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Early to Mid-Holocene Burial Traditions of Island Southeast Asia and a 5th millennium BP flexed inhumation from Bubog-1, Ilin Island, Mindoro Occidental

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Introduction

Recent archaeological investigations at Bubog-1 rockshelter on Ilin Island, Occidental Mindoro have produced evidence of a dense shell midden and human habitation, dating from *c.* 30000 cal BP onwards (Neri *et al*. 2015, Pawlik *et al*. 2014, 2015, Piper 2016). The discoveries at Bubog-1 have contributed significantly to our regional understanding of diversification in human economic strategies with the warming global climate at the end of the Pleistocene, adaptation to maritime environments, technological innovation and community connectivity across Southeast Asia (SEA) as far as Near Oceania (Bulbeck 2008, Rabett&Piper, 2012; Pawlik *et al.*, 2014, 2015; Piper 2016; Reepmeyer *et al.* 2011). What is less well-known is the social and cultural milieu that was potentially transmitted across SEA along with material culture and technological knowledge through interactions between the inhabitants across the region between c. 14000-4000 cal BP.

Here we report on a burial found at Bubog-1 in 2013. It consisted of a single adult inhumation interred in a secluded location under a rock overhang. Direct and associated radiocarbon dates indicate that the individual was buried around 5000 years ago (Supplementary Information; Table S1). The Bubog-1 individual is the first burial older than 4000kya recorded east of Huxley's modification of Wallace's Line in the Philippines. The flexed position in which the individual was interred is one of several complex prescribed burial practices that manifest during the Terminal Pleistocene across Island Southeast Asia (ISEA) that includes seated burials, cremations and mutilations. The emergence of these complex mortuary practices provides useful insights into some of the culture and ideology transmitted across ISEA along with the more tangible evidence of technological innovation in the Early Holocene. The Bubog-1 flexed burial appears to be a late manifestation of these diverse burial traditions associated with forager communities inhabiting the region. After *c.* 4000 cal BP new modes of treating the dead emerge along with the incorporation of a variety of grave goods into burials.

INSERT FIG. 1 HERE

The Archaeology of Bubog-1

Bubog-1 is located at the southeast end of Ilin, a small island just off the south-west coast of the much larger Mindoro Island (Figure 1). The rockshelter varies slightly in orientation along its *c.* 45m length, but is predominantly north-east facing, and currently at *c.* 31m above mean sea level. Its main floor consists of a broad, bright and spacious area approximately 20m in length with a maximum height of *c*. 10m and depth of *c.* 4m from the lip of the overhang to the rear limestone wall. This is where most of the Late Pleistocene-Holocene human activity has been recorded.

INSERT FIG. 2 HERE

The archaeological record consisted primarily of nine layers of well-stratified shell midden *c.* 1.5m deep (Figure 2). The stratigraphy is anchored to an absolute chronology by several radiocarbon dates, ranging from 4240-4081 cal BP in Layer 4 (S-ANU 32037) to 33.3-31.8 cal kBP (S-ANU 53626) in Layer 9 (Table S1). Chronological variation in the frequency and abundance of different mollusc communities collected by the human inhabitants provide a remarkable record of sea level and landscape transformations that occurred between the islands of Ilin and Mindoro from the Terminal Pleistocene to Mid-Holocene (Pawlik *et al*. 2014).

Layers 10-13 below the shell midden are composed of silty homogenous sediments and volcanic ash, containing chert and obsidian flakes, and the remains of an endemic terrestrial fauna and marine fishes. Absolute dating has been unsuccessful so far, but a stratigraphic position below Layer 9 suggests a Late Pleistocene age, before *c.* 33-30kya.

INSERT FIG. 3 HERE

South-west of the main rock shelter is a large rock fall and a sink hole that forms the entrance to a deep cave (Figure 3). On the east side of the sink hole, *c.* 10m from the south-eastern end of the Pleistocene-Holocene midden deposits, is another small rock overhang approximately 15m in length, with a breadth from the dripline to rear wall of *c.* 6m. In 2013,

Trench 4, a small 1m^2 test pit was excavated to evaluate the archaeological record east of the sink hole.

At *c.* 0.35m below modern ground surface, fragments of a human skull were uncovered. Further careful excavation revealed several more skeletal elements (Figure 4A). Due to the extremely poor preservation of the bones, excavation was halted, and the skeleton removed "*en bloc*" to preserve original anatomical position. To remove the burial, the original 1m^2 square test pit was enlarged to 2m^2. In the process of excavation concentrations of flat limestone blocks were observed above and below the inhumation that might have been intentionally used to line the burial (Figs 4B-C).

INSERT FIG. 4 HERE

The interred individual consisted of an adult who had been buried under a rock overhang in a tightly flexed position on his/her left side, facing the sea. The skeletal remains had suffered extensive fragmentation because of crushing and compression by the weight of the limestone blocks and sediment overburden. The facial bones, including the zygoma, maxilla and mandible had not survived well and had become separated from the rest of the skull, and experienced a degree of migration (Figure 5A). The isolated nature of the individual, and the rarity of comparative contemporaneous material in the region makes the assessment of sex based on poorly preserved features, particularly problematic. However, the presence of the 3rd molars and fusion of the medial epiphysis of the clavicle suggests a skeletally mature individual. An average M1 molar occlusal wear score of approximately 20-25 and M2 wear score of 15-20 (after Scott 1979) is also consistent with a middle-aged adult. However, it is acknowledged that without knowledge of the correlation between wear and age of the relevant population, age-at-death estimation is problematic. Aside from some calculus, no other evidence for skeletal or dental pathology was observed. While observed to be gracile in nature, the only specifically diagnostic features (see Figure 5A), moderately expressed external occipital protuberance and mastoids (see Walrath et al. 2014) neither clearly indicate male nor female.

