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BROWN'S COWS AND THE MOTUKOREA ARCHAEOLOGICAL LANDSCAPE

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Introduction

Motukorea/Browns Island in the inner Hauraki Gulf, is a 60 ha island reserve owned by the Auckland City Council and administered by the Department of Conservation. It was occupied from the time of early Polynesian settlement in the Hauraki Gulf, and was one of the first European land purchases in the Auckland region. Its combination of early Maori and early European settlement sites and low visitor impact make Motukorea one of the most complex and intact historic landscapes in the Auckland Region.

The island is gazetted as a Recreation Reserve, but its management has been that of a Historic Reserve, and there has been a recommendation since the mid 1990s that the classification be brought into line with its intrinsic historic values. Despite its proximity to Auckland lack of a wharf in recent times has meant that visitor numbers are relatively low. A landing block provides high tide access, but otherwise access is restricted to small craft able to land on beaches or nose into rocks.

Management of the Motukorea landscape as an open space reserve has required concessionaire farming of the island. While grazing stock maintains open pasture and allows for the suppression of weeds, the limited size and stocking capacity of the island, combined with its steep slopes and the fragile nature of some of the sites have presented certain difficulties.

Historic Background

The history of Motukorea prior to European arrival is not well documented, and while many of the sources available speculate as to the origins of Ngati Tama Te Ra mana whenua and their right to sell the island in 1840, few dispute it. Phillips (1981) makes mention of the *Tainui* canoe stopping at the island after leaving Wakatiwai on the Firth of Thames, before proceeding

to Rangitoto and meeting up with the *Arawa* canoe. In the intervening years, the general area came to be controlled by the Ngati Paoa and the lands to the west came under the control of Ngati Whatua, but the island remained under the control of Ngati Tamatera of the Marutuahu confederation. Opinion is divided as to why this may be; Phillips postulates that mana may have been vested in return for assistance in battle (Phillips 1989:3), whereas Monin regards the occupation and sale of Motukorea as evidence of more wide spread penetration of the inner Gulf by numerous Hauraki iwi and hapu (Monin 1996:42). Motukorea's location at the mouth of the Tamaki River was certainly important as it effectively controlled access up the river, and as a result the Otahuhu portage through to the Manukau (Phillips 1989:3). The archaeological remains suggest Motukorea was intensively occupied in pre-European times, with people engaged in stone tool manufacture, marine exploitation, gardening of the fertile volcanic soils, and establishing open and defended settlements. Archaic type artefacts found on the island include worked moa bone, and one piece fishhooks. Stone resources included greywacke, basalt, argillite from the local region and chert, basalt, and obsidian from sources and as far afield as Coromandel and Great Barrier Island (Frederickson 1991: 95). The name Motukorea commonly refers to the 'island of the oystercatcher', but an alternative translation is the 'rat pit' perhaps in reference to the central crater.

Starting from 1820 early European visitors included Richard Cruise, Samuel Marsden and John Butler, who traded with Maori for produce. Dumont D'Urville visited the island in 1827 and reported it abandoned, probably on account of the musket wars (Cruise 1824: 200–204; Elder 1932: 312–313; Wright 1950: 156157). As it was already abandoned by Ngati Tamatera and located a considerable distance from where they were based in Coromandel, Te Kanini of Ngati Tamatera and the sub-chiefs Katikati and Ngatai were willing to sell Motukorea when William Brown and John Logan Campbell indicated a desire to buy the island on 22 May 1840. Brown and Campbell settled on the western side of the island from 13 August 1840, making it one of the earliest European settlements in the Auckland area (Campbell 1881: 229–253). They built a raupo whare and ran pigs on the island, using it as a base from which they aspired to establish and supply the town of Auckland as soon as land was available on the isthmus (Campbell 1881: 239).

Not long after Brown and Campbell had taken up residence on the island, it was 'gifted' by Ngati Whatua chief Apiha Te Kawau to entice Captain Hobson to select Auckland as the new capital for the colony (Campbell 1881: 300). A flagpole was to be erected on the summit and the island claimed for the Crown, but upon hearing what was transpiring, Brown and Campbell re-

Figure 1. Painting of Waitemata harbour showing Motukorea and Rangitoto in 1855.

turned to their island and asserted their right to occupy it. The idea was abandoned, but Governor Hobson refused the application for a Crown grant made by Brown in August 1840. The official reason for the refusal was because the Brown and Campbell's purchase was made after Sir George Gipp's 1840 proclamation forbidding direct land purchases from the Maori, and it was not until FitzRoy assumed the role of Governor in 1843 that Brown and Campbell's fortunes changed. The grant was officially made on 22 October 1844 (Monin 1996: 42–43; Deeds CT 364/284).

