

A Multidisciplinary Account of the Orang Asli in Peninsular Malaysia



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Abstract This review aims to present contemporary scholarship relating to Orang Asli in the context of their ancestral relationships. It begins by drawing a clear picture of present-day Orang Asli groups in Peninsular Malaysia, followed by a synthetic account of Orang Asli ancestry that emerges from the fields of archaeology, anthropology, linguistics and genetics. The whole survey contains detailed information about our own work and that of others, which together, forms the basis of our “Genetic Layer Cake Model” for human settlement in Peninsular Malaysia. In this review, we also present new and compelling evidence about material cultures and beliefs to expand the original model so as to make it a more inclusive, if not yet fully complete, account of human prehistory in Peninsular Malaysia. This new multidisciplinary account of the Orang Asli in Peninsular Malaysia not only highlights the latest views of ancient indigenous dispersals and settlements across the region, but also suggests how better understanding of the Orang Asli’s origins may improve their prospects like health and socio-economic status.

Keywords Orang Asli · Semang · Senoi · Proto-Malays · Genetic layer cake model

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Introduction

The term Orang Asli specifically refers to three ancient tribes of indigenous people in Peninsular Malaysia, namely the Semang (Negrito), Senoi and Proto-Malays. These natives are a minority who constitute just 0.8% of total population in Peninsular Malaysia (Population and Housing Census of Malaysia, 2010 and Centre for Orang Asli Concern). They have distinct cultures and lifestyle from the Malays, Chinese and Indians, which are other races in mainstream society. The Orang Asli have retained much of their cultural heritage and today, they are represented by many sub-groups, such as the Kensiu, Kintaq, Lanoh, Mendriq and Orang Kanaq. The sub-tribes generally persist as small collections of families numbering between 80 and 600 people. Table 1 shows the population statistics of Orang Asli sub-tribes and Fig. 1 shows the geographic distribution their settlements in Peninsular Malaysia.

The Orang Asli either live in their “original homeland” or have relocated to settlements equipped with electricity and clean water supply, and modern education and healthcare systems (Figs. 2, 3, and 4). The relocation programmes are carried out under various socio-economic development plans by the Orang Asli Development Department (JAKOA) – the government agency under the Rural Development Ministry responsible for their welfare (<http://www.jakoa.gov.my>). It is without doubt that these efforts are much needed by Orang Asli communities. It is equally important that all such development schemes should properly consider the identities, cultures and lifestyle of Orang Asli sub-tribes. Otherwise, such well-intentioned intervention schemes may lead to the loss of a priceless heritage that has long been at the heart of Orang Asli communities.

The following sub-sections discuss the multidisciplinary perspectives of Orang Asli origins that shaped the socio-cultural milieu of their descendants. We also review and evaluate data from new genetic surveys conducted on several loci associated with resistance to diseases. This information is crucial because most Orang Asli villages are located in the interior with improper and/or poor healthcare (Phua 2015; Michael and Chuen 2012). Thus, they frequently suffer from treatable diseases like skin diseases, worm infection, amoebiasis and malaria (Hotez 2014; Hotez et al. 2015).

A Contemporary Inventory Plus Brief Pre-historical and Historical Account, Including Summary of Previous Theories and Models

Census on the Orang Asli were first conducted in Pahang from the 1890s (Annual Report of the British Resident Pahang 1891). In subsequent years, they were grouped under the “Malaysian” category by colonial administrators. This category also included Malays, Indonesians and other natives, which lasted until after World

Table 1 Orang Asli tribes and sub-tribes in Peninsular Malaysia

Groups ^a	Sub-groups ^a	Locations ^a	ID on map ^b	Language ^c	Population size ^d
Semang	Kensiu	Baling, Kedah	1	Austro-Asiatic	232
	Kintak	Gerik, Hulu Perak	2	Austro-Asiatic	157
	Lanoh	Perak	3	Austro-Asiatic	350
	Jahai	Remote areas of Perak and Kelantan	4	Austro-Asiatic	1843
	Bateq	Pahang, Kelantan and Terengganu	5	Austro-Asiatic	1255
	Mendriq	Gua Musang, Kelantan	6	Austro-Asiatic	164
Senoi	Semai	Pahang, Perak and Selangor	7	Austro-Asiatic	43,892
	Temiar	Perak, Kelantan, and Pahang	8	Austro-Asiatic	25,725
	Mah Meri	Coastal areas of Selangor, Putrajaya, and Negeri Sembilan	9	Austro-Asiatic	2986
	Jahut	Temerloh and Jerantut, Pahang	10	Austro-Asiatic	5104
	Semoq Beri	Pahang and Terengganu	11	Austro-Asiatic	3545
	Che Wong	Raub and Temerloh, Pahang	12	Austro-Asiatic	664
Proto-Malay	Temuan	Negeri Sembilan, Selangor and Johor	13	Austronesian	22162
	Jakun	Southern parts of Peninsular Malaysia	14	Austronesian	27448
	Semelai	Pahang, Negeri Sembilan and Johor	15	Austro-Asiatic	6418
	Orang Kuala	Batu Pahat and Pontian, Johor	16	Austronesian	4067
	Seletar	Coastal regions of Johor	17	Austronesian	1407
	Orang Kanaq	Kota Tinggi, Johor	18	Austronesian	83

^aJabatan Kemajuan Orang Asli (JAKOA; <http://www.jakoa.gov.my>)

^bLabelling of Orang Asli settlements on Fig. 1

^cEthnologue Languages of the World (<http://www.ethnologue.com>)

^dPopulation size of Orang asli group were obtained from Center for Orang Asli Concern (COAC; <http://www.coac.org.my>)

War 2. Since the 1930s, three groups of Orang Asli have been identified; namely the Semang who usually lead a nomadic life, the Proto-Malays who plant cash crops and live in permanent dwellings, and the Senoi whose mode of life is an extension of the Proto-Malays (Noone 1972). In 1947, Malayan authorities recorded an Orang

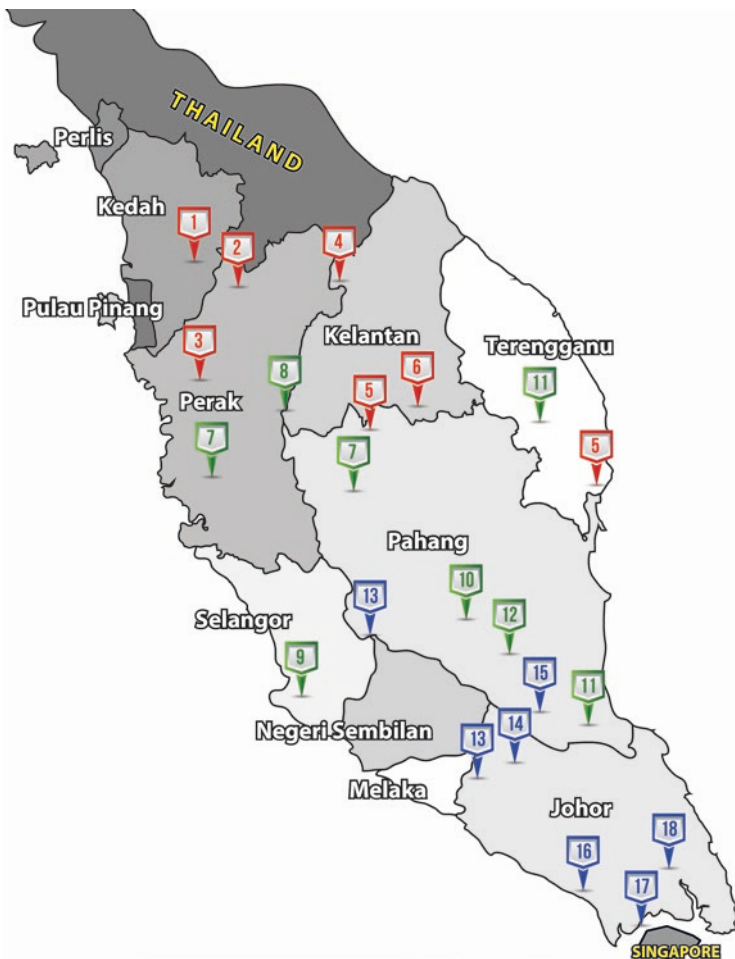


Fig. 1 Approximate locations of Orang Asli settlements in Peninsular Malaysia. Refer Table 1 for their ID on the map



Fig. 2 (a) Children from the Jahai sub-tribe, which belongs to the Semang tribe. (b) They live in Kampung Sungai Tiang, Gerik, Perak. (Photo: Z. Yusof)



Fig. 3 (a) The village of the Bateq sub-tribe, which belongs to the Semang tribe, in Pos Kuala Lah, Gua Musang, Kelantan. (b) Bateq women participating in a traditional performance. (Photo: Z. Yusof)



Fig. 4 A Temiar man of the Senoi tribe in his hut in Pos Bering, Gua Musang, Kelantan. (Photo: Z. Yusof)

Asli population of 4.7 million, of which the majority were Senoi (62%), followed by Proto-Malays (33%) and the Semang (5%) (Leary 1995).