The dentition remained *in situ* with a portion of the left mandible and teeth, indicating the original positioning of the head. The distal third of the right ulna was orientated just in front of, and parallel to, the face. The proximal third of the right humerus indicated flexion at the shoulder, in agreement with the position of the right ulna. A hand phalanx was visible in the approximate area of the facial bones (Figure 5B). Essentially, the individual had been placed

in the ground on his/her left side, with the arms flexed at the shoulder and elbow and the hands placed just in front of the face. The thoracic region consisted of very friable vertebrae and ribs. The ribs were found to be in anatomical position and consistent with primary inhumation and decomposition *in situ* (Figure 5C). The foot bones were found behind the pelvis, indicating tight flexion of the leg at the knee. Despite the extensive fragmentation, it was possible to reconstruct a significant portion of the skeletal remains (Figure 6A). Tight flexion and possible wrapping of the interred body is further supported by the small size of the oval-shaped burial pit of just *c.* 0.80 x 0.40m (Figure 6B). The reconstructed position of the burial suggests that it was placed with the head approximately facing northwards and towards the sea (Figure 6C), very similar to the reconstructed position of Early Holocene Burial SK4 from the cave site of Song Keplek in Java (Figure 6D). No material culture or objects that might have been placed in the burial were found in association with the body.

INSERT FIG. 5 HERE

INSERT FIG. 6 HERE

Bubog-1 and Early to Mid-Holocene Burial Traditions in Island Southeast Asia

The Bubog-1 burial overlaps chronologically with the shell midden deposition located under the same rock overhang. Conceivably, this individual was a member of the community intermittently inhabiting the rock shelter *c.* 5000 years ago. The deliberate placement of the burial in a secluded location away from the main centres of domestic activity is perhaps significant and suggests intentionality in creating 'space' between the living and the dead. No material culture was found associated with the interred individual, but the burial pit appears to have been deliberately underlain and covered with limestone slabs.

The Bubog-1 burial has many characteristics shared with other Early to Mid-Holocene burials recorded in ISEA, some more securely dated than others (Table 1). At Niah Cave, Borneo for example, 25 individuals have been identified, interred in several different groups (Rabett *et al.* 2013). Burial positions and funerary rites included tight flexion with the individual buried on the left or right side, or on the back with the feet on the pelvis and arms towards the face, and flexed and decapitated individuals (Lloyd-Smith 2012). There were also secondary unburnt burials, cremations and a complex burial rite that incorporated building a fire and seating the corpse on top. Clear organization was also evident in the layout of burials suggesting segregation along the lines of familial or perhaps group affiliation (Lloyd-Smith,

2012). Three direct 14C dates on bone collagen were considered reliable (Rabett *et al*. 2013:238-239; Table 1). B155, one of a pair of bound, flexed and decapitated individuals buried contemporaneously produced a date of 9137-8336 cal BP. The seated burial B147 yielded a date of 8154-7594 cal BP, and the non-burnt secondary burial B92 produced a date of 8313-7670 cal BP. None of the individuals were buried with any material culture (Rabett *et al*. 2013:236).

In Kalimantan, two flexed burials, probably dating to the Terminal Pleistocene or Early Holocene were excavated at Kimansi Cave. Of the two partial skeletons recorded, the bottom half of the individual identified in test pit KMS/TP appears to have been buried on the left side with the left or right arm between the legs (Arifin 2004:82, fig.5.3). An isolated, flexed burial was recorded at Gua Tenkgorak and dated by stratigraphic association to *c*. 6000 cal BP (Piper 2016).

In eastern Java, several sites have produced burials exhibiting a diversity of mortuary traditions (Simanjuntak & Asikin 2004). At Song Terus, a single individual buried in a flexed position on the right side with the right hand on the face in a natural alcove in the north wall and several limestone blocks placed to delineate the burial (Détroit 2006:188-190). An unspecified shell recovered just above the burial produced a date of 10405-9881 cal BP. At Song Keplek, an individual (SK4) was buried in a flexed position, on its right side, arms folded along the body, left hand on the chest and the right hand under the chin or in front of the face (Détroit 2006:191-192; Figure 6D). An associated 14C date on charcoal in the grave fill provides a tentative age of 5326-4870 cal BP (Table 1; Noerwidi 2017). At Gua Braholo, seven or eight inhumations showed unusual funerary practices that appear to have included disarticulation and deliberate bone breakage. Of the two reported in detail, BHL-1 was buried with the upper body in a supine position, right hand on the knees and left hand over the right side of the abdomen with the feet tight under the pelvis. Two large stones had been placed on the right side of the torso. Charcoal recovered near the skeleton produced a date of 12036-10554 cal BP. BHL-2 was a secondary burial whereby disassociated parts of the skull, mandible, maxillae and pelvis were selected for burial, possibly within a restricted container and placed on top of a fire (though the bones were not burnt) as part of the burial ritual. Charcoal found in the burial returned a date of 10224-9492 cal BP (Détroit 2006:193-196). At Gua Lawa, an undated, potentially Early Holocene cremation seems to have also included deliberate selection of body parts including the skull, mandible, ribs and long bones (Détroit 2006: 197-198).

At Gua Pawon, Bandung, West Java, PAW1 and PAW2 were incomplete burials, all stained red, possibly with haematite. Charcoal recovered from the same stratigraphic horizon tentatively dates the remains to 6859-6173 cal BP. PAW3 was a tightly flexed inhumation lying on its right side with a rock placed on the chest (Yondri 2005). A direct 14C assay on bone returned a date of 8454-7784 cal BP. PAW3 overlayed PAW4 (Yondri 2005:197, Foto 27), a highly weathered flexed burial with the skull supported by a sandstone block directly dated to 11262-10251 cal BP (Noerwidi 2017).

At Ille Cave, northern Palawan, several cremation burials have been uncovered. Complex treatment of Burial 758 seems to have consisted of systematic disarticulation at the joints, skinning and breakage of long bones such as the femora and humeri, followed by cremation and placement within a container before burial. There are two direct dates on bone of 9260-9006 cal BP and 9425-9280 cal BP (Lara *et al.* 2013; Table 1).

