

Examining the Dispersal of Domestic Chickens into and around the Pacific Before and After European Contact: A case study from the Santa Cruz Islands

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Introduction

A comprehensive investigation of potential agents and ports of introduction of chickens into the Santa Cruz Islands has never been undertaken before. While early European trade with the indigenous populations of the Santa Cruz Islands needs to be examined thoroughly, other instances of contact also extend our understanding of the history of human/chicken interactions. This study is unique in that it was extended to include contact with missionaries, slavers, traders and whalers, military vessels, World War II military shipments and secondments, aid agencies, as well as introductions by contemporary commercial chicken operations. In this brief review over 3000 years of chicken introductions and translocations are explored from first Lapita settlement through to the present. It would be impossible to detail every instance in which a chicken was introduced to or moved from an island but this overview illustrates the dynamic nature of the history of one domesticated animal in a Pacific archipelago and illustrates the complexity of human/animal interactions across the prehistoric/historic divide.

Archaeological and linguistic evidence supports the view that the Lapita peoples had a variety of plants and animals that were regularly moved from place to place and were included in what can be described as a transported landscape (Kirch 1997; Baldwin 1990). Initial studies have revealed that the transported landscape included a variety of plants and animals including; domestic or tamed pigs, dogs and chickens carried as part of the colonisation process (Oliver 1989).

Recent studies have revealed that the transportation of plants and animals into the Pacific by the Lapita peoples was significantly more complex than originally believed

(Matisoo-Smith 2007; Storey *et al.* 2008). Recent evidence does not support the view that there was a single unified conolonization package of plants and animals that the Lapita peoples brought with them during initial settlement (Baldwin 1990). These studies suggest that the plants and animals the Lapita people brought with them differed from island to island (Anderson 2009; Baldwin 1990; Giovas 2006; Intoh 1986; Kirch 2000; Storey *et al.* 2008; Wickler 2004).

Chickens were introduced to Near Oceania, by humans, before 3000 BP and yet their remains have only rarely been recovered from Near Oceanic archaeological sites (Storey *et al.* 2008). The earliest date for their introduction to the Pacific awaits direct attestation from the sites of Talepake-mali and Etakosarai in Mussau (Kirch 2001). It has been suggested that chickens were among the first animals introduced to new islands and served as the establishment species during the period in which surpluses that could support pigs and dogs were accumulated (Kennett *et al.* 2006).

Understanding human animal interactions requires careful consideration of the archaeological, historical, and ethnographic evidence. Chickens have been recovered from archaeological excavations in several islands of the Santa Cruz archipelago and were also introduced in the post-contact period. In prehistory a great deal of evidence, particularly of butchery, demonstrates that chickens were utilized as a food source (Steadman *et al.* 2002). Their bones were used for as raw materials for the production of objects such as musical instruments, and needles for tattooing and sewing (Rorrer 1998; Steadman 1997; Steadman *et al.* 2002). Chickens were also used in rituals during the ethnographic period (Baldwin 1990) and their feathers were used in the production of costumes (Baldwin 1990; Rolett 1998; Steadman 1997). In-depth studies of the archaeological distributions and ancient DNA signatures of chickens in the Pacific has been used to reconstruct some aspects of human colonization and later trade and exchange (Storey *et al.* 2007; Storey *et al.* 2008; Storey 2009; Storey *et al.* 2010) and we build upon those

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ideas in this paper. After initial contact with the Spanish, specific introductions of chickens can be identified using documentary evidence. Combined with data from the archaeological record the origins of chickens in the Pacific can be examined from first settlement, though the changes of the historic period, and to the present. Examining the archaeological and historical evidence allows us to speculate about the importance of chickens to different groups of people and also potential changes in cultural values related to poultry through time.

The dividing line between prehistory and history for the Santa Cruz Islands is AD 1595, when Alvaro de Mendaña arrived on the island of Nendö (Markham 1904). After this point ethnographic records are available to add to our understanding of how people were interacting with one another and with chickens in the protohistoric period and beyond. For example Graebner (1909) observed that the people of Santa Cruz rarely ate chickens, and never ate eggs. He suggested that this might be related to totemic affiliations with the domestic fowl. In the exogamous totemic system practiced on the islands social groups were tied to various animals including *kuli*, the dog, and *kio*, the chicken. Clan members were forbidden from eating their totem and husbands were required to respect the totems of their wives (Graebner 1909). Firth (1957) also noted an affiliation between birds and spiritual attitudes and linked this to the fact that few birds were included in the regular Tikopian diet. Graebner (1909) also noted the importance of chicken feathers in the construction of head-dresses.

This project began as the background investigation for a DNA study comparing ancient and modern chickens from the Santa Cruz Islands. It has been noted in several studies that the genetic patterns of modern domestic animals are part of a palimpsest assemblage and the underlying complexities must be understood to ensure that the genetic data is being properly interpreted (Jobling 2012). Therefore, it was important to explore all the potential agents of introduction for chickens to the Santa Cruz Islands from earliest settlement to the modern day before proceeding with the interpretation of modern genetic data from contemporary chicken flocks. However, as the research was being undertaken it became clear that the study had a much broader appeal and impact. Understanding the translocation of chickens in the prehistoric and protohistoric periods can help archaeologists understand the trade and exchange networks that involved the movement of domestic animals, and so tell us something about ancient human behaviour. Interactions between foreign visitors and indigenous groups are also of interest to archaeologists as well as historians and interactions in the early post-contact period in the Americas, involving the European transported landscape have been investigated by several archaeologists (Reitz and Scarry 1985; Deagan 1983; deFrance 1996).

