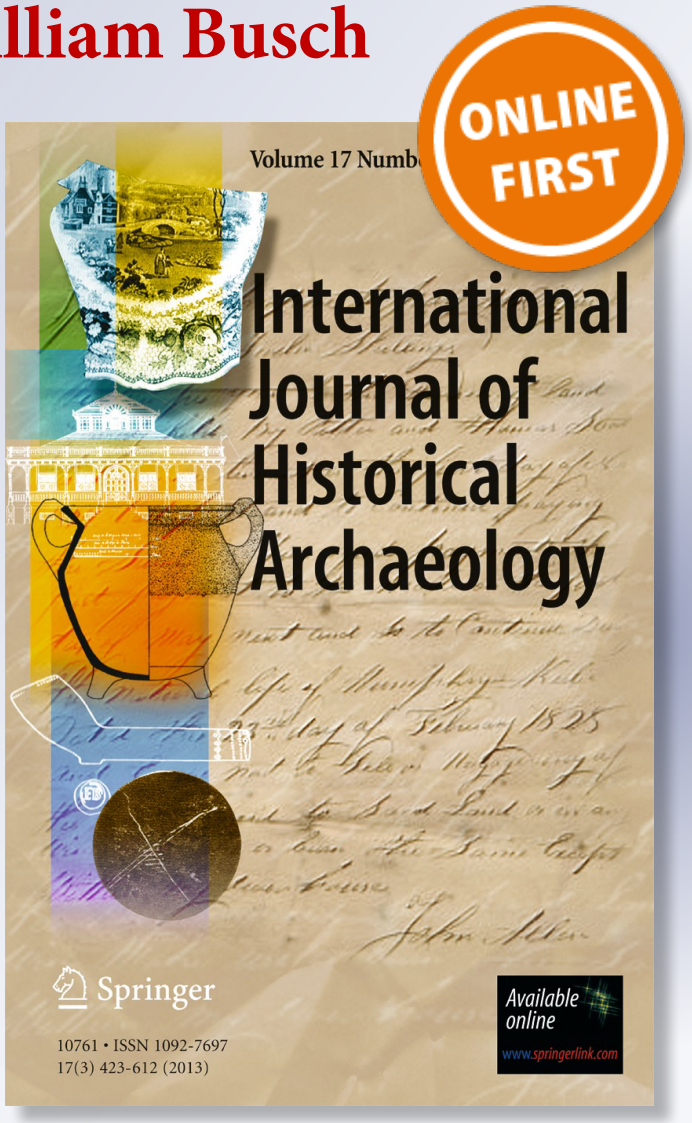
Understanding Cultural History Using Ground-Penetrating Radar Mapping of Unmarked Graves in the Mapoon Mission Cemetery, Western Cape York, Queensland, Australia

With contributions by Alma Day, Harriet Flinders, Florence Luff, Susie Madua, Zoe De Jersey, Stan De Jersey, Roy Savo, and William Busch

International Journal of Historical Archaeology

ISSN 1092-7697

Int J Histor Archaeol
DOI 10.1007/s10761-013-0242-1



Springer

Your article is protected by copyright and all rights are held exclusively by Springer Science +Business Media New York. This e-offprint is for personal use only and shall not be self-archived in electronic repositories. If you wish to self-archive your article, please use the accepted manuscript version for posting on your own website. You may further deposit the accepted manuscript version in any repository, provided it is only made publicly available 12 months after official publication or later and provided acknowledgement is given to the original source of publication and a link is inserted to the published article on Springer's website. The link must be accompanied by the following text: "The final publication is available at link.springer.com".

Author's personal copy

Int J Histor Archaeol
DOI 10.1007/s10761-013-0242-1

Understanding Cultural History Using Ground-Penetrating Radar Mapping of Unmarked Graves in the Mapoon Mission Cemetery, Western Cape York, Queensland, Australia

Mary-Jean Sutton · Lawrence B. Conyers · With contributions by Alma Day, Harriet Flinders, Florence Luff, Susie Madua, Zoe De Jersey, Stan De Jersey, Roy Savo, and William Busch

© Springer Science+Business Media New York 2013

Abstract The Mapoon Mission Cemetery in Cape York, Queensland contains unmarked pre-contact burials with potential national heritage values, despite a lack of formal recognition and protection through State and National heritage listings. Ground-penetrating radar (GPR) showed great potential as a non-intrusive technique to identify over 120 potential unmarked graves and understand mortuary practices at the Cemetery. When integrated with written and oral histories, such information provided new insights into the cultural history of this region, particularly the continuity of Aboriginal occupation and changes in mortuary practices since the establishment of the Mapoon Mission.

Keywords Missions · Mapoon · Ground-penetrating radar · Unmarked graves · Burial detection

With contributions by Alma Day, Harriet Flinders, Florence Luff, Susie Madua, Zoe De Jersey, Stan De Jersey, Roy Savo, and William Busch
Elders, Mapoon, Queensland Australia
email: virtusheritage@gmail.com

M.-J. Sutton (✉)
School of Social Science, University of Queensland, Brisbane, Queensland, Australia
e-mail: virtusheritage@gmail.com

L. B. Conyers
Department of Anthropology, University of Denver, Denver, CO, USA
e-mail: lconyers@du.edu

Published online: 06 August 2013

Author's personal copy

Introduction

Aboriginal people in Cape York Peninsula have strong emotional attachment to cemeteries and the burial places of their ancestors. Often many such places are unmarked and neglected, as is the case in Mapoon and many other places across Australia (Byrne 1998; Howe-Pienning and Byrne 1998; NPWS 2003; Nugent 1998). Unmarked graves and burial places are sites that are difficult to identify on the ground surface, either because they were never marked, or because the grave markers have subsequently decayed, or been removed or destroyed. The neglect of burial sites is a cause of emotional distress to Elders and families within Mapoon as these sites are the resting places of their ancestors and therefore, are of high cultural sensitivity. Mapoon people favored non-invasive techniques such as ground-penetrating radar (GPR) coupled with ethnohistorical information (particularly the knowledge of Elders and historical documents) to establish the boundary and location of unmarked graves rather than destructive methods (such as archaeological excavation). Unmarked graves have been studied around the world using a number of non-invasive geophysical techniques (Bevan 1991; Buck 2003; Conyers 2006; Davenport 2001; Killam 1990; Nobes 1999; Ruffell and McKinley 2008).

Ground-penetrating radar is a geophysical method that reflects waves of radar energy from buried materials in the ground, which are then recorded in three dimensions and mapped spatially over a study area. Using this method many aspects of burials can be studied including depth of burial, clusters of burials, and even physical aspects of the extant remains. While other studies of mission-time cemeteries in Australia have adopted an approach dependent on historical documents, ethnohistory and/or microtopography (Lomax and Long 1991; Long et al. 2000), in their research, without details provided by GPR there is no ability to actually study the buried remains and other associated features in the ground. Despite the potentially large number of unmarked Aboriginal burial sites across Australia, the significance of these places to Aboriginal people and the potential of non-invasive geophysical methods (such as GPR) as culturally appropriate methods to identify and delineate unmarked Aboriginal graves, there is very little published archaeological work that reports on the use of geophysical techniques to investigate these places. The ability to reestablish the location of otherwise forgotten graves, delineate the boundaries of these important places, and even study individual burials that have been lost to time is one of the benefits of GPR as a non-invasive method. This article is an account of the results of the use of one geophysical technique, integrated with other historical data and oral histories to investigate mission and post-contact unmarked graves in the Mapoon Mission Cemetery, one of the oldest known burial places in Cape York, Queensland (which consists primarily of unmarked graves and has no delineated boundary). Here we summarize methods of data acquisition, processing and results of the GPR survey, and discuss the importance of how GPR imaging provides new evidence about the location and nature of unmarked burial places, information that was unknown to contemporary Mapoon people.

"Mapoon people" is a term referred to people who currently live in the remote township of Mapoon, western Cape York, Queensland. Mapoon people mostly identify as Indigenous people and include the language groups of Tjungundji (the traditional owners of the Mapoon peninsula), Mpakwithi, Taepithiggi, Thaynakwith, Warrangku and Yupungathi groups. The former Mapoon Mission was a large removal

Author's personal copy

center for Indigenous people across Queensland. Present generations of Mapoon people, include many descendants from language groups across Queensland, (including Normanton, Coen and Cloncurry) from non-Indigenous Australians and also from the Solomon Islands, Tonga, Samoa, China, Malaysia and other countries in the Pacific, who were the former inhabitants of the Mapoon Mission. We argue that information provided by GPR coupled with historical records and ethnohistory can assist with fulfilling the aspirations of Mapoon Elders to protect this important cultural heritage site through heritage preservation and in the education of broader public about the cultural and archaeological value of this cemetery.

Geophysical Investigations and Unmarked Aboriginal Burial Places in Australia

Since 1977, archaeologists have applied geophysical methods sporadically as non-invasive techniques to identify Aboriginal unmarked graves in Australia. Graham Connah and John Stanley (NPWS 2003, pp. 8–10; Stanley and Connah 1977, pp. 37–50) first applied geophysical methods in 1977, to identify Aboriginal unmarked graves at a cemetery at Forster, using magnetic surveys. Their survey successfully identified several areas of unmarked graves (NPWS 2003, pp. 8–10). Earth resistance, a technique coupled with historical research successfully identified Aboriginal unmarked graves and cemetery boundaries at the Wybalenna Aboriginal Burial Ground on Flinders Island (Ranson and Egloff 1988) and at an Aboriginal cemetery at the former site of Western Port Aboriginal Protectorate Station, Dandenong, Victoria (Rhodes 1998). The Wybalenna survey identified numerous Aboriginal graves and the cemetery boundary (Ranson and Egloff 1988). In comparison, electrical and earth resistance study undertaken in Dandenong was less successful and only identified several features, considered "mostly inconclusive" (Brown et al. 2004, pp. 148–149; Rhodes 1998).

