How to explain Polynesian Outliers' heterogeneity?

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Abstract

Eighteen islands or localities, distributed across Micronesia and Melanesia, are identified as Polynesian Outliers. Their current populations display Polynesian linguistic and cultural features. Linguistics, ethnography and archaeology have questioned the modalities of their formation. Rather than focusing on long-distance voyaging and migrations of Polynesian people into the Micronesian and Melanesian regions, we synthesised archaeological and biological data, the latter frequently omitted from this type of analysis, from the regions in question. While cultural remains show sporadic evidence of external contacts, biological data display a North-South cline emphasising a decrease of Polynesian affinities from Micronesia to South-Melanesia. We propose several hypotheses of patterns of interaction at different scales, considering various dynamics of encounters between the arriving and pre-existing populations, likely influenced by the size of the groups in contact.

Keywords: Polynesian human migrations, Interaction networks, Settlement history, Pacific Islands, Polynesian Outliers

Résumé

Dix-huit îles ou localités, situées en Micronésie et Mélanésie, sont identifiées comme étant des Enclaves Polynésiennes. Aujourd'hui, leurs populations présentent des traits linguistiques et culturels polynésiens. Les disciplines de la linguistique, de l'ethnologie et de l'archéologie ont interrogé les modalités de leurs formations. Plutôt que de s'intéresser aux sens des migrations effectuées par des groupes Polynésiens dans les régions de Mélanésie et de Micronésie, nous proposons ici plusieurs modèles d'interactions à différentes échelles spatiales à partir de synthèses de données archéologiques et de données biologiques qui sont fréquemment omises. Alors que les assemblages archéologiques des Outliers indiquent des contacts extérieurs sporadiques, les données biologiques humaines révèlent un gradient Nord-Sud selon lequel les affinités biologiques polynésiennes décroissent de la Micronésie à la Mélanésie du Sud. Ces modèles prennent en compte la diversité des dynamiques de rencontres entre une population migrante et une population déjà installée, probablement influencées par la taille des groupes.

Mots-Clés : Migrations humaines polynésiennes, Réseaux d'interactions, Histoire de peuplement, Iles du Pacifique, Enclaves polynésiennes

Introduction

Buck (1938) was probably the first to list the 18 Polynesian Outliers which are the ones most commonly recognised currently. 'Polynesian Outliers' is a general term used to designate islands

or localities on the windward sides of islands in Micronesia and Melanesia where human societies speak a Polynesian language, have a Polynesian kinship system and a wide range of Oceanian biological characteristics (Feinberg and Scaglion 2012). Since the 19th century, the question of the mechanisms of formation of these Polynesian entities has been a matter of debate. Were they 'relics' of a Polynesian settlement, as postulated by Churchill (1911) and Capell (1958), and restated more recently by Wilson (2012, 2018) and Hudjashov *et al.* (2018)? Or were they the products of 'backward' migration(s) originating from Polynesia into Melanesia and Micronesia, as claimed by Thilenius (1902) and Buck (1938), and a number of authors today (e.g. Kirch 1984; Carson 2012)?

Adopting the view that Polynesian Outliers result from East to West migration(s) and installations of newcomers in regions already occupied by pre-existing groups, we discuss the role of interactions with neighbouring Melanesian and/or Micronesian human populations in the Outliers formation. We emphasise the significance of a model including multiple Polynesian arrivals over the scenario of a single arrival evolving locally, based on archaeological and biological data (skeletal, genetic, genomic), and hypotheses of patterns of settlement at different scales which illustrate various situations of interaction and exchange. While cultural remains do not appear to co-vary and highlight unclear and sporadic evidence of external contacts, biological data, recorded on ancient and living populations, emphasises a North-South cline in which Polynesian affinities decrease from Micronesia to South-Melanesia.

On the heterogeneity of archaeological records

Figure 1 presents the geographical location of the 18 better documented Polynesian Outliers. Table 1 provides a summary of their geomorphology, chronology of occupation and an estimation of the time of arrival of Polynesian populations. Polynesian Outliers are generally divided into two linguistic subgroups: a Northern Polynesian Outliers group (with populations speaking Ellicean languages similar to those from Tuvalu and Tokelau) and a Southern Polynesian Outliers group (using Futunic languages analogous to those of East Uvea and East Futuna) (Wilson 1985; Marck 1999). In this paper, we decided to group the Polynesian Outlier islands into four groups according to their geographical location and their relative proximity to one another, in an attempt to better characterise the nature of their differences. Our four groups are the following: the Micronesian group comprising Kapingamarangi and Nukuoro; the Northern Solomon group with Takuu, Ontong Java, Nukumanu, Nukuria and Sikaiana; the Southern Solomon group with Pileni, Anuta, Taumako, Rennell, Bellona, Tikopia and the Southern group with Emae, Mele-Ifira, Aniwa, West-Futuna, and West-Uvea.

Archaeological endeavours have been undertaken on some Polynesian Outliers, while others such as the Northern Solomon Outliers remain under-researched (Table 1). Kirch (1984) and Carson (2012) propose syntheses, showing no clear correspondence between the archaeological sequences of each group of Outliers, and suggesting different histories of human migrations and settlements. However, a number of dates still need to be revised and more archaeological excavations must be undertaken in order to better define the timing and nature of occupation of several islands and localities.