The Semang consists of the Jahai, Bateq, Kensiu, Kintak, Lanoh and Mendriq sub-tribes (see Table 1 and Fig. 1). Their social structure still reflects their nomadic way of life, with a leader heading a small number of community members. The Senoi includes the Temiar, Semai, *Semoq* Beri, Mah Beri, Che Wong and Jah Hut sub-tribes. They have a loose form of leadership, where a headman is in charge of a few kin groups. The Proto-Malays comprise the Temuan, Jakun, Semelai, Temoq, Orang Kanaq, Orang Seletar and Orang Kuala sub-tribes. Their social organisation is more complex, with village elders owing allegiance to a headman who, in turn, is placed under a chief who owes allegiance to an even higher chief. The tripartite division of the Orang Asli reflects their spatial distribution, with the Semang mostly living in the north and northeast of Peninsular Malaysia, whereas the Senoi may be found in the main range, while the Proto-Malays are in the central and southern parts of the peninsula (Fig. 1).

The Orang Asli population continued to increase in later years and by 1965, their population was recorded at 45,895 people (Dunn 1975). This study provides the following numerical breakdown of Orang Asli subgroups: Semang at 1447; Temiar at 9326; Semai at approximately 12,748; other Senoi groups (Semoq Beri, Mah Beri, Che Wong and Jah Hut) at 4791; Temuan with 7221; Jakun at 7331 and other Proto-Malays (Semelai, Temoq, Orang Kanaq, Orang Seletar and Orang Kuala) at approximately 3032. By 1994, their population had increased to 95,529 (Lim 1997) with the greatest numbers located in Pahang (Nik Hussain 2007).

Theories and Models Relating to the Orang Asli

In 2012, well-known Malaysian anthropologist Hood Mohd Salleh gathered and surveyed the existing literature on the Orang Asli. The writings were first produced by non-Malaysians in the mid-nineteenth century, and Malaysian scholars only began contributing to the subject almost a century later (Salleh 2012). The wider literature covers general ethnographic studies and the natives' belief, modernisation and linguistics. Salleh stated that there has been broad specialisation among scholars, with the first two topics becoming the preserve of foreign scholars, while Malaysians seemed to dominate the remaining two. Our brief review of the literature (see following) bears this observation in many respects. Salleh's survey covered all fields relating to the Orang Asli, namely history and historical change, linguistics, general ethnography, cultural ecology, religion and belief systems, kinship and social organisation, psychological anthropology, economic anthropology, demography and development, assimilation and inter-ethnic relations.

On history and historical change, Salleh (2012) particularly cited the works of G. Benjamin (1966, 1968) and his diachronic approach to discovering the internal structures of a society without generating new theoretical principles. This is the first of three major models proposed for understanding Orang Asli societies. Salleh found that Benjamin's work fell more or less entirely within the realm of historical anthropology. He was not agreeable with Benjamin for advancing theories based on speculation, but to be fair, this latter scholar did refer to linguistics and other evidences. There is nothing new in this approach as scholars, including the respected historian O.W. Wolters (1982), have made similar attempts to unravel the nature of state and society in Southeast Asia before the onset of Indian influence, using evidence drawn from various disciplines, including linguistics and art history. Recently, archaeologists working in Southeast Asian historical sites have pointed to the importance of developments that took place at the end of the Iron Age between the early and mid-first millennium CE (Murphy and Stark 2016). In general, historians do seem to be quite comfortable with Benjamin's diachronic approach.

A second model is known as the development, assimilation, and interethnic relations model. It has received much input from Malaysian researchers, with most of them arguing for the integration of the Orang Asli into mainstream societal development. This view is held despite the Orang Asli's unhappiness with the effects of proposed developments, notably due to encroachment on their native

lands or *saka* without adequate compensation (Alias and Daud 2011). They are also concerned about recognition of their indigenous rights. By the 1960s, the Semelai of Tasik Bera were no longer averse to change, including the concept of wealth accumulation and use of outside goods such as matches, knives, machetes, bicycles and even radios. But the headman found his position less attractive after the government imposed control on his people following the communist insurgency, also known as the Emergency, from 1948 to 1960 (Hoe 2001). Based on his study of four Orang Asli villages (three in Pahang and one in Perak), Lim (1997) reached a similar conclusion that the Orang Asli were not opposed to development per se. Resettled natives enjoyed health services and had greater ownership of assets like motorcycles, radios and televisions compared with others in the interior. The author also observed that the Orang Asli have assimilated well with other Malaysians, although a small number had reservations about their new situation due to lack of freedom, open country living environment, domination by Malays and fear of losing their identity, besides having to bear indignities and criticism on their lifestyle. Elsewhere, in Kota Tinggi in the southern state of Johor, the Orang Kanaq were relocated north to Gombak in the central state of Selangor in the early 1950s, where many lived until the end of their lives. Few survivors managed to return to Johor and are now adjusting to an agricultural life with official assistance (Musa 2011).

The third and much discussed theory is known as the “Dream People” theory, which came into vogue through Noone (1936), who wrote about the Temiar. Under this theory, the author claimed that the Temiar confined crime and legal procedures to marriage disputes (Leary 1995), although such incidents could end in violence. He first presented his ideas on “dream manipulation” among the Senoi as an outline of his PhD thesis. Even though he left no tangible records of his research on dream manipulation, Noone’s contributions were complemented by American anthropologist K.R. Stewart (1951, 1962), who was interested in the investigation of traditional psychiatric systems. Stewart highlighted Noone’s non-violence hypothesis among the Orang Asli in general. However, the importance of dreams varies in Orang Asli culture and religion, with the Semai and Temiar placing more importance on the interpretation of dreams (Leary 1995). Experts on Orang Asli hold that these dreams are an outlet for feelings of hostility and aggression, and may act as a psychological safety valve (e.g. see Stewart 1951, 1962).

The Dream People model has inspired a number of writings on the Orang Asli, notably by Noone’s younger brother, Richard, who became an adviser to the Malayan government on Orang Asli affairs in the 1950s (Noone 1972). The myth that the Orang Asli are intrinsically non-violent has been debunked during the Emergency through the way they responded to violence perpetrated on them by government and communist forces (Leary 1995). The logging blockade that took place in Gua Musang, Kelantan, in September 2016 had demolished whatever remained of the image and concept of the Orang Asli as non-violent “dream people” (The Star 2016). The blockade was erected by the Orang Asli and social activists to prevent loggers from accessing the area despite the latter being granted permission to harvest timber by the state authorities. The Orang Asli and activists claimed that logging would destroy the forest and threaten their livelihood.

The Orang Asli During the Prehistoric and Historic Period

Looking at the Orang Asli over a much longer period, say from 500 AD, the seminal study by Dunn (1975) has been widely influential on later research. It has provided crucial insight into the Orang Asli and their economic relationship with the Malays right up to the nineteenth century. This author used archaeology, anthropology, history and ecology to study human adaptation in tropical rainforest ecosystems in southern Peninsular Malaysia during protohistoric and prehistoric periods. He highlighted the importance of the Orang Asli in the exploitation of forest products over this period. He discerned four phases in their developing role in collecting and trading natural resources – periods between the fifth and fourteenth centuries, the fifteenth century, sixteenth and eighteenth centuries, and the nineteenth century. During the first phase, the Orang Asli were almost exclusively forest collectors, who sold their products to Indianised coastal Malays acting as conduits to international markets. In phase two, the Orang Asli were still major collectors of forest products, of which demand had risen considerably. The middlemen were still Malays, including those from Indonesian islands who were based in Melaka, which was the gateway to the international market. In phase three, Orang Asli collectors included those living in the interior of Peninsular Malaysia. Malays now functioned as either secondary or tertiary traders. In phase four, the Orang Asli were no longer exclusive collectors of forest products as they were joined by Malays and even the Chinese. Malays remained as secondary traders and the Chinese were tertiary traders.

Dunn (1975) suggested one further recent phase in the twentieth century, with the Orang Asli as major collectors and primary traders working with Chinese secondary and tertiary traders. The basis of exchange was no longer bartering, but by cash and credit. By then, the relationship between the Orang Asli and the outside world had changed considerably. In fact, this transformation had started to take place much earlier. During the Melaka Sultanate (1400–1511), some Semang people were sold into slavery by Malays. In the late nineteenth century, British officials in Pahang had noted the age-old animosity of Orang Asli towards Malays (Annual Report Pahang 1890). For the twentieth century, Andaya (2008) aptly summarised the situation:

The pressure of modernity, the nation state and the competitive global economy made the lifestyle and economic pursuits of the forest and hill people increasingly irrelevant and undervalued.