Aid Agencies and Non-Government Organizations, such as the Food and Agricultural Organisation (FAO) now

work in developing countries to promote indigenous horticultural systems and farming. Aid groups are interested in ancient use of domestic animals, the sources of introduction of modern populations, their breeds, and the complex interactions of people with domestic animals both ancient and modern (Nonga and Keqa 2004). Therefore this study of the archaeological distribution of chicken remains and historic literature related to later introductions has much to offer. It may also serve as a case study for the sort of multi-disciplinary research necessary to document the introduction and translocation of domestic animals in Pacific Island environments.

Archaeological evidence for chicken in the outer Eastern Islands of the Solomons

The chicken was first introduced to the Outer Eastern Islands of the Solomon Island chain more than 3000 years ago. A directly dated chicken bone from Nenumbo demonstrates this occurred no later than 3150 to 2850 cal. BP [3047±25 yrs BP (NZA26177) ΔR of -81±64] (Jones *et al.* 2007; Beavan-Athfield *et al.* 2008). Contextually secure chicken bones have been recovered from multiple archaeological sites in the region, primarily during excavations carried out as part of the Southeast Solomon Islands Culture History Project.

Archaeological evidence from the Santa Cruz Islands

The Santa Cruz group is dominated by the main high volcanic island of Nendö and its small adjacent raised coral islands, Tömotu Neo and Tömotu Noi. The group includes the islands of Vanikoro, Banie, and Teanu as well as the island of Utupua (Fig. 1). In addition the Polynesian outlier islands of Anuta and Tikopia are also defined as part of the Santa Cruz group and have the distinction of being settled first by people carrying the Lapita cultural complex and later by Polynesians (~750 BP) (Kirch 2000).

In the Santa Cruz Island group, chicken bones have been recovered from a number of site assemblages. Chicken remains associated with Lapita style pottery dating from ca. 3100 BP to 2600 BP were found in sites SE-SZ-33 (Mdailu), Layer V and SE-RF-2 (the Nenumbo site) on the islands of Nendö. Chickens persisted into the Plainware period dating from 2600 to 1900 BP at Mdailu (Layers I, II and IV). The identification of chickens from these sites was undertaken by the late Alan Ziegler (2002) and supported by their subsequent examination at the University of Auckland by AS. Other possible chicken bones from Plainware, as well as the much later non-ceramic sites in this group await identification by Pacific avifaunal specialists (Doherty 2007).

Utupua and Vanikoro

Archaeological investigations of Utupua and Vanikoro are still in the preliminary stages. Decorated Lapita sherds have been recovered from submerged locations on one of the islands of Vanikoro (Galipaud and Foanaota 2005

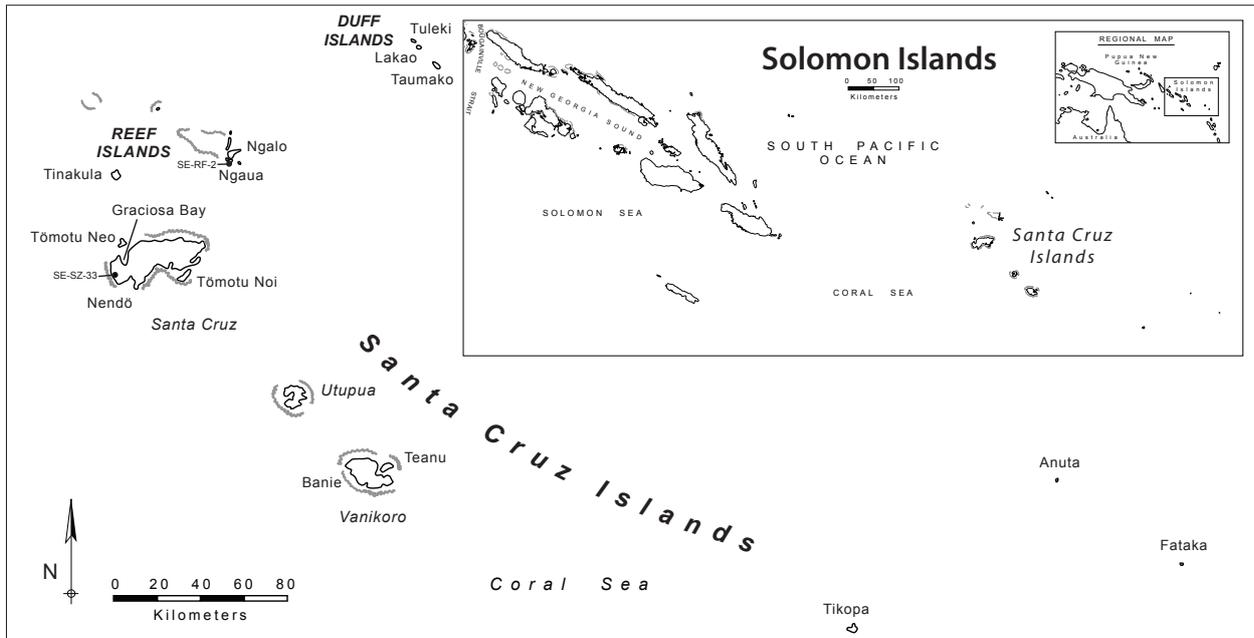


Figure 1. Map of the Santa Cruz Islands showing the main locations mentioned in the text.