Location	Site	ID	Burial Type	Disarticulation	14C age BP	Calib. date BP (2 sigma) / est. Age	Sample No.	Calib set	Direct Date	Sample type
Mindoro, PH	Bubog 1	1	Flexed		4210 ± 20	4842-4652	S-ANU 41027	IntCal13	X	Tooth enamel
Palawan, PH	Ille Cave	758	Cremation	X	8155 ± 50; 8315 ± 50	9006-9462	OxA-16095, 16020	IntCal13	X	Bone
Palawan, PH	Duyong Cave	na	Flexed		na	c.4500-4000	na	na		na
Palawan, PH	Sa'gung	1,6,8,11	Flexed		na	Mid or Late Holocene	na	na		na
Borneo, MAL	Niah Cave	B155	Flexed, decapitated	X	7850 ±175	9137-8336	N-1357	IntCal13	X	Bone
Borneo, MAL	Niah Cave	B147	Seated		7020 ±135	7594-8056	N-1355	IntCal13	X	Bone
Borneo, MAL	Niah Cave	B92	Secondary	X	7140±165	8313-7670	N-1346	IntCal13	X	Bone
Kalimantan, MAL	Kimansi Cave	na	Flexed		na	Early Holocene	na	na		na
Kalimantan, MAL	Tenkgorak	na	Flexed		na	Mid-Holocene	na	na		na
Java, IND	Song Terus	ST1	Flexed		9330±90	10405-9881	na	Marine13		Shell
Java, IND	Song Keplek	SK4	Flexed		4510±90	5326-4870	Beta 69689	IntCal13		Charcoal
Java, IND	Gua Braholo	BHL1	Supine/Flexed		9870±230	12131-10648	P3G	IntCal13		Charcoal
Java, IND	Gua Braholo	BHL2	Secondary	X	8760±170	10227-9496	P3G	IntCal13		Charcoal
Java, IND	Gua Lawa	na	Cremation		na	Early Holocene	na	na		na
Java, IND	Gua Pawon	PAW I	Other		5660±170	6859-6173	PT3IR	IntCal13		Charcoal
Java, IND	Gua Pawon	PAW III	Flexed		7320±180	8454-7784	PT3IR	IntCal13	X	Bone
Java, IND	Gua Pawon	PAW IV	Flexed		9525 ± 200	11262-10251	PT3IR	IntCal13	X	Bone
Aru, IND	Liang Lemdubu	na	Secondary	X	na	c. 18000-16000	na	na		na
Aru, IND	Liang Nabulei Lisa	na	Secondary		several	12000-10000	na	na		Charcoal, Shell
Alor, IND	Tron Bon Lei*	na	Unknown		10230 ±30	11730-11332	S-ANU 41825	Marine13		Shell ornament
Alor, IND	Tron Bon Lei*	na	Unknown		9340 ±35	10665-10432	S-ANU 40128	IntCal13		Charcoal

Table 1: Identified burial types from the Terminal Pleistocene to Mid-Holocene age in Island Southeast Asia
*Burial only partially excavated and type unknown

Fewer burials have been identified west of Wallace's Line. But a primary inhumation at Tron Bon Lei Cave in Alor was dated by a rotating fish hook found around the neck, and charcoal recovered from the eye socket to 10665-10432 and 11730-11332 cal BP, respectively (O'Connor *et al.* 2017). Comingled burnt and unburnt secondary burials of juveniles and adults from Liang Nabulei Lisa on Aru Island is dated by several samples on different organic materials to *c.* 12000-10000 cal BP (Bulbeck 2006a:163-170; O'Connor *et al.* 2006:129-132).

Later Holocene Burial in Island Southeast Asia

In the later Holocene there is a notable change in burial traditions. The initial phase of this re-ordering of funerary practice can perhaps be recognized in the deliberate introduction of material culture into graves. The best examples of this are on Palawan Island, Philippines. At Duyong Cave, an individual was buried in a typical flexed position, but with face down and arms and legs doubled beneath the body. However, the individual had been interred with edge-ground *Tridacna* adzes of local manufacture arranged along the sides of the body (Fox 1970:60-64) and a fully polished stone adze, a new technology likely introduced to ISEA after the mid-5th millennium BP, placed next to the body (Pawlik *et al.* 2015). A date of 4500-4000 cal BP is likely for the Duyong burial based on stratigraphy and associated dates (Pawlik & Piper 2018). Two centrally perforated *Conus* shell disks recovered from near the ears are almost identical to those recovered from two poorly preserved burials (no burial position reported) at Ille Cave in northern Palawan (Burial 874 and 727) interred with a variety of shell artefacts manufactured from *Tridacna, Conus* and *Turbo mamoratus*. Direct assays on fragments of *Tridacna* artefact and a *Conus* shell disk from Burial 874 produced dates of 4386-4125 cal BP (AA-92542) and 4419-4236 cal BP respectively (WK-30657). Fragments of *Turbo mamoratus* and *Conus* disk from Burial 727 returned dates of 4608-4415 cal BP (WK-30656) and 4787-4525 cal BP (AA-92543) respectively. As far as the authors are aware, these are the earliest directly dated perforated shell disks recorded in Southeast Asia. This form of ornamentation would become more widespread throughout ISEA and the Pacific after 3500 cal BP (Szabó 2010).

At Sa'gung, also in central Palawan, Kress (2004:239-275) reported 11 burials, of which four were interred in flexed positions. Three individuals, Burials 1, 6 and 8 were buried with crocodile tooth and *Conus* shell disk necklaces, ground adzes and lime plugs, while Burial 11

lacked grave goods. None of the burials were directly dated but are considered here to be of a similar age to the Duyong burial, or slightly later.