Ground-penetrating radar (GPR) is a geophysical method that has been applied in the identification of Aboriginal unmarked graves in Australia with varying success. The method was first used as a technique to identify Australian Aboriginal unmarked graves during the early 1990s by Randolph et al. (1994, p. 411) to investigate Aboriginal prisoners' graves at Rottnest Island in Western Australia. They identified a possible cemetery and argued that some areas potentially contained Aboriginal burials. Since that study, there have been very few published results of using GPR to identify Aboriginal unmarked graves, specifically within former mission or government settlements in Australia. Two exceptions include a GPR survey at the former Taroom Aboriginal Reserve, Central Queensland, and at the site of the former Ebenezer Mission Cemetery, Victoria. At Taroom, the GPR survey included information provided in oral testimony by Aboriginal residents of the Reserve as part of a research project. Oral testimony and Death Registers indicated there were two cemeteries at Taroom Aboriginal Reserve with the remains of approximately "268 deaths … between 1911 and 1927" (L'Oste Brown et al. 1995, p. 48). The GPR survey at Taroom indicated that in addition there were at least two areas (also believed to be cemeteries identified through oral history testimony) that contained "concentrations of human burials" and a total of 46 graves were identified based on the GPR data (L'Oste-Brown et al. 1995, pp. 48–50; Yelf and Burnett 1995).

Author's personal copy

Archaeologists working at Ebenezer Mission Cemetery, Victoria in 1997 also applied GPR in combination with other techniques (historical research, micro-topographic survey, and ground magnetic survey) to identify unmarked graves and the cemetery boundary (Brown et al. 2004, p.154; McDougall et al. 1997). Ebenezer Mission was established in late 1858 on the Wimmera River in north-west Victoria by the Rev. Spieseke and Rev. Hagenauer (Brown et al. 2004, p. 149). Significant for our research, the Ebenezer Mission was controlled by Moravian missionary, Rev. Hagenauer who was involved in the early establishment of the Mapoon Mission (CPI 2009).

The GPR survey of Ebenezer Mission Cemetery was conducted by the Department of Earth Sciences, Monash University, using low frequency, low resolution antennas (200 MHz). The results showed some areas that were known to have high probability for containing graves, described only as anomalies in data (Brown et al. 2004, p. 154; McDougall et al. 1997). The use of GPR was not successful during the Ebenezer Mission Cemetery survey. Brown et al. (2004, p. 154) attributed their lack of success to problems with the methodology of the survey including the 1 m transects that were too wide "to identify small linear features" as well as "a lack of spatial control prevented the accurate relocation of any features identified."

GPR has been utilized elsewhere in the world for the investigation of Indigenous unmarked graves. In the United States of America, American Indian graves have been studied including those of the Cherokee along the "Trail of Tears" in Oklahoma (Di Naso et al. 2010, p. 50; Suhr 2005, p. A.14; Ruckman 2005, p. A.1) and pre-contact graves of the Maori in New Zealand (Nobes 1999, pp. 57–367). In these case studies, application of GPR has lead to greater success than some of the Australian case studies, perhaps due to the application of more narrow transects and greater spatial control.

History of Mapoon: Background

The Mapoon Mission was a former mission village within the region of western Cape York. This Mission was the first established by the Moravian church by Reverends Hey and Ward in 1891 (Fig. 1) (CPI 2009). It was the "mother mission" and the foundation for a network of other Christian missions (known as the "daughter missions"). Reverend Brown, who trained at Mapoon, went on to establish the 20 Mile Mission, south of Mapoon at Weipa in 1898 (CPI 2009; Wharton 2000). Two other missions with close connections to Mapoon were later established by the Presbyterian Church: Aurukun Mission in 1904 and Mornington Island Mission in 1914 (see Fig. 1). With the retirement of Reverends Brown and Hey in 1919, the Missions were formally taken over by the Presbyterian Church (CPI 2009; Wharton 2000, pp. 8–9).

The Mapoon Mission closed in 1963 when the Queensland State Government's Department of Native Affairs (DNA) took over, a result of the interests of Comalco (a mining corporation) in mining bauxite through the region (IDA et al. 1975–76). The closure resulted in the forced relocation and removal of many Indigenous families by police and DNA officials to the settlement of Hidden Valley (often referred to as "New Mapoon"), as well as to Weipa and the burning of some Mapoon residents' homes (CPI

Author's personal copy

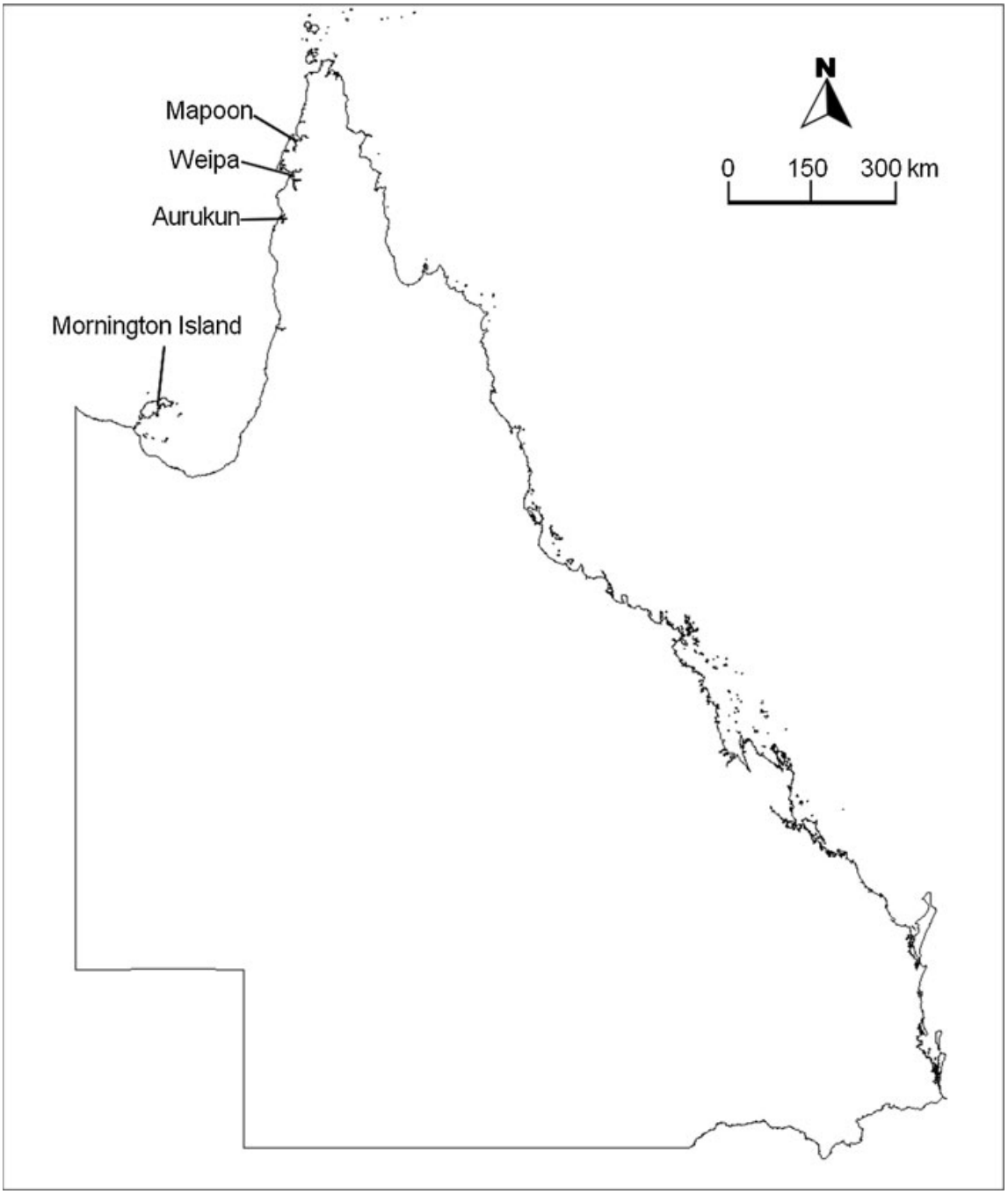


Fig. 1 Approximate locations of former Presbyterian missions in Gulf of Carpentaria and western Cape York, Queensland (Based on University of Melbourne online maps, www.lib.umimelb.edu.au/collections/maps/digital/outline-maps/index.html)

2009; Wharton 2000, pp. 8–9). The burning of parts of the Mapoon Mission, particularly the former mission village, camps and houses of Indigenous occupants, has left a strong visual image in the minds of contemporary Mapoon residents, especially amongst those who were directly associated with the former mission village.

"Mapoon" is the name still used by Mapoon people to describe the former mission village and settlement located near Cullen Point, (hereafter referred to as "Mapoon Mission"). Mapoon is also the name used for the contemporary Indigenous settlement at Red Beach, south of Mapoon (hereafter referred to as "Mapoon"). Both the Mapoon Mission and Mapoon are part of the Mapoon Deed of Grant in Trust (DOGIT) lands, governed by trustees including the Mapoon Aboriginal Shire Council.

Author's personal copy

Connections between the former occupants of the Mapoon Mission and other contemporaneous communities have continued throughout Mapoon's history (for example, through the Western Cape Communities Coexistence Agreement and during the Centenary celebrations held at Mapoon in 1991 to commemorate the arrival of the Moravian missionaries). The commencement of bauxite mining in the 1960s jointly impacted the former mission villages of Aurukun, Mapoon and Weipa and continues to impact communities associated with these places today (IDA et al. 1975–76; M. Sutton pers. obs. 2010–11). The Mapoon Mission has strong cultural heritage values for contemporary Indigenous families of Mapoon, who—contrary to the wishes of the Queensland State Government—resettled near the site during the 1970s and have remained there since.