(ms)), but the best documented archaeological assemblage was recovered from sites on the islet of Teanu particularly the Emo Dune site (VK-10) (Kirch 1983: 85–97). In that multi-layered site *Gallus gallus* was securely represented by eight chicken bones recovered from its earliest occupation. The lowest levels of the Emo site's stratigraphic units date to 1800 to 1900 years BP (Kirch 1983: 96). A single bone recovered from a later period of prehistory has so far only been identified as belonging to a Galliform and thus it is not clear if populations of chickens persisted past the early settlement phase (Kirch 1983:93).

Tikopia

The faunal remains from the excavations by Kirch and Yen (1982) in a number of sites on the larger island of Tikopia also yielded reliably identified bones of *Gallus gallus* from all three phases of the cultural sequence. These ranged in density from less than 0.5% to 1.1% of the total bones recovered. The earliest chicken bones occur in assemblages together with the Lapita ceramics of the Kiki phase dating from 2850 to 2050 BP. Small numbers of chicken bones also appeared in the following Sinapupu Phase which is dominated by potsherds from vessels of Vanuatu origin. Chicken bones continue to occur in the same low frequency in the non-pottery assemblages making up the Tuakamali Phase, a period strongly associated with the ancestors of its present day Polynesian speaking inhabitants. The cultural intrusion does not seem to have had a marked influence on the consumption of chickens. A continuous presence of chicken populations in Tikopia is likely to extend to at least 500 BP. The modern European contact period for that island began when Quiros arrived in AD 1606 (Kirch 2000; Kirch and Yen 1982). Unfortunately Quiros did not go ashore and therefore did not provide records of the fauna of Tikopia. As will be discussed in more detail

in the historic section of this paper there were no chickens on the island when Dillon arrived in the 1800s.

Anuta

The excavation of the coastal site of An-6 on the island of Anuta resulted in the recovery of bird bone from each of the midden layers, increasing in abundance through time. When the excavation report was published, Kirch and Rosendahl (1973) remained cautious and stated they 'were uncertain' about the presence of domestic fowl among the avian remains. More recent inspection of these faunal remains in the Bishop Museum collections has identified probable *Gallus gallus* bones in varying quantities from several test pit assemblages that are now awaiting confirming analyses. These should establish the presence of the chicken on Anuta by at least 2850 BP (Kirch 2000).

The Duff Group

The eleven islands of the Duff Group are in the Temotu province of the Solomons, located just northeast of the main Santa Cruz Islands. Very few excavations have been carried out in this region and none have yet been extended to the atolls. Excavations of the two main islands of Taumako and Lakao have been undertaken by Leach and Davidson (2008). No chicken bones were recovered from those excavations (Leach and Davidson 2008). However the absence of chicken bone in their midden samples is more likely to be due to the poor preservation of bone samples and not due to a true absence of the domestic fowl in prehistory. A habitation site dating to the early historic period, excavated by Leach and Davidson (2008), contained extensive marine shell but yielded only a meagre number of bone specimens, none of which could be identified as chicken.

Chickens were not present at the time Leach and Davidson (2008) undertook their research in Taumako but Spanish accounts place chickens on the island in A.D. 1606. Quiros specifically noted that ten cocks were killed and cooked for consumption during their stay in the Duffs but that the hens on the island were hidden away from the Spanish (Markham 1904). Fox (1917) provides further affirmation of the chicken's continuing presence in Taumako into the early 20th Century when he learned that the chicken in that island group in fact served as one of the island's clan totems and went by the indigenous name *kio*.

Interregional Contact and Exchange

People were very likely moving chickens between islands as they engaged in both regional and inter-archipelago exchange in formalized and opportunistic trading relationships. Local and long distance exchange has been documented in the archaeological and ethnographic record. For the prehistoric period in Santa Cruz Green (1996) has defined four levels of exchange and outlined the sorts of materials that moved within and between islands and archipelagos. These examples included, transport of obsidian from the Banks Islands to Taumako and Santa Cruz, as well as the importation of low levels of Furgusson Island and Talasea obsidian to Santa Cruz (Davidson 2012; Green 1996). Pottery was moved in quantity between Santa Cruz and the Reef Islands (Green 1996) and in the Sinapupu phase Mangaasi style ceramics appeared in Tikopia, along with other distinctive aspects of material culture with origins in Vanuatu (Kirch 1982). There is also good evidence for the movement of stone adzes from Samoa to Taumako (Davidson 2012) and from Vanuatu to Tikopia (Kirch 1982; Kirch and Yen 1982). Green (1996) has even suggested that some of the muscovite-garnet-schist found in Santa Cruz may have come from New Caledonia. In the Taumako assemblage there are also other exotics for which origins have not yet been established, thus providing tantalizing suggestions of contacts yet to be discovered (Davidson 2012). Strong evidence also exists to suggest contacts between the Solomons and the Caroline Islands in prehistory (Intoh 1998).

