

Cross-cultural Research Comparing the Hunting Tools and Techniques of Hunter-gatherers and Hunter-gardeners

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ABSTRACT

Modern humans (*Homo sapiens*) have succeeded in dispersing themselves around the globe. One reason they could do so is that they were able to develop the technology and techniques to subsist in a variety of natural environments. This paper focuses on Asian and African human populations that have traditionally depended on hunting activities, including hunting-gathering and hunting-gardening societies. The objective is to try and identify the factors correlated with the technology and techniques of hunting, and to present a cross-cultural perspective on the cultural evolution of modern humans' subsistence activities. This comparative study is based on descriptions in ethnographies and the authors' own fieldwork. We discuss the relationship between socio-ecological environments, material culture, and human behaviour to highlight the similarities and differences in hunting activities in different social structures. In the process of dispersion, human populations have produced cultural strategies to adapt to nature, such as hunting behaviour with tools. In different ecological environments, the types of animals that can be caught, the materials available for tools, and the instruments used to make the hunting tools have determined the hunting methods and tool kits involved.

INTRODUCTION

This study compares the hunting methods and target animals of modern hunter-gatherers and hunter-gardeners to consider whether the choice of animal to be captured depends on differences in hunting methods. We propose suggestions for thinking about hunting activities from an evolutionary angle, with the aim of providing an ethno-archaeological model to determine whether the hunting behaviour and tools correlate with the fauna excavated from the archaeological site.

It is generally agreed that agriculture was invented in the early Holocene era, when most of the human population shifted from a hunting and gathering economy

to an agricultural one. Some parts of the world began to produce grain, which became the driving force behind the expansion of civilisations. The distribution of hunter-gatherer societies in the world today, including in the recent past, has been skewed towards areas where there is less potential for agricultural production, such as the tropics or the far north (Ikeya and Hitchcock eds. 2016). This, of course, does not negate the possibility that hunter-gatherer populations have been able to adapt to these marginal ecological environments. Tallavaara identified the complex interactions between climatic and biotic factors that constrain hunter-gatherer densities worldwide (Tallavaara et al. 2017). Unlike agrarian groups, traditional hunter-gatherer groups practiced hunting and gathering in a variety of ecological niches. However, it is unlikely that modern hunter-gatherer populations have maintained any continuity from the Palaeolithic, aside from the genetic traits of some populations.

On the other hand, in temperate regions, where large-scale agrarian societies were established and civilisations evolved, and in neighbouring subtropical regions, many societies practiced horticulture. The question of whether they were in the process of transitioning from the hunter-gatherer phase to the large-scale agrarian phase requires discussion based not only on archaeological evidence but also on their ethno-history. We term these populations ‘hunter-gardeners’ and discuss their subsistence strategies in contrast with those of hunter-gatherers and farmers. For hunter-gardeners, hunting is essential to acquire animal protein and plays a critical role in building and maintaining social ties. The hunting practices of hunter-gardeners are important in considering not only the evolution of hunting techniques, but also the role that hunting has in society from an evolutionary standpoint. In contrast to foragers, hunter-gardeners regularly practiced hunting on specific hunting grounds. This was one condition of their sedentary lifestyle.

THE GARDEN HUNTING MODEL

The first aspect of garden hunting was in the zooarchaeological research undertaken by Linares in the American neotropics (Linares 1976). Her model showed that ancient humans were interested in hunting a select group of larger mammals that could be found in abundance. This led to the exclusion of aquatic taxa in their dietary habits. On the other hand, Neusius argued that humans hunted more aggressively and non-selectively, capturing whatever animals they could approach (Neusius 2008). This model assumes there was a high diversity of plants and consequently a high diversity of animals. Neusius claimed that garden cultivation places further constraints on time; people would have had little time for hunting, and hence captured game when and where they could (Neusius 2008). A non-selective garden hunting strategy clearly addresses the scheduling conflicts created by agricultural activities.

Another feature of garden hunting is the relationship between the plants grown and the types of targeted animals. Based on his research in the Peruvian Amazon,

Naughton-Treves demonstrated that ‘shortly after maize was planted, wildlife visits to the disturbed areas peaked and [were] statistically higher than the amount of wildlife that visited fallow fields or forests’ (Naughton-Treves et al. 2003: 1112). He also indicated that only a small number of animals approached areas that were too intensively managed (Naughton-Treves and Weber 2001: 1107). Smith (2005) asserted that garden hunting was not a response to game depletion as Linares suggested, but rather a productive activity that was complementary to broader cultural and economic patterns. Gardening or shifting cultivation produced heterogeneous habitat mosaics that played a role in the relationship between people and wildlife in the humid neotropics. This led to adjustments in both animal foraging patterns and indigenous hunting practices.