First, it was Benjamin (1997), and later Andaya (2008), who pushed this date further back to 3000 YBP by stressing the traditional role of the Orang Asli and their enduring economic relationship with the Malays. As highlighted by Benjamin, the Orang Asli in Ulu Tembeling, Pahang, were the only people capable of extracting forest products besides working in gold mines that the area was well known for. Ulu Tembeling was also linked to Muar, Johor, in the west through the “Penarikan” route, and with Tasek Bera, Pahang, and onwards to Pattani, Thailand, in the north through the Lebir Valley. In this relationship, the Orang Asli were the suppliers of forest products while the Malays offered them access to international markets,

besides providing them with basic needs from the outside world. Initially, trading with Malays involved exchanging rattan, tree bark and stones with sea shells to be used for various purposes like utensils. During the Melaka Sultanate, the range of these forest products had expanded to include camphor, dammar, rattan, gaharu and beeswax, which were exchanged for iron, salt, ceramics and other domestic needs. So, over a long period, the Orang Asli were able to keep their tribal secrets regarding the location of their forest products. However, by the nineteenth century, there was pressure on ethnic boundaries as forests were increasingly cut down to open plantations geared for the export market. Meanwhile, Malay attitude towards the Orang Asli began to change for the worse, although their support was keenly sought during times of local power contest (Andaya 2008).

Prehistory and History of Orang Asli: Archaeological and Oral History Evidence

The existence of prehistoric communities in Peninsular Malaysia from late Pleistocene onwards is proven by the discovery of cave and rock shelters. Gua Sagu and Gua Tenggek in the state of Pahang are the oldest cave sites in Peninsular Malaysia. There is evidence of Gua Sagu being occupied by humans between 14,000 years to 1000 years ago, while Gua Tenggek was occupied from about 10,000 years ago. Another cave, Gua Kechil which is also located in Pahang, has indications of a three-phase human occupation, with the first phase (12,000–8000 years ago) dominated by Hoabinhian stone tools, while the second (8000–4800 years ago) is characterized by the use of plain pottery, polished adzes, shell and animal bones. In the third phase (4800 years ago), the use of pottery became predominant, while bones and shells declined. That phase is regarded by many scholars as the beginning of the Neolithic age and also evidence of horticulture, according to Bellwood (1998).

Gua Cha in the state of Kelantan (8000–9000 years ago) is probably the best-known rock shelter in Peninsular Malaysia. An excavation in 1979 discovered two main periods of habitation – the Hoabinhian and Neolithic periods. The Hoabinhians were most probably hunter-gatherers. They were followed by the Neolithic people, although there was no convincing evidence for any chronological overlap. This means that it is also difficult to determine with certainty if the Neolithic period evolved locally from Hoabinhian in Gua Cha. The absence of marked differences in physical features between the Hoabinhians and Neolithics indicates a common origin. Taha (1985a) suggested that the evolution from Hoabinhian to Neolithic culture took place elsewhere, with the Gua Cha Hoabinhians acquiring new tools and pottery from people domiciled in the coastal region of Peninsular Malaysia and southern Thailand. The relative scarcity of Neolithic occupation materials in Gua Cha shows that it may just have been used as a burial ground. The site contains substantial amount of complete pottery items, including those related to southern Thailand's Ban Kao Neolithic culture of the second millennium B.C.

Elsewhere, the limestone caves and rock shelters in Lenggong Valley have been inhabited 13,000 years ago and were still in use until 2000 years ago. The caves include Gua Teluk Kelawar, Gua Ngaum, Gua Kajang, Gua Gunung Runtuh, Gua Dayak, Gua Badak, Gua Harimau, Gua Batu Tukang and Gua Batu Dinding. Stone tools, pottery, faunal remains, riverine shells and human skeletons have been found in these caves. They are more than adequate proof of the existence of prehistoric communities *in situ* (Isa 2015). One of the most important discoveries was made in 1990, when the “Perak Man” was found in Gua Batu Runtuh (Majid 1994). At this prehistoric burial site, a human skeleton dating back to 10,120 YBP was found, and it is the most complete Paleolithic skeletal remains unearthed so far in Southeast Asia. The ancestry of present inhabitants of Peninsular Malaysia can be traced back to this period, and this attracted much scholarly attention. Benjamin (1989) claimed that the archaeology done in Malaysia was really “Orang Asli archaeology” most of the time. The study by Andaya and Andaya (2001) supported this claim. Hence, the discovery of the “Perak Man” and other skeletal remains, plus their associated prehistoric tools, suggests that the early inhabitants of Peninsular Malaysia were genetically linked to smaller sized and dark skin northern Orang Asli (Semang) and the Senoi, with the latter displaying stronger connections with the Neolithic society in southern and central Thailand. However, scholars are divided between those who see cultural and biological shifts as occurring locally (Solheim 1980), and those who place greater emphasis on immigration (Andaya and Andaya 2001; Bellwood 1985).

Under the traditional viewpoint, it is believed that the Orang Asli arose from the migration of two major races – the Austroloids and Southern Mongoloids – although *in situ* evolution might have played a role (Bellwood 1985). The Semang have their roots from the Austroloids, while the Senoi and Proto-Malay were descendants of the Southern Mongoloids. Hoabinhian sites dated 18,000 and 10,000 YBP provided more details on hunting and gathering activities of the inhabitants, who were the cultural ancestors of the Semang and Senoi to a certain extent, although the latter’s biological affinity laid more with the Neolithic Southern Mongoloid population that migrated into Peninsular Malaysia about 4000 YBP (Norhalifah et al. 2016a, b).

Andaya (2008) stressed that there seemed to be a sharp transition from Hoabinhian to Neolithic period as attested by the introduction of agriculture and Austroasiatic languages. In contrast, the other wave of Southern Mongoloid expansion (i.e. the Austronesian-speaking populations) took place from 5000 YBP in Taiwan and occupied most of the Island of Southeast Asia (ISEA) region by 3500 YBP. The descendants of this layer of Southern Mongoloid expansion are now numerically dominant in most Pacific countries and are related to the Proto-Malays and Deutro-Malays in Peninsular Malaysia (Norhalifah et al. 2016a, b; Chambers and Edinur 2015).

Andaya (2008) also explained an alternative reconstruction of the Orang Asli population prehistory long advocated by Benjamin, who emphasized local adaptation rather than migration in explaining group differentiation. Benjamin believed that until 2500–2000 YBP, the wet-zone Southeast Asian Neolithic people combined hunting and gathering with vegeticulture of root crops, sago and bananas. A small number of people remained nomadic and the use of readily available cane,

bamboo or wood made intercommunity trade unnecessary at this time. Populations slowly increased and their self-sufficient communities had simple social organisations. From about 2000 YBP, some sub-groups became more efficient at farming, and as they moved down to lower ground with foraging confined to the foothills and at the edge of farmed areas. With the intensification of hunting and gathering, the residual upland foragers gradually reduced their reliance on swidden farming. The rise in importance of trans-isthmian/trans-peninsular routes at about this time encouraged the collection of forest produce, which complemented the agricultural pursuits of their lowland neighbours.

Archaeologists and others have claimed the forest people have an ancient tradition of trading with the outside world (Dunn 1975). During the Hoabinhian period, the Orang Asli were already involved in the trade of coastal shells for forest products like rattan, resin, tree bark and stone for making tools. By about 5000 YBP, this trade extended to communities as far away as northwestern and central Thailand. Maritime trade in forest products between Orang Asli and their trading partners, such as Malays and Thais, continued to be strong from about 2500 YBP to the founding of Melaka in/around the fifteenth century. Undoubtedly, this was spurred by polities in southern Thailand, the Isthmus of Kra, and the northern part of the Malay Peninsula (Andaya 2008). Until the nineteenth century, the forest aborigines were the only people available to extract most of Malaya's forest produce. They were armed with the necessary experience and knowledge to seek out and exploit forest resources. Forest products that were exported from the Peninsula between the fifth and early nineteenth centuries must have been supplied mostly by them although after the nineteenth century, Chinese and Malays began joining the industry.

Based on archaeological evidence, Dunn (1975) reiterated that trading links had existed between the peninsula's coasts and remote interior during the Hoabinhian and Neolithic age. Species of marine molluscs have been found regularly at all levels of inland caves, indicating that these shells must have been traded for. From these pieces of evidence, Dunn provided a hypothetical reconstruction that from 20,000 YBP (at which time the Peninsular Malaysia was united with Sumatera, Java, Borneo and Indochina in the greater Sundaland area), the people probably subsisted as hunter-fisher-gatherers, and trading exchanges must have been exclusively *internal* and primarily *inland-inland*.

At 10,000 YBP, roughly the end of the Pleistocene period, rising sea levels had isolated the Malay Peninsula from surrounding regions of Southeast Asia. Limestone caves of the interior were occupied by Hoabinhian people, although not for long after the end of the Pleistocene age. For the next few thousand years, their subsistence lifestyle was probably based on hunting, fishing and gathering, together with subsidiary cultivation of root crops and other plants. Crop cultivation at this time may have been quite casual, while the swidden form of "agriculture" may not have evolved until much later, around 5000 YBP. Dunn insisted that trading must have been almost exclusively internal, but despite the predominance of *inland-inland* trading, *inland-coastal* trading was now on the rise.