Campbell left the island in December 1840 to set up a trading business in the newly establish settlement of Auckland (Campbell 1881:330; Stone 1982:88), while Brown remained on the island until February the following year to manage the pig farm, and probably to watch over their vested interest in the island. In 1856, both men left the colony, appointing a resident manager in charge of their affairs. Campbell eventually bought out Brown's share in their business, including Motukorea, in May 1873 for £40,000 when Brown refused to return from Britain to resume control of their affairs. This transaction was carried out via William Baker who appears to have acted as an intermediary, receiving Brown's share for two days while the transaction was being carried out. In 1877 Campbell proposed to transplant olives to Motukorea and 5000 seedlings were grown in a nursery on One Tree Hill for this purpose, but were never transplanted (Stone 1987: 117). Campbell eventually sold to the

Featherstone family in 1879, who built a larger house on the north-eastern side of the island which burnt down in 1915 (Rickard 1985: 11).

In 1906 the island was sold to the Alison family who operated the Devonport Steam Ferry Company, and during their ownership the hulks of several paddle steamers were abandoned on the island (Balderston 1986: 16; Debreceney 1991). Browns Island is also significant in aviation history, with the Barnard brothers of Auckland carrying out what may have been New Zealand's first glider flights from the upper slopes of the cone in June 1909 (Brassey 1996: 3). A 1922 survey plan shows a cottage on the north western flat presumably built to replace the one that was lost in 1915. The Auckland Metropolitan Drainage Board purchased the island in 1946 proposing to build a sewerage treatment plan, but controversy surrounding this forced the plan to be abandoned and the island was eventually purchased by Sir Ernest Davis who presented it as a gift to the people of Auckland in July 1955 (Bush 1980). Ernest Davis had been the chairperson of the Devonport Steam Ferry Company for 20 years, which may explain some of his affinity

Figure 2. Homestead at northwest flat belonging to the Alison family (1909–1915).

Figure 3. Browns Island Devonport Steam Ferry Company hulks circa 1909 (reproduced from Mafey 1972).

with Browns Island (Bush 2006: 2). The Auckland City Council administered the island until 1968 when it became part of the Hauraki Gulf Maritime Park (NZ Gazette 20/6/1968, 38: 1035). Management control was vested in the Department of Lands and Survey and in 1987 this was transferred to the Department of Conservation. After the demise of the Hauraki Gulf Maritime Park Board in July 1990, the Auckland City Council was again the designated administering body, and passed back the responsibility for management to the Department of Conservation.

The present day landscape

Motukorea is considered to be the least modified of the Auckland volcanic cones, which comprise a larger landscape of national cultural and historic significance. The island is one of Auckland's iconic landmarks, with un-vegetated slopes that allow archaeological and geological features to be clearly seen from a considerable distance. Three distinctive pa types were built on the island, including volcanic cone, hilltop and ring-ditch defences. Other recorded archaeological sites include stone tool manufacturing sites, fish traps, complex garden systems and rock shelters as well as defended and open settlement sites. Historic period archaeological sites include stone walled pens, house sites, tracks, plough marks, shipwrecks, hulks, wharves and landing remnants and water catchment facilities. Unrecorded features of heritage significance include relict plantings, memorials and burials.

Motukorea is described in the Auckland Conservation Management Strategy as "an outstanding and near-intact historical landscape" (DOC 1995b:181). The island comprises an area intensively occupied in pre-European times, and the 68 recorded sites include several pa, and in particular the prominent cone pa which bears the same name as the island itself. Many of the sites overlap to form a landscape of early Polynesian settlement culminating

in intensive Maori occupation, overlaid with historic period features dating from 1840 (DOC 1998).