Considering the possibility that the Micronesian atolls were not shaped before 2000 BP (Dickinson 2001, 2003), Micronesian Outliers appear to have been first occupied temporarily around 1000 BP or before. Kapingamarangi was intensively settled between 300 and 100 BP (Leach and Ward 1981) following a transient occupation period between 1000 and 700 BP. The site of Nu-6 on Nukuoro provided similar dates with a continuous occupation from around 1200-1100 BP to the present (Davidson 1992). However, because of her observation of similarities between Nukuoro and surrounding Micronesian island cultural assemblages, Davidson maintains that the Polynesians were not the first colonists but remains uncertain as to when Nukuoro became 'Polynesian'.

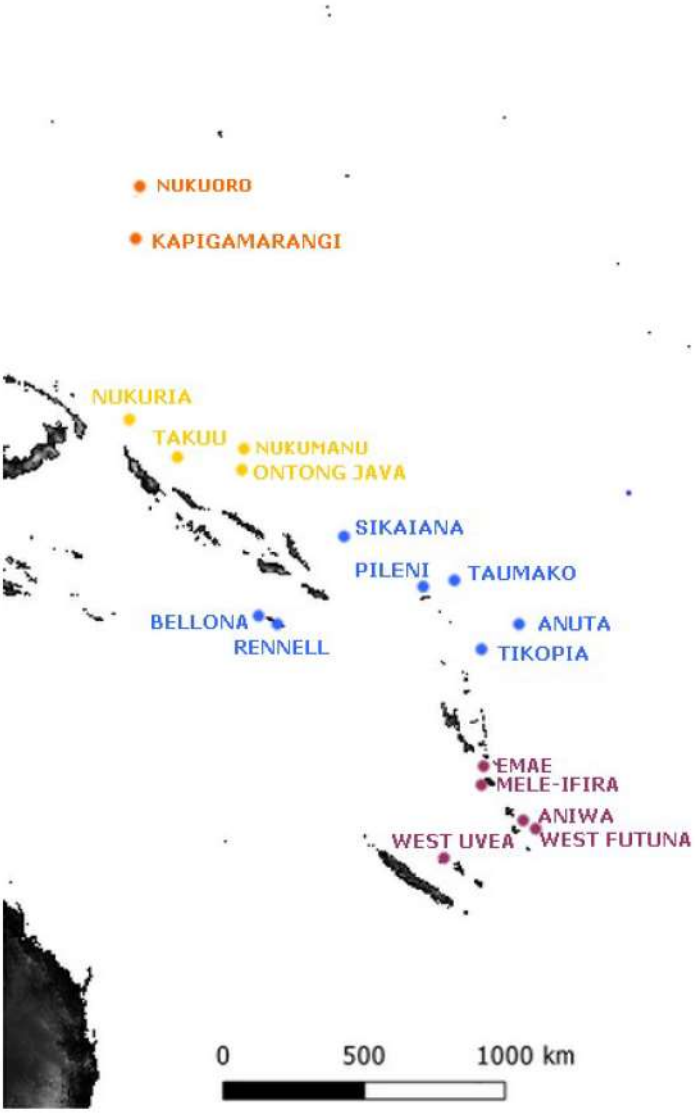

Figure 1. Geographical distribution of 18 Polynesian Outliers.

The Southern Solomon Outliers like Tikopia were first occupied at 2996-2719 BP by people making the calcareous tempered ceramics of the Kiki phase (which includes dentate-stamped Lapita) found at the TK-4 site (Kirch and Swift 2017: 326). Taumako was settled at the early date of 2602 BP with the site of Ana Tavatava. Dentate-stamped Lapita sherds were found in association with this site (Leach and Davidson 2008). The first occupation of Anuta occurred around 2793-2356 BP at the AN-6 site and the ceramic style is similar to that of the Kiki phase of Tikopia, although without evidence of dentate stamping (Kirch and Rosendhal 1973). These settlements correspond to early arrivals of human groups carrying a specific material culture associated with the Lapita Cultural Complex (Kirch 2017: 143; see also Sheppard 2011). Rennell and Bellona provide somewhat later dates with an initial occupation reported around 2000 BP (Chikamori and Takasugi 1985; Poulsen 1972). The Polynesian occupation of Tikopia is dated to 830-738 BP (Kirch and Swift 2017). Associated with the Tuakamali phase, it is characterised by the presence of trolling lures and basalt adzes of distinctively Western Polynesian form. On Taumako, possible Polynesian intrusions are associated with the Namu period dated to 950-150 BP (Leach and Davidson 2008). The Polynesian arrival on Anuta is indicated as dating to around 400 BP (Kirch 1982). The Polynesian occupation would postdate 950 BP on Rennell (Chikamori and Takasugi 1985), which is consistent with dates provided by the oral tradition encompassing 700-500 BP (Roberts 1958).