Between 5000 and 4000 YBP, the Neolithic people were dependent on hunting, fishing and gathering, but root crops had assumed an important place in their

subsistence economy. These early Neolithic farmers preferred to live in caves, although open living sites (e.g. Gua Kepah) were also inhabited (Dunn 1975). This particular Hoabinhian site continued to be occupied or at least visited occasionally by the later Neolithic people. Overseas trade was growing by 4000 YBP. This economy involved coastal aboriginal peoples supplying products from the forests for sea shells. According to Dunn (1975), there was also an exchange of ideas and techniques among the Malayan coastal people, who served as information and commodity filters for inland people, as seen in the diversity in form, colour and decorative experimentation of coastal ceramics compared with those found in Gua Cha and Gua Kechil. Between 5000 and 4000 YBP, *internal* (inland-inland) trading continued as before, but coastal-inland exchanges had developed into an *external* trade from the perspective of the forest people. It is possible that *maritime* trade had begun during this period due to the rapid expansion in seafaring activities in insular Southeast Asia (Dunn 1975).

It is interesting to note that Gua Cha is situated at the boundary between the Temiar Senoi to the west, and the Semang to the north and east. Both these tribes speak Aslian languages within the Austroasiatic family, like the Mons in Myanmar and Khmers in Cambodia. These languages have an ancestry within southern mainland Southeast Asia, which is much older than either Thai or Malay. In this sense, Taha (1985a, b), a Malaysian archaeologist involved in the excavation of Gua Cha, believed that the prehistory of the cave's settlement was almost certainly related to the Orang Asli. The Gua Cha site contained 27 burials dated between 10,000 and 2000 YBP, spanning both the Hoabinhian and Neolithic periods (Bellwood 1985). The discovery of Hoabinhian artefacts throughout this region proved that in Peninsular Malaysia, they were made by population ancestral to the present Austro-Asiatic-speaking Semang and Senoi. These ancestral groups had stopped making flaked stone tools long before recorded history, but the Negritos, according to Bellwood (1985), have preserved hunting and gathering, and may thus be regarded as modified descendants of the original inland Hoabinhian economy. Hoabinhian sites are found mostly in rock shelters, but there are a few coastal shell middens in Sumatra, Peninsular Malaysia and northern Vietnam. In Peninsular Malaysia, a number of inland Hoabinhian caves and shelters have been excavated in the northern states of Perlis, Kedah, Perak, Pahang and Kelantan (Bellwood 1985).

From the 1979 excavation, Taha (1985a, b) concluded that there was no apparent hiatus in the occupation of the Gua Cha rock shelter between the Hoabinhian and Neolithic periods. He also argued that the Hoabinhian and Neolithic cultures in Gua Cha and other sites with similar remains are closely related to the Orang Asli. The Indianised civilisations and maritime trade of coastal Peninsular Malaysia had no real impact on people in this part of the peninsula, and neither did the Malays, at least not until recent times. Based on these archaeological discoveries, prehistoric society in Peninsular Malaysia was a creative one, hardworking, innovative and imbued with logical thinking that enabled improvement, which was no different from similar societies in other parts of the world (Saidin 2011). As emphasised by Majid (2003), these findings showed Southeast Asia was not part of "the backwaters of civilization".

A Review of Anthropological Studies

The broad descriptive term “Orang Asli” refers to the 18 tribes of ancient indigenous people who live in Peninsular Malaysia, and who are believed to be among the oldest inhabitants of the country. As explained earlier, they have conventionally all been seen as belonging to one of three main groups, namely the Semang, Senoi and Proto-Malays (Table 1). They were first classified according to their morphology, language, culture and geographical distributions for administrative purposes by the British and Malayan authorities (Masron et al. 2013). The Semang generally have frizzy hair and dark skin. In contrast, the Senoi have a range of skin colours and curly hair, while the Proto-Malays have lighter average skin colour, straight hair and epicanthal folds. The Senoi are the most populous and they are widely distributed across the central part of the Peninsular Malaysia. Unlike the Semang and Senoi, who mostly live in the hinterlands, the Proto-Malays are seafarers who established their settlements in coastal and riverine areas (Andaya 2002). They possess agricultural skills as well as advanced knowledge in acquiring maritime commodities. Most of the Orang Asli have retained their old form of economic subsistence, which include hunter-gathering and swidden-agriculture. A small number of Semang still retains a semi-nomadic lifestyle. Their culture and technology revolve around utilising surrounding resources. The Orang Asli have existed side-by-side with the predominant Malay community for centuries, with continuous cultural and economic interactions. Trade relations involve jungle products being exchanged for salt, iron tools, cloths, etc. (Andaya 2002). In certain cases, the Orang Asli became part of the Malay political organisation and often became intermediaries between the Malay rulers and their chieftains in the hinterland (Tuck-Po 2011). In Perak, various headmen of the Semai sub-tribe to have been conferred titles and awards by the sultan as recognition for being representatives of people in the state’s interior. The Temiar have a history of interacting with the Thais (Masron et al. 2013). Such economic and political relationship show that in spite of differences in language, culture and distribution, the Orang Asli were not entirely isolated from the dominant Malays.

Early references regarding the Orang Asli were made in the sixteenth century in literature like *Sejarah Melayu*, the accounts of the French Catholic missionaries as well as British adventurers (Tuck-Po 2011). More complete accounts about them started to surface in the nineteenth century, especially in the works of Abdullah (1960), Clifford (1897) and Logan (1847a, b, c, d, e, f, g, 1848a, b), as well as other European scholars and travellers such as Borie (1865, 1886, 1887), Mikluho-Maclay (1878) and Saint-Pol Lias (1883). From the early twentieth century, there were more systematic observations of Orang Asli, especially through the work of Skeat and Blagden (1906) entitled *The Pagan Races of the Malay Peninsula*. This work contained detailed descriptions about the Orang Asli and their way of life, as well as classifications regarding their ethnic divisions and nomenclature. Systematic fieldwork-based research on the indigenous tribes have been done by a few specialised scholars, such as Vaughan-Stevens (1892–1894), Winstedt (1922), Evans (1923, 1927), Noone (1936, 1939, 1954), Wilkinson (1971) and Schebesta (1952).

All through this period, new discoveries were made, including the names and locations of indigenous tribes that were previously unknown to the Western scholars. These researchers also managed to revisit the tribes themselves and refined earlier classifications of the Orang Asli. Among the many contributions are those of Schebesta (1952, 1954, 1957, 1973), which give in-depth insights into the Semang he encountered, as well the first grammatical accounts of the Aslian language.

After World War 2, more scholars started to show keen interest in the Orang Asli, especially with the establishment of the Department of Aborigines by the colonial administration to document personal, historical and political accounts of the natives. One of the most prominent writers during this period was P.D.R. Williams-Hunt, who produced an overall survey on Orang Asli tribes, focusing on their cultures and societies in 1952. In the 1960s and 1970s, the researchers who made major contributions were Needham (1956, 1974, 1976, 1984), Hood (1974, 1978), Dunn (1975), Carey (1976) and Howell (1982, 1989, 2011) and Endicott and Endicott (2008). Aside from anthropological and ethnographical studies which focus on the culture and lifestyle of the Orang Asli, new studies on ethno-archaeology have also been carried out recently. Systematic research in this field was done by A.H. Taha, especially in Upper Kelantan and Pahang (Taha and Jaafar 2015; Taha 1983, 1985a, b, 1988, 1991). Currently, Ethno-Archaeological research is being carried out by the archaeological team of Universiti Sains Malaysia led by Dr Hamid Mohd Isa. His research involves the study of the cultural materials of the Orang Asli in comparison with prehistoric societies in the Malay Peninsula, as well as remapping of the Orang Asli settlements in Kelantan, Perak and Pahang (Isa 2007, 2010a, b, 2015; Isa and Ramli 2015; Isa et al. 2015). The Orang Asli revolves around what they can get from their immediate surroundings. For the Semang and Senoi groups, economic activities revolve around hunting and gathering forest products, either for self-consumption or trade. They also plant several types of crops, and work for Malay paddy planters. Their staple includes wild yams, dry rice, bushmeat, maize, tubers and fish. Their traditional hunting equipment includes blowpipes, spears, hooks and lines. They also use knives, machetes, pots through trading with the Malays.