Geologically, the island comprises a basaltic scoria cone and lava flows approximately 10 000 years old, making it one of the younger cones in the Auckland Volcanic field (Kermode 1992). The northern and eastern parts of the island comprise a partially eroded lithic tuff from an earlier eruption, and the inner cone comprises the more recent basaltic and basanite scoria and lava flows which also extend underwater on the western and eastern sides. Soils on the southern flat are undifferentiated alluvium (Kermode 1992). The island is internationally significant as the type locality for Motukoreaite, a mineral first discovered in 1976 and only known to occur on Browns Island (Rodgers et al. 1977; Kermode 1992: 36). Also of interest is the presence of Sydney mud-cockle, a species now extinct in New Zealand, in the ash layers uplifted during from tidal flats during the volcanic eruption (Kermode 1992: 268–289).

Archaeological recording and investigation

Archaeological site recording on Motukorea started with the recording of the cone pa by Bob Brown in 1961. Eight sites were recorded in 1967 by the Auckland University Archaeological Society and a further nine by Agnes Sullivan in 1975 and 1978. Eleven more sites were recorded by the Auckland University Anthropology Department in 1981 and a small test excavation was carried out on one of the stone alignments, revealing larger outer stone construction filled with smaller scoria (Sullivan 1981). An additional seven sites were identified by Viv Rickard who produced the first comprehensive report on the history and archaeology of Motukorea for the Department of Lands and Survey (Rickard 1985), and a further twenty-nine sites were recorded by Ian Smith who carried out a detailed survey of the island in response to re-vegetation proposals for the island (Smith 1987). Since that time Robert Brassey carried out limited excavations to investigate a rectangular platform believed to be a possible location for Brown and Campbell's house site (Brassey 1991b). A complete upgrade of archaeological information was undertaken between 2003 and 2006 by DOC, ARC, and consultant archaeologists, and an assessment of significance was carried out by the Auckland City Council as part of the Inner Gulf Islands Archaeological Assessment in 2006.

Farming operations

Starting with Brown and Campbell's pig farm, stock of one form or another have been on the island almost continuously since 1840. William Brown resided on the island and ran the farming operation in the 1840s and

Figure 4. Location of recorded archaeological sites (all R11) after Smith 1985.

early 1850s, and from 1856 the island was left in the charge of a resident farm manager employed by the pair. Following his acquisition of Brown's share of the business in 1873, Campbell leased the island for stock grazing at a rate of £25 per year (Stone 1987: 117). Little has been documented about the farming operations of the Featherstones, but historic and archaeological features that may be attributed to them include some of the stone walled enclosures, and plough lines on the southern flat. The water retention improvements are likely to have been undertaken by either the Featherstones or the Alisons, and may have been possible with capital injection that came with the Devonport Steam

Ferry Company operations (Smith 1987: 30–31). Certainly the Alisons' use of the island as a day excursion and picnic destination would have required ongoing grazing to manage the open pasture.

Departmental files have documented many of the significant changes in the farming operation following the acquisition of Motukorea by the Auckland City Council and its subsequent management by the Department of Lands and Survey. Because the management of the archaeological landscape has largely been an issue of controlling the effects of animals on the island, numbers of stock and their effects have also been reasonably well documented.

Cows and rabbits

In 1959, four years after the gifting of the island to Auckland City, a 10-year grazing licence to run stock on the island was granted to Ewen Alison. Alison grazed the island for seven years, before transferring the remainder of his lease to the Lintons who held a grazing lease from 1966 until 1982. Rabbits were introduced to the island in the early 1970s and soon multiplied to the point where the farming operation was significantly affected. By 1978 the rabbit population was estimated at between 5000 and 10000, and in the following year, at the request of the Lintons, the chief ranger inspected the island to assess the extent of the problem. The ranger's report of 14 August 1979 noted that in addition to the burrowing, stock damage was occurring on the western slopes and around the Davis memorial, and recommended that grazing be restricted to sheep as the cattle appeared to be a significant factor in causing the damage. Stock numbers at the time were estimated by the ranger at approximately 100. Sporadic rabbit control was undertaken from 1978 using a variety of methods, and estimates of kills of up to 90% of the population were reported in 1979, but populations kept on recovering due to lack of commitment to follow through with a complete eradication.