Island Groups	Polynesian Outliers	Island Type	Language Subgroup	Oldest occupation currently known	Polynesian arrival (estimated)	Cultural Sequence	References
Micronesian	Nukuoro	Atoll	Ellicean	1200 BP	1000 BP?	Undetermined	Davidson 1992; Carroll 1965; Lieber and Dikepa 1974
	Kapingamarangi	Atoll	Ellicean	1000 BP	300-100 BP?	Sporadic and continuous from 300 BP	Leach and Ward 1981; Elbert 1949; Emory 1965; Marck 1997; Wilson 1985
Northern Solomon	Nukuria	Atoll	Ellicean or (NO-EPN)	NO DATA	NO DATA	NO DATA	Pawley 1967; Wilson 2012, 2018
	Takuu	Atoll	Ellicean or (NO-EPN)	NO DATA	NO DATA	NO DATA	Pawley 1967; Wilson 2012, 2018
	Nukumanu	Atoll	Ellicean or (NO-EPN)	NO DATA	NO DATA	NO DATA	Pawley 1967; Wilson 2012, 2018
	Ontong Java	Atoll	Ellicean or (NO-EPN)	NO DATA	NO DATA	NO DATA	Pawley 1967; Wilson 2012, 2018
Southern Solomon	Sikaiana	Atoll	Ellicean or (NO-EPN)	NO DATA	NO DATA	NO DATA	Pawley 1967; Wilson 2012, 2018
	Pileni	Fragment of raised atoll	Ellicean	NO DATA	NO DATA	NO DATA	Pawley 1967; Bayard 1966
	Taumako	Volcanic Island	Ellicean	2602 BP	post 950 BP	Continuous	Pawley 1967; Leach and Davidson 2008
	Anuta	Volcanic Island	Ellicean	2793-2356 BP	Around 400 BP	Hiatus (1450-1370BP) Continuous from 450 BP	Pawley 1967; Kirch 1982; Feinberg 1989
	Tikopia	Volcanic Island	Ellicean	2996-2719 BP	830-738 BP	Continuous	Kirch and Yen 1982; Kirch and Swift 2017; Pawley 1967
	Rennell	Raised Coral Island	Ellicean	2000 BP?	Post 950 BP?	Continuous	Chikamori and Takasugi 1985; Elbert 1967; Roberts 1958
	Bellona	Raised Coral Island	Ellicean	2000 BP?	Post 950 BP?	Continuous	Poulsen 1972; Roberts 1958
Southern Outliers	Emae	Volcanic Island	Futunic	NO DATA	NO DATA	Undetermined	Garanger 1972
	Ifira	Islet and adjacent costal area of Efate	Futunic	1090 BP?	450-250 BP?	Undetermined	Shutler 1968; Garanger 1972
	Mele	Islet and adjacent costal area of Efate	Futunic	325 BP?	325 BP?	Undetermined	Shutler 1968; Garanger 1972
	West Futuna	Raised coral Island	Futunic	1180-1060 BP?	In-building data	Undetermined	Shutler 2002; Flexner *et al.* 2018
	Aniwa	Raised coral Island	Futunic	630-490 BP?	In Building data	Undetermined	Shutler 2002; Flexner *et al.* 2018
	West Uvea	Atoll	Futunic	ca 1780 BP	950-850 BP	Continuous	Carson 2002

Table 1. Summary of archaeological data for 18 Polynesian Outliers.

The Southern Outliers seem to have been settled after the Southern Solomon Outliers. Currently, the first known occupation of West Uvea is indicated by a temporary camp on Muli Islet (West Uvea), at the LUV030 site where a combustion feature is dated to 1780 BP and permanent human occupation (with finds including pottery, flaked lithic material, one shell armband, one fishhook), is interpreted as being associated to the Polynesian arrival, and dated to 1260 BP (Carson 2002). West Futuna provides evidence of human activities at 1080-1060 BP in the coastal area of Sinou (Flexner *et al.* 2018) and a burial, uncovered in the filling of a funerary rock-shelter (FURS 12), has provided a date of 1640 BP (date on human bone, Shutler *et al.* 2002), recently re-dated to c. 1100 BP (Posth *et al.* 2018). Recent excavations on Aniwa, at the coastal site of Iatoto, provided evidence of temporary occupations around 630-490 BP (Flexner *et al.* 2018). However, we expect that further investigations will confirm first settlement on Futuna and Aniwa sometime during the third millennium BP as has been demonstrated on the nearby and intervisible islands of Aneityum and Erromango (Bedford 2006; Bedford *et al.* 2016).

On-going research issues associated with the Outliers'

Polynesian Outliers are generally poor in material culture and are exposed to specific environmental conditions. This situation explains the difficulty, mentioned by several authors (e.g. Davidson 1992; Bayliss-Smith 1974), in identifying a Polynesian occupation and detecting evidence of human intrusions on uninhabited or previously occupied environments. Three classes of archaeological data are indicative of external contacts: exotic materials; artefacts showing exotic stylistic features; non-local animal and vegetal remains (Kirch 1986: 37). However, Polynesian Outlier assemblages generally provide unclear evidence of foreign influences.