None of these mid-late 5th millennium BP burials in the Philippines contain pottery, a technology that first appears in the Philippines, initially in northern Luzon, after c. 4200-4000 cal BP (Pawlik & Piper, 2018).

Following a burial hiatus of c. 3500 years in the West Mouth at Niah Cave, several individuals were interred in flexed position around 3500-3300 cal BP. Unlike the Early Holocene burials, Burial B205 contained a polished stone adze (Lloyd-Smith *et al.* 2013: 264). After 3000 cal BP a completely new method of burial emerges at Niah, and across SEA - supine fully extended. A formalized cemetery with rows of graves was established with people interred in wooden coffins and/or wrapped in shrouds. Individuals are now buried with a variety of material culture for the first time, such as pots, stone adzes and basketry (Lloyd-Smith *et al.* 2013: 265-266). A similar sequence of flexed burials dating from the late Mid-Holocene to c. 2700 cal BP that preceded extended supine burials of less than 2000 years of age were recorded in Gua Harimau Cave on Sumatra (Matsumura *et al.* 2017).

At Pain Haka on Flores, a variety of mortuary practices were employed including flexion, dismemberment and seated between *c*. 3000-2100 years ago. However, over 50% of the inhumations were supine with limbs extended. (Galipaud *et al.* 2016).

The Significance of Burial Traditions in Island Southeast Asia

Although anatomically modern humans have been present in Southeast Asia since at least 70,000 years (Westaway *et al.* 2017), there is no clear evidence for deliberate burial before about *c.* 20,000 cal BP. Currently, the oldest recorded burial in ISEA comes from Liang Lemdubu, Aru Islands. This adult female had likely been left to decay before being wrapped and buried beneath a large limestone slab (Bulbeck 2006b: 259). An ESR assay on a tooth and associated dates on shell and *Cassuarius* eggshell from the same stratigraphic layers date the burial to between 19,000-22,000 cal BP (O'Connor *et al.* 2006). After 12,000kya, a diversity of prescribed burial traditions emerged across Mainland and ISEA (Oxenham *et al.,* in press).

Probably the most commonly recorded burial practice is primary flexed (Table S2). The body appears to be placed on the left or right side, or less commonly on the back, often with the hands close to the face, or between the knees. Other prescribed mortuary practices include flexed and decapitated, secondary burials consisting of partial or complete skeletons, seated burials, and cremations. The treatment of the dead appears to have been elaborate in some

cases and included disarticulation, skinning and/or partial or complete cremation before being placed in a container and buried. It is possible that even some more subtle positioning of the body, such as the differences in leg or arm positions in flexed burials, as is observed in Java, might have had some significant embedded meaning. Fire appears to have played a significant role (Lloyd-Smith 2012) both in terms of deliberate burning of the body, or in the case of the seated burials recorded at Niah and the secondary inhumation at Gua Braholo, perhaps in 'preparation' for the burial of the dead.

The intentional use of stone also seems to have been important in burial (Oxenham *et al.,* in press), either placed on top, around the sides or beneath a burial, as was observed at Bubog-1, Liang Lemdubu and Pawon, or in the case of BHL1 at Gua Braholo, on the individual's chest and feet.

The inclusion of material culture in graves before 4500 cal BP is rare. There does however seem to be a strong association with animal body parts. At Song Terus, for example, a partially burnt piece of bovid vertebral column and complete skull of a Javan Lutung (*Trachipithecus auratus*) were placed in the burial (Detroit 2006: 190; Piper 2016). At Niah, flexed burial B27 appears to have contained a rhinoceros right radius that was used as a 'pillow' (Rabett *et al*. 2013: 236, Figure 6.21). In Bubog-1, pig and fish remains might have been incorporated into the burial. The Early Holocene foragers of ISEA clearly had very sophisticated relationships with the natural world. Animals were not only captured to satisfy calorific and technological requirements, but also for a variety of social and cultural demands such as personal adornment and group status (Piper & Rabett 2014). It is not inconceivable that some animals had considerable ideological significance that included associations with death, burial and the afterlife.

The emergence of complex burial traditions across ISEA would strongly imply maritime mobility between communities inhabiting the mainland and various islands and archipelagos of the region (Bulbeck, 2008; Lloyd-Smith, 2012; Lloyd-Smith *et al*. 2013; Piper 2016; Oxenham *et al*., in press). Connectivity between populations is also evident in the dissemination of information and ideas manifested in numerous innovations including technologies and ornamentations in bone, stone and shell (Bulbeck 2008; Piper 2016; Pawlik & Piper, 2018) and the movements of obsidian (Reepmeyer *et al.* 2011; Neri *et al.* 2015). The restricted geographic distributions of some material culture, such as the occurrences of edge-ground shell adzes, bone points from the Philippines across northern Wallacea as far as Island Melanesia (Pawlik *et al*. 2015; Pawlik & Piper 2018), and shell fish hooks in the eastern Lesser Sundas (O'Connor *et al*. 2017) illustrate that not all interactions were regionally

ubiquitous, or that all communities likely adopted new innovations as and when they became available. Different inter-connected communities developed their own unique identities and ways of perceiving the world (Lloyd-Smith 2012) and this is reflected in the diversity of mortuary practices observed across ISEA in the Early and Mid-Holocene.

Further significant changes in the treatment of the dead occurred around 4500-4000 years ago. This is initially reflected in the material culture being included within burials. The retention of the flexed burial position would suggest an emphasis on continuity in well-established culturally accepted modes of interring the dead while the appearance of a range of local and exotic material culture might represent new locally emergent practices with some external influences on traditional practice.