The Semang practise conjugal marriage and marriages among relatives are discouraged (Benjamin 2001). The marriage ceremony involves bestowing gifts to the bride's family with a small feast. Couples may live with the bride's family or vice versa, or even alternate between them, as there is no specific rule governing this matter. In most cases, divorce is acceptable when couples stop living together. Such separation is done on good terms and often, the separated couples still continue to live in the same village. Children are raised by both parents, though the wife plays a more important role. The children learn their skills through participation and observation rather than formal training. As for the Senoi, marriage is a casual practice and sometimes brothers may swap wives. After marriage, the couple first live with the bride's family and later move in with the groom's relations. Apparently, divorce among Senoi couples is quite common (Benjamin 2001).

The Semang form egalitarian societies, which are made up of units of conjugal families, which come together and break up in the village camps according to their

convenience and necessity. They do not traditionally have any form of social hierarchy, and with the absence of headmen, each individual has his own autonomy in making decisions on daily matters. Disputes are settled through amicable negotiations or public discussion, and individuals who are not on friendly terms with one another can join different social groups. The Senoi live in settlements of up to 200 people, usually located near a stream or river. They usually live in one area for few years before moving to family homes built around a long house, known as the *balai sewang*, which serves as a community meeting place. Their dwellings are made of bamboo, wood bark and thatch. The Senoi live in semi-permanent settlements, moving on from one place to another as they practised slash-and-burn agriculture (Masron et al. 2013). As for Proto-Malays, the Jakun and Temuan sub-tribes have similar lifestyle with the Senoi and live in the interior, while the Orang Kanaq, Kuala and Seletar people live along coastlines, exploiting the maritime resources.

One of the important aspects of research regarding the Orang Asli is their religion. Their belief system revolves around spirits which dwell in animate and inanimate objects (Masron et al. 2013). Most Semang sub-tribes perceive the world as a disk placed at the back of a snake, with trees and flowers growing abundantly in paradise above, which is connected to the living world by stone pillars. They believe in the existence of immortal things living in the stone pillar below the earth. They were once humans and occasionally appear in people's dreams. The occurrence of natural phenomena, such as wind, rain, thunder etc. is believed to be related to the spirits' powers. These supernatural beings include the Thunder God, Grandmother of the Underworld and the Snake of the Underworld. The shaman is the medium through which humans can communicate with the supernatural world. They are known as the *Halak*, who presides over religious ceremonies (Carey 1970). Their view about life after death involves the soul linger around as malevolent spirits before eventually departing to an afterlife in the western horizon. They bury their dead in shallow graves (Skeat 1902), conducting rituals to protect the living from the spirits of their departed.

The Senoi take great efforts to make offerings to appease spirits and gods, and practising taboos as they viewed mankind as vulnerable. Communication with the supernatural, especially to cure illness in the temporal world, is done through dreams and trances in ceremonies that may easily last up to six nights. The Senoi bury their dead with their possessions but, unlike the Semang, they do not have clear idea about the afterlife. They believe that human beings have a few souls, including those which may be malevolent spirits capable of harming others. The mourning may last for an entire month and involves elaborate ceremonies.

For Proto-Malays, their beliefs, too, revolve around gods and ancestors. The Temuan believe they were placed on the earth to assume a sacred duty of protecting the rainforest. For them, every inanimate object contains a guardian spirit, while rivers are guarded by snakes and dragons. Their rituals include practising magic and spiritual ceremonies, taboos and healing. Their healers and shamans will lead an annual rite to appease their ancestors and guardian spirits (Sam 2015; Masron et al. 2013).

Comparative Linguistics of the Orang Asli

Linguistically, the Orang Asli are broadly classified as Austroasiatic or Austronesian, with the former further subdivided into northern Aslian (Mintil, Batek Nong, Che Wong), central Aslian (Semai, Jah Hut) and southern Aslian (Besisi, Semaq Beri, Semelai and Temoq) (Benjamin 1997). The Northern, Central and Southern subdivisions were previously known as Jahaic, Senoic and Semelaic, respectively (Burenhult 1999). These linguistic differences are the result of two influences in Peninsular Malaysia – one coming from the north (i.e. Austroasiatic) and the other from the south (Austronesian) – several millennia ago (Benjamin 1997). The Senoi from the north came with Mon-Khmer influence, as seen in the more than 15 Aslian languages which are still spoken in south Thailand. In Peninsular Malaysia, more than half of these speakers are found in Pahang (Mintil, Bateq, Che Wong, Semai, Jah Hut, Besisi, Semaq Beri, Semelai and Temoq). It is believed that the early civilisation in Peninsular Malaysia was Mon and Mahayana-Buddhism until 1200–1300, and these were later replaced by the Malay language and Islam. In Pahang, we still have Mon-Khmer names for places like Benom, Reman, Kampong Singhora and Dong (Benjamin 1997). This can also be readily be seen among Semang foragers, who once have their own original aboriginal language, but had since undergone a language shift because of prehistoric contact with the sedentary Senoi people (Blust 2013). Language shifts are relatively common among indigenous populations. For example, as observed among Negritos in Philippines and Melanesians, who both adopted Austronesian languages but have predominantly Australoid genetics (Bellwood 1997). Nonetheless, research has shown some evidence of an ancient common culture and language. For example, the thunder complex (a set of beliefs about punitive thunderstorms) is shared between the Semang and Philippine Negritos. This preceded the colonisation of ISEA by the agricultural Austroasiatic- or Austronesian-speaking populations (Blust 2013). Another example is Cham people in Indochina, who speak the Austronesian language, but whose maternal and paternal genetics are closely affiliated to Austroasiatics and Thai-Daics, respectively (Peng et al. 2010; Li et al. 2008). These people established the Cham Empire between sixth and twelfth centuries in Southern Vietnam, which slowly declined due to continuous pressure from the Kinh people. They then migrated to Cambodia, and only few small groups remained in Southern Vietnam (Musa 2006). In 1975, large numbers of Cham refugees sought asylum in Malaysia (mostly in the north-eastern states of Kelantan and Terengganu) following the turmoils in Vietnam and Cambodia (Wong 2013).

In contrast to Austroasiatic, the Austronesian language came from the south and is spoken by the Malays and Proto-Malays like the Temuan and Jakun. The Proto-Malays still keep their animistic beliefs and their influence have travelled far north into the Mon-Khmer areas, which may be seen from the appearance of Austronesian loan words in Aslian languages. Various recent accounts of Austronesian prehistory have been proposed and some of these are in conflict with the views espoused earlier by others. This has led to some degree of academic tension among scholars in this area of research. Interestingly, several earlier models of Austronesian expansion

were hard to evaluate and not fully supported by established evidence (Donohue and Denham 2011). The key point of difference is the ultimate source of proto-Austronesian genes and/or languages; i.e. Taiwan or ISEA as the original ancestral source of their roughly 387 million descendants today (Norhalifah et al. 2016a; Donohue and Denham 2011). In the “Out of Taiwan” model, Malaysia holds just one of the descendant Austronesian populations, first received well within the last 3000–4000 YBP. The Southern (Zhejiang, Fujian or Guangdong province) or eastern coast of China (Shandong province) are the most probable potential homelands of Pre-Austronesian speakers before this language differentiated into the Formosan and Malayo-Polynesian sub-groups in Taiwan and ISEA, respectively (Andaya 2002; Bellwood 1997). The former is exclusively spoken by the aboriginals of Taiwan, while the latter is by the descendants of Austronesian populations in Polynesia and ISEA, including Malaysia (Blundell 2011). This view of the pattern of Austronesian language spread has been supported by dating languages across the Pacific and Indian Oceans (Gray et al. 2011). However, the inferences of migration events that took place several millennia ago solely based on a single evidence (linguistic study in this case) seem vulnerable. Any chronology of human settlement should be integrated with those appearing from multidisciplinary studies – e.g. see Donohue and Denham (2011) for different ideas about the origins of language and genes in ISEA. In this context, the classification of Orang Asli based on their current language affinities (Austroasiatic or Austronesian) only ignores their other features (genetics and physical characteristics) that are unique only to either Semang, Senoi or Proto-Malays.

The Genetic Trail in Malaysia

The preceding sections provide an account of the ancestral original origins of the three major Orang Asli groups. This raises expectations about their genetic affinities with one another and with other populations. In this sub-chapter, the literature is surveyed to present an analysis of these expectations. For the first time, we integrated our own data from autosomal loci of medical significance (transfusion and transplant genes) into the wider account. The emergent picture suggests that haplotype distributions from sex-limited markers are equivocal in their ability to resolve the “Out of Taiwan vs. Out of ISEA” debate (Chambers and Edinur 2015). In particular, we point to the difficulties that may arise if one puts too much faith in molecular clock estimates of divergence dates, which are often in conflict with archaeological chronology and linguistic relationships.

