were practising tropical horticulture would have limited any chance of perpetuating potato crops alongside kūmara. The success of both crops in the New Zealand environment is only due to independent entry routes and to the countries geographical location from latitudes ~35°S - 46°S which covers a broad climatic range, conducive to many crops by location.

So for the kūmara, and less so, the taewa, mythology captures elements of traditional knowledge and understanding relative to the crop and indicates a long-standing relationship between people and plants. Put into further context, interested people still look to these mythological interpretations to understand the crops better and to reinforce the relationship between people and plants as repositories of that knowledge.

The lack of alternatives of high-carbohydrate foods during centuries contributed to the high degree of esteem that Māori held for kūmara. The main source of carbohydrate for the original inhabitants of Aotearoa before the introduction of kūmara was the aruhe or fern root, which was not very palatable and was extremely fibrous. As such, the introduction of the kūmara was the most important event in the history of early Māori agriculture. The major change in general lifestyle that arrival of kūmara entailed is perpetuated in the whakapapa and in the personal names of some of the prominent people at the time of the introduction, such as Toi-kai-rākau (Toi-the wood eater) in reference to the people's previous reliance on aruhe and other fibrous foods from the bush.

"Western" social sciences often fail to grasp to what extent kūmara permeated and shaped Māori culture. The crop was not only religiously and culturally significant, but belonged to the same spiritual realm as the other natural elements and revered features such as mountains, rivers, and important trees. The fact that some traditions claim that kūmara was previously a man from Hawaiiki reflect the profound degree of intimacy, to the point of mystically transfiguring the crop into a tupuna or ancestor.

The taewa, although categorised as a tapu crop unlike most of the other food plants introduced by Europeans, did not have the significance of the kūmara which can only be developed over a prolonged period of association and over the occurrence of crucial events that bestow a sacred quality over an entity. However, it carried another type of significance: that of the survival and prosperity of the people during the early European contact. Taewa was by far the most important commodity to barter with Europeans in exchange for muskets for use including defending their people and rohe.

The introduction of taewa can be regarded as the other key event in the history of Māori agriculture (read: horticulture). The crop and the prosperous commercial environment at the time stimulated Māori agriculture to unprecedented levels and greatly contributed to alter the way Māori had been living for at least 500 years. It was mostly through the commercialization of taewa, among some other items, that Māori first entered the global economy, were exposed to Western culture and were introduced to the concept of currency. However, due to the irreversible decline of Māori agriculture in the later part of the 19th century, the profound effects of taewa on Māori society have generally remained in relative obscurity.

In the present day, taewa and kūmara are the most important crops associated with Māori traditional agriculture. Māori have maintained their kaitiakitanga responsibilities over these crops for centuries and, even though nowadays they are not indispensable for the physical survival of the

people, they constitute an essential part of Māori identity and will largely contribute to the endurance and continuity of Māori culture in a rapidly changing world.

What are the factors therefore that have influenced the role of these crops in Māori society? First and foremost has to be the conduit the crops provide in determining and continuing a relationship between cultures across the South Pacific and including the South American continent and cultures. As within any cultural process, the relationship is of primary importance and necessary for anybody to understand the importance of associated activities or knowledge. For Māori, and arguably other Pacific cultures, the contribution of the plant-people relationship for both kūmara and taewa to their cultural space through whakapapa associations, myths and legends, or mātauranga further cements their role in society.

Secondly, the western science fields including oceanography, ethnography, ethnobotany and horticulture generally which contribute to our knowledge on oceanic currents and other impacts on oceanic travel, plant relationships to location and people, and factors such as crop management and perpetuation. The largely accepted view drawn from a broad appraisal of science outcomes around the research question relative to crop movements across the Pacific does not dismiss the possibility of a direct relationship between Māori and the South American cultures, nor does it confirm with any surety any alternative hypothesis. So while the question is still not answered to the satisfaction of different interest groups, the various options as answers are quite apparent.