The garden hunting model can be applied beyond the American neotropics. The favourable environment for gardening found in temperate and subtropical regions may have made hunting and gardening possible. Prehistoric gardeners could offer a reliable, convenient source of protein for their settlements because gardening fields were attractive to, and regularly accessed by, certain terrestrial animals. Typical animals included wild boar or deer that were easy to catch in traps and liked to feed on cultivated crops. More importantly, these animals had the reproducibility to withstand relatively high depletion rates. This bias towards animals specific to garden hunting may be evidence of its practice. In the discourse about garden hunting, particular attention has been paid to the kinds of resources used, and there is ongoing debate about what conditions led people to choose to capture large mammals, small and medium-sized mammals, or aquatic animals. On the other hand, there has been very little exploration of the differences in hunting methods and tools used to acquire different types of animals.

In this study, we focus on the correlation between hunting methods, including hunting tools, and the animals these are used to capture. Cross-cultural analysis is applied to the hunting tools employed in each group, as well as their target animal. The morphological aspects of tools (such as size, weight, shape, and the technique needed for use) are scrutinised. The target animals are categorised by their general (mean) weight, behavioural characteristics, and living area (such as land regions, maritime places, and land aquatic areas). By identifying the relationships between the tools and the target animal’s key characteristics, we aim to clarify the importance of tool morphology in the food-acquisition behaviour of modern human societies.

We chose ethnographic data mainly from tropical and sub-tropical regions in Asia, as well as in central Africa, for comparison. We centred on the hunting methods adopted by the Baka Pygmies (hunter-gatherers in Cameroon) and Taiwan’s indigenous peoples (hunter-gardener groups in Taiwan). What the two have in common is that they engage in hunting activities in both anthropogenic habitats and natural forests. Further, we present an ethnographic description of the hunting activities of the Andaman Islanders and the Orang Asli of the Malay Peninsula to establish the role of aquatic resources.

THE CASE OF THE BAKA PYGMIES

1) The Baka Pygmies

The Baka is one of the Pygmy hunting-gathering groups living in the Congo Basin rainforest region. They are found primarily in the northwest part of the Congo Basin including Cameroon, Gabon, and the Democratic Republic of the Congo; there are also a few groups in the Central African Republic. Ethnographic records of the Baka are mostly from their daily lives and date back about a hundred years to when European colonists began exploring where they lived. Like other Pygmy groups, the Baka largely depend on the forest for their subsistence. They live in huts in the forest together with their closest relatives, but never settle down in one particular spot. They have maintained their nomadic hunting-gathering lives in the forest, while at the same time preserving contact with farming groups. The governments involved (both colonial and Cameroonian) introduced and promoted settlement policies to allow the Baka and farming groups to shift their dwelling from small camps to villages with higher population. Until now, the Baka have continued to hunt and gather extensively in the forest, even after having adapted to farming. Most ethnographies of the Baka were written after this shift. Thus, the data we found on the Baka's hunting techniques in past ethnographies still represent their traditional techniques and technology today.

2) Hunting Methods among the Baka

The quantitative data on Baka Pygmies have mostly been collected from the authors' fieldwork (Table 1), with some additional data from Yasuoka (2006). The Baka people, living in the northwest part of the Congo Basin rainforest, pursue small-scale agriculture in the area around their settled village. However, hunting, gathering, and fishing continue to be vitally important as their main forms of subsistence to this day. Only local residents are allowed to hunt in the forest, including Baka people and farming groups, and only for the purpose of self-consumption. Despite having shifted from a nomadic life in the forest to a sedentary life in the village, the Baka's hunting activities have not changed dramatically, though the proportions and varieties of target animals may have shifted somewhat in comparison to the nomadic period (Yasuoka 2006).