After 4000-3500 cal BP supine extended burials containing a range of material culture appear across ISEA for the first time. The transition from flexed burial in ISEA mirrors similar changes observed in MSEA where after 4500 cal BP burial practices dramatically change and the dead are predominantly interred in extended supine positions with a wealth of material culture that includes pottery, ground stone implements and shell artefacts (Oxenham *et al.,* in press; Piper *et al.,* in press). In MSEA, the late Holocene transformation in burial practice is a clear reflection of human population history – whereby Late Pleistocene/Early Holocene flexed burial and dismemberment is associated with local Southeast Asian foraging communities, whereas the appearance of supine burial and the inclusion of grave goods reflects the first arrival of agricultural communities migrating from southern China into the region, bringing with them a broad range of exotic material culture, agriculture, domestic animals, and new modes social and cultural interaction, ideologies and belief systems (Matsumura *et al.* 2017; Piper *et al.,* in press). This hypothesis is supported by ancient DNA, craniometric data and dental non-metric traits, which all show that the hunter-gatherer communities of MSEA have a deep ancestry that can be traced back to the original human populations with Australo-melanesian/Australo-papuan cranio-facial morphology to enter the region in the Late Pleistocene, whereas the farming communities are immigrant East Asian populations, albeit admixed with a smaller number of individuals of Australo-papuan morphology (Matsumura *et al.* 2017).

In ISEA, and based on craniometric reconstruction of the poorly preserved skulls of the Niah Cave, Barker *et al.* (2013) argued for population continuity from the Early into the Late Holocene, and that both populations were morphologically most similar to modern East Asians. In the light of the accumulating evidence from MSEA, the population continuity model for ISEA as predicted in Barker *et al.* (2013) seems rather unlikely. The recent isotopic

work on the Niah Cave cemeteries of West Mouth and Lobang Jerangan indeed proposes a mixing of 'immigrant' and 'local' populations (Lloyd-Smith et al. 2016). A recent craniometric study of the Gua Harimau cranial remains has indicated that all burials before 3000 cal BP are of Australo-papuan ancestry. After 3000 cal BP there is a mixture of local indigenous community members and new arrivals with East Asian ancestry (Matsumura *et al.* 2017), possibly either, originating from MSEA, or Taiwan as predicted by the Austronesian migration hypothesis (see Bellwood 2017).

Conclusion

Around 5000 years ago a single adult was wrapped and buried in a flexed position at Bubog-1 in a secluded location away from the main centres of contemporaneous human occupation and shell midden accumulation under a rock overhang. The burial appears to have been lined above and below with flat slabs of limestone. The Bubog-1 burial is one of a diverse range of burial rites that emerge across ISEA from the Terminal Pleistocene to Mid-Holocene. Although the earliest burials date to c. 21 -16,000 BP, it is after *c.* 12,000 BP that various forms of prescribed burial practice become relatively common across the region, with the majority probably dating from 9000-8000 cal BP onwards.

The most widespread burial tradition appears to be various forms of flexion, with the individual buried either on the left or right side, or on the back. Other forms of primary inhumation include flexed and decapitated, and seated burials. A variety of secondary burial has also been recorded, including interment of selective body parts or isolated skulls, and cremation burials. Where multiple burials are recovered from the same cave or rockshelter there seems to be no obvious chronological sequencing in burial practice, suggesting that parts of the same forager groups, or different groups using the same location to bury their dead applied a variety of different complex burial rites. At least some of the time, there appears to have been deliberate segregation of liminal space from daily activities and/or the demarcation or lining of the burial with stone. The addition of material culture within burial contexts appears to have been rare throughout the Early to Mid-Holocene burials. While the inclusion of animal body parts in graves perhaps indicates that some taxa had particular socio-ideological significance, both in this world and the next.

The regional emergence of burial practices across ISEA coincides with the appearance and geographic spread of a variety of technological innovations that imply increasing maritime mobility and interaction between different island populations. The ideology embedded in burial and burial practice implies that new sociocultural, ideological and cosmological

perspectives and ways of perceiving the world were also transmitted across ISEA during the Early to Mid-Holocene.

In the later Holocene, after 4500 cal BP new prescribed burial practices start to emerge in ISEA. Initially, there is continuity in the tradition of burying individuals in a flexed position, as they were in the terminal Pleistocene and Early Holocene, but with the incorporation of a variety of local and exotic grave goods into burials for the first time. After *c.* 3500 cal BP there is an abrupt change in funerary practice with the appearance of formal cemeteries and supine extended burials, loosely associated with the initial appearance of pottery. This change reflects the arrival of new populations, probably from MSEA, where the transition to Late Holocene burial practice and associated material culture, social and ideological practices occurs somewhat earlier than in ISEA.

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Radiocarbon analysis of the human tooth from the burial in Bubog-1

Two teeth were screened for collagen preservation by measuring nitrogen content (Brock, *et al*., 2012). Unfortunately, neither contained any nitrogen (0.0%N), suggesting that no collagen survived. In the absence of any other material to directly date the burial, enamel was sampled from one tooth. The sample contained 0.7%C (measured volumetrically), as expected for enamel (Zazzo & Saliège, 2011), and produced a date of 4842-4652 cal BP (4210±20 BP, S-ANU 41027). In his recent synthesis of dates on unburnt apatite Zazzo (2014) found that in the Holocene, dates are normally up to 500 14C years too young, although beyond 8000 BP divergence increases substantially. The date on enamel from Bubog-1 must therefore be regarded as a minimum age (Hedges *et al.* 1995, Zazzo 2014), and an actual age for the burial of around 5000 cal BP is likely. The age is further substantiated by a date of 4408±34 BP or 4701-4430 cal BP (S-ANU 47833) on a fragmented *Conus* sp. shell found in the south-west quadrant of the initial 1m^2 test pit and *c.* 0.2m above the cranium (Table S1). The local ΔR (marine reservoir correction) is only marginal with -14±76 14C years BP, derived from three pre-1950 shell samples from the Philippines (Southon *et al.* 2002). The dates relate the Bubog-1 flexed burial to the Early to Mid-Holocene burial traditions observed across ISEA.