Firstly, the definition of the Polynesian culture is unclear for its formative period. Polynesian culture is better characterised for the period starting after 1000 BP, including stonework and monumental architecture associated with political or religious ideologies, the use of basaltic stone tools and polished shell pendants, as well as the absence of pottery production (Kirch and Green 2001; Burley and Clark 2003). However, differences exist in artefact forms between Western and Eastern Polynesian assemblages (Smith 2002; Walter 1996; Davidson 1977). Aceramic occupations could be seen as an indication of the Polynesian occupation of the Polynesian Outliers. However, a decrease in pottery use is not necessarily related to Polynesian arrivals as it seems to occur at different periods across the southwest Pacific. The loss of pottery seems to occur prior to the Polynesian arrivals on Anuta, where occupation layers dated to 350 BP do not contain potsherds (Kirch 1982). On Tikopia, the absence of local pottery manufacture characterizes the Sinapupu phase dated to 1050-750 BP (Kirch and Yen 1982). Similarly, the Loyalty Islands show a loss in pottery production by 2000 BP (Sand *et al.* 2011). Pottery-making ceased by 2000 BP in South Vanuatu and by 1200 BP in Central Vanuatu (Bedford and Spriggs 2018).

Two cultural elements appear nevertheless to be clearly related to Polynesian arrivals in Melanesia and Micronesia: basaltic stone adzes were found on Tikopia, Anuta, Taumako and two-piece trolling lures were found on Tikopia and West Uvea (Leach and Davidson 2008; Kirch and Rosendahl 1973; Kirch and Yen 1982; Carson 2002). Some basaltic stone adzes or flakes from Taumako were attributed to Samoan sources like the Tataga Matau quarries on Tutuila (American Samoa) by a petrographic analysis (Best *et al.* 1992). Anuta (Zone A) and Nukuoro excavations have provided artefacts including a fishhook, a bone lure point and bone beads which can be related to a specific Polynesian typology (Kirch 1982; Davidson 1992). Distinctive shell ornaments from Mele, Ifira, and West Futuna in the Southern Outlier group, as well as at the Roy Mata burial site on Retoka island (Efate, Vanuatu), might represent a local expression of Polynesian identity (Carson 2012: 35, 39-40; Garanger 1972; see also Shutler and Shutler 1968). Ivory reels, which have been ethnographically documented in Polynesian Islands including the Marquesas, Cook Islands, and Tonga, are another example of such objects found in the Namu burials, Taumako (Leach and Davidson 2008: 209).

However, the typologies of Polynesian artefacts require refinement, particularly for shell artefacts which are abundant in the Southern Solomon Outliers and in the Southern group. Changes in dietary practices, such as the consumption of shark and turtles in Tikopia during the Tuakamali Phase, could also be indicative of a Polynesian intrusion (Kirch and Yen 1982). Nevertheless, it remains difficult to determine to what degree one may replicate one's own culture following a long journey and with the discovery of a new environment, new resources, as well as unknown people and customs. Many practices are Pacific wide and not particularly distinctive to any cultural group (Flexner *et al.* 2018). Perhaps, our focus has for too long been on finding 'true' Polynesian archaeological features and we have underestimated the importance of lost traditions and of the advent of innovations as visible in linguistic studies (Bayard 1966; Pawley 1967; Wilson 2012). Some Outliers might exhibit in their more recent archaeological levels new and composite cultural features, which do not correspond to what is already known in Oceania (*cf.* Carson 2012; Flexner *et al.* 2019).

Secondly, the impact of ecological factors and of the climate; together with small island area may have influenced the way groups occupy the islands. For example, climatic events like cyclones may have caused the abandonment of the island and consequently a hiatus in the stratigraphic sequence as observed for Anuta (Kirch 1982). However, multiple responses to ecological and climatic constraints could be at play simultaneously. As demonstrated by Rasmussen *et al.* (2009), people living today on Ontong Java, Bellona and Tikopia are equipped to resist climatic crises (cyclones, droughts and erosion), by relying on a partial abandonment of the island. On Tikopia, pig husbandry was abandoned ca. 350 BP as means of reducing competition for resources (Kirch 1997: 37). Abortion practices have been used to regulate demography, as observed in Ontong Java (Hogbin 1931). Resource production and land use can be controlled (via technological innovations) to increase productivity, allowing for a larger population to be sustained (Bayliss-Smith 1974). Cannibalism has been used to endure periodic episodes of starvation as reported for East Futuna (Burrows 1937). Survival behaviours and adaptations to marginal environments were perhaps an integral component of the Polynesian baggage that the migrants brought to the Outliers along with an adapted socio-political system.

Biological anthropology data

Biological anthropology indicates differences between Outliers populations and those of the surrounding islands populations. Early works on living populations demonstrate the biological uniqueness and the specific biological history of the Outlier populations. The Kapingamarangi population was shown to be highly differentiated from Micronesian populations, based on anthropometrical data and genetic markers (Morton and Lalouel 1973). Outlier populations of Kapingamarangi, Rennell and Bellona were shown to display a high frequency (of 70%) of the L*M gene compared to the Melanesian populations of Bougainville, Vanuatu and New-Caledonia regions (30%) (Kirk 1989). Odontometric analysis of human groups from Bougainville, Malaita Islands, Ontong Java and Ulawa show that the dimensions of teeth from Ontong Java are aligned with the Austronesian-speaking samples of Malaita prompting the idea *'that language and, thus, historical affinity outweigh the influence of geography as the prime determinant of phenetic similarity'* (Harris and Bailit 1988: 258).