Currently, the most popular hunting technique used by the Baka is the snare trap. A technique involving the use of hands and smoke is another basic way of capturing small animals, such as giant rats or fish. In this case, the machete (a metal tool introduced by the neighbouring farmers) can be used for that purpose, as well as for hunting turtles and pangolins, and for digging up wild yams. Spear hunting is much rarer than the previous two, but is still used in men's daily hunting activities. Larger mammals, such as wild boar, brush-tailed porcupines, water chevrotains, and even elephants, are hunted by spear, but with a lower frequency of success. Bows and arrows are used in some regions for shooting

birds, but they are not as widespread as spears. The use of guns is considered the most efficient technology for hunting by local people, including the Baka, but the Baka do not usually own firearms. When necessary, they occasionally borrow them from farming groups.

Trap hunting

The most popular trap used by the Baka is the snare trap. This is chiefly used to snare the target animal's foot. The string of the trap is usually made with a strong vine, and is wrapped around an elastic wooden branch to keep the trap tense (figure 1). The other end of the vine is set into the earth using a small stick, and is lightly covered with leaves and soil. The choice of materials for each component depends on which animal the hunter is trying to catch, and the location for setting the trap is highly dependent on the hunter's knowledge of the animal's behaviour. The authors had several opportunities to go and observe the process of setting up snare traps with a group of women. It is very rare for women to go hunting, and they are generally not expected to succeed, although some women are occasionally successful. Our group, however, was not particularly successful. The reasons included a lack of knowledge of the animals, the unusual scent of the women (which may have kept the animals away from the trap), or the poor setting of the



Figure 1 A Baka man carrying his spear and axe.
(Photo taken by Peng in Cameroon, 2017)

snare traps. Thus, the successful use of a snare trap involves not only knowing about its mechanism, but also entails the accumulation of the hunter's experience of observing and understanding animals' behaviour, of setting the trap, of choosing the right materials, and similar factors.

Spear hunting

The precise size of the spear head that the Baka use can vary, but is generally about 20 cm long and 5 cm wide. The shaft is made with a very straight piece of wood, about 2 m long, but only around 2 cm thick. A hunter explained that this kind of shaft is light for carrying to the hunting site, but tough enough to kill a wild boar from a distance. Although all iron products, including spear heads and machetes, are industrially produced and imported from outside, other parts such as the shaft and holder, are made and repaired by the Baka themselves using materials sourced directly from the forest. Only the men can own and use spears in Baka society. The typical kit of an adult Baka man for walking in the forest includes a spear, an axe or machete, a knife or dagger, tools for lighting a fire, and at least one dog if possible (figure 2). According to most Baka hunters, spears are only employed for dealing the final blow to large animals, such as wild pigs. Two Baka men told me their story of a time that they unsuccessfully hunted a wild pig. They both expressed deep regret that they did not have spear to kill the large wild pig. At the time they only had a machete, which was insufficient to tackle such a strong animal. This situation shows that the Baka still regard the spear as the best tool to kill big game, while the chance of encountering larger animals is much lower than small game.



Figure 2 A Baka man preparing the metal wires for his snare trap. (Photo taken by Peng in Cameroon, 2014)

Bows and arrows

During fieldwork, the authors came across someone who owned a bow and arrows, but there were no opportunities to observe them being used. Based on an interview with the bow's owner (a Baka man of about fifty years), the Baka used to employ bows and arrows to hunt birds and monkeys, and occasionally applied plant-derived poison to the arrow heads. The arrows are about 60 cm in length, which is similar to the length of the bow itself (figure 3). Crossbows, another type of bow-and-arrow hunting tool, are also used for nimble animals living in high places. At around 1.5 m long and about 70 cm wide, crossbows are much larger than normal bows. The authors were not able to observe one of the darts, but we found an example in an ethnographic documentary film. The darts seem to be shorter than normal arrows. Nowadays, guns have taken the place of bows and arrows for capturing birds and monkeys, but for the Baka people, they cost far more than bows and arrows.

As shown in Table 1, the Baka use spears to hunt animals that are physically large and strong, but on the other hand, their hunting tools are much simpler compared to the other three groups. Small fish and shellfish are caught by hand, while large fish are caught using a fishing pole made from a single piece of wood. They do not have special tools for maritime fishing since they live land.