Location	Layer/Context	Sample Type	Sample No.	δ13C*	14C age BP	Calibrated date (cal BP, 95.4% probability range)	Calibration curve (Reimer et al. 2013)
Trench 1/2	*Layer 4*	*Charcoal*	S-ANU 32037	-34	3770 ± 30	4238-4000	IntCal13
Trench 2-S	*Layer 2*	*Charcoal*	S-ANU 41924	-27	4220 ± 20	4848-4658	IntCal13
Trench 1/2	*Layer 5*	*Conus sp.*	WK-32984	-24	5306 ± 38	5891-5525	Marine13
Trench 1/2	Layer 5	*Tridacna sp.*	S-ANU 48436	4	5360 ± 35	5849-5625	Marine13
Trench 1/2	*Layer 5*	*Bivalve fragment*	S-ANU 48437	4	5516 ± 33	5986-5792	Marine13
Trench 1/2	Layer 7	*Charcoal*	S-ANU 32038	-28	4465 ± 35	5288-4971	IntCal13
Trench 1/2	Layer 8	*Tridacna shell adze*	S-ANU 35132	-4	6875 ± 35	7550-7250	Marine13
Trench 1	Layer 9	*Canarium nut*	WK-32983	-24	9584 ± 29	11099-10762	IntCal13
Trench 1/2	Layer 9	*Geloina coaxans*	S-ANU 48438	-1	24853 ± 145	28802-28113	Marine13
Trench 1/2	Layer 9	*Geloina coaxans*	S-ANU 48439	-1	27072 ± 185	31139-30591	Marine13
Trench 1/2	Layer 9	*Conus sp.*	S-ANU 53625	6	27754 ± 185	31485-30987	Marine13
Trench 1/2	Layer 9	*Strombus sp.*	S-ANU 53626	7	28975 ± 212	33277-31783	Marine13
Trench 1/2	Layer 9	*Conus sp.*	S-ANU 53632	6	27820 ± 185	31529-31016	Marine13
Trench 4	Layer 3	*Conus sp.*	S-ANU 47833	4	4408 ± 34	4701-4430	Marine13
Trench 4	**Burial**	***human tooth (enamel)***	**S-ANU 41027**	**-15**	**4210 ± 20**	**4842-4652**	**IntCal13**
Trench 4	Below burial	*Terebralia*	S-ANU 49216	-2	30613 ± 274	35047-34041	Marine13

Trench 4	Below burial	*Terebralia*	S-ANU 49217	-2	30731 ± 278	34836-33892	Marine13

Table S1: Radiocarbon dates of Bubog-1, shell midden and burial trench
WK = The University of Waikato, New Zealand Radiocarbon Dating Laboratory
S-ANU = The Australian National University Radiocarbon Dating Laboratory
* S-ANU δ13C values were produced by AMS and are not equivalent to IRMS values

All uncalibrated radiocarbon dates reported herein have been recalibrated with Calib 7.0.4 (Stuiver and Reimer 1993) using Intcal13 for charcoal, bone and enamel or Marine13 for shell (Reimer *et al.* 2013) and are given as a 95.4% probability range. Calibrated dates are given in cal BP.

Location	Site	Flexed Burial	Seated	Cremation	Secondary	Skull	Other
Mindoro, PH	Bubog 1	X					
Palawan, PH	Ille Cave	X		X			
Palawan, PH	Duyong	X					
Palawan, PH	Sa'gung	X					
Sarawak, MAL	Niah	X	X	X	X	?	X
Kalimantan, IND	Kimansi	X					
Kalimantan, IND	Tenkgorak	X					
Java, IND	Song Terus	X					
Java, IND	Song Keplek	X			X		
Java, IND	Gua Braholo	X			X		X
Java, IND	Gua Pawon	X				?	X
Java, IND	Gua Lawa			X			
Aru, IND	Liang Lemdubu				X		
Aru, IND	Liang Nabulei Lisa				X		
Alor, IND	Tron Bon Lei*						X

Table S2: The various burial types recorded from the Terminal Pleistocene to Mid-Holocene by site (PH = Philippines, MAL = Malaysia, IND = Indonesia; ? = possible; Other refers to unknown positioning; *The burial at Tron Bon Lei was only partially excavated and no burial position was recorded).

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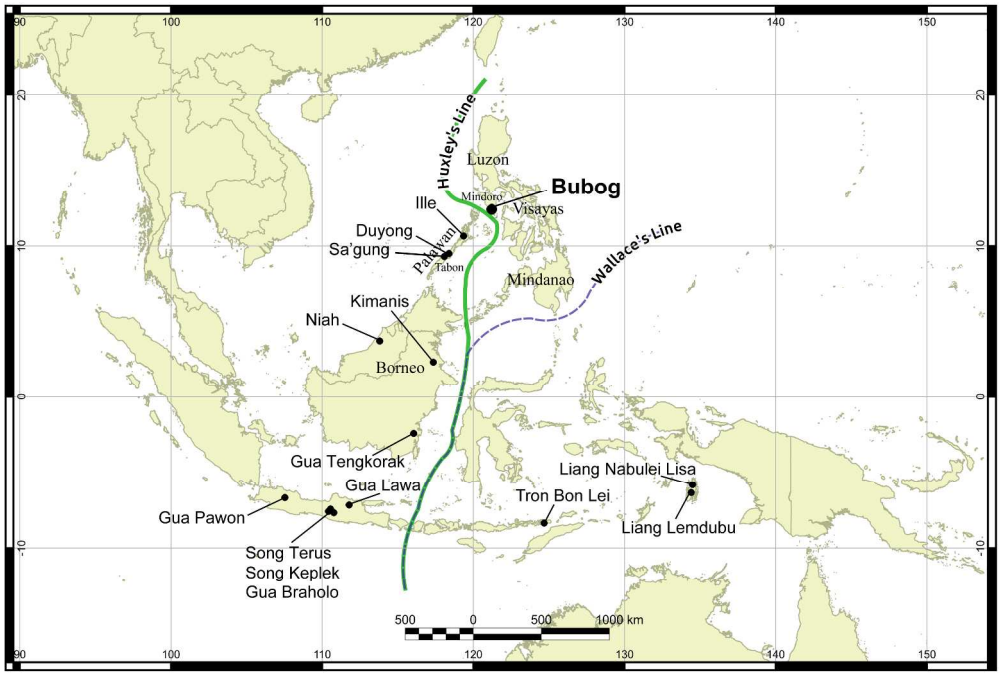

Figure 1. Geographical situation of the Philippines and relevant burial sites in Island Southeast Asia.