Mapoon Mission is a cultural, social and political landscape which encapsulates the attachment of families (both Indigenous and non-Indigenous) who maintain connections with other former missions and government settlements in western Cape York. Today the remains of the Mapoon Mission include footings, building foundations, fence posts, house stumps and other partially buried artifactual remains of the mission compound, as well as former houses and camps of Aboriginal families. Remnant mission-planted coconut, beach almond, mango, and frangipani trees also remain. The area includes the graves of both Reverends Ward and Allan (within the former mission compound near where the old mission house once stood), the remains of the original Mapoon Mission Cemetery, which contains a few unfenced grave markers, and other associated cemeteries and numerous unmarked burial places. More recent additions to the site indicating contemporary connections with the broader non-Indigenous community is a monument erected in 1991 (plaque made in 1988) which commemorates the establishment of the Mapoon Mission by the Weipa Bicentennial Community Committee and the Mapoon Community Council. Other archaeological sites are located nearby and many cultural sites, including story places, exist within this landscape, interconnected before and after the mission time.

Mapoon Mission is one of the Australia's oldest mission sites and a cultural heritage landscape of recognized national significance to Indigenous and non-Indigenous Australians "worthy of national heritage conservation and protection" (Mulvaney 1989, Afterword). The Mapoon Mission Cemetery is the oldest Aboriginal cemetery in the region, with the greatest potential to contain unmarked pre-contact burials. Despite such potential heritage value, Mapoon and its cemeteries are not listed on the National Heritage List or on Queensland Heritage databases, and as result are not afforded protection under a local, regional or State cultural heritage conservation agreements. The Mapoon DOGIT lands, which contain these important cultural heritage sites, may be under threat by encroaching mining interests from both Rio Tinto Alcan, a company currently mining approximately 90 km south at Andoom, and Cape Alumina.

Mapoon Mission Cemetery

The Mapoon Mission Cemetery, established ca. 1891 during the early days of the Mapoon Mission, is potentially the earliest known Moravian Aboriginal mission cemetery in Queensland. Since Mapoon Mission was one of the Queensland State's

Author's personal copy

largest removal centers for Aboriginal children during the first 30 years of its establishment, it is likely that the Mapoon Mission Cemetery contains the remains of Aboriginal people from many different language groups across Queensland. Located predominantly within a sand dune, approximately 100 m from the ocean, the cemetery today is overgrown with acacia and native vegetation (Fig. 2). It has no identifiable boundary or fence and is not actively managed or protected. The site is accessible via a four wheel drive vehicle track, which runs parallel to the beach leading up to Cullen Point. One of Mapoon's local residents' homes is situated north of the cemetery and may actually be located directly on some graves. Reports of spirits in the cemetery or within the home have been made by the some Mapoon people (Mrs. Alma Day, December 14, 2010, interview, Field Notes). The only existing headstone in the cemetery with the remains of a formal burial plot, belongs to Charles De Bosch, who died on February 19, 1918 (Fig. 3). Charles De Bosch's grandson, William Busch, lives in Mapoon today and is the Chairperson of the Mapoon Interim Land and Sea Advisory Committee.

Other physical remains include two metal and timber posts, which are thought to be the remains of head posts for burials. Other remains include coral rock and scattering of small white shells and stones across the cemetery site are likely to have once delineated burial locations, as these materials were commonly used to mark graves in historic and pre-mission times (Mrs. Susie Madua, Mrs. Harriet Flinders, Mrs. Alma Day, Mrs. Zoe De Jersey, December 16–17, 2010, interviews, Audio Recordings #VN680008 and #VN680010; see also NPWS 2003, pp. 1–5). Wild horses frequent the cemetery today, disturbing actively eroding sand dunes and moving many of the coral pieces and shells across the ground surface.

In fieldwork carried out over 2010–11, the cultural heritage values of the Mapoon Mission and associated cemetery area were identified by Elders. Mapoon Elders and their children have an emotional connection to this as well as other cemeteries and areas of unmarked graves in the region. Mapoon people greet the "old people" when driving or walking past the Mapoon Mission Cemetery, a custom with historic roots (Mrs. Susie Madua, October 19, 2010, interview; Audio Recording #VN680003, Mrs. Zoe De Jersey, September 6, 2011, interview, Field Notes). The care of these cemeteries and the identification of unmarked graves, looking "after our old people" is a strong concern, which has been vocalized by Mapoon community members for

Fig. 2 Overview of the Mapoon Mission Cemetery after partial clearing, December 2010

Author's personal copy

Fig. 3 Mr. William Busch holding the headstone of his grandfather, Charles De Bosch at the Mapoon Mission Cemetery (July 2010)

some time (e.g., Moran 2006). Prior to the GPR survey reported herein, the projected boundary of the cemetery based on oral history and the living memory of Mapoon Elders, was thought to be approximately 30×40 m.

Mortuary Practices: Oral History and Historical Records

Preceding this study, there was no formal oral history investigation with Mapoon Elders regarding mortuary practices or unmarked burial places within the Mapoon DOGIT lands. Oral history interviews were carried out to document the cultural heritage values of the Mapoon Mission Cemetery and other Aboriginal unmarked graves as part of a broader, doctoral research project on the Mapoon Mission. During these interviews, Mapoon Elders requested GPR investigation of the Mapoon Mission Cemetery.

The sawmill was operational at the Mapoon Mission from late 1920s to 1930s and timber was used to make caskets during this time. Elders believe that Mr. Alan Parry (Mapoon Elder Mrs. Harriet Flinders' father and a Tjungundji man) made the first wooden caskets, from a nonda plum, which has a yellow fruit, called "gurruku fruit" (Mrs. Harriet Flinders and Mrs. Alma Day interview, December 17, 2010, Audio Recording #VN680010). In 1950, the sawmill at the Mapoon Mission still remained in operation (Department of Native Affairs Office, File 6G/17, Queensland State Archives). However, not everyone at the mission who died was buried in coffins. For example, Peter Peter a man who died around this time from a crocodile attack, was carried to the cemetery on a canvas stretcher, laid out covered in blankets. He was later buried wrapped in a blanket tied with rope and string (Mrs. Alma Day interview, December 17, 2010, Audio Recording #VN680010). Also during the 1950s there was a similar burial at an outstation cemetery located south of Cullen Point, where a

Author's personal copy

woman called Amy who had died, was buried in wrapped and sewn blankets (Mrs. Zoe De Jersey interview, October 19, 2010, Audio Recording# VN680003). Blankets were also used to wrap deceased persons in the early days of circa 1930s and prior to that (ca. 1925) tea tree bark was used to wrap up deceased persons (Mrs. Susie Madua interview, October 19, 2010, Audio Recording# VN680003).

Coral pieces and shell were often used to decorate burial places, and evidence of this practice is visible at the cemetery today (Fig. 4). During the mission time the "old people" would collect shells from the beach in handmade baskets and later use them to line graves (Mrs. Harriet Flinders interview, December 17, 2010, Audio Recording #VN680010). The coral and shell originally may have shown the general location of individual plots within the cemetery, indicating burial locations and a pathway through the centre of the cemetery (Mrs. Harriet Flinders and Mrs. Florence Luff interview, December 17, 2010, Audio Recording #VN680010; Mrs. Zoe De Jersey and Mrs. Susie Madua interview, December 16, 2010, Audio Recording #VN680008).

Mapoon Elders do not remember confidently if a fence bordered the Mapoon Mission Cemetery, although it is possible one constructed of barbed wire may have existed in the 1930s (Mrs. Susie Madua interview, September 6, 2011, Field Notes; Mrs. Alma Day and Mrs. Harriet Flinders interview, September 7, 2011, Field Notes). However, it is possible graves were oriented towards the west and in line with the abovementioned pathway (Mrs. Susie Madua, interview, September 6, 2011, Field Notes; Mrs. Alma Day and Mrs. Harriet Flinders interview, September 7, 2011, Field Notes). Elders remember that the cemetery went out of use sometime in the mid-1940s, because it was full. A second cemetery was then established closer to Red Beach, in an area often referred to as Musgrave "outstation." This outstation was established about 1907.

Fig. 4 Detail of concentrations of coral fragments, shell and stone within the Mapoon Mission Cemetery

Author's personal copy

Prior to Mapoon Mission's establishment, there was little information about mortuary practices of the local Tjungundji people. Some Elders were told that it was customary in the past for family members to carry the bones of their deceased wrapped in a particular tree bark for "three moons," not talking to anyone during this time (Mrs. Harriet Flinders, Mrs. Alma Day and Mrs. Florence Luff interview, December 17, 2010, Audio Recording #VN680010). This description is confirmed by early mortuary practices documented at Mapoon Mission by missionaries who observed: "[T]he bone is wrapped up in a piece of bark, and carried about for three months by the nearest male relative. During this time he never speaks. Indeed, he is supposed to have lost his power of speech, and only the old men have the power of restoring it (Ward 1908, pp. 121–122). Mortuary practices were also influenced by age, gender and whether the deceased had surviving kin. Walter E. Roth (the former Chief Protector of Aboriginals in Northern Queensland) documented mortuary practices in the Pennefather River region in about 1898 as being:

> fairly typical of the procedures usually followed in the upper portions of Cape York Peninsula…Old men and women, as well as young women, are buried within a day or two after decease in the neighbourhood of the camping ground, and the camp shifted. Children are usually put out of sight directly after death, though sometimes they may be carried about, wrapped up in bark, until they get dried, before being stowed away rather than buried among the roots of a tree, in a cave, etc. (Roth 1907, p. 368).