Concerns about overstocking were repeated by the District Field Officer who visited the island on 6 September 1979 and reported that erosion was occurring on the steeper slopes on the cone, and that other contributing factors were the wet winter, shortage of feed, effect of rabbit burrowing, and lack of fertiliser to encourage pasture growth. His concerns were supported by Alien Fox (1980) who repeated the suggestion that sheep would be preferable to running cattle. As the Lintons' lease expired on 31 July 1982, the Maritime Park Board decided it would not renew the lease, but instead would pursue alternative arrangements (NP28/1).

At the request of the Board an assessment of stock damage on the landscape was carried out by Jan McKay on 22 December 1983 (McKay 1983). She reported that tracking around slopes was noticeable, exacerbated by rab-

bits, and that the clustering of cattle under trees was causing surface damage. Her report also noted that the soils of Motukorea were prone to sheet erosion. The stocking levels of the later 1980s are poorly documented on the files, but continuing references to the damage caused by rabbits and cattle suggest that stocking levels were too high. A soil conservation report in 1985 noted that the island was still being stocked for 10 months per year with 150 one year old heifers, estimated at10 stock units/hectare, and that overstocking combined with rabbit burrowing was causing considerable damage (Heaps 1985)

Viv Rickard's 1985 archaeological survey report identified rabbit burrowing, stock grazing and natural erosion as the greatest threat to the landscape, emphasised the combined effects of rabbit and cattle damage and stressed the urgent need to control the rabbit population and to graze sheep in preference to cattle. A file note by Rickard the following year noted continuing erosion around the cone attributable to the rabbits, that small cattle were being confined to the coastal flats and that cattle tracking scars on the cones caused during the wetter months appeared to be repairing themselves (Rickard 1986). Ian Smith's 1987 report also addressed the rate of site damage and used previous descriptions on existing site records to determine the rate of damage (Smith 1987: 25). He noted that rabbits had burrowed into virtually every site on the island and their removal was imperative if the archaeological deposits were to be preserved. Cattle had exacerbated the damage caused by the rabbits, and even where rabbit burrowing was less evident, cattle were scuffing and pugging the ground around fence lines, and scattering the stone alignments. Two foreshore midden sites, R11/1500 and R11/564, were singled out as being particularly affected. Repeated warnings about running cattle in preference to sheep were made, but the status quo prevailed. A commitment to eradicate the rabbits was made in 1992 and the operation finally succeeded after 2 years, requiring a permanent staff member stationed on the island, with a programme of shooting and baiting, followed by rounding up the remainder using ferrets (DOC 014).

The island was without a grazing concessionaire in 1993, and in 1994 Motutapu Farms Ltd grazed the island for 6 months, on the condition that DOC was able to request the cattle be removed if they were found to be causing damage (DOC-014 vol.1). The island was stocked with 143 two-year-old steers to control rank pasture and to suppress boneseed and tobacco weed. Upon inspection by historic staff, it was noted that the stocking had caused trampling, pugging and down slope movement on the cones, especially on the south-facing slopes. Patches of denuded ground had resulted from cattle trying to walk across muddy slopes, and movement of stone was evident. Where the alignments and mounds were situated on slopes, stones up to 350

mm diameter were dislodged, and cattle were causing breaches in the walls. Further additional damage was ascribed to camping and pawing. It was noted that the damage was not as bad as it had been prior to rabbit eradication, but effects were exacerbated by stocking in winter. Overstocking to the point of creating bare ground effectively negated the rationale behind stocking to control weed growth, as those areas would probably be colonised by weeds as soon as the stock were removed (RB on file DOC014-40). The following year stock numbers were reduced to 50 15 month old steers over a two month period from March–April, although this was extended upon request of Motutapu Farms to mid May 1995.

Mice

Another cause of burrowing damage that been identified prior to the eradication had been mice. The Motukorea mouse population had a tendency to peak annually in March–April, presumably coinciding with the seed food source. A proposal to eradicate mice and rats in the 1995 Working Plan (DOC 1995) was approved by the Conservation Board on 13 June 1995, and the island was closed for a month from 1st September, with an aerial poison drop on 13th September successfully eradicating mice on the island.