Few discussions of trade and exchange in prehistory include mention of commensals, although Kirch (1982; 1986) has examined the potential for novel introductions of plants and animals in both Tikopia and Vanikoro. He suggested that the *Canarium* almonds of Vanikoro may have been imported from Vanuatu and also speculated on the potential of a secondary introduction of mosaic-tailed rats from the Solomons in later prehistory. In addition he commented on a change in the types of anthropophilic land snails over time and linked this with the movement of plants. Kirch (1986) also surmised that Tikopians may have obtained pigs or at least pig meat from Vanikoro. The archaeological remains of commensals do not display morphological differences that might reveal their geographic origins and so it is difficult to document the potential for and directionality of movement of specific animals; such as pigs and chickens. However, given the

historical records that will be detailed in the next section, it is clear that at least in the protohistoric period the people of the Reef and Santa Cruz Islands considered chickens a trade item. It was something they regularly brought with them during interactions with Europeans which were specifically aimed at trade and exchange (for example see; Dillon 1829).

In order to understand the potential for prehistoric transfers of chickens, one must investigate the potential routes by which chickens may have been moved in prehistory; this is most easily done by examining the routes revealed through the transport of exotic artefacts to reconstruct trade relationships. The Santa Cruz Islands provide an excellent starting point to examine the utility of such an endeavour for the Pacific as trade and exchange relationships have been studied carefully by several scholars for the prehistoric, protohistoric, and ethnographic periods (Kirch 1986; Clark 2003; Green 1996).

Clark (2003) has carefully examined the trade and exchange relationships which are revealed by the study of the movement of exotic European artefacts from the wreck of La Pérouse's ships. He found that the historic artefacts moved more readily through less formalized opportunistic trade between Vanikoro and Tikopia, than they did through well established formal channels, including those that existed between Santa Cruz and Vanikoro. Clark suggested that the trade in red feathers between Vanikoro and Santa Cruz was separate from the feather money system and thus there was an institutionalized notion of what could be traded between certain islands and island groups.

Another potential source of chickens that will be difficult to distinguish archaeologically are drift voyages and accidental contacts between the Santa Cruz Islands, and Tikopia in particular, from a range of places in West Polynesia, including Rotuma, Samoa, 'Uvea and Tonga. Firth (1957) recorded oral traditions relating to such contact and revealed that Tonga was where one of the four chiefly lines of Tikopia was thought to have originated.

Documenting Sources for Post-contact Introductions of chicken to the Reef/Santa Cruz

There are many potential agents for the introduction of chickens to the Solomon Islands after AD 1595. In the post-contact period not only are chickens likely to have been moved by indigenous people but records exist for their translocation by foreigners. A detailed summary of the explorers and missionaries in the region is provided by Doherty (2007). Other potential agents of introduction include World War II Army regiments, international aid agencies often directed by the FAO, and commercial chicken suppliers who employ industrial style production to provide meat and eggs to the Solomon Islands and beyond. Each of these agents had the potential to initiate the movement of chickens in or out of the islands and these are often predicated by different motivational factors.

Chickens are described as 'native' and abundant across the outer eastern islands in accounts by 19th Century European visitors to the Solomon Islands. The earliest reports of native fowls were made by the Spanish when they arrived on the island of Nendö in the Reef/Santa Cruz Island group (Allen 1976). These were described as 'fowls of Castille' by Quiros (Markham 1904) and 'common barn door fowl' by Dillon (1829) and the descriptions may also imply that the descendants of the prehistoric chickens of Nendö were white in colour (Markham 1904; Burney, 1967 [1803]).

After the Spanish reports of the early 1600s no further mention is made of chickens in the Solomons for over one hundred years until Peter Dillon's 1827 account. The missionary and ethnologist, Rev. Robert H. Codrington observed that, in the decades immediately before A.D. 1891, 'the rapidity with which imported fowls have replaced the indigenous breed is remarkable' (Codrington, 1972:18). In the Solomon Islands the replacement seemed to have occurred in only thirty years and in ports commonly visited by European sailing vessels. He did note that there were still some fowl which he regarded as native on Santa Cruz in the late 1800s. Otherwise, Codrington was unable to recollect having seen native chickens except on on Lepers Island (Aoba, northern central Vanuatu) and Florida (the Nggela Island group) of the Central Solomons. However, since no archaeological evidence is available to suggest that chickens were ever successfully introduced to any of the main Solomon Islands (Storey *et al.* 2008) the attribution is questionable and backs up the statement made by local informants that 'there were no fowls in the Solomon's until white men came' (Codrington 1972: 18).