During oral history interviews, Elders recollected similar stories which had been handed down to them by their Elders relating to burial practices in caves (Mrs. Alma Day and Mrs. Harriet Flinders interview, December 17, 2010, Audio Recording #VN680010). Documentary material indicates that younger men who died at the Mapoon Mission and other sites throughout Cape York were:

> put into a sheet of bark, bound round and round, and slung to a pole supported by two forks…the body is finally burnt …. Where the corpse is burnt, the nearest tree is marked with a sloping vertical cut, and the camp shifted: it is believed that when once the body is cremated, there is no more chance of the Cho-I coming back in the flesh, but that it hovers somewhere about the bush.... The fibula bones are wrapped in match-box bean or tea-tree bark, tied round and round with fibro-twine (raddeled or not) and further decorated with Emu, Blue Mountain Paroquet, Cockatoo or Native-Companion feathers (Pl. lxix) : such a pau-to is slung either from around the forehead so as to hang over the nape of the neck, or else over the fore-arm (Roth 1907, pp. 368–370).

Roth (1907, p. 370) noted that partial cremation was the next step in the mortuary practices for the region. His observations indicate that around 1898, in the vicinity of the Mapoon Mission, the remains of old men and both old and young women were buried, while the remains of young men were partially cremated and the bodies of deceased children were wrapped and kept in caves and other places. Thus in the pre-mission era, and in the area that became the Mapoon Mission, burials occurred differentially based on age and gender.

Author's personal copy

In the early twentieth century, Ursula McConnel (1936/37, p. 346, pp. 350–357) carried out early ethnography in western Cape York, including lands within the Mapoon DOGIT, and provided published descriptions of mortuary practices. McConnel focused intensively on the Wik-mungkan language group but also conducted fieldwork in the lower Batavia, Embley, Archer, Kendall-Holroyd and Edward Rivers (north side only) on the Gulf of Carpentaria. McConnel (1936/37, p. 349) discussed different mortuary practices including placing dead bodies in "bark bundles" in caves and interment of the dead by burial, mummification and cremation. She (McConnel 1936/37, p. 349) argued that burial was used "as a means of removing the flesh from the bones, which were afterwards dug up and carried about in a bark bundle by relatives." McConnel (1936/37, p. 349) attributed these practices due to the decrease in the numbers of "mourners" in the mission times to perform elaborate rituals associated with mummification and cremation and also as burial was "encouraged by mission influence." McConnel (1936/1937, p. 349) concluded that burial and exhumation of bones sometimes substituted for cremation and mummification because the former were "easier methods for preserving the remains of the deceased."

Prior to missionary influence and pre-contact with Europeans, McConnel (1936/1937, p. 340) maintained that within the "tribes of the lower Archer, Batavia, Embley, Kendall-Holroyd and Edward Rivers," mummification was the "orthodox procedure." Her description of traditional mortuary practices (McConnel 1936/1937, p. 350) share similarities with those of Roth, specifically with respect to the removal of internal organs from the body and placing the corpse on "a platform supported on four forked sticks…in some tribes it is tied to a pole which is supported on two forked sticks." Also similarly to Roth, McConnel documented that bodies were then dried using fire and, "wrapped" in "sheets of tea-tree bark," interred for over "two or three years, or sometimes even longer" during an elaborate mourning process involving family members (McConnel 1936/1937, p. 350). Based on McConnel's (1936/37, p. 355) observation of a cremation ceremony on the Archer River in 1927, after an appropriate mourning period (up to two years or more), the body was then finally disposed of by cremation.

The mission experience in Aurukun, where much of McConnel's fieldwork observations were concentrated, was different to that at the Mapoon Mission, particularly in relation to the individual personalities and the degree to which Indigenous cultural practices could be maintained without persecution, coercion and or/discouragement by the Church or State. While it is not definitively discussed in the early historical records of the Mapoon Mission, it appears that Indigenous people were gradually influenced by missionaries to bury their dead using Christian methods. As observed by Reverend Hey (Hey 1901, p. 10) burials were the predominant, if not the only method of mortuary practice from this time as a result of his or other missionaries' coercion:

> It was formerly the custom of our natives to keep their dead friends and relatives for a considerable time, the corpses being hung and dried. During this … process the nearest relatives had to remain beside the corpse day and night, while the rest of the camp performed various ceremonies, which consisted chiefly of dancing … Knowing the bad effects such proceedings produced on all, or more especially on the young, we did our best to discontinue such

Author's personal copy

> unhealthy and immoral practices but at first with little effect. We then tried another method, namely to give the natives something better instead. We rigged out our school children with a number of flags of all descriptions, who march in procession to the newly laid out burial ground, where a number of hymns are sung, and a short Gospel service is conducted. This small act of sympathy on our part has won the hearts of not a few, and the blacks [sic] bring now their dead from many miles to receive the same honour as their friends of Mapoon and with the burial of the corpse all further ceremonies have ceased. This instance has taught us that it is not wise to pull down the idols of others without giving them something better instead.

This excerpt indicates that Christian burial was accepted by some, but may have been rejected by other Indigenous people of Mapoon Mission in the earliest decade of its establishment. If Indigenous people did accept some form of Christian burial as Hey reported, it is likely to have occurred from ca 1900 based on the absence of earlier documentary evidence. Hey's excerpt also indicates that the Mapoon Mission Cemetery was what he terms the "newly laid out cemetery" in his report and was predominantly used beginning about 1900. This statement does not preclude the idea that burials in the area of the cemetery were not undertaken in pre-mission times. In arrival records of Reverends Hey and Ward, Aboriginal people are reported as camping on the lands of the site of the Mapoon Mission and the surrounding lands, which include the sand dunes associated with the cemetery (Ward 1908, pp. 62–74). It is possible these people buried their dead or partially interred them in the cemetery's sand dunes before 1891.

Aims, Methods, and Results of the Ground-Penetrating Radar Survey

GPR survey at the Mapoon Mission Cemetery was carried out in December 2010 with involvement of Mapoon Elders and assistance from Mapoon Land and Sea Rangers (Figs. 5, 6 and 7). The aims of the survey were to comply with the aspirations of Mapoon Elders to delineate burials and define cemetery boundaries in hopes of subsequently fencing the area so as to ensure preservation, protection and as an aid for managing the Cemetery. The method of the GPR survey was valued by Mapoon Elders and Rangers as it was culturally important not to disturb the remains of their ancestors. Many Indigenous people value non-invasive approaches to detect human remains as disturbing these burial places through other methods of detection such as excavation are deemed culturally inappropriate (Ruckman 2005; NPWS 2003).

The Ground-Penetrating Radar Method

Ground-penetrating radar is a near-surface geophysical technique that allows for discovery and mapping of buried objects and features not visible on the surface. The method consists of measuring the elapsed time between when pulses of radar energy are transmitted from a surface antenna, reflected from buried discontinuities, and then received back at the surface (Conyers 2013). Those buried discontinuities where radar energy is reflected can be changes in lithology and the contacts between buried objects

Author's personal copy

Fig. 5 Mapoon Elders, Mrs. Florence Luff, Mrs. Harriet Flinders, the lead author, Mrs. Alma Day, and Mapoon Land and Sea Rangers at the Mapoon Mission Cemetery

and the surrounding matrix. With graves, reflections can be produced from the tops, bottoms and sides of caskets, edges of the burial shafts, objects that were buried with the deceased, and even the human remains themselves (Conyers 2006, 2012, p. 129). Ground-penetrating radar is a geophysical technique that is most effective at burial sites where remains are located within 1-3 m of the surface (Conyers 2013, p. 14, 2008).

As radar pulses are transmitted through various materials on their way to the buried remains, their velocity will change, depending on the physical and chemical properties of the material through which they are traveling (Conyers 2013, p. 15). Each abrupt velocity change generates a reflected wave, which travels back to the surface to be recorded. Velocities of radar energy in the ground are important because only the wave travel times are measured, not their actual depth in the ground. However, velocity through the ground can be calculated then distance (or depth in the ground) can be accurately estimated (Conyers 2013, p. 49), producing a useful three-dimensional data. Velocities at Mapoon were calculated using hyperbola fitting, producing velocities from which all reflections measured in time were converted to depth in amplitude maps. The one-way travel time velocity averaged 20 cm/ns across the grid. All profiles illustrated below show the two-way travel time (the time it takes radar energy to move from the surface, to the object in the ground and back to the surface) on the vertical axis, and therefore each 10 ns of two-way time is 1 m in real depth in the ground.

Fig. 6 Mrs Zoe De Jersey and Mapoon Land and Sea Rangers undertaking data collection at the Mapoon Mission Cemetery

Author's personal copy

Fig. 7 Data collection using the 400 MHz antennas with a survey wheel attached, connected to the SIR-3000 system control unit with a blue cable

Typically in the GPR mapping for graves, antennas are moved along the ground surface in transects (see Fig. 7) and two-dimensional profiles of a large number of reflections at various depths (as measured in travel time) are created, producing profiles of subsurface stratigraphy and buried archaeological features along lines (Fig. 8). When data are acquired in a closely-spaced series of transects within a grid and reflections are correlated and processed, an accurate three-dimensional picture of burials can be constructed (Conyers 2013, p. 171). This can be done visually by analyzing each profile, or with the aid of computer software that can create maps of many thousands of reflection amplitudes from all profiles within a grid producing maps at various depths.

Ground-penetrating radar surveys allow for a relatively wide aerial coverage in a short period of time, with excellent subsurface resolution. This three-dimensional resolution is what gives GPR an advantage over other near-surface methods with respect to mapping burials in most geological contexts.