Sheep

Shortly after the mouse eradication Ron Richards expressed an interest in trialling sheep grazing on Motukorea for one year. A one year lease was signed from 11 January 1996, although he continued grazing with the knowledge of the Department beyond this date. Stocking numbers reported in April 1996 were 289 sheep and 29 cattle, comprising an approximate stocking rate of 5 stock units/hectare. Unforeseen problems with sheep poaching and the labour intensive nature of sheep farming prompted Richards to make an application for a resident livestock manager on the island. Unfortunately, restrictions under the Conservation Management Strategy and District Plan precluded new structures on the island, and upgrade of present cinder block was discounted due to its undesirable location. At a meeting with Richards it was conceded that it was not practical to run sheep on the island without additional facilities. Of principle concern was the small size of the island, and lack of infrastructure for crutching, drenching and docking.

And cows again…

A new agreement with Richards, drafted in October 1996, stipulated a maximum of 45 cattle, maximum finishing weight of 240 kg (3 stock units/hectare). In addition there was to be no grazing on the cone without the agreement of field centre manager.

In August 1998 an opportunity arose to combine the grazing lease with that of Ronnie Harrison and Terry Gibbons on nearby Motuihe Island. Richards was reluctant to leave the island, but there was no recourse as his concession had already expired and a new concession had already been offered. In hind-sight the combination of the Motukorea and Motuihe grazing leases at this time was unfortunate as the grazing of Motuihe has since been succeeded by native restoration planting of the island, and the concession to graze Motukorea effectively ended in April 2006.

In light of the termination of the lease, a DTZ farming consultancy report was commissioned in 2005 (Wiseman 2005). This vindicated the earlier requests for money to be spent on infrastructure, suggesting low soil fertility on the island prevented the regeneration of grass, and identifying additional issues. The rank kikuyu increased the risk of fire, and the rapidly invading gorse and apple of Sodom needed to be removed so as not to establish seed base. An estimated 3800 m of post and batten fencing was in poor condition and gates needed replacing. The report suggested that given the present state of facilities cattle was likely to be the most practical short-term option, and suggested 55 head (4 stock units/hectare), with de-stocking in winter. Stocking in summer would require a water upgrade, and application of fertiliser and lime was suggested to improve the low soil fertility.

Farm type	Class	SU	%
Dairy	Dairy Cows	7	73.1
	Dairy Replacements	4.25	24.5
	Other (bulls etc)	5.5	2.4
Beef	Beef Cows	5.5	21.5
	Beef Dry	4.75	57.2
	Beef Replacements	4	14.4
	Other	5.5	6.9
Sheep	Breeding Ewes	1	67.6
	Sheep Dry	0.8	13.8
	Sheep replacements	0.7	5.9
	Other	0.8	12.7
Deer	Hinds	1.9	49.9
	Deer for Meat	1.8	30.2
	Stags for velvet	2.1	5.3
	Other	1.8	14.6

Table 1. Stock units (ewe equivalent) information from AgriQuality NZ Ltd. (Yearling cattle = 4.5s. u.). % indicates a typical mix.

1820	First recorded European visitor to the island Richard Cruise visits island, shoots birds and trades with Maori for pigs and potatoes	Cruise 1823
1820	Samuel Marsden and John Butler visit the island. Samuel Marsden climbs to the top of the island but does not mention the pa suggesting it may not have been in use at the time, Maori reported to be living there at this time tending cultivations	Elder 1932: 312–131; Stone 1982
1827	French explorer Dumont d'Urville visits island to obtain wood. Island is uninhabited	Wright 1950: 156-157
1840	William Brown purchases island from Ngati Tamatera chiefs	Deed of Sale 22 May 1840
1840	Brown and Campbell arrive on island and construct a 10 x 8 m timber and raupo house on the western flat	Campbell n.d. 197
1840	Apiha Te Kawau of Ngati Whatua meets with Captain Hobson to advocate for Auckland to be the new capital of NZ and offer Motukorea as a gift to the crown	Rickard 1985: 10
1840	Campbell returns to Motukorea with 60 pigs purchased from Ngati Whatua chief Te Kawau	Campbell 1881: 299
1840	Colonial government attempts to erect a flagpole on the cone. The idea was abandoned after Brown and Campbell protest, but not before a 2 m deep hole is dug near the summit.	Campbell 1881: 302–308
1840	Campbell leaves the island to set up a business in Auckland	Stone 1982: 88
1840	Brown returns to island, Campbell remains in Auckland as trader	Stone 1982: 88
1841	Brown leaves the island to join Campbell in Auckland	Stone 2006a: 1
1844	Crown grants title to William Brown	CT 364/284
1855	William Brown and his family leave Auckland to return to Britain	Stone 2006a: 2
1856	Campbell leaves Auckland and the firm Brown and Campbell is entrusted to a salaried manager	Stone 2006b: 1
1871	Campbell returns to Auckland to resume direct control of affairs the firm	Stone 2006a: 2
1872	Campbell proposes the dissolution of partnership	Stone 2006a:2
1873	Campbell buys out Brown's share of company including Browns Island for £40 000. Transfer of title to William Baker	Rickard 1985: 11; Stone 2006b: 2
1873	Transfer of title to John Logan Campbell	Rickard 1985:11
1879	Transfer of title to William Featherstone, of Devonport. Featherstones build ornate house on northwest side of island (probably in the vicinity of remnant fig trees)	Rickard 1985:11
1903	Transfer of title to Henry Bloomfield	Rickard 1985:11
1906	Transfer of title to Devonport Steam Ferry Company (Alison family of Devonport)	Rickard 1985:11
1908	Ferries abandoned on the island between 1908-1914	Maffey 1972; Auckland Harbour Board
1909	Banard brothers of Auckland carry out what appears to have been the first glider flights in NZ from the upper slopes of the cone	Brassey1996: 3