254x172mm (300 x 300 DPI)

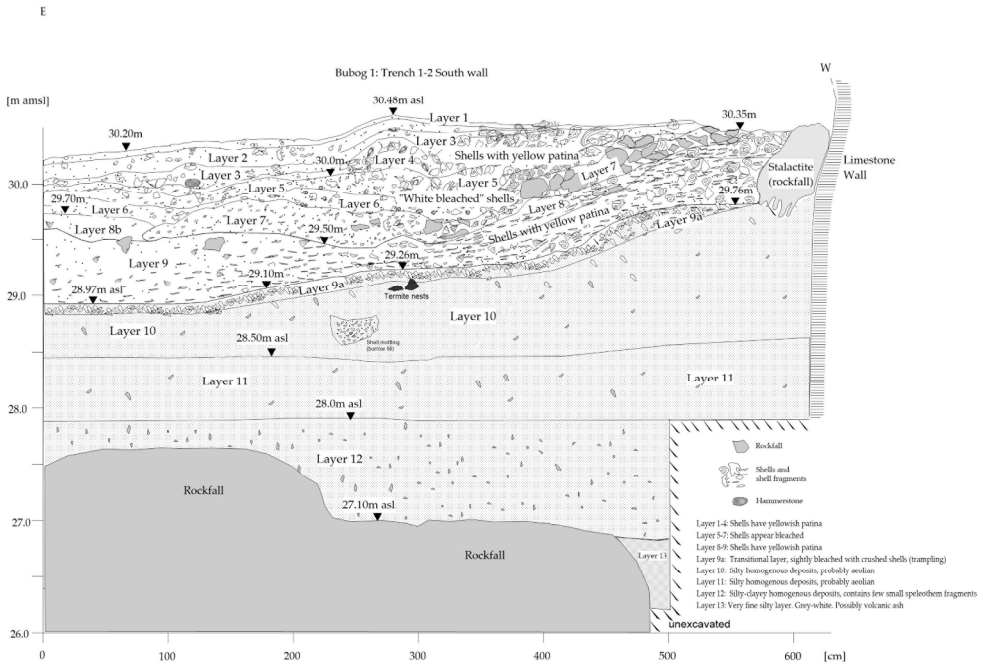

Figure 2. The conjoined south profile of Trenches 1-2 at Bubog-1.

248x164mm (300 x 300 DPI)

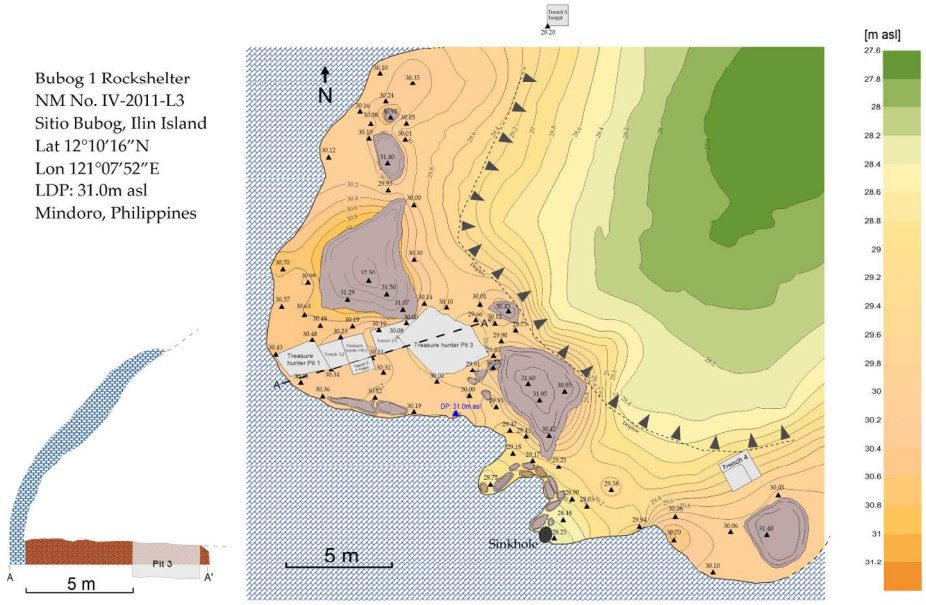

Figure 3. Plan of the treasure hunter pits and excavation trenches at Bubog-1. The profile of the east wall above the excavation trenches is pictured on the left.