Our understanding of population history in ISEA, including Peninsular Malaysia, is informed by the composite picture revealed by earlier and widespread analyses of mtDNA and Y-chromosome markers, which leads to the introduction of several models of population expansion to the Asia-Pacific region. These sex-limited data suggest Pleistocene colonisation of ISEA by Anatomically Modern Humans, who later spread north and south, including to Taiwan and remote Oceania (Soares et al. 2016; Donohue and Denham 2011). Supporters of this single wave colonisation of

ISEA agree that material culture and linguistic changes did take place during the Holocene through acculturation process, rather than involving population movements and changes. This view is well supported by molecular dating of the frequently revised molecular clock of maternally inherited mtDNA haplogroups, and it indicated Pleistocene colonisation and evolution of people already settled in ISEA. The indigenous origins suggest ISEA as the major source of people in Asia-Pacific region, including Austronesians, based on the age of several candidate “Out of Taiwan” mtDNA haplotypes (e.g. E and B4a1a), which appear to be older than those in Taiwan aboriginals. Or, it may also be the most probable homeland of Malayo-Polynesians (the Batanes Islands) to interpret as indigenous evolution in ISEA before Neolithic expansion in Southern China/Taiwan (Soares et al. 2016), but receive no support from linguistic, archaeological and anthropological studies (Ross 2005; Bellwood 1997). In this context, the molecular clock should be validated using archaeological records, which is sparse in ISEA. This is not the case in Southern China, Vietnam, Philippines and Oceania, where a relatively large number of archaeological specimens are available for validation (Bellwood 1997).

In contrast, genetic data from autosomal markers are much more credible to support various ancestries in ISEA compared with the uniparentally inherited mtDNA haplotypic data, which are more affected by the founder effects and sex-biased gene flow, especially in ISEA, which is occupied by either matrilineal- or patrilineal-marriage practice societies. The effects on mtDNA and male-specific uniparental Y-chromosome markers may mean the ancestry components revealed from both mtDNA and Y-chromosome analyses do not directly parallel what has been demonstrated in the genome-wide studies; see Soares et al. (2016) for an attempt to directly link information derived from uniparental and genomic ancestral fractions. Our own findings on various immune systems and genes that determine tissue compatibility in transfusion and transplantation showed various ancestral fractions in Malaysian sub-populations. Even though these genes are more affected by selective pressure, they still yield relatively strong ancestral signals from the loci of their immune cells, such as the killer-cell immunoglobulin-like receptor (KIR) in natural killer cells and other genes in platelets, neutrophils, leukocytes and lymphocytes. These can differentiate the Semang, Senoi and Proto-Malays (Manaf et al. 2016; Norhalifah et al. 2016b; Syafawati et al. 2016; Tasnim et al. 2016; NurWaliyuddin et al. 2015) (Table 2 and Fig. 5). For example, there is high frequency of KIR haplotype B (KIR2DL1, KIR2DL3, KIR3DL1, KIR3DL3, KIR2DS4, KIR2DL2, KIR2DL5, KIR3DS1, KIR2DS1, KIR2DS2, KIR2DS3, KIR 2DS5, KIR2DP1, KIR3DP1, KIR3DL2 and KIR2DL4) and KIR haplotype A (KIR2DL1, KIR2DL3, KIR3DL1, KIR3DL3, KIR2DS4, KIR2DP1, KIR3DP1, KIR3DL2 and KIR2DL4) among the Semang (Lanoh, Bateq and Kensiu) and Senoi (Semai and Che Wong). The KIR haplotypes A and B are frequently found in descendants of Africans and Indochinese populations (NurWaliyuddin et al. 2015) and play a vital role in fighting infectious diseases and reproduction, respectively (Chambers et al. 2016). The possible clinical consequences of these ancestral fractions in Orang Asli are important future subjects for disease association studies as has previously been conducted by Edinur et al. (2013) and Chambers et al. (2016) in Polynesians.

We also observed a unique pattern of allele frequency spectra in Orang Asli of similar sub-tribes; HNA alleles (i.e. HNA-4 and HNA-5) and several single nucleotide polymorphisms (SNP) in pro-inflammatory (IL12-1188A/C and IL2+166G/T) and anti-inflammatory (IL-10-819C/T and IL-10-1082A/G) cytokine genes distributed differently in Proto-Malays (i.e. the Orang Kanaq) as compared with their other Austronesian relatives, the Malay subethnic groups (Norhalifah et al. 2016b; Manaf et al. 2016). Genetic differences between these Austronesian groups may be due to isolation and bottleneck events that took place in the Orang Kanaq. The Orang Kanaq currently live as a small group in the interior of Peninsular Malaysia (Musa 2011) as opposed to Malay subethnic groups. The latter group is numerically larger and have admixed with other major sub-populations including with the modern Malays (i.e. Deutro-Malays), Chinese and Indians. Similar effects were observed for the HLA loci, the most polymorphic region in human genome, where only 43 alleles were recorded across the HLA-A, HLA-B and HLA-DRB1 genes of the Kensiu and Semai people. These Orang Asli sub-tribes also have fixed human platelet antigen (HPA) (HPA-2a, HPA-4a, HPA-6a) and TGF- β 1 +915G cytokine systems. Only 10 and 9 KIR genotypes were detected in Kensiu and Semai, respectively (Norhalifah et al. 2016b; Syafawati et al. 2016; Tasnim et al. 2016; NurWaliyuddin et al. 2015). Overall, these apparently distinctive gene pools of Orang Asli are the result genetic refinement via admixture, founder effects and selective pressure after multiple settlements and long periods of isolation since they settled in Peninsular Malaysia.

The current trends in genetic ancestry studies focus on large scale SNP surveys and whole genome sequencing because they generate large volumes of data (Wong et al. 2013; Lipson et al. 2014). This new development contributes towards our present understanding of ancestral and admixture fractions in ISEA and includes representative Orang Asli in Peninsular Malaysia and Taiwanese aborigines. The ancestry pattern revealed by the SNP surveys and whole genome sequencing supports our inferences using immune and histocompatibility genes. In addition, the indigenous evolution model for ISEA was not supported from other biological data – dental and craniometric analyses showed distinct patterns of variations between ancient and modern human specimens in ISEA, which indicated demographic changes in the region associated with several human settlements (i.e. Austronesian and Austroasiatic speakers) in the region from Pleistocene to 2500 YBP (Matsumura and Oxenham 2014). Skeletal analysis showed morphological similarities between pre-Neolithic samples in ISEA (Gua Niah in Sarawak and Tobon in the Philippines) and those from Australian Aborigines and Papuans, which correlated with the late Pleistocene colonisation of Asia-Pacific region by anatomically modern humans (Matsumura and Oxenham 2014). In Peninsular Malaysia, this is related to the Semang, who are genetically and physically distinct from the other two language families (Austronesians and Austroasiatics) of food-producing populations, who migrated to the region in the Neolithic period (Matsumura and Oxenham 2014; Bellwood 1997). Nonetheless, admixture did occur between these populations and is evident in whole genome SNP analyses (Soares et al. 2016; Deng et al. 2015; Lipson et al. 2014).

Table 2 List of genetic systems screened in Orang Asli and alleles/haplotypes/genotypes that are unique to a particular tribe/sub-tribe

Marker	Gen/hap/ allele	Semang			Senoi		P-M OK
		Bateq	Kensiu	Lanoh	CW	Semai	
KIR	Gen. AA	0.00	0.18	0.12	0.21	0.46	0.09
	Gen. AB	0.33	0.55	0.65	0.61	0.41	0.82
	Gen. BB	0.67	0.26	0.23	0.18	0.14	0.09
	Hap. A	0.17	0.46	0.44	0.52	0.66	0.50
	Hap. B	0.83	0.54	0.56	0.48	0.34	0.50
HPA	1a	1.00	0.96	1.00	1.00	0.99	1.00
	1b	0.00	0.04	0.00	0.00	0.01	0.00
	2a	1.00	1.00	1.00	1.00	1.00	1.00
	2b	0.00	0.00	0.00	0.00	0.00	0.00
	3a	0.50	0.88	0.64	0.42	0.67	0.82
	3b	0.50	0.13	0.36	0.58	0.33	0.18
	4a	1.00	1.00	1.00	1.00	1.00	1.00
	4b	0.00	0.00	0.00	0.00	0.00	0.00
	5a	0.85	0.85	1.00	0.79	0.89	1.00
	5b	0.15	0.15	0.00	0.21	0.11	0.00
	6a	1.00	1.00	1.00	1.00	1.00	1.00
	6b	0.00	0.00	0.00	0.00	0.00	0.00
	15a	0.00	0.36	0.26	0.5	0.52	0.91
	15b	1.00	0.64	0.74	0.5	0.48	0.09
	HNA	1a	0.44	0.54	0.82	0.56	0.58
1b		0.56	0.46	0.14	0.44	0.35	0.23
1c		0.00	0.00	0.00	0.00	0.00	0.00
1null		0.00	0.00	0.04	0.00	0.07	0.00
3a		0.93	0.95	0.86	0.74	0.94	0.91
3b		0.07	0.05	0.14	0.26	0.06	0.09
4a		1.00	0.99	0.90	0.87	0.93	0.86
4b		0.00	0.01	0.10	0.13	0.07	0.14
5a		0.76	0.79	0.86	0.85	0.77	1.00
5b		0.24	0.21	0.14	0.15	0.23	0.00
CytokineTGF- β 1 +869/+915 gene SNPs		CC	0.00	0.00	0.00	0.00	0.00
	CG	0.82	0.50	0.62	0.75	0.70	0.55
	TG	0.18	0.50	0.38	0.25	0.30	0.41
	TC	0.00	0.00	0.00	0.00	0.00	0.05
CytokineTNF- α -308/-238 gene SNPs	GG	1.00	0.93	0.98	0.86	1.00	0.91
	AG	0.00	0.04	0.02	0.10	0.00	0.00
	GA	0.00	0.03	0.00	0.02	0.00	0.00
	AA	0.00	0.00	0.00	0.02	0.00	0.09
CytokineIL-2-330/+166 gene SNPs	TG	0.64	0.60	0.62	0.73	0.55	0.77
	GG	0.26	0.18	0.18	0.25	0.33	0.23
	GT	0.00	0.00	0.00	0.00	0.03	0.00
	TT	0.10	0.22	0.20	0.02	0.09	0.00