Different antenna frequencies are used for varying depth penetration and subsurface resolution (Conyers 2013, p. 42). The higher the frequency waves that are

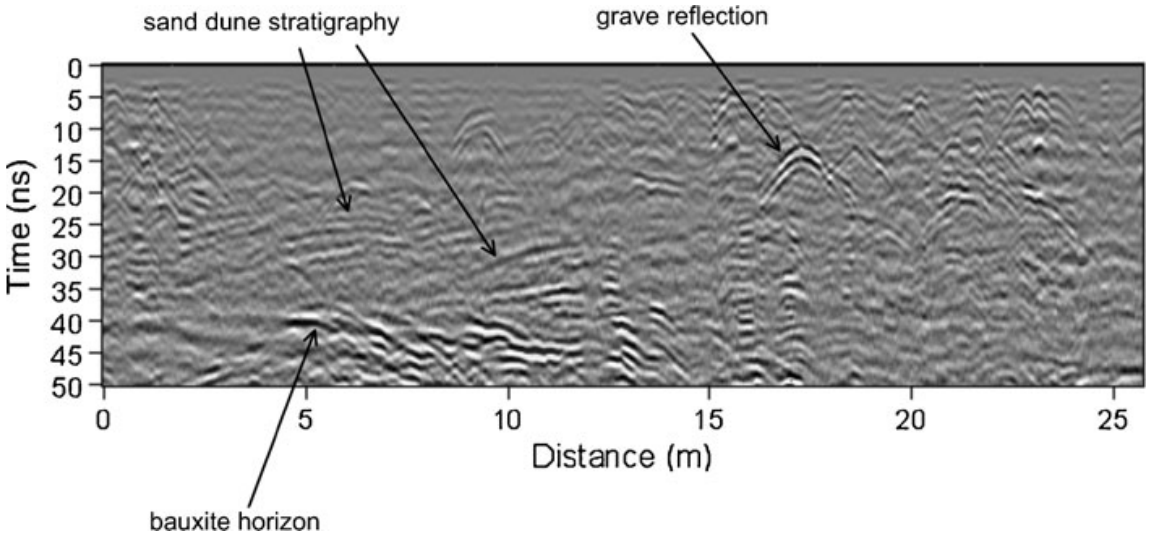


Fig. 8 GPR reflection profile showing the bauxite horizon at about 40 ns (4 m) depth, with faint beds from the sand dune strata. One grave can be seen as a high amplitude hyperbolic-shaped reflection

Author's personal copy

produced from a surface antenna, the shallower the depth of energy penetration, but the greater the resolution of subsurface features (and vice-versa for lower frequency antennas). In the current study the 400 MHz antennas were capable of resolving burials as small as about 15-20 cm or so in dimension and transmit energy to a maximum depth of about 6 m. Spatial resolution can be estimated by determining the wavelength of radar wave travel in the ground in estimated chemical and physical conditions (Annan and Chua 1992). Waves will not be reflected if the objects in the ground are less than about one half of a wavelength (Conyers 2013, p. 62). In the very dry sand at Mapoon the 400 MHz energy moving through the ground had a wavelength of between 30-40 cm, making the minimum resolution between about 15-20 cm. Depth of energy penetration can be calculated by determining the depth at which no coherent reflections have been received back at the surface and only background noise is recorded (Conyers 2012, p. 96).

While the GPR method has wide applicability in many different sediment and soil types, the best energy penetration and subsurface resolution occurs when the ground is electrically resistive (Conyers 2013, p. 47; Conyers and Connell 2007). In the Mapoon area the ground within which burials are located is very dry wind-blown quartz sand, which was an excellent medium for radar transmission. This sand ranges in thickness from 2-5 m across the area, overlying a dark red bauxite unit, which is bedrock in this area of the Cape York Peninsula.

Methods Used in the Field

The GSSI (Geophysical Survey Systems Inc.) Subsurface Interface Radar Model 3000 with a 400 MHz center-frequency antenna was used to collect radar reflection in the Mapoon Mission Cemetery (see Fig. 7). A survey wheel was used for encoding distance into the reflection data string. Reflections were recorded in a 60 ns time window (about 6 m depth) and all reflections were filtered prior to recording, removing all received frequencies lower than 200 MHz and higher than 800 MHz. Thirty reflection traces were recorded each meter along all profiles. Mapoon Elders came out to Mapoon Mission Cemetery to observe the ground-penetrating radar survey and to provide information to assist the survey. Mapoon Land and Sea Rangers were involved in the clearing of vegetation and assisted Professor Conyers with data collection.

A total of 70 reflection profiles were recorded in a grid that was 69x50m in maximum extent. Profile length varied through this grid in order to avoid large trees and other surface obstructions. All reflection data were saved to disk and used to produce images of profiles and amplitude maps.

GPR Data Processing and Interpretation

Raw GPR reflection data are a collection of many individual traces, spaced at varying intervals, along two-dimensional transects within a grid (Conyers 2012, p. 26). Each reflection trace consists of a series of stacked waves received from certain depths in the ground at one surface location, which vary in amplitude depending on the amount

Author's personal copy

and intensity of energy reflection that occurred at buried interfaces. When traces are stacked vertically, and in sequence, standard two-dimensional profiles are created showing the variations in amplitudes of reflected waves that vary along transects (see Fig. 8). They can be viewed much like profiles along vertical faces of excavations. An analysis of the varying amplitudes in space can potentially show subsurface changes in stratigraphy and physical properties of burials, caskets and associated materials within the matrix of sediments and soils. The higher the physical contrast between the burial and the surround sediment, the greater the amplitude of the reflected wave generated at that contact (Conyers 2013, p. 59). When viewed in profile the higher amplitude reflections are the areas of black and brighter shades of white visible within a gray-scale image, while neutral gray denote areas of little or no reflection (see Fig. 8).

Results from GPR Survey in Mapoon

When the GPR reflections were processed and viewed in standard reflection profiles (see Fig. 8) faint reflections are visible from dipping beds of the sand dune strata. A strong linear reflection is visible in most profiles toward the bottom of each profile, which is the reflection of the bauxite layer. Graves are distinctly visible as hyperbolic shaped reflections ranging in depth from ca. 1-2 m in depth.

Elsewhere in the world graves are visible using GPR as hyperbolas (Buck 2003; Conyers 2006; Davenport 2001; Nobes 1999). In these studies it was found that as long as there are caskets or burials wrapped in some material that produces a velocity contrast with the surrounding soil, reflection profiles will be created. Tests have been performed on whether singular bones, and even concentration of bones will produce radar reflections (Solla et al. 2012). Those laboratory and field tests appear to indicate that bones by themselves do not contrast enough to yield reflections. Very ancient Indigenous burials in Australia have proven to be almost impossible to detect with GPR (Wallis et al. 2008). All that potentially remains of burials when only bones remain, or almost all human remains have decomposed are the burial shafts themselves (Conyers 2012, p. 129)

Objects in the grave shafts are usually visible as hyperbolic shaped reflections, produced from coffins, crypts, or individual human bodies in the ground. Hyperbolic shaped reflections are produced from objects in the ground due to the spreading of radar energy as it leaves the antenna and then spreads out as it travels to depth. Objects can therefore be "seen" before the antenna is directly over the object and after the antennas pass by. But travel paths to and from graves in front and behind are longer than when the antenna is directly over the object, the reflections are plotted in a hyperbolic shape in vertical profile (Conyers 2013, p. 58).

A number of different grave types were discovered at Mapoon from simple burials with no casket or associated goods, to more elaborate burials with caskets with associated metal. Metal objects produce very high amplitude reflections (see Fig. 8). Older burials, which have decomposed over time likely lacked coffins or any associated metal items but which may retain their fabric wrapping or are bundled in some other way appear as very low amplitude reflections. Tree root reflections are

Author's personal copy

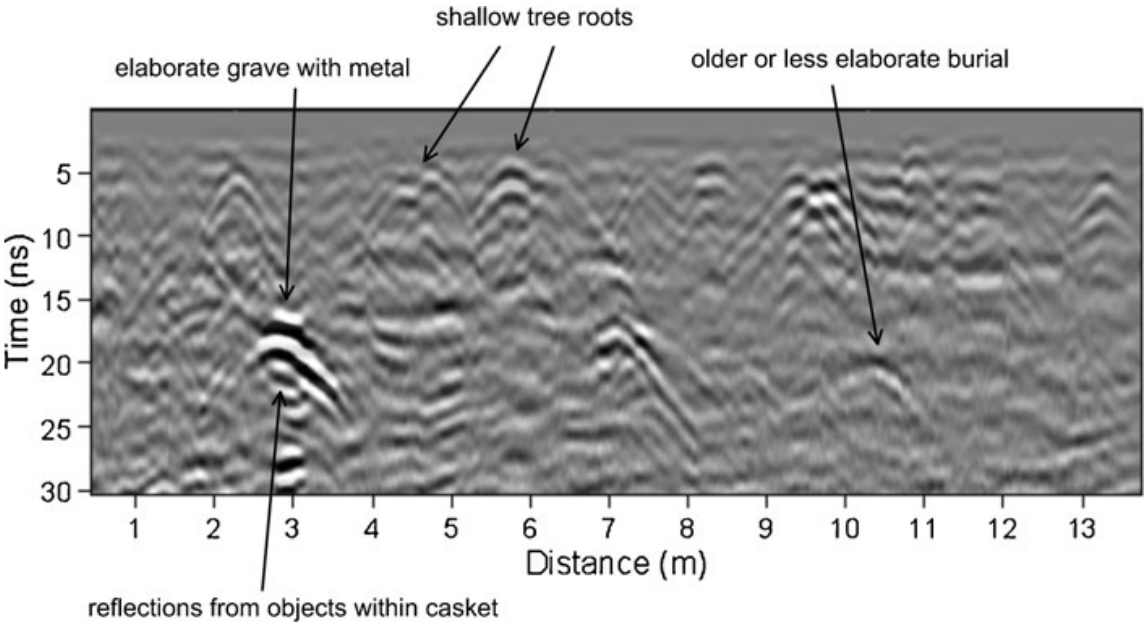


Fig. 9 GPR reflection profile showing an elaborate burial with associated metal on the left and a very old burial on the right, which is likely lacking in any associated burial items. The casket on the left shows reflections within it, which may be the corporeal remains or other objects

also common in profiles, but are almost always located within the upper 8 ns (80 cm) of the ground surface (Fig. 9).