Thirdly, the perceived importance of these crops as witnessed at the time of European contact, both the Spanish and Portuguese in the wider Pacific region, and subsequently the British, French, and other peoples including their missionary cohorts in Aotearoa / New Zealand, consolidates the mātauranga on the pre-existing relationship. In support of this is the linguistic relationship between South Pacific neighbours and what can be learnt from the similarities of both language and any interpretation of the etymology of specific terms. Cultural knowledge within the Pacific relies heavily on language, especially as traditional knowledge was primarily transferred orally. Etymology, or the understanding of the origins of words, is a useful tool which Māori and other cultures employ to support their language use. Crucial to all Māori knowledge, including etymology, is the association of words and spiritual connotations, hence the use of honorific names for plants, foods and many other elements in Māori society.

Finally, the extended value of these crops to the endurance of Māori culture (physically, socially and spiritually), both as providers of sustenance and in their contribution to survival in times of conflict or other struggles remains significant. Both crops retain an importance to Māori society

which is beyond doubt. Both crops feature in the whakapapa of all tribes, their history and knowledge systems. And if you listen to informants of today's world, both crops have primary status in their horticultural association to Māori generally, and in their contribution to the *mana* or status of individuals and groups, and as such are so strongly inter-twined in Māori society they cannot be ignored.

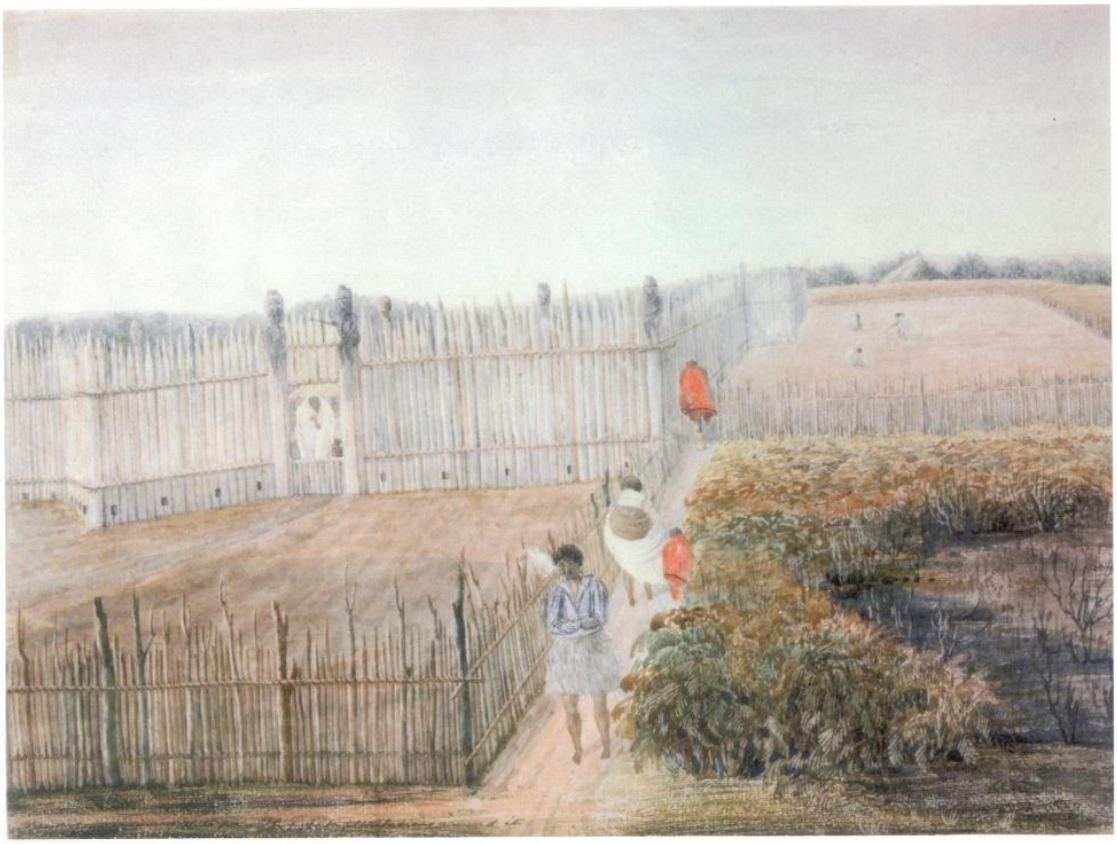


Figure 24: View of an ordinary New Zealand Pa with potato plantations arounbd it [1845]. Painting by Cyprian Bridge [1807-1885], Courtesy of Alexander Turnbull Library, Wellington, New Zealand (REF A-079 031)