(continued)

Table 2 (continued)

Marker	Gen/hap/ allele	Semang			Senoi		P-M OK
		Bateq	Kensiu	Lanoh	CW	Semai	
CytokineIL-4-1098/-590/-33 gene SNPs	TTT	0.80	0.51	0.72	0.74	0.61	0.64
	TTC	0.00	0.00	0.00	0.00	0.09	0.00
	TCT	0.00	0.00	0.00	0.00	0.00	0.09
	TCC	0.18	0.43	0.16	0.02	0.17	0.23
	GTT	0.00	0.00	0.00	0.00	0.00	0.00
	GTC	0.00	0.00	0.00	0.00	0.00	0.00
	GCT	0.000	0.00	0.00	0.00	0.01	0.00
	GCC	0.02	0.06	0.12	0.24	0.13	0.05
CytokineIL-6-597/-174 gene SNPs	GG	0.72	0.88	0.62	0.64	0.73	0.64
	CG	0.24	0.11	0.34	0.19	0.26	0.36
	GA	0.00	0.01	0.00	0.05	0.00	0.00
	CA	0.04	0.00	0.04	0.12	0.01	0.00
CytokineIL-10-1082/-819/-592 gene SNPs	GCC	0.05	0.07	0.06	0.27	0.10	0.50
	GCA	0.00	0.00	0.00	0.00	0.00	0.00
	GAC	0.00	0.00	0.00	0.00	0.00	0.00
	ACC	0.57	0.47	0.20	0.06	0.23	0.00
	ACA	0.00	0.01	0.00	0.02	0.02	0.00
	ATC	0.04	0.00	0.02	0.02	0.00	0.00
	ATA	0.31	0.44	0.72	0.64	0.66	0.50
	GTA	0.01	0.00	0.00	0.00	0.00	0.00
δHLA-A	02:01	•	0.41	0.26	•	0.07	0.15
	11:01	•	0.14	0.04	•	0.04	0.27
	24:02	•	0.07	0.12	•	0.20	0.10
	24:07	•	0.24	0.32	•	0.41	0.21
	33:03	•	0.00	0.08	•	0.00	0.17
δHLA-B	13:01	•	0.14	0.08	•	0.00	0.08
	15:02	•	0.00	0.02	•	0.17	0.06
	15:13	•	0.19	0.10	•	0.16	0.13
	15:25	•	0.02	0.00	•	0.00	0.15
	18:01	•	0.19	0.28	•	0.17	0.15
	35:05	•	0.05	0.14	•	0.15	0.06
δHLA-DRB1	09:01	•	0.19	0.32	•	0.15	0.19
	12:02	•	0.14	0.14	•	0.29	0.15
	15:01	•	0.19	0.04	•	0.11	0.10
	15:02	•	0.14	0.30	•	0.16	0.08
	16:02	•	0.00	0.00	•	0.16	0.21

There are many genetic similarities and differences observed between Orang Asli tribes across the five genetic loci. In addition, differences were also recorded between Orang Asli of similar tribe (e.g. refer KIR genotype profiles between Bateq, Kensiu and Lanoh of the Semang). Evidence of reduced genetic variability in Orang Asli is shown by several monomorphic loci (bold) and largely observed in small Orang Asli subtribes, such as the Bateq and Orang Kanaq. The population data for KIR, HPA, HNA, cytokine and HLA listed here were compiled from Jinam et al. (2012), NurWaliyuddin et al. (2015), Manaf et al. (2016), Norhalifah et al. (2016b), Syafawati et al. (2016) and Tasnim et al. (2016). *Gen* genotype, *hap* haplotype, *CW* Che Wong, *OK* Orang Kanaq, • no data available, δ only the most frequent HLA types in Kensiu, Jahai, Semai and Temuan were listed

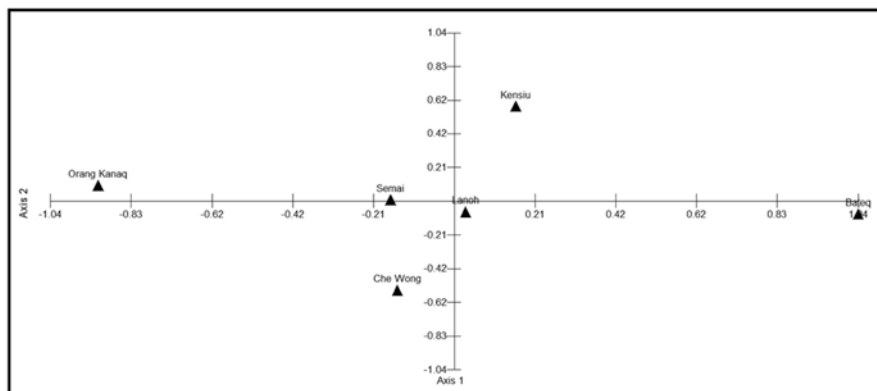


Fig. 5 Principal coordinate plot constructed using allele frequencies (except for HLA, where data is not available for all reference populations) listed in Table 2 and methodology described by Edinur et al. (2009). The plot illustrate the diverse gene pools of the three Orang Asli groups with evidence of admixture between the Semang (Lanoh) and Senoi (Semai and Che Wong)

A Multidisciplinary Synthetic Model: Including Evaluation of the Evidence and Relation of Our Model to Earlier Ones

The emerging picture of ancestries in Peninsular Malaysia was first described by Lipson et al. (2014) and followed by Norhalifah et al. (2016a). The Genetic Layer Cake Model proposed by Norhalifah et al. (2016a) included pre-historical and historical migration events and socio-economic relationships (e.g., between Orang Asli and Malays, and between Orang Asli tribes and sub-tribes) since the first century among sub-populations in Peninsular Malaysia. Kusuma et al. (2016) demonstrated the same approach taken by others to interpret the origins and migration patterns of other genetically admixed Austronesian populations. Figure 6 shows three waves of settlements in Peninsular Malaysia (Semang, Senoi and Proto-Malays) and was inferred from linguistic, archaeological data discussed earlier, besides the latest evidence from genome wide studies (Lipson et al. 2014; Bellwood et al. 2011). The Semang (also known as Australo-Papuan or Negrito) are the first to settle in Peninsular Malaysia before migrating south and east towards Australia, Papua New Guinea and the Philippines. The pre-Neolithic settlements of the Semang in Peninsular Malaysia was followed by the Austroasiatic-speaking agricultural population (i.e. Senoi), who migrated from Indochina and the Asian part of their genome came in with Austroasiatic languages (i.e. a branch of Mon–Khmer of Austro-Asiatic language family) about 4000 YBP (Norhalifah et al. 2016a; Blust 2013; Andaya 2002; Saha et al. 1995).