A number of burials were very elaborate and appear to have been placed in crypts or were covered with perhaps cement tops (Fig. 10). Two of these were found in the surveyed area and were very reflective. One appears to be a crypt that contains two individual caskets. The cement (or other hard covering of some sort) is highly reflective and overlays what appears to be two individual caskets. More modern crypts of this sort have been studied elsewhere and are quite distinct in GPR reflection profiles (Conyers 2012, p.134).

A few areas contain many concentrations of graves, which might be family plots or areas that were active burial plots during one period of time. These areas have graves

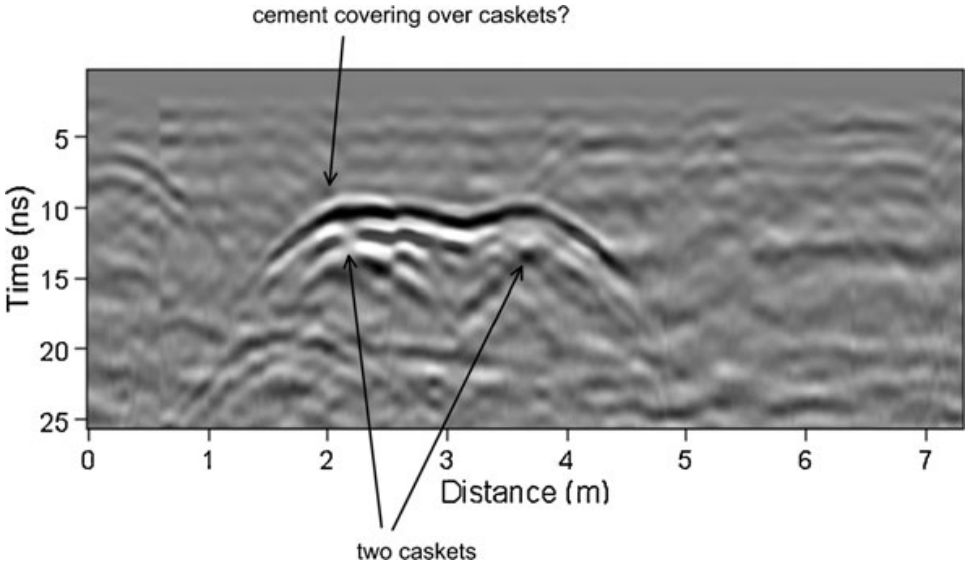


Fig. 10 A very elaborate burial showing what appear to be two caskets within a possible crypt, covered perhaps with a cement slab

Author's personal copy

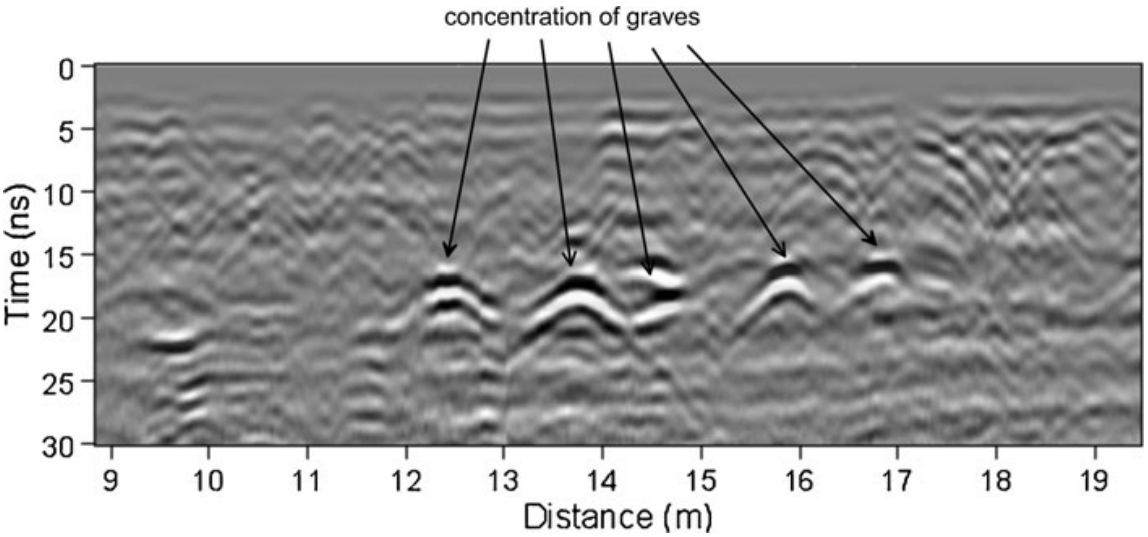


Fig. 11 A reflection profile showing five closely spaced graves were found in a concentration of at least 30–40 graves in one small area

spaced about 1–1.5 m apart (Fig. 11), all buried at approximately the same depth (1.5 m or so to the top of the casket or remains).

The most elaborate graves are quite visible in reflection profiles, with some containing a good deal of metal, which is highly reflective. One casket discovered has a very reflective top and a bottom that contain metal of some sort, which produced multiple reflections below it (Fig. 12). Multiples are produces from metal as energy is reflected between metal objects within the void space in the casket, and produces what appears as a "ringing" of energy through the reflection profile below the object. Other elaborate burials that have metal only in the top of the caskets produce very strong reflections, but no multiple reflections below.

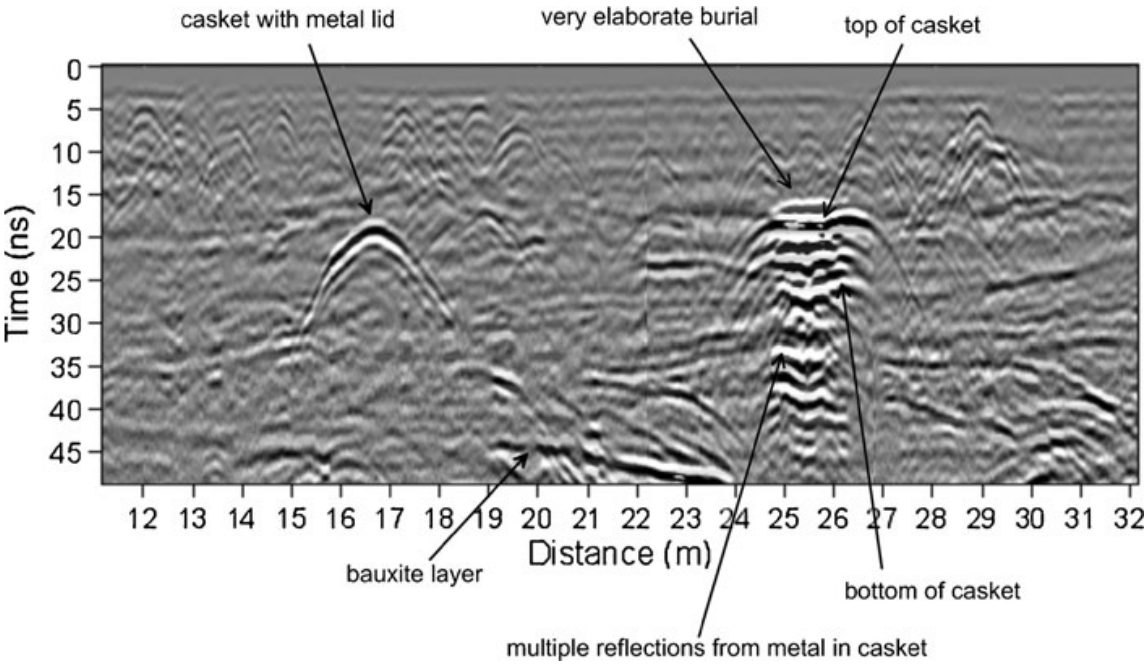


Fig. 12 Reflection profile showing a very elaborate burial on the right with metal in the lid, and likely at the bottom of the casket, producing multiple reflections below the casket itself. Another elaborate burial with metal only in the casket lid can be seen on the right

Author's personal copy

The spatial location of amplitudes in a three-dimensional volume can help greatly in subsurface interpretation when slice-maps at specific depths in the ground are produced. Maps of this sort are produced by re-sampling all reflection amplitudes in all profiles within a grid and then averaging the amplitudes in slices of a given thickness. Reflection amplitudes are then gridded and interpolated to provide a uniform placement of radar reflection strengths throughout the mapped area (Conyers 2013, p. 172). When viewed in map-form each slice can portray in plan view the distribution of all reflected wave amplitudes at a desired depth, which were collected from burials (Fig. 13). In these maps low amplitude variations within a slice denote little subsurface reflection and therefore the presence of homogeneous material while high amplitudes indicate significant subsurface discontinuities, in this case the presence of burials and associated objects. Degrees of amplitude variation in each amplitude slice can be assigned arbitrary colors along a nominal scale.