8 Conclusion

Whatungarongaro he tangata, toitū he whenua hoki
Man may perish, but the land remains
Māori whakataukī

So how do all the elements of knowledge gathered into a thesis like this help us to answer the question on the relationship to Māori around the movement of key crops across the Pacific, figuratively and physically? The answer remains embodied within the traditional knowledge systems. All the traditional cultural stories of various informants from across the Pacific including Coastal South America and New Zealand indicate a very long-standing and indispensable relationship between people and key plants. These knowledge systems do not classically identify dates and periods for which certain actions or movements happen, rather they align them to the existence of key people within their history (or whakapapa), and often these key people represent various epochs in the development of their culture. In even more detail, the relationship of the plants to people can be represented metaphorically with the traditional tuakana:teina concept between the two plants, embodied in the level of spiritual association aligned to each crop

Alongside ancient knowledge, including the mātauranga held by Māori, there is now a layer of academic knowledge, recently developed which either supports the concept of plant-people relationships and movement or not. The examples of knowledge aligned to kūmara and taewa all strengthen the relationship to tribes and informants to the plant and all acknowledge that relationship as central to the mechanism of movement from different locations, eventually to Aotearoa / New Zealand. As within any cultural process, the relationship is of primary importance and necessary for anybody to understand the importance of associated activities or knowledge. In support of this is the linguistic relationship between South Pacific neighbours and what can be learnt from the similarities of both language and any interpretation of the etymology of specific terms.

The factors introduced highlight the central discussion around the movement of crops with people. They contain variously subjective and objective elements of knowledge and serve to consolidate the relationship of people to plants – Māori to the crops of importance. These factors include; the conduit the crops provided in determining and continuing a relationship between cultures across the South Pacific and including the South American continent and cultures; the contribution of scientific knowledge from western science including oceanography, ethnography,

ethnobotany and horticulture generally; and the perceived importance of these crops as witnessed at the time of European contact in the Pacific and Aotearoa / New Zealand, especially the Spanish and Portuguese in the wider Pacific region, and later the British, French, and others including their missionary cohorts in Aotearoa / New Zealand. The extended value of these crops to the endurance of Māori culture (physically, socially and spiritually) is clearly evident as both crops retain an importance to Māori society which is beyond doubt.

The largely accepted view drawn from a broad appraisal of mātauranga Māori and the science outcomes around the research question relative to crop movements across the Pacific does not dismiss the possibility of a direct relationship between Māori and the South American cultures, nor does it confirm with any surety any alternative hypothesis. So while the question is still not completely answered to the satisfaction of all the different interest groups, the hypothetical answers discussed here provide a strong basis for future research which can further draw upon mātauranga and science knowledge systems.

Glossary

The following definitions are provided from the Kaumātua roopu, Tahuri Whenua, selecting the appropriate meaning as intended:

ariki: paramount chief, high chief, chieftain, lord, leader, aristocrat, first-born in a high ranking family

atua: ancestor with continuing influence, god, demon, supernatural being, deity, ghost, object of superstitious regard, strange being

heke: to migrate, move

hui: gathering, meeting, assembly, seminar, conference

kaitiaki: a guardian (physical and/or spiritual)

kaumatua: elder or senior (kaumātua = plural), can be either gender but generally male

kuia: elder or senior, specifically female

kōrero: dialogue, speak

marae (atea): ceremonial ground in from of the main houses, courtyard

mātauranga: knowledge, wisdom, understanding, skill - sometimes used in the plural

pātaka: storehouse raised upon posts, pantry, larder

Pākehā: English, foreign, European

pākeke: adults

pūrākau: myth, ancient legend, story

rangatira: chief (male or female), chieftain, chieftainess, master, mistress, boss, supervisor, employer, landlord, owner, proprietor

roopu: group (collective)

rua: storage pit, two

taewa: potato, (*Solanum tuberosum*)

taonga: treasure, something that is treasured

tipu: seedling, growth, development, shoot, bud, plant

tohunga: skilled person, chosen expert, priest, healer

tuakana:teina: a metaphor for the senior:junior sibling relationship

tupuna: ancestor, grandparent (tūpuna = plural)

waka: canoe.

waiata: song, chant, psalm

whakapapa: genealogy, genealogical table, lineage, descent

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Personal Communications

Mrs Atareiria Heihei, Māori Heritage Advisor at New Zealand Historic Places Trust, Northland. February 10, 2015.