Explorers

There are many instances of potential interactions which may have resulted in the introduction of chicken to the Santa Cruz Islands by European explorers, even if the exchange of chickens between local populations and explorers were not expressly recorded. Due to their ubiquity in the ports frequented by European sailors chickens were not consistently recorded (Reitz and Scarry 1985). European explorers carried chickens in their holds as ready sources of protein and often exchanged them for local goods and then later restocked their ships in locales where supplies were sufficient. Confirmed incidences of contact between early explorers and indigenous people, as well as records relating to specific introductions of chickens to particular islands will be examined herein. In addition it was considered important to explore instances of contact in which the introduction of chickens was probable if not explicitly recorded. In many cases a close analysis of the records relating to voyages of discovery reveals that domestic fowl were picked up at various points and were often onboard the ships when they arrived in Santa Cruz. This provides a serious complicating factor in establishing the origins of particular flocks and it is important not only to record the trade to and from European vessels but also the likely origins of the birds that were traded from Europeans to the Cruzians in order to fully understand historic

and prehistoric interactions. In many cases it is likely that the Europeans were translocating Pacific chickens from archipelagos to the east and west to the Solomon Islands.

Of the forty eight instances of contact spread amongst the records of nine early European explorers in the Solomon Islands, only four records explicitly mention chickens on the Santa Cruz islands. These four mentions were found within the entries of Pedro Fernandez de Quiros and Peter Dillon (see Appendix 1 for a summary of the resources used in compiling this information). Quiros observed that chickens were present on the Duff islands and also noted the presence of chickens in Graciosa Bay on the Island of Santa Cruz. Quiros further recorded similarities between the chickens in the Santa Cruz Islands and those of the Solomon Islands proper (Markham 1904).

As well as noting the trade of chickens between explorers and the local populations Peter Dillon's account provides an example of the complexities involved in documenting the translocation of chickens in the post-contact period. In AD 1827 Peter Dillon took command of the *Research* to search for La Perouse and the *Astrolabe*. The *Research* and her crew were outfitted in Calcutta, India and sailed for Vanikoro. On its way the *Research* made stops in Australia, New Zealand, Tonga, Fiji, and Tikopia. In Tonga, Dillon traded with the locals on multiple occasions and received various items including a rooster. The *Research* also received fowls in trade from the Rotumans after a stop in Fiji. No chickens were recorded from trades with Tikopians and in fact Dillon (1829) was surprised enough to note it in his journal. He reported that fowl no longer existed on Tikopia due to intentional extirpation but that they were readily available on neighbouring islands. Upon arriving in Vanikoro Dillon and his crew received 'barn door fowl' from some of the 180 canoes that surrounded the *Research* (Dillon 1829). Unfortunately this morphological description provides little assistance in reconstructing the potential breeds of chicken that may have been on the island at the time. The term barn door fowl was commonly used in the 1800s to describe mongrelized fowl of no specific breed or type (Tegetmeier 1867).

Missionaries

Voyages to the Santa Cruz Islands by missionaries to convert the local populations to Christianity are also an important potential source for the introduction of plants and animals to the islands. While records of the frequent and repeated instances of contact were detailed, the supplies with which each ship was equipped were not recorded. In addition the choices they made regarding the stock that they took to islands were also not explicitly stated. However, various possibilities exist beyond simple subsistence, including the use of food supplies for trade, as an incentive for people to convert to Christianity, or simply because it was an animal to which they were accustomed. Missionaries, unlike explorers or traders, often intended to stay in one village for several years and so were likely to bring supplies to facilitate extended residences in the islands, as

opposed to shorter sea voyages between the continents. Contemporary Missions still contribute significantly to local diets, along with schools they are estimated to produce 20% of the chickens consumed by local communities in the Solomon Islands (Nonga and Keqa 2004). Thirty-two instances of contact between missionaries and the local peoples were examined for mention of chickens, and four of those mentioned chickens across a number of years (see Appendix 1).

The records of the Missionary ship *Southern Cross* provided multiple entries which refer to the trade of chicken between the ship and natives of the Santa Cruz Islands. In 1864 Codrington was offered 'native fowls' for trade (Codrington 1972 [1891]). Several years later aboard the same ship Beattie recorded in his personal diary in 1906 over 100 canoes surrounding the *Southern Cross*. Chickens were prominent on the canoe platforms and were offered in trade for tobacco. Beattie notes that the tobacco was so valued by the natives that they would dive into the water to retrieve the smallest amount that the missionaries would throw into the water (Beattie 1906). Writing in 1908 O'Ferrall also recorded the trade of chickens, coconuts, and bananas as well as decorative items for the tobacco brought by the Missionaries (O'Ferrall 1908).

Cecil Wilson's 1901 visit to Graciosa Bay documented two very interesting instances of trade between indigenous people and the missionary ship *Southern Cross*. Wilson records that while on land and visiting a local village he and his men were able to trade tobacco for so many chickens that they were able to fill the hold of their ship (Wilson 1932). Wilson also wrote that on their canoes 'they carried small fowls, like Bantams, for sale at two sticks of tobacco each' (Wilson 1932). Bantams are a miniature breed of chickens which are thought to have been named for the port city of Bantam of Indonesia (Dickson 1853). These particular birds may have proved more popular with European sailors for stocking their ships due to their diminutive size. Therefore, the chickens in Santa Cruz in the early twentieth century may have actually been Indonesian varieties or had at least cross-bred with more recently introduced breeds of fowl from Southeast Asia.