More than 120 burials are visible in the mapped area of about 50x69m. While some of these reflection features could be objects in the ground other than burials, the probable graves counted as part of this analysis were all found at the same general depth as known burials that retained headstones or other markers. All known Christian burials were oriented east–west, as were most of the less-distinct possible Indigenous burials. In the areas where concentrations of probably burials were mapped, the orientation of burials was more random, suggesting these might be internments made prior to Christian influence on burials practices. Some GPR-delineated graves are more elaborate than others, with the very reflective caskets showing up as the red and yellow colors in the amplitude maps (see Fig. 13). There

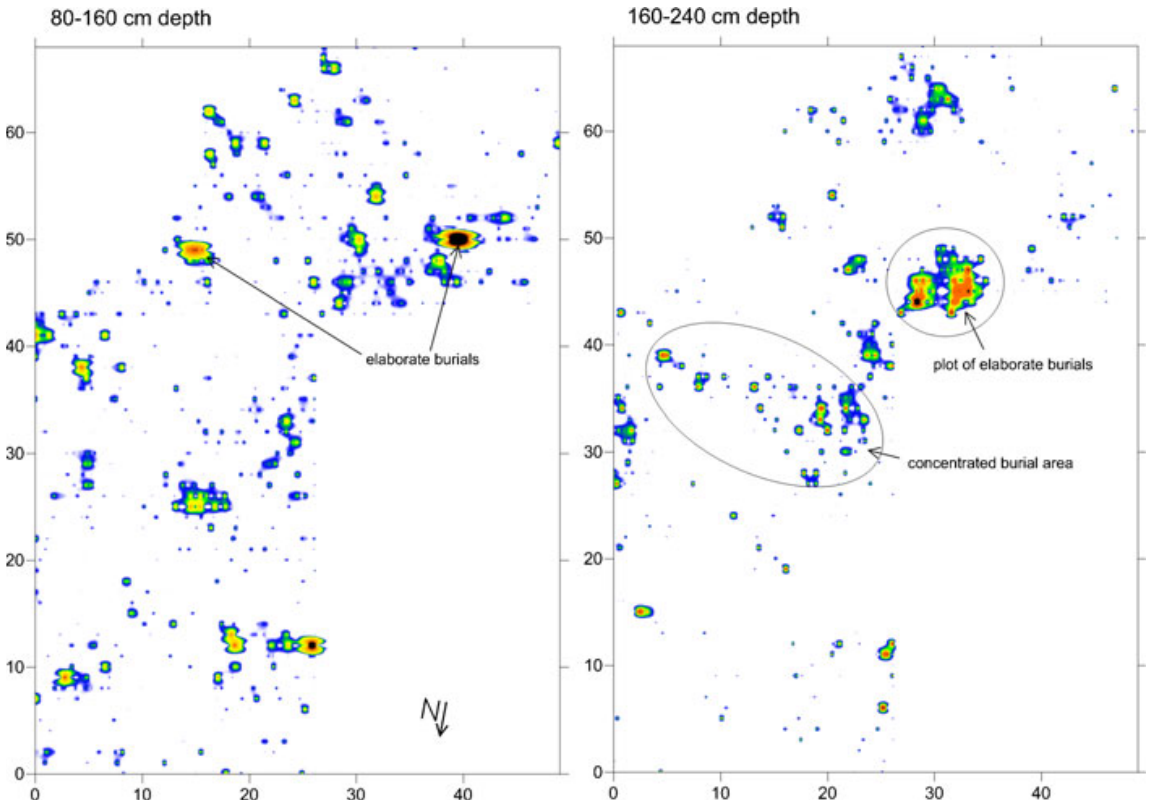


Fig. 13 Amplitude maps of the surveyed area showing graves in two depth slices. In the shallow slice two elaborate burials are visible in the southern portion of the grid, and many less elaborate burials throughout. In the deeper slice a concentration of elaborate burials can be seen in one plot, with another concentration of less formal burials

Author's personal copy

are also many scattered more-random burials are found throughout the grid as blue and yellow reflections. One area of the Mapoon Mission Cemetery contains many closely spaced elaborate burials, which are visible in the deeper slice with all caskets containing metal, producing very high amplitude reflections. Other areas of no burials show up as white in these amplitude maps. Those areas may be totally devoid of burials, or could contain burials that are very old or decomposed (possibly very early pre-mission burials), and therefore produce little or no radar reflection.

It is likely that the high amplitude reflections from elaborate graves are mission burials, and likely Christian-tradition burials. This is especially true in the one area where there is a plot of multiple elaborate burials. The concentration of burials in the one area of the grid in the deeper slice contain many less-elaborate burials, which are likely mission burials of Aboriginal people. These two areas of Christian-style burials are likely to be Aboriginal people including Tjungundji people (the traditional residents of the former Mapoon Mission) known to have lived on the site of the Mapoon Mission prior to the arrival of the missionaries and from the other neighboring lands, Mpakwithi, Taepithiggi, Thaynakwith, Warrangku and Yupungathi clans and other language groups across North Queensland (Mrs. Harriet Flinders and Mrs. Alma Day, December 17, 2010, Audio Recording# VN680010, Mrs. Susie Madua, December 16, 2010, Audio Recording# VN680010). These neighboring clans were known to be forcibly removed into the Mapoon Mission in its early days as a removal centre (Ward 1908). The results of consultation with the Presbyterian Church, Brisbane, the review of State and Church historical records to date (2011), the memories of surviving Elders and missionary families do not indicate that former missionaries and staff were buried in the Mapoon Mission Cemetery. It should be noted that Rev. J. G. Ward and Rev. Calder Allan's graves are not within this cemetery but within the former mission compound, near where the old mission house once stood facing the sea.

The scattered and random weak reflections from burials are likely pre-contact emplacements (or the very early mission burials made between 1891–99 which may have included partially dismembered and interred remains, mortuary practices described in Roth (1907) and McConnel (1936–37). This is especially the case for those that are very low in amplitude, indicating a period of time that would have allowed significant decomposition of remains with only some remaining burial wrappings of cloth or other materials still remaining in the ground to reflect radar waves. These pre-contact burials are concentrated in the middle of the grid and are likely of some antiquity, at the latest between 1891–99, before the missionaries began to enforce Christian burials based on the review of historical records and oral testimony (Hey 1901, p. 10; Ward 1908, pp. 121–122 and Mrs. Harriet Flinders, Mrs. Alma Day and Mrs. Florence Luff interview, December 17, 2010, Audio#VN680010). These burials date to potentially much earlier than 1891, before contact with missionaries. These pre-contact burials are most likely the remains of Tjungundji people, the recognized traditional inhabitants of Mapoon based on oral history testimony (Mrs. Harriet Flinders, Mrs. Alma Day and Mrs. Florence Luff interview, December 17, 2010, Audio#VN680010).

The burials identified during the GPR survey at the Mapoon Mission Cemetery may contain evidence of different types of potential mortuary practices during pre-contact times and very early mission time (from about 1891–99), partially cremated,

Author's personal copy

dismembered or interred human remains with grave goods, Christian burials using blankets and tea-tree bark wrappings (possibly from 1900-20s) and the use of locally made wooden caskets with lead or cement casing or coverings (1920s-45). The results of this preliminary GPR survey and ethno-historical investigation also indicates that other areas in the locality which were easy to dig by hand and stick with loose sandy soil or within the sand dunes along the coast (for example, heading north from the Mapoon Mission Cemetery to Cullen Point, from Cullen Point leading down to Red Beach and from Cullen Point to Janie Creek) are also likely to be sensitive for potential pre-mission and mission time, unmarked Aboriginal burials. Other unmarked burial places are known to exist in these areas from oral history testimony provided by Elders and in some locations through spot checks with the GPR (Mrs. Susie Madua, Mrs. Zoe De Jersey and Mrs. Harriet Flinders interview, October 19, 2010, Audio# VN680003; Mrs. Susie Madua and Mrs. Zoe De Jersey interview, September 6, 2011, Field notes; Mrs. Harriet Flinders, Mrs. Alma Day, and Mrs. Florence Luff interview, December 17, 2010, Audio#VN680010). Ground-penetrating radar mapping may be able to detect pre-mission burials in these areas. Any pre-mission burials detected by GPR could also potentially be detected at more shallow depths in these areas than mission burials. The detection of concentrations of potential pre-mission unmarked Aboriginal graves using GPR within the Mapoon Mission Cemetery and outside the boundary as remembered by the Elders, provides good evidence of Aboriginal occupation and burial in this area long before the establishment of the Mapoon Mission. Oral history testimony and identification by Elders of the existence of burials outside the Cemetery throughout the Mapoon DOGIT lands during the mission time also suggests further GPR survey of these additional unmarked graves (particularly if continuation of elements of traditional mortuary practices as documented by Roth (1907) and McConnel (1936–37) are identified) could provide further insight into the mortuary practices of Mapoon people during the mission time and their interaction with the missionaries (Mrs. Susie Madua, Mrs. Zoe De Jersey and Mrs. Harriet Flinders interview, October 19, 2010, Audio# VN680003; Mrs. Susie Madua and Mrs. Zoe De Jersey interview, September 6, 2011, Field notes; Mrs. Harriet Flinders, Mrs. Alma Day, and Mrs. Florence Luff, interview, December 17, 2010, Audio#VN680010).

Conclusions

GPR has great potential as a non-intrusive technique to identify unmarked graves and to understand other important aspects of Aboriginal burial places. This method was valued by Mapoon Elders as an appropriate way to delineate a culturally sensitive cemetery and provide other important information about past mortuary practices. The results of GPR provided new information on the aerial extent of plots within the Mapoon Mission Cemetery, frequency of burials, as well as the potential nature of mortuary practices and the history of this burial place. None of this information was available using only historical records and the analysis of oral history testimony. Information on mortuary practices and other unmarked burial places within Mapoon DOGIT by Elders in oral testimony, and in the review of early ethno-historical documents assisted in the analysis of the results of the GPR survey. The combination

Author's personal copy

of GPR and ethnohistory is significant in this study as these two datasets have shown that when integrated, a much more complete and nuanced history of this largely forgotten, but still important cultural location was obtained.

The GPR results show that the Mapoon Mission Cemetery contains evidence of a minimum of 120 burials, including potential pre-contact and early mission time Aboriginal burials. The presence of potential pre-contact Aboriginal burials and a possible range of mortuary practices, highlight the historical, scientific, social and cultural values of this cemetery that can be used to meet criteria for inclusion in not only State but National heritage lists. The Mapoon Mission Cemetery has documented value not only to Mapoon people, but to Indigenous people across Australia who descend from the inhabitants of the former Mapoon Mission. No known Aboriginal unmarked burial place in Australia presently has evidence of both pre-contact and mission time Aboriginal burials or the range of mortuary practices shown by the results of the GPR survey.