Patterns of variation among Outliers populations have also been observed, suggesting several biological trajectories. Analysing 11 polymorphic loci in individuals from Santa Cruz, Banks and Torres Island, Blake *et al.* (1983) noted that individuals from Tikopia are genetically closer to populations of the Southern Solomon's groups than individuals from Rennell and Bellona, and that individuals from Anuta exhibit an unexplained isolated position. Polynesian and Melanesian speakers of West Uvea have the same low HLA-A2 gene frequency (4-8%) as other Melanesian islands populations while Polynesian populations exhibit a higher average (18-30%) (Serjeantson 1984).

More recent genome-wide works have refined these analysis and interpretations. They demonstrate that western and eastern Solomon Islands populations have followed different historical trajectories, with the Polynesian Outlier populations displaying stronger similarities with Tongan populations, pointing to their common origin (Pugach *et al.* 2018). These Polynesian biological influences appear to not be restricted to Polynesian Outliers islands but encompass a larger area including North-Melanesia. However, it is still unclear whether this admixture signal reflects the initial Austronesian (Lapita) signal or relates to additional gene flow initiated by/ with Polynesian migrations (Pugach *et al.* 2018: 875). Genome wide data assembled and analysed by Hudjashov *et al.* (2018) is interpreted as supporting a model of interconnectivity within the Pacific and the formation of the Polynesian genome around 1700-1200 BP. The authors consider that this has occurred within the Polynesian Outlier populations of the Solomon Islands from which Eastern Polynesian islands were settled, reinvigorating the old theory of 'Polynesian relics' within Melanesia. However, assessing to what degree current populations reflect the biological composition of past populations is a matter of ongoing discussion. In fact, the only way to reconstruct the composition and origins of past populations is through analyses of ancient human remains by combining morphological and ancient DNA data garnered from skeletons from known archaeological contexts. The homogeneity of the Polynesian make–up has long been recognised (Houghton 1996; Van Dijk 1999; Katich and Turner 1974; Pietrusewsky and Douglas 2016) as has its internal diversity (Stefan and Gill 2016, Stefan and Chapman 2003; Buck and Vidarsdottir 2012; Pietrusewsky 1969, 1996, 2005).

Skeletons from Polynesian outliers have been studied since the 20th century with a particular emphasis on the Solomon Outliers, offering a complementary picture to archaeology and ethnography. Shapiro's (1933) morphometrical study based on 13 measurements recorded on 157 modern individuals from Ontong Java demonstrates close relations with individuals from Micronesia, suggesting a shared ancestry. However, six individuals found at Kapingamarangi, at the Putau site, were identified as Polynesian, based on morphological and metric characteristics including the presence of rocker jaws and flattening of the femoral shafts (Houghton 1981, in Leach and Ward 1981). Other individuals from Nukuoro and Kapingamarangi were shown to also have affinities with Polynesian populations (Tonga, Samoa, Northern Cook Islands, Marquesas and New-Zealand) in a multivariate analysis of seven metrical characters in 151 Pacific-region population samples (Howells and Schwidetsky 1981).

Regarding the Southern Solomon group, the 226 skeletons uncovered at Namu cemetery (Taumako) and dated around 775-205 BP (Leach and Davidson 2008) were the focus of several bioarchaeological studies, resulting in contradictory conclusions (Houghton 2008; Katayama 1988; Pietrusewsky 2008). Relying on morphological analysis of the cranial, dental and infracranial elements, Houghton (2008) found that they present more Polynesian features than Melanesian features. Confirming this view, Katayama's (1988) non-metric study shows that specific anatomical variations (high frequency of the antegonial notch, supraorbital foramen, parietal notch, condylar canal patent, infraorbital suture and exsutural mastoid foramen) are shared by individuals from Namu and Mangaia (Cook Islands). Katayama's (1988) comparative metric study using the cranial index of 77 reconstructed skulls from Namu shows that their variability overlaps Easter Island variability. Interestingly, Pietrusewsky (2008) found that 12 male and 6 female crania from the same site displayed morphology close to that of prehistoric and modern Melanesian groups. A more recent study of these individuals reiterates this conclusion, underscoring affinities between Namu and modern individuals from Fiji, the Loyalty Islands and Santa-Cruz (Pietrusewsky *et al.* 2014). Analysis of the distribution of infectious diseases, such as yaws, is another way to gain information pertaining to populations movements. Interestingly, there are high incidence of infection in both the Namu population (57.7%) (n=41/70) (Buckley and Tayles 2003) and the Ha'ateiho population (TO-AT 36, Tongatapu, Tonga) (19.7%) (n=13/66) dated to precontact period (750-150 BP) (Pietrusewsky *et al.* 2019) while yaws is unreported in the region for earlier periods.

Polynesian influences have also been detected in the South Melanesia group. Weet's (1996) metrical and non-metrical dental analysis, conducted on 408 permanent and deciduous teeth from Melanesian and Polynesian regions including 58 individuals from West-Futuna (Vanuatu) dating to an undetermined time period, demonstrates similarities between individuals of West-Futuna and Hawaii. Polynesian influences were also detected through paleogenomic studies performed on other individuals from Vanuatu. Individuals of Ifira and Pango from the South-East coast of Efate, dating to ca. 150 BP, show significant allele sharing with a Tongan population (Lipson *et al.* 2018). Some living populations from Vanuatu, including Efate, Makura and the Polynesian Outlier of West-Futuna show a similar pattern (Lipson *et al.* 2018). However, four prehistoric individuals from West-Futuna, dated between 1270 and 970 BP, display a small proportion of initial Austronesian/Asian (FRO) ancestry (11 to 17%) like other present-day populations of Vanuatu (Posth *et al.* 2018), suggesting that any biological exchanges which might have taken place would have happened later in the last millennium.