The attribution of Bantam to the fowl of Nendö strongly suggests a new source population as small fowl were not reported by previous visitors. Archaeological remains of chickens introduced by the Spanish to Florida are also notably smaller than full sized chickens. Reitz and Scarry (1985) found the dimensions of the Spanish chicken bones to be most like Brown Leghorn bantams, which also provides evidence that the bantam varieties Wilson saw in 1901 were not native birds.

Traders, whalers, military vessels and slave ships

A number of trading, whaling, military and slaving vessels visited the Santa Cruz Islands after their first discovery, and for this reason the trade between these ships and

Santa Cruz islanders needs to be considered as an agent of introduction. A study of shipping movements in the Pacific between late 18th and mid 19th century reveal that the most frequent visitor to many of these islands were whaling vessels from New England (Scrimgeour 1983). Trading was important for island communities of the Pacific as well as the whalers and conflict between the two groups was rare, due to the mutually beneficial nature of the trade relationship (Gray 2000). While several instances of trading were recorded, the details of the supplies traded were not. Whalers worked in the area around the Solomon Islands each year and the ships were at sea for up to three or four years at a time making resupply necessary from local ports (Scrimgeour 1983). Chickens were regularly traded with whalers who landed in New Guinea and the records indicate that whalers voyaged between New Guinea and Malatia following pods of whales (Gray 1999), suggesting that New Guinea stocks may have been traded into the main Solomon Islands. Since neither New Guinea nor the Near Oceanic Solomons are known to have had chickens in the prehistoric period (Storey *et al.* 2008), this trade may have facilitated their first introduction to the region. The movement of chickens may be better recorded in the Americas than in the Pacific, but can be used as an indicator of likely behaviour. For example McGrew (1921) reported that Spanish sailing vessels 'landing with a surplus stock of fowls were willing to dispose of them and taken on a new supply that would be better able to stand the strain of the return trip.' In fact ships Captains (both naval and commercial) were considered such authorities on the global varieties of chickens they were given status as honorary and corresponding members of the New England Society for the Improvement of Domestic Fowls in the 1850s (Bennett 1854).

Slave ships also operated in the Solomon Islands recruiting or kidnapping people to work in the sugar cane fields of Queensland. The ships would have required supplies for the journey but records relating specifically to the supplies taken on board were not recovered during the research phase of this project. It is, like the supplies on board whaling and trading vessels, an important avenue for future investigation in examining the impact of the European transported landscape on Pacific society in the early historic period. The nature of the slaving industry has left few detailed records, which create gaps in the knowledge of the interactions between the slavers and Pacific island populations.

Sixty-five instances of contact between traders, whalers, military vessels, slave ships and the local peoples were examined for possible instances of introduction, and three of those records mentioned chickens (Appendix 1). On 2 December 1871 the military vessel HMS Rosario traded chickens with the locals in Byron Bay (Doherty 2007). Also in 1871 the HMS Basilisk purchased two chickens from the locals in Carlisle Bay and Brenchly, on board the Curacoa, also traded chickens with the locals in 1865 (Doherty 2007).

World War II

The Solomon Islands campaign of World War II commenced in January 1942 and continued until August 21 1945, therefore the potential for the introduction and transportation of live chickens by Allied and Japanese forces also needs to be considered. Several Allied and Japanese garrisons were set up within the Solomons and there was substantial inter-island movement of men and supplies by both forces during this period (Thomson 2000).

The movements and number of the respective fleets of the Allied and Japanese forces involved in the campaign of the Solomon Islands are well documented and the potential for chicken to be introduced into the Solomon Islands were numerous (Marshall 1992). The Japanese forces were resupplied on a nightly basis. These supplies of food and ammunition were brought from the neighbouring islands of the Pacific as well as from Japan. The Japanese ships were known as the 'Tokyo Express' and mainly consisted of fast battle ships from the 8th fleet based in Rabaul, Bougainville, and Truuk (Coombe 1991). The Japanese soldiers valued chicken as a food item and a series of incidents are documented in which Japanese soldiers traded cigarettes for chickens and on other occasions the Japanese stole domestic fowl and either took them to other islands or killed and ate all of the chickens in the village (White and Lindstrom 1989).

The allied forces are less likely to have been agents for the introduction of exotic chickens to the Solomons, as live chickens were considered too bulky to be shipped to the troops and supplies of pork and mutton were the preferred stock for overseas garrisons (Squier 2011). Eggs were a different story, and the techniques for the production of dried eggs for shipment to the troops considered crucial to the war effort. Chickens could be requisitioned to provide food for soldiers and this was done in 1943 in the continental US (Squier 2011). This is also likely to have occurred on islands in which military were installed for longer periods of time. Allied forces had a detachment of Catalina's operating in the Santa Cruz area and these men were supplied by the USS Mackinac and the USS Ballard (White 1989). As well as the multiple entry points of regular supply by ships Allied and Japanese forces also had permanent garrisons of troops on Guadalcanal and Tulagi (Wiest and Mattson 2001) which involved thousands of men (Hammel 1998). The introduction or movement of chickens by the military likely fed into the indigenous trade and exchange networks documented in the ethnographic period, including opportunistic and formalized trade relationships which served to disperse them even further.