The shallow nature of some of these burials, indicate the urgency for management and protection of the Mapoon Mission Cemetery against further disturbance and erosion. It also highlights the need for conducting future GPR surveys in potential sensitive areas surrounding Mapoon that are being considered for future housing by the Commonwealth government or under threat by encroaching mining interests. Funding for additional GPR studies to more accurately define the extent of the Mapoon Mission Cemetery (due to the limits on timing and the number of burials outside the remembered boundary of the Cemetery identified in this preliminary study) and explore other potential areas with sensitivity for unmarked graves surrounding Mapoon are currently being sought by partnerships with State and Commonwealth heritage agencies, commercial funding agreements and the Mapoon Aboriginal Shire Council to meet the aspirations of Mapoon Elders and to protect the Mapoon Mission Cemetery, the resting place of their "old people" and a historical site of national heritage significance.

Acknowledgments We would like to thank the Elders of Mapoon who were involved in the preparation of this paper and who welcomed us into their homes. This paper would not have been possible without their support and generosity. We would like to acknowledge Mapoon Land and Sea Rangers and the Mapoon Interim Land and Sea Advisory Committee for their participation and support in the ground penetrating radar survey. We would also like to acknowledge the support of the Mapoon Aboriginal Shire Council for accommodation and assistance during these investigations. We would like to acknowledge Dr. Sally Babidge and Geoff Wharton who reviewed an early draft of this paper. Thanks to Dr. Sean Ulm, Prof. Paul Memmott, and Dr. Lynley Wallis who provided encouragement during fieldwork throughout 2010. Lastly, we would like to thank Chris Newman of Rio Tino Alcan who prepared historical aerial photographs of Cullen Point which assisted with these investigations and Craig Evenden, who assisted with fieldwork voluntarily throughout June to October 2010 and with the preparation of the figures.

References

Annan, A. P., and Chua, L.T. (1992). Ground-penetrating radar performance predictions. In Pilon, J.A. (ed.) *Ground Penetrating Radar*. Geological Survey of Canada Paper 90–4: 5–13.

Bevan, B. W. (1991). The search for graves. *Geophysics* 56: 1310–1319.

Brown, S., Avery, S., and Goulding, M. (2004). Recent investigations at the Ebenezer Mission Cemetery. In Harrison, R., and Williamson, C. (eds.), *After Captain Cook: The Archaeology of the Recent Indigenous Past in Australia*, Altamira, Lanham, MD, pp. 147–170.

Author's personal copy

Buck, S. C. (2003). Searching for graves using geophysical technology: field tests with ground penetrating radar, magnetometry and electrical resistivity. *Journal of Forensic Sciences* 48: 1–7.

Byrne, D. (1998). *In Sad But Loving Memory: Aboriginal Burials and Cemeteries of the Last 200 Years in NSW*, NSW National Parks and Wildlife Service, Hurstville.

Conyers, L. B. (2006). Ground penetrating radar techniques to discover and map historic graves. *Historical Archaeology* 40(3): 64–73.

Conyers, L. B. (2008). Ground penetration radar mapping. In Nadel, D., Lengyel, G., Bocquentin, F., Tsatskin, A., Rosenburg, D., Yeshurun, R., Bar-Oz, G., Bar-Yosef Mayer., D. E., Beeri, R., Conyers, L., Filin, S., Hershkovitz, I., Kurzawska, A., and Weissbrod., L. The late Natufian at Raqefet Cave: The 2006 Excavation Season. *Journal of the Israel Prehistoric Society* **38**: 78–86

Conyers, L. B. (2012). *Interpreting Ground-penetrating Radar for Archaeology*, Left Coast Press, Walnut Creek, CA.

Conyers, L. B. (2013). *Ground-Penetrating Radar for Archaeology*, 3rd ed, Altamira Press, Rowman and Littlefield, Latham MD.

Conyers, L. B., and Connell, S. (2007). The applicability of using ground-penetrating radar to discover and map buried archaeological sites in Hawaii. *Hawaiian Archaeology Journal* 11: 62–77.

CPI (Centre for Public Culture and Ideas), Griffith University. (2009). *German Missionaries in Queensland: A Web Directory of Intercultural Encounters.* http://missionaries.griffith.edu.au/qld-mission.

Davenport, G. C. (2001). Remote sensing applications in forensic investigations. *Historical Archaeology* 35(1): 87–100.

Department of Native Affairs Office (1950). *File 6G/17*, Queensland State Archives, Community and Personal Histories, Brisbane.

IDA (International Development Action Team), Roberts, J., Parsons, M., and Russell, B. (1975–76). *The Mapoon Story According to the Invaders: Church Mission, Queensland Government and Mining Company.* International Development Action, Fitzroy.

Di Naso, S.M., Gutowski, V.P., Henson, H., and Leonard, R. (2010). Lost graves, Trail of Tears. *GPS World*. **April**: 50.

Hey, N. (1901). *Report of Mission Work Done at Mapoon Station, North Queensland under the Supervision of the Rev. N. Hey*, William Brooks, Brisbane.

Howe-Pienning, A., and Byrne, D. (1998). *Caring for Aboriginal post-contact cemeteries, progress report/ year 1*. Report by NSW National Parks and Wildlife Service, Hurstville.

Killam, E. W. (1990). *The Detection of Human Remains*, Charles C. Thomas, Springfield, IL.

L'Oste-Brown, S., and Godwin, L. (with Henry, G., Mitchell, T., and Tyson, V.) (1995). *"Living Under the Act" Taroom Aboriginal Reserve 1911–1927*. Queensland Department of Environment and Heritage, Brisbane

Lomax, K., and Long, A. (1991). *Lake Condah Mission Cemetery Investigations.* Report to the Kerrup Jmara Elders Aboriginal Corporation, Melbourne.

Long, A., MacKinnon, A. (with contributions by Hawker, J., and Perry, D.) (2000). *Ebenezer Mission Cemetery: Microtopographic and Surface Vegetation Study, Stage 3*. Report to Aboriginal Affairs Victoria, Melbourne

McConnel, U. (1936/37). Mourning ritual among the tribes of Cape York Peninsula. *Oceania* **7**: 346–371.

McDougall, M., Massie, D., and Cull, J. P. (1997). *Ground Penetrating Radar Investigation, former Ebenezer Mission Cemetery.* Report to Aboriginal Affairs Victoria, Melbourne.

Moran, M. (2006*).* Practicing Self-Determination: Participation in Planning and Local Governance in Discrete Indigenous Settlements*.* Doctoral dissertation, University of Queensland, Brisbane.

Mulvaney, D. J. (1989). *Encounters in Place*, Australian Heritage Commission, Canberra.

Nobes, D. C. (1999). Geophysical surveys of burial sites: a case study of the Oaro Urupa. *Geophysics* 64: 357–367.

NPWS (National Parks and Wildlife Service) (2003). *Lost But Not Forgotten: A Guide to Methods of Identifying Aboriginal Unmarked Graves*, National Parks and Wildlife Service, Hurstville.

Nugent, M. (1998). *A Search of the Archives of the Aborigine's Protection Board and the Aborigine's Welfare Board for Material Relating to Burials and Cemeteries*. Report to the NSW National Parks and Wildlife Service, Hurstville.

Randolph, P., Wilson, V., Frampton, C., and Merritt, C. (1994). Rottnest Island Aboriginal prisoners cemetery: delineation of extent using ground penetrating radar. In Sullivan, M., Brockwell, S., and Webb, A. (eds.), *Archaeology in the North: Proceedings of the 1993 Australian Archaeological Association Conference*, Australian National University, Darwin, pp. 394–415.

Ranson, D., and Egloff, B. (1988). The application of earth resistivity surveys to Australian archaeological sites. *Australasian Historical Archaeology* 6: 57–73.

Author's personal copy

Rhodes, D. (1998). *An Archaeological Survey of Ebenezer Mission*. Report to Aboriginal Affairs Victoria, Melbourne.

Roth, W. E. (1907). Burial ceremonies and disposal of the dead. *Records of the Australian Museum* 6(5): 365–403. Plates lxviii–lxxiv.

Ruckman, S. E. (2005). Caring for forgotten graves. *Tulsa World*, May 17: A.1.

Ruffell, A., and McKinley, J. (2008). *Geoforensics*, John Wiley, London.

Solla, M., Riveiro, B., Alvarez, M. X., and Arias, P. (2012). Experimental forensic scenes for the characterization of ground-penetrating radar wave response. *Forensic Science International* 220(1–3): 50–58.

Stanley, J., and Connah, G. (1977). Magnetic evidence of an Aboriginal burial ground at Forster, NSW. In Coutts, P., and Brooks, R. (eds.), *A Collection of Papers Presented to ANZAAS 197 August 29th-September 2nd, Section 25A*, vol. 2, Memoirs of the Victorian Archaeological Survey, Melbourne, pp. 37–50.

Suhr, J. (2005). Cemetery might hold Trail of Tears remains. *Tulsa World,* November 25: A.14.

Wallis, L. A., Moffat, I., Trevorrow, G., and Massey, T. (2008). Archaeological geophysics in the Indigenous reburial process: A case study from Ngarrindjeri ruwe, South Australia. *Antiquity* 82: 750–760.

Ward, A. (1908). *The Miracle of Mapoon or From Native Camp to Christian Village*, S. W. Partridge and Moravian Mission Agency, London.

Wharton, G. S. (2000). *"Mission Time": A Guide to Queensland Presbyterian Church Records Relating to the Gulf Missions at Aurukun, Mapoon, Mornington Island, Weipa and Thursday Island Mission Agency 1891 to 1978*, Presbyterian Church Press, Fortitude Valley.

Yelf, R., and Burnett, A. (1995). *Ground Penetrating Radar Survey of Unmarked Cemeteries at Taroom Aboriginal Reserve, Bundulla, Queensland*. Report for Department of Environment and Heritage, Rockhampton.