1915	Featherstone house burns down	Rickard 1985:11
1924	Brigantine *Defiance* abandoned near the barge landing	Brassey 1996
1946	Transfer of title to Auckland Metropolitan Drainage Board	Bush 1980
1954	Transfer of title to Ernest Davis	CT364/284
1955	Browns Island gifted to the mayor, councillors and citizens of Auckland Island becomes known as Davis Marine Park	NZ Gazette notice A 298561
1968	Browns Island becomes part of Hauraki Gulf Maritime Park management assumed by Department of Lands and Survey	NZ Gazette 20/6/1968 No.38: 1035
1972–3	Estimated date of the liberation of rabbits on Browns Island	DOC 014
1977	Gazetted as a Recreation Reserve	
1981	Small excavation carried out by Agnes Sullivan on stone rows	DOC 014-40
1983	NZHPT authority 1983/20 issued for stock fencing	DOC 014-40
1985	Archaeological survey by Department of Lands and Survey	Rickards 1985
1987	Archaeological survey by University of Auckland	Smith 1987
1987	Administration of Browns Island transferred to Department of Conservation	
1990	Conservation Law Reform Act 1990 abolishes Hauraki Gulf Maritime Park Board. Ownership reverts to Auckland City Council and management vested in the Crown	
1990	Island de-stocked for rabbit eradication	DOC 014-40
1991	R11/1563 excavated under authority 1991/4 to determine if it was Brown and Campbell's house site	DOC 014-40
1992	Rabbits eradicated from Browns Island	DOC 014-40
1994	Cattle used for two months to control rank pasture	DOC 1995a:3
1995	10 year partnership agreement between ACC and DOC to manage the island	DOC 014
1995	Browns Island draft Working Plan prepared	DOC 1995a
1995	Cattle used for two months to control rank pasture	DOC 1995a:3
1995	Rabbit fences removed	DOC 014-40
1995	1 year trial lease granted to Ron Richards to run a combination of sheep and cattle	DOC 014-01
1997	Browns Island draft Landscape plan prepared (based on 1995 working plan)	Hawley 1997
1998	Arborlab assessment of 27 heritage trees on the island.	DOC 014-40
2004	Archaeological records updated for upgrade programme	NZAA site records
2006	Landscape Heritage Assessment completed	Dodd 2006
2006	ACC Inner Gulf Island Archaeological Assessment completed	
2006	Last cow removed	