The modern chickens of Reef/Santa Cruz

It has been reported that contemporary flocks of village chickens are left largely to fend for themselves and fed scraps occasionally to prevent them from going feral. Eggs are not eaten and rarely collected, but when collected are typically set to lay under tame hens. Hens also frequently

lay eggs in the bush and chick mortality is high due to predation from dogs and hawks (Jansen *et al.* 2006). The FAO's Domestic Animal Diversity Database (DAD-IS <http://dad/fao.org/>) currently lists eight distinct chicken breeds as extant in the Santa Cruz Islands. These are Ancona, Australop, Hampshire, Malayan Game, Rhode Island Red, Santa Cruz Wild Fowl, Temotu Wild Fowl, and Village chicken. The first five are listed only as imported exotic species, although breed pedigrees can be examined in more detail in the American Standard of Perfection (American Poultry Association 2001). Santa Cruz fowl are classified by DAD-IS as an autochthonous breed, most likely introduced by Mendaña in AD 1568; however there is no evidence in the historical accounts to support the introduction of chicken into Santa Cruz by Mendaña in 1568. Village chickens are listed as a mixed lot of birds whose origins cannot be ascertained. These are assumed to be the progeny of many different flocks of chickens introduced from 3000 BP onwards to the present. There is no information provided at all with regards to the origins of Temotu wild fowl.

Aid agencies and non-government organisations (NGOs)

Aid agencies are another source for the introduction of chickens to the Santa Cruz Islands in the more recent past. Two factors motivate the Aid Agencies and NGOs. The first is the immediate relief of natural disasters, and the second is the bolstering of local economies through stimulating production. In the 1950s and 1960s the perception was the local chickens were inferior to commercial breeds and NGOs acting on behalf of the FAO imported foreign breeds of chickens to developing countries. Unfortunately these breeds were developed to utilize special diets and the impact of and low quality feed and local diseases often left these chickens and their descendants ill equipped to cope with life on tropical Pacific islands (Jansen *et al.* 2006). In contemporary times hybrids can be vaccinated against several known diseases affecting poultry but this was not so in early periods.

A particularly striking example of the change in attitude to animals through their introduction by Aid Agencies is that of Tikopia. The localized extirpation of chicken in Tikopia was reported by Dillon in both 1813 and 1827 (Dillon 1829; Firth 1959). Just when the prehistoric populations of chicken disappeared in Tikopia remains uncertain, although some island residents suggested the demises was due to predation on the crops by fowl (Firth 1959; Dillon 1829). Chickens were reintroduced to the island on several occasions as aid after natural disasters. Rivers (1914) had been informed by John Maresere that they had been reintroduced in the early 1900s and another group were brought to the island after a severe hurricane devastated Tikopia and created serious food shortages at the beginning of 1952 (Feinberg 1981). No records have been located which identify the sources of these chickens and Feinberg (1981) provides no further information. However, some descendants of the 1952 flock were also taken to Anuta.

The acceptance of chickens back into the cuisine and social world of Tikopians provides a striking contrast to the pests purposefully eradicated from the island in an earlier period. These reintroduced fowl were served with coconut cream and reserved for important ceremonial occasions (Feinberg 1981; Firth 1957). Is this a reflection of their status as a gift in a time of need? Why did the Tikopians change their attitudes to chickens in the recent past? Perhaps it was due first to necessity but later to the importance placed on them by foreigners.

The Department of Agriculture has actively encouraged the importation of foreign dual purpose breeds, including Australorps, Rhode Island Reds, New Hampshires, and Anaconas, to the Solomon Islands and disseminated these throughout the archipelago (Jansen *et al.* 2006). The European Union (EU) is known to have introduced commercial broiler stocks to the Solomon Islands in the last fifty years (Jansen *et al.* 2006). Hybridized broilers and layers are often common in Solomon Island village chicken flocks. Documented introductions of chickens to the Solomons are known from New Zealand, Australia, and China (Nonga and Keqa 2004). It has also been reported that several populations of village chickens have been crossed with an Australian chicken breed, the Australop, in order to improve productivity (Martin and Epstein 1999). However, other reports suggest that attempts to cross breed 'wild' chickens and domestics have been unsuccessful (Nonga and Keqa 2004) and so it is not clear which individual chickens are of mixed ancestry and which are not. Identifying pedigree is also problematic as many crosses are likely to occur naturally and are not observed by Aid Workers during short term visits.

Commercial Chicken Operations

Industrial style intensive poultry production was introduced to the Solomon Islands in the early 19th Century (Jansen *et al.* 2006). Until the social unrest in the Solomons resulted in the destruction of the commercial chicken operations for broilers and layers these were located almost exclusively near Honiara in the main Solomon Islands. However, sales of live produce were made to local farmers on Guadalcanal and had the potential to introduce European commercial lines to the outlying islands as local farmers on Guadalcanal were then free to pass on their chicks to other consumers. Currently there are no commercial operations active in the Solomons and most of the chicken market relies on imports, such as day-old chicks from New Guinea (AUSAID 2004).