This language was then adopted by the already settled Semang group but never spread into Indonesia as far as we know. In contrast, Proto-Austronesian Neolithic speakers of Southern China migrated and dispersed throughout Asia-Pacific region as far as Madagascar in the west, and New Zealand in the east, via Taiwan, Philippines and Borneo (Kusuma et al. 2016; Bellwood 1997). Austronesians migrated from west to east along the northern coast and offshore islands of New

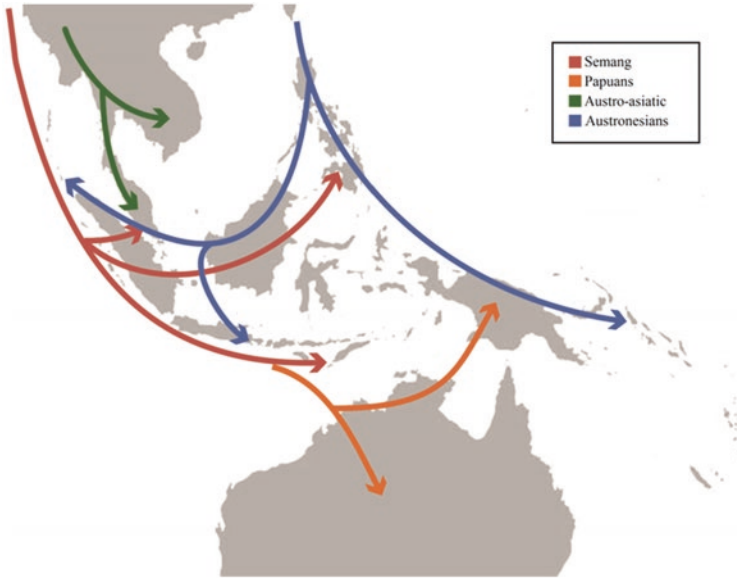


Fig. 6 Historical patterns of migration and settlement of Semang (red), Senoi (green) and Proto-Malay (blue) ancestors in Peninsular Malaysia. This figure is edited from Lipson et al. (2014), with permission from Macmillan Publishers Ltd

Guinea (Marianas, Palau, Admiralties and Bismarck Islands), but certainly not anywhere through the central highlands of Papua New Guinea (PNG); cf. as originally shown in the diagram by Lipson et al. (2014). Therefore, while it is likely true that the modern Malays are descendants of indigenous Proto-Malays, the admixed component from Indians, Arabs and East Asian components should not be overlooked and has been well demonstrated by the growing number of genome wide studies (Soares et al. 2016; Hoh et al. 2015; Aghakhanian et al. 2015; Deng et al. 2015; Deng et al. 2014, Liu et al. 2014; Jinam et al. 2012; Hatin et al. 2011).

We agree that the gene pools of contemporary Orang Asli in Malaysia and those in Philippines, Australia, Taiwan and PNG are different, and this is related to local adaptation, admixture and socio-economic interactions. But they are all descendants of the earliest settlers in ISEA and represent several genetic lineages of people settled in the Asia-Pacific region in prehistoric time. This is what one may expect since these ancient populations split around 30–50,000 years ago as shown by Soares et al. (2016), the HUGO Pan-Asian SNP Consortium (2009) and Deng et al. (2015) using mtDNA, Y-chromosome and whole genome-wide data. The authors also proposed migration patterns and timelines in ISEA/Peninsular Malaysia. This is totally different from other populations, such as the Taiwanese aboriginal tribes who are the ancestors of the Proto-Malays and Malays, but not thought to have been in extensive or extended contact with genetically distinct populations (Norhalifah et al. 2016a). Several ancient settlements and polities (e.g. Pan Pan, Dan, Kataha, Chi Tu and Kalah) existed in Peninsular Malaysia between fifth and eleventh centuries and received strong influences from external Hindu-Buddhist civilisation. They became distribution hubs for forest products (rattan, resins and aromatic wood, such

as camphor and gaharu) collected by different Orang Asli groups in Peninsular Malaysia and for other trade items (silk and spices) from Chinese, Arab, Persian and Maluku traders (Hussein et al. 2007; Musa 2006; Andaya 2002; Manguin 1993). This period was followed by the arrival of Islam (largely via trading and inter-marriage between Indian traders and local people) as early as from the eleventh century in the northeast (Pahang and Terengganu) of Peninsular Malaysia (Nor et al. 2012; Hussein et al. 2007; Hussin 2004;). During the Melaka Sultanate, the Chinese admiral, trader and explorer Cheng Ho, representing the Ming Emperor, led an expedition to Malacca and many of the members settled down with the locals, marking the beginning of a unique Chinese-Malay melange in Melaka called the Baba-Nyonya culture (Lee 2008). This has also proved that the Chinese had arrived in Peninsular Malaysia long before the European colonisation from the fifteenth to nineteenth century. The effects of the European colonial era can also be readily seen with the existence of Portuguese–Eurasian influence in Melaka (Pillai et al. 2015). Both, Baba-Nyonya and Portuguese–Eurasian cultures are products of socio-economic interactions in Melaka that emerged as unique ethnicities with socio-cultural characters that closely resembled a hybrid of their original populations (Chinese, European and Malay). Later in the nineteenth century, even larger numbers of Chinese and Indian labourers were brought to Peninsular Malaysia during the British administration to supply the workforce at tin mines, rubber plantations and timber mills. It was also at this time that the role of Orang Asli as main suppliers of jungle products began to decrease (Andaya 2002). These are all the contributing factors to not only on the observed complex genetic make-up, but also on the demographic changes in the Peninsular Malaysia.

Overall, the demographic history in Peninsular Malaysia matches well with the Malaysian Genetic Layer Cake Model we proposed (Norhalifah et al. 2016a), which includes waves of prehistoric migrations (by the Semang, Senoi and Proto-Malays) and socio-economic relationships since the first century in Peninsular Malaysia. In this review, new and compelling evidences from material cultures and beliefs are also included in the revised and expanded version of the model make it more inclusive, if not yet fully complete, account of human prehistory in Peninsular Malaysia.

Summary and Conclusions: Future Prospects for the People and Recommendations for Further Studies

In preceding sections, an account was presented with hope that it properly reflects the totality of received wisdom on the biology and culture of the Orang Asli. The picture that emerged is one of three distinct lineages of people who arrived at different times from three different directions – ancient Semang from the south, Senoi with Asian affinities from the north and Proto-Malays from the east. This ancestral history and geographic dispersal pattern have resulted via a direct set of causal mechanisms in the suite of genes, languages and culture that can be observed in these groups today. Thus, we hold that the extensive genetic, linguistics,

anthropology and archaeology research in this region, including historical data on cultural materials and trading activities, support our view of several waves of migrations occurring into ISEA (Morseburg et al. 2016; Matsumura and Oxenham 2014; Xu et al. 2012; Bellwood 1997). This model of ISEA settlements is in contrast to those supporting a single common origin of various populations in this region, as a result of one migration wave without major demographic changes since the Pleistocene – see Donohue and Denham (2011) and Soares et al. (2016) and for a discussion of these ideas. In particular, archaeological and linguistic data showed two or more sources for the major spread of Neolithic culture in this region after the Pleistocene. First settlements by the ancient Semang people followed by one from north (Southern China/Indo-China) associated with the Austroasiatic Senoi 5000–6000 years ago and finally one more related to Austronesian-speaking population, who presently form the majority across the Asia-Pacific region (Blust 2013; Xu et al. 2012; Bellwood 1997). These archaeological and linguistic reconstructions of human dispersals in ISEA have received some new support from large-scale genomic studies; i.e. that the genetic dating of Asian components observed in ISEA populations does not predate population migration and expansion during the Neolithic era (Lipson et al. 2014; Xu et al. 2012) and from morphological analysis of dental traits; i.e. that the dental morphology variations observed between mid-Holocene to Neolithic populations were the result of demographic changes since they are robust to environmental pressure, which is not consistent with the a common source of ancestral population in Peninsular Malaysia (Matsumura and Oxenham 2014).

In more recent time, these earlier settlers in Peninsular Malaysia have been genetically and linguistically influenced by contact with traders (Arab and Indians) and by the large number of Chinese and Indian labourers brought in by the British administration (Hussein et al. 2007). All these demographic changes appeared in the genepools of modern inhabitants in Peninsular Malaysia (Morseburg et al. 2016; Deng et al. 2015) and are captured in our Malaysian Genetic Layer Cake Model of human settlement in Peninsular Malaysia. Population history may not always be as accurately reflected in the genepools of descendants as one might expect (Fix, 2000), but our extensive genetic research has effectively revealed traces of various ancestral fractions in the DNA samples collected from Orang Asli sub-populations in Peninsular Malaysia (Manaf et al. 2016; Norhalifah et al. 2016b; Syafawati et al. 2016; Tasnim et al. 2016; Deng et al. 2015; NurWaliyuddin et al. 2015). This genetic complexity cannot be generated from a single wave of migration and contradicts any hypothesis that claims that the Orang Asli tribes, with their distinct languages and material cultural heritages, are differentiated from a single ancestral population. This is in marked contrast with the situation in Taiwan, where aboriginal populations are genuinely derived from a single source but have become linguistically and culturally diverse while remaining genetically homogeneous. Another valuable prospect towards greater understanding of demographic history in this region should come from analyses of ancient DNA (cf. current data from possibly admixed modern human DNA) and new archaeological records.

In other contexts, our emerging view of genetic complexity in ISEA should be seen from any perspective, which may bring benefits to these people, for example, including but not limited to, economic, socio-cultural and health aspects. We have previously demonstrated a symbiosis between understanding genetic ancestry and health in Asia-Pacific region populations of Orang Asli and Polynesians (Edinur and Chambers 2017), while Blundell (2011) had highlighted the value of sharing a common heritage as a motivating drive to attain improved socio-economic status among the Austronesian speaking countries. All these cannot eventuate simply from a single field of study but can best be visualised from multidisciplinary data. We strongly feel that this is the leading lesson that we have taken from preparing this article.

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