282x189mm (300 x 300 DPI)

Figure 4. A) The burial with fragmented cranium prepared for "en bloc" removal; B) concentration of larger flat limestones above and C) below the burial

160x240mm (300 x 300 DPI)

Figure 5. A) Extensively fragmented skull; B) Detail of a hand phalanx next to the facial bones; C) Ribs found in anatomical position

160x224mm (300 x 300 DPI)

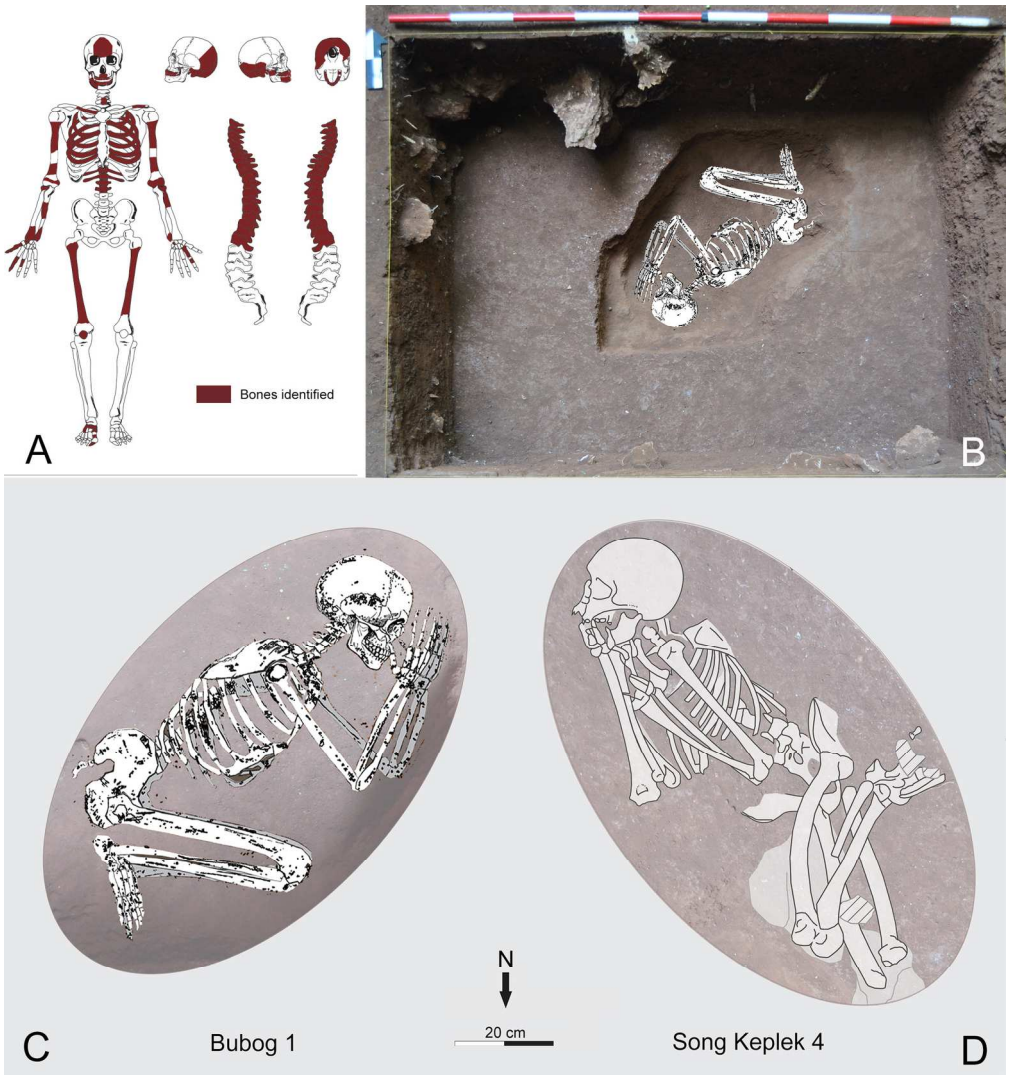

Figure 6. A) Identified bones from the burial (marked in red); B) Burial pit with the reconstructed position of the flexed skeleton; C) Reconstructed position of the burial with the head facing northwards and towards the sea (A-C: skeleton illustrations by Annie Valera); D) Reconstructed position of the burial SK4 at Song Keplek (after Détroit 2006)

171x182mm (300 x 300 DPI)

Radiocarbon analysis of the human tooth from the burial in Bubog-1

Two teeth were screened for collagen preservation by measuring nitrogen content (Brock, *et al.*, 2012). Unfortunately, neither contained any nitrogen (0.0%N), suggesting that no collagen survived. In the absence of any other material to directly date the burial, enamel was sampled from one tooth. The sample contained 0.7%C (measured volumetrically), as expected for enamel (Zazzo & Saliège, 2011), and produced a date of 4842-4652 cal BP (4210±20 BP, S-ANU 41027). In his recent synthesis of dates on unburnt apatite Zazzo (2014) found that in the Holocene, dates are normally up to 500 14C years too young, although beyond 8000 BP divergence increases substantially. The date on enamel from Bubog-1 must therefore be regarded as a minimum age (Hedges *et al.* 1995, Zazzo 2014), and an actual age for the burial of around 5000 cal BP is likely. The age is further substantiated by a date of 4408±34 BP or 4701-4430 cal BP (S-ANU 47833) on a fragmented *Conus* sp. shell found in the south-west quadrant of the initial 1m^2 test pit and *c.* 0.2m above the cranium (Table S1). The local ΔR (marine reservoir correction) is only marginal with -14±76 14C years BP, derived from three pre-1950 shell samples from the Philippines (Southon *et al.* 2002). The dates relate the Bubog-1 flexed burial to the Early to Mid-Holocene burial traditions observed across ISEA.

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Palawan, PH	Duyong	X					
Palawan, PH	Sa'gung	X					
Sarawak, MAL	Niah	X	X	X	X	?	X
Kalimantan, IND	Kimansi	X					
Kalimantan, IND	Tenkgorak	X					
Java, IND	Song Terus	X					
Java, IND	Song Keplek	X			X		
Java, IND	Gua Braholo	X			X		X
Java, IND	Gua Pawon	X				?	X
Java, IND	Gua Lawa			X			
Aru, IND	Liang Lemdubu				X		
Aru, IND	Liang Nabulei Lisa				X		
Alor, IND	Tron Bon Lei*						X

Table S2: The various burial types recorded from the Terminal Pleistocene to Mid-Holocene by site (PH = Philippines, MAL = Malaysia, IND = Indonesia; ? = possible; Other refers to unknown positioning; *The burial at Tron Bon Lei was only partially excavated and no burial position was recorded).

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