Discussion and Conclusions

The literature review presented here demonstrates the dynamic nature of commensal animal movements throughout Pacific islands, as exemplified by the movement of chickens in and out of the Santa Cruz Islands over 3000 years. This information may be used by a variety of scholars and is particularly enlightening in cases where modern distributions, morphological characteristics, or genetic

signatures are presumed to reflect prehistoric populations. The modern DNA of several Pacific domesticates, including pigs (Gongora *et al.* 2004; Lum *et al.*, 2006) and chickens (Dancause *et al.* 2011) have previously been used in an attempt to infer prehistoric colonisation and later trade and exchange. This review clearly demonstrates some of the potential pitfalls in employing such an approach.

The introduction of domestic animals to Pacific islands resulted in the movement of chickens from Southeast Asia into the Pacific from earliest settlement though to the recent past. This may cause problems with differentiating proximate and ultimate origins of modern flocks. In addition non-Pacific sailors, missionaries, commercial interests, and Aid Agencies have moved chickens within the Pacific further complicating prehistoric signatures that may be retained in modern flocks. This suggests that only through the use of well controlled temporally relevant and directly dated chicken bones for DNA analyses can a better model of past migration and interaction be constructed. This may then be compared and contrasted with the DNA profiles of contemporary flocks for a broader understanding of their origins. In addition the application of modern DNA to ancient questions must include sufficient background material to demonstrate a firm grasp on potential issues of later introductions. Without this such studies are likely to be flawed and should not be readily incorporated into archaeological reconstructions of the past. This is an even greater concern when only short stretches of mtDNA are targeted for studies of modern populations. It has recently been suggested that these are insufficient to distinguish ancient, historic, and modern chicken lineages in contemporary Pacific flocks (Storey *et al.* 2012). The appropriate application of DNA to answering the sorts of questions about interaction networks that archaeologists are interested in may lie in the future as the chicken genome is decoded and the technology becomes available to reliably extract and amplify nuclear DNA from ancient Pacific samples and modern chicken populations.

This study goes well beyond a cautionary tale aimed at exemplifying the dynamic nature of the movement of animals in the post-contact Pacific and the confounding effect this is likely to have on the interpretation of modern DNA signatures. The literature review also highlighted some interesting cultural changes associated with the trade and exchange of common objects with new partners. As was illustrated by the Tikopian case, animals that were purposefully excluded from the economy in prehistory may be reintroduced and take on important ceremonial roles in the present. In addition the preliminary evidence also seems to suggest a relationship between trade in chickens and tobacco in the Santa Cruz Islands. Trade both with missionaries in the early twentieth century and during World War II seems to have involved the exchange of chickens for tobacco and cigarettes. Further study is needed to confirm or refute this association. It is also interesting to note that in modern Santa Cruz eggs are rarely eaten (Graebner 1909; Jansen *et al.* 2006). Graebner (1909) had suggested almost a century earlier that such a prohibition on chick-

ens and eggs could be linked to totemic associations but the heavy Spanish influence in the early history of Santa Cruz may also have a role to play. The Spanish demanded hens and eggs as tribute in both Philippine and South American colonies (Caudill 1975; Newson 2009). While this has not yet been documented specifically in the Santa Cruz islands it is worthy of further investigation and may reflect a shift in cultural values due to foreign influence and not the persistence of a prehistoric belief system.

The use of chickens and their importance to humans will be of particular interest to Aid Agencies who now aim to augment existing horticultural systems to bring about effective grass roots changes to productivity in developing countries. Aid Agencies will also benefit from an examination of the many potential ports and agents of introduction in trying to determine the ancestry of contemporary village chicken flocks. This will be very important in making decisions about what to introduce, what to conserve, and what to eradicate. This is the sort of information that can be used to supplement the DAD-IS database and to consider which types of chickens fare better in free-ranging village agricultural systems and thus will bring the greatest benefit to contemporary Solomon Islanders.

This paper does not represent a comprehensive list of chicken introductions to the Santa Cruz Islands. It seems unlikely that one could ever be assembled due to the sporadic reporting of chicken transfers by all potential historic agents. However it does exemplify how in a few short months of intensive research the overlapping waves of commensal introductions and transfers can be documented. This is not an exercise out of reach of any scholar assembling a study of contemporary plant and animal communities in the Pacific and more detailed information about post-contact interactions in the Pacific is sure to shed even greater light on prehistoric economies, cultural practices, trade relationships, and how new interactions bring about cultural change.

Acknowledgements

This paper is part of a much larger project that was initiated by two studies at the opposite end of the chronological spectrum. The first was a linguistic study led by Professor Roger Green who assembled much of the archaeological data in this paper. The second is a genetic study, inspired by the study of, and desire to conserve, the native fowl of Santa Cruz by Russell Parker. We are grateful to Dr. Martin Gibbs who was an invaluable asset in assisting SH with his historical inquiries as was Moira Doherty's PhD Thesis. Thanks to Kim Newman for the preparation of Figure 1. We would also like to acknowledge Professor Elizabeth Reitz for email discussions about the European transported landscape in the Americas. As always a hearty thank you is due to Valerie Green for her numerous contributions in the evolution of this study over many years and many revisions.

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APPENDIX

This appendix was assembled to show the resources that were consulted in the preparation of this document. Documents that contain accounts of chickens are discussed in the main text, however, resources which did not mention chickens were also important to acknowledge. They are provided here to ensure that future scholars do not replicate these efforts in compiling a more complete picture of post European introductions.

European Explorers

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