Mr Hemi Hautu Cunningham, kaumatua, Ngāti Hauiti ki Rangitīkei and Tahuri Whenua Kaumātua roopu July 13, 2014. (*since deceased*).

Mr Mesulame Tora, horticulturist and student, Nadi, Fiji. January 20, 2014.

Dr Nick Roskruge, Chairman Tahuri Whenua Collective, Ngāti Rāhiri , Ngati Tama-Ariki. Various dates.

Mr Pita Richardson, kaumatua & Chairman, Parewahawaha Marae Committee. Chair of kaumātua roopu, Tahuri Whenua. June 29, 2014.

Mr Tihema Haare, kaumatua o Ngāi Tūhoe. September 23, 2014.

Mātauranga Mentors

Most of the following mātauranga mentors are not directly referenced in the thesis. However, over the past two years they have provided the mātauranga that made this work possible. Without their contribution and support, this thesis would have been worthless.

Mr Akerama Taiaki, kaumātua o Ngāti Rāhiri ki Whakarongotai, Paraparaumu.

Mrs Arohānui Lawrence, pākeke o Ngāti Kahungunu, Waipatu.

Mrs Christina Kawau, pākeke o Te Whānau a Ruataupare, Whanganui.

Mr Hamiora Hautapu, pākeke o Ngāti Porou.

Mr Hemi Cunningham, kaumātua, Ngāti Hauiti ki Rangitīkei (*since deceased*).

Mr James Edward Doherty, kaumātua o Ngāi Tūhoe, Ruatahuna.

Mrs Hine Kane, pākeke o Ngāi Tūhoe, Te Aitanga-a-Hauiti, Tāneatua.

Mr Kenneth Trinder, Chairman Kairau Marae, Te Ātiawa.

Mrs Maikara Tapuke, pākeke o Ngāti Rāhiri , Waitara.

Mr Neville Lomax, Chairman Ngāti Hauiti (Rata marae).

Dr Nick Roskruge, Chairman Tahuri Whenua, Ngāti Rāhiri.

Mrs Queenie Gripp, kuia o Ngā Rauru Kiitahi, Wai-o-Turi Marae, Pātea.

Mrs Piki Winitana, kuia o Ngāti Kahungunu, Waimarama.

Mr Pita Richardson, kaumatua & Chairman, Parewahawaha Marae Committee, Ōhakea.

Mr Raymond Blackmore, kaumatua Parewahawaha Marae, Ngāti Raukawa (*since deceased*).

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Mr Tawhai McClutchie, kaumatua, Uepohatu, Ngāti Porou, Ruatōrea.

Mr Warner Tapuke, pākeke o Te Ātiawa, Waitara.

Mrs Wharemawhai Timutimu, kuia o Ngāti Rāhiri .

Mrs Whero-o-te-rangi Bailey, kuia o Taranaki Tūturu me Te Ātiawa**,** Tikorangi.

Appendices

Appendix 1: Low Risk Notification Approval by Massey University.

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA

6 June 2014

Rodrigo de la Cerda
3/56 Rangitikei Street
PALMERSTON NORTH 4410

Dear Rodrigo

Re: The Migration of Potato (*Solanum tuberosum* L.) into the South Pacific

Thank you for your Low Risk Notification which was received on 29 May 2014.

Your project has been recorded on the Low Risk Database which is reported in the Annual Report of the Massey University Human Ethics Committees.

You are reminded that staff researchers and supervisors are fully responsible for ensuring that the information in the low risk notification has met the requirements and guidelines for submission of a low risk notification.

The low risk notification for this project is valid for a maximum of three years.

Please notify me if situations subsequently occur which cause you to reconsider your initial ethical analysis that it is safe to proceed without approval by one of the University's Human Ethics Committees.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

> *"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.*
>
> *If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, e-mail humanethics@massey.ac.nz".*

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to provide a full application to one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

J. O'Neill

John G O'Neill (Professor)
Chair, Human Ethics Chairs' Committee and Director (Research Ethics)

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Appendix 2: Kūmara Specimen collected by Banks and Solander in 1769. (Banks collection)