Table 2. Summary of historic reserach and archaeological investigation

Discussion

Until recently, not much consideration has been given to documenting stock damage in the New Zealand archaeological literature other than acknowledging that it occurs, and providing recommendations for its mitigation. One reason for this is probably the limited access to privately owned farms to monitor effects. Prickett (1985) compared 1950s aerial photography with 1980s field data in an attempt to gauge the effects of various types of site damage, including stock damage, and noted that while most sites suffered some stock damage it was difficult to isolate stock damage from other factors causing deterioration. Effects of cattle on stone structures have been documented at the Wiri stonefields by Sullivan, who noted that cattle have a tendency to cause breaches in free standing walls and low alignments, and pawing in cleared areas (Sullivan 1974: 130). More recent observations at Otuataua suggest that provided the stonefields are not overstocked and adequate feed is available, cattle prefer not to cross the stone alignments and mounds; and it is more often people attracted by the prospect of a better view who dislodge stones (Veart pers. com.). Site based case studies by Jones and Simpson have presented management solutions to stock damage (Jones and Simpson 1995: 47–55), and estimates of appropriate stocking limits have been offered in a subsequent publication (Jones 2007: 86–87, compare also stock unit guidelines outlined in Table 1). The recommended stocking of 50 yearling cattle on Browns Island (60 ha) equates to a stocking rate of 3.3 stock units per hectare (Hawley 1997), which is significantly lower than the maximum of 6-10 suggested by Jones (2007: 87–93), but when other considerations are taken into account, including restricting stock access to the steeper cone area, excluding cattle during the wet months and maintaining reduced rates to allow for the friable nature of the soils, the discrepancy is reduced. The damage caused by burrowing animals exacerbated by the restricted island confines has also necessitated lower stocking numbers. Where available, past observations of site damage at a given locality can provide useful indications of the extent that stocking density may need to be revised from the general rule of thumb. Unfortunately, local experience of a property's capacity to sustain stock is seldom documented for the purpose of establishing the best rate to maintain landscape features, but instead it tends to be orientated towards maximising economic gain or the ability to sustain stocking rates.

The destructiveness of the cattle and rabbit combination has been noted (Jones 2007: 68) but the national scope of this document means there is little assessment of local conditions. Erosion caused by cattle and rabbits on Motukorea was undoubtedly exacerbated by a combination of factors including the local soils, steeper slopes and wet weather. The island factor was

clearly another cause, with natural erosion along the coastal escarpment and an inability for rabbits to spread beyond the island boundary. The combination of cattle and rabbits on an island farm is also immediately apparent on nearby Motuihe. While typically not as steep as Motukorea, the soils of Motuihe are less friable and free draining, and the resulting cattle pugging combined with extensive rabbit burrowing has caused extensive damage to surface archaeological features and deflation of midden deposits. Prior to the island being retired from grazing in 2003, surface features of previously recorded archaeological sites located within the farm were barely visible except for those located in the fenced off bush remnants and coastal margin. Exceptions were the Te Rae-o-Kahu pa (R11/151) and hilltop pit clusters (R11/158, 159) which were fenced off to exclude stock and prevented more serious damage occurring.

Where publicly owned land is farmed under lease or concession there is an opportunity to gather information on the effects of stocking density at various places. Farming concessions are agreements between the managing agency and the farmer and can stipulate conditions on the lease. Monitoring of stock damage had been a requirement outlined in the working plan (DOC 1995a) and subsequent landscape plan (Hawley 1997) but the focus has been on reporting damage rather than gathering information about the effects of stocking at different rates. Should stocking resume on Motukorea in future, stock numbers and duration on the island would be useful information for future reference. Regardless of the conditions, it is important to remember the reason for keeping the reserve as an open space landscape, and that control of weeds or farming profits should be considered in the context of the preservation the intrinsic values of the landscape. Loose concession agreements have frequently caused unnecessary damage, either through wilfull exploitation of a poorly written agreement, or by failure to impart information on conservation values to the concessionaire.

Conclusions

The stocking arrangements for Motukorea require additional infrastructure and a flexibility that is likely to be better managed by contract rather than by concession, especially given the low recommended stocking rates for the island. Removing profit incentives for an external agency will also mean that preservation of the conservation values is given primary importance. Sheep are still the preferred option but require a significant capital expenditure to provide accommodation and facilities for shearing and drenching, and there may be difficulty getting this approved. However, an internally run farming operation such as that of Urupukapuka Island might achieve this by

ensuring that any profits go back into the operation and is eventually run on a scale sufficient only to maintain pasture cover and control weed invasion. In a wider Hauraki Gulf perspective, productive areas might also be used to off-set potential losses from unproductive areas. Cattle would probably still be required initially to suppress rank pasture and weeds, and to start the operation, but with the long term goal of reverting to sheep. Fortunately, with the removal of mice and rabbits, the adverse effects of cattle will be lessened. Ensuring that they are only run on the slopes during the summer and in limited numbers should reduce these effects.

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