To summarize, biological data tend to suggest a North-South cline, with a decreasing degree of 'Polynesianness' from North to South: very Polynesian-like in the North, contradicting data in the Southern Solomon group that show biological affinities interpreted as Polynesian or as Melanesian, and very Melanesian like in the South. This pattern suggests different biological trajectories in the north and in the south, with less Polynesian admixtures in the South than in the North. Polynesian influences, currently observable in the Polynesian Outliers, appear to have been mainly shaped by interactions between new-comers and settlers.

Hypothesis of multi-level interaction networks

The pattern of variations provided by biological and archaeological evidence needs to be investigated and contextualised considering the diversity of network dynamics operating in the Western Pacific during the last millennium. We propose three hypothetical models for settlement of the Polynesian Outliers. Our description relies on three levels of interaction, from the micro-regional to the inter-regional levels, depicting various situations of sharing and exchange, all plausible in the case of the Polynesian Outliers. Indeed, rather than seeing these as mutually exclusive, we would consider any of these models to apply to different islands at different times, depending on the archaeological, biological, and linguistic evidence. Figure 2 presents a schematic representation of our interpretation of these levels of interactions.

Local level hypothesis

Given the geographical situation of most of the Outliers on small islands located to the windward side of the larger islands in Micronesia and Melanesia, we, as others (e.g. Carson 2012), first hypothesise that Polynesians decided to approach an uninhabited, or sparsely inhabited island, as an easier area to settle. The Polynesian group would have had the possibility to invest in the whole island and develop a society preserving Polynesian features. While most of the Polynesian Outliers' chronological sequences indicate that the islands were already occupied prior to the probable Polynesian arrival, Polynesian groups did not necessarily meet pre-existing people. The Anuta sequence, for example, supports the idea that an island can be abandoned for a few centuries because of an unsuccessful habitation or due to an ecological and climatic crisis (Kirch 1982).

Our second case considers the Polynesian occupation of a previously occupied island and involves a range of interactions with the local population. In this case, a variety of possibilities emerge, from marriage between the Polynesian and local populations, to warfare between the two groups. Traditions, especially from Rennell and Bellona, Tikopia, West Uvea and West Futuna, feature various scenarios of sharing land and women and non-sharing: wars or competition. A mythical history of Rennell, recorded by Roberts (1958), mentions the presence of small people named

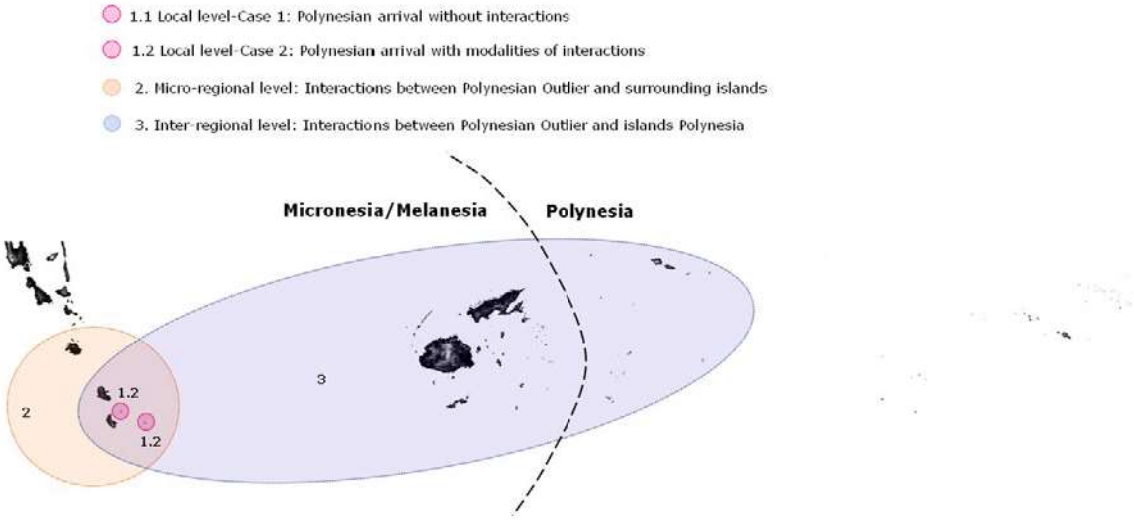

Figure 2. Schematisation of the three hypothesised levels of interactions.

Hitihiti on Bellona at the time of the arrival of Kaitu, one man from Ubea (Uvea, Wallis Island?) that passed through Hutuna (East or West Futuna?) during their journey. The myth details interactions between the local groups and the newcomers and indicates that a land was given to the Polynesian group with the authorization to cultivate it: '*One of the members of Kaitu's crew, Temoa, managed to capture one of the Hitihiti and to converse with it, and this Hitihiti led Temoa to water holes and to gardens of taro from which Kaitu and his followers were able to obtain food*' (Roberts 1958: 4). A mythical history of West Futuna mentions that 'toga' (meaning foreigners or Tonga) women often flew to Sinou on the Northern coast of the island, that one of them stayed with Mahjijiki, a mythical figure from the island, who hid her wings to prevent her from flying back to her homeland (Keller and Kuautonga 2007: 146-165). According to Guiart (1953a) single Polynesian men, who arrived from Wallis in the early 20th century, married local West Uvea women shortly after their arrival on the island. Marriage is a complex institution, resulting sometimes in particular situations. For example, in We-hali Austronesian villages (Timor Leste), women can marry Papuan men but their progeny adopts the maternal cultural system and ignore the language and customs of the paternal lineage (Lansing *et al.* 2011). Wars and competition between arriving and local groups are also reported in several ethnographies of Solomon and South Melanesia Outliers. One example is that of Bellona for which Robert (1958: 4) mentions: '*These Hitihiti had no knowledge of fighting, and in time Kaitu killed and ate them*'.

Micro-regional level hypothesis

The two local-level situations upon arrival can equally engage with multiple forms of interactions with surrounding islands of the Melanesian and Micronesian area including other Outliers islands. These range from an absence of interaction to a high level of interaction. Imported volcanic glass sourced from the Banks Islands (Vanuatu) in layers of the Tuakamali phase, associated with the Polynesian arrival in the Tikopia stratigrapy, illustrates continued interactions within the region after the Polynesian arrival on the island (Kirch and Yen 1982). Cases like Nukuoro (Micronesia) and West Futuna (Vanuatu) are more difficult to interpret in this respect. Davidson (1992: 296) claims (contra Kirch 1984) that for Nukuoro: '*There is no clear evidence of cultural replacement and nothing unambiguously Polynesian rather than Micronesian in the assemblage from the excavations*'. Shutler and Shutler (1967: 98) reached a similar conclusion for West Futuna: '*The artifacts which come from areas in which Melanesian languages are spoken today are indistinguishable from those found on Polynesian outliers*'. What are the mechanisms behind this absence of distinction: an absence of introduction of Polynesian material culture, as might have happened in cases of involuntary voyages (Kirch 2000: 130-134), or a total fusion between local

and outsider cultures resulting from an acculturation process involving the loss of typically Polynesian items?

Other Outliers' archaeological sequences witness other forms of interactions while biological data point to various forms of admixture, from a near absence, as in the case of West Uvea (Loyalty Islands) where populations speaking a Polynesian language display local genetic features (Serjeantson 1984), to a clear presence as in the case of Kapingamaringi where skeletons from Putau are identified as Polynesian-like (Houghton in Leach and Ward 1981). Such patterns of biological variation are likely related to the ratio between the size of migrant and local groups as well as the power of their political organization as emphasised by Spriggs (1997: 221).

Inter-regional level hypothesis

The presence of Polynesian characteristics within Melanesian and Micronesian islands might result from larger spheres of interaction. Some local populations could have adopted Polynesian features in relation with exchange networks established with variable and not mutually exclusive purposes: political alliances, social relationships, and trade (Kirch 2017: 130-134). This model requires no massive Polynesian presence or Polynesian biological incorporation within the receiving populations. It is possible that a few Polynesians might have remained on the Polynesian Outlier representing a sort of authority, regulating exchanges and power, and maintaining connections between Polynesia and other islands in a large area involving several archipelagos. As such, Polynesian Outliers, like Tikopia and Taumako, were probably involved in the large network of the Tongan State which became increasingly active after 750 BP. Geochemical studies have demonstrated long-distance and multi-directional exchanges of stone tools from Tutuila (Samoa), in which Taumako and Tikopia were included (see Clark *et al.* 2014 for a synthesis). However, the existence of connected Polynesian Outliers used as satellites of Polynesian entities or trade-posts in large exchange networks in a 'continued contact' frame requires further investigations. Such mechanisms might have facilitated indirect dispersals of Polynesian features in non-Polynesian areas and vice-versa. For example, close connections are apparent between the Polynesian Outliers of Futuna and Aniwa, and the island of Tanna in Vanuatu. A moiety social system is practiced in both Futuna and Tanna (Lynch and Fakamuria 1994; Flexner *et al.* 2018). Other Polynesian influences, including the presence of the mythical figure of Mahjijiki (or Mahjijiki in Futuna spelling) in oral traditions (Spriggs 1997) and the use of Polynesian terms, including in the ritual drinking of kava (Lynch 1996) were recorded on Tanna.

Discussion

The available archaeological and biological data points to three main issues requiring refined discussion in order to improve the understanding of the formation of Outliers within their Melanesian or Micronesian contexts. These include: the timing and the number of Polynesian arrivals in a given locality; the degree of interactions between Polynesian migrants and local communities; and the size of the groups in contact.

As emphasised by several authors, Polynesian Outliers settlement does not belong to a single common history but to several distinct histories (Kirch 1984; Carson 2012). Even a single island or locality might have hosted several groups of migrants over time. As Kirch (2017: 333) mentions about the Tuakamali phase of Tikopia, it '*represents the successive arrival of several Polynesian-speaking groups who were the direct ancestors of the various social lineages presently occupying the island*'. These contacts would have occurred during the last millennium, postdating at the earliest 950 BP in Tikopia (Kirch and Swift 2017), and the major Polynesian diaspora to Eastern Polynesia that occurred around 925-829 BP (Wilmshurst *et al.* 2011; see also Horsburgh and McCoy 2017). A number of other arrivals from different sources occurred also in several Outliers in more recent

times: for example a mythical history mentions the arrival of one canoe from Tonga and of two others from Samoa a dozen of generations ago in Sikaiana, in the Northern Solomon group (Woodford 1906 in Bayard 1966, see also Guiart 1953b). The abundance of evidence of Polynesian contacts in the Melanesian/Micronesian region, during this millennium, suggests that the Polynesian components currently observed on the Polynesian Outliers were not necessarily brought into the island by a large group of migrants but rather by successive arrivals of smaller groups, overshadowing the effects/impacts of the previous arrivals in a cumulative process of influences from potentially different sources.

The three hypothesised levels of interaction could have intervened variously and successively, over the millennium, on any given island or within any given locality. Tikopia is a concrete example of an island with a non-'*closed system*' (Kirch 1986: 33) integrated in a multi-scale and directional interaction network. Tikopia was indeed involved in two-way circulations with Anuta in one direction, and Vanikoro (Santa-Cruz) and Vanua Lava (Banks Islands) in another. While contacts with Vanua Lava and Vanikoro seem to relate to rudimentary and strictly economic exchanges, relationships between Tikopia and Anuta are turned towards matrimonial transactions and social exchanges. Interestingly, the red-feather exchange system of Santa-Cruz which involved Vanikoro did not included Tikopia, emphasising the particular social, political and economic position of this Polynesian Outlier in the regional networks. Another example of a specific trading relationship, that may apply to the case of Polynesian Outliers, is that of obsidian/nephrite exchanges between the North and South Islands of New-Zealand. In this case, Walter *et al.* (2010) recognize two successive modes of interactions: first, a 'colonizer' mode implying intense interactions between the new settlers and the pre-established population, and second, a 'trader' mode implying interactions motivated by economic or political exchanges between the communities. The first Polynesian contacts, following the 'colonizer mode', could have resulted in cultural interactions and biological admixtures between migrants and settled groups. At a further stage, admixed populations of Outliers could have interacted with other Polynesian groups practicing the 'trader' mode, when interaction networks expanded across the Western and Central Pacific.

The culture, language and biology of the Outliers do not appear to co-vary. If the linguistic data, despite borrowings, point to a language replacement, biological data suggests a more varied pattern of integration: none of the ancient or modern individuals look entirely 'Polynesian'. The case of the Polynesian speakers of West Uvea is illustrative of the phenomenon, which is particularly visible in our Southern Outliers group. They share a low HLA-A2 gene frequency with Melanesian speakers from the same island suggesting that '*the arrival of Polynesian immigrants in Ouvea had a far greater impact on language than on genetics, a situation not uncommon in Melanesia*' (Serjeantson 1984: 167). Tikopia is also indicative of this paradox. The Tikopian population shows genetic affinities with Melanesian populations of the Santa-Cruz and Banks islands although archaeological evidence indicated limited contacts between both regions (Blake *et al.* 1983; Kirch 1985). By contrast, the Anutan population displays a genetic profile that does not match the range of the Melanesian variation (Blake *et al.* 1983) despite social and economic inter-island exchanges with Tikopia (Kirch 1986). This opposition between an apparent genetic continuity and a language replacement is likely directly related to both the power and the size of the arriving group relatively to the pre-existing group. Absent or limited admixture suggests that Polynesian groups were of smaller size than the local groups while the maintenance of Polynesian language and cultural features may represent what was seen as an advantage for both the arriving and receiving groups (cf. Bayard 1966).

In the same vein, Polynesian biological influences identified on Kapingamarangi may suggest that this region was less populated and in geographical isolation than Southern Melanesia allowing for the preservation of Polynesian features, a situation possibly facilitated by close genetic and phenotypic proximity between Polynesian and Eastern-Micronesian populations (Lum and Cann

2000, Valentin *et al.* 2016). These *'genetic similarities among Micronesian and Polynesian populations result, in some cases, from a common origin and in others, from extensive gene flow'* (Lum and Cann 2000: 151). Addison and Matisoo-Smith (2010) have recently suggested that this proximity resulted from human intrusions from Micronesian population into Western Polynesia at the origin of the formation of the Ancestral Polynesian Society.

Conclusion

One of the lessons to be drawn from this review is that in the case of the Polynesian outliers, language is not necessarily related to culture nor to biology, and that assumptions about historical process of their formation based on what we observe today should be handled with care. Contextualisation of each island within its own regional environment appears to be indispensable, as existing data tend to confirm that Oceanian societies have never evolved in total isolation. It rather emphasises the fact that external exchanges, or forces, have considerably contributed to build the present-day societies. The observed patterns of variation of biological and archaeological evidence, particularly the biological distinction between the Northern and the Southern Outliers, point to several distinct histories rather one, at both regional and island scales. Our hypothesis of multi-scale interactions, involving demographic and socio-political factors, reflects the multiple possibilities of interactions at various scales across the region. Both of these factors would have considerably shaped the prevalence of Polynesian components observed today in Polynesian Outliers and in the surrounding Melanesia/Micronesia areas. Those features would be the products of accumulations of various Polynesian components introduced from different sources during successive arrivals, in combination with conservation of local characteristics.

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