Figure 3 Bow and arrows of a Baka man. (Photo taken by Peng in Cameroon, 2018)

Table 1 The hunting tools and target animals of the Baka (Created by the authors)

Method	Complexity of tool(s) (Oswalt 1976)	Target animal	Animal rank (by body mass)	Ecological environment
Spear	2	wild pig	middle	land
		brush-tailed porcupine	middle	land
		water chevrotain	middle	land aquatic
		elephant	high	land
Bow/arrows	2 (bow) 2-3 (arrow)	birds	low	land
		monkey	low	land
Fishing pole	1-2	large fish	middle	land aquatic
Traps/hands	0-5	duiker	low	land
		wild pig	middle	land
		brush-tailed porcupine	middle	land
		water chevrotain	middle	land aquatic
		porcupine	low	land
		pangolin	low	land
		small fish	low	land aquatic
		small shellfish	low	land aquatic
		rat	low	land

THE CASE OF TAIWAN'S INDIGENOUS PEOPLE

1) Taiwan's Indigenous People

Taiwan's indigenous peoples have lived on the island of Taiwan and the surrounding islands longer than the Han Chinese, who make up the majority of Taiwan's population, and their native languages belong to the Austronesian language family. There are currently 16 officially recognised ethnic groups. Some populations inhabit the plains and islands, but most indigenous peoples live in mountainous regions. Their ways of life have continued to preserve the proto-Malay culture. This can be seen in: their conventional forms of subsistence, such as the cultivation of millet and root crops, and the hunting of terrestrial mammals; their practice of animism, which reveres the human and other various spirits; values that emphasise valour and discipline; and the practice of headhunting, which was once widespread but is no longer observed. Their languages have kept some of the older features of the Austronesian language family. Taiwan may have even been the homeland of the Austronesian language family (Blust 1984). Molecular anthropological findings suggest that Taiwan's indigenous peoples may have originally been a single group that later became differentiated after arriving in Taiwan (Melton et al. 1998: 1814-1815). The formation process of Taiwan's human populations must be considered in the context of archaeological evidence, molecular anthropology, and linguistics, but the Taiwanese indigenous peoples have a close and systematic relationship with the peoples of Southeast Asia and

Oceania.

2) Hunting Methods among Taiwan's Indigenous People

Currently, only indigenous people in Taiwan are allowed to engage in hunting activities and under certain legal restrictions. The legal regulations on hunting in Taiwan limit the kind of hunting gear that can be used; the indigenous people may only hunt with hunting gear that they have made themselves according to their own designs. Their current hunting methods can be broadly divided into chase hunting with guns and spears, and trap hunting at specific hunting grounds (see Table 2).

Table 2 The hunting tools and target animals of Taiwan's indigenous people (Created by the authors)

Hunting tool(s)	Complexity of tool(s)	Target animal	Animal rank (by body mass)	Ecological environment
Spear/gun	2-3	wild boar	middle	land forest, garden
		deer	middle	land forest
		muntjac	middle	land forest
		mountain goat	middle	land forest
		black bear	middle	land forest
Bow/arrows	2 (bow) 2-3 (arrow)	wild boar	middle	land forest, garden
		deer	middle	land forest
		muntjac	middle	land forest
		mountain goat	middle	land forest
		black bear	middle	land forest
		river fish	low	land aquatic
Firewood	1	squirrels	low	land forest, garden
		flying squirrel	low	land forest
Snare traps	4	deer	middle	land
		wild boar	middle	land
		muntjac	middle	land
		mountain goat	middle	land
Neck hunting	2	deer	middle	land forest
		wild boar	middle	land forest
		muntjac	middle	land forest
		mountain goat	middle	land forest

Trap hunting

One of the major hunting methods employed by Taiwan's indigenous people is trap hunting. The types of traps used are foot snares and neck traps. The foot snare consists of a wire tied to the end of a springy rod to bind the legs of the game. Traps with the same mechanism are prevalent around the world. The basic



Figure 4 A Paiwan snare trap. Most of them can be obtained from the surrounding environment. (Photo taken by Nobayashi, 1997)

operation of the trap is as follows: when the prey steps on the stepping board that holds the springy rod, the rod rises up, and a wire tightens around the animal's ankle, capturing it. It is possible to make foot snare traps using natural materials obtained from hunting grounds (figure 4). The strings used for the traps were traditionally made from rattan or other vine plants or ramie. Since metal wire has become readily available for purchase, this has been used more frequently. There is no specific species of tree used for making the springy rod. If there is a suitable tree growing in the area where the trap is set up, the tree itself can be harnessed for the springy rod without further modification. Neck hanging traps employ the same mechanism as foot traps, but there are also simpler arrangements whereby the string of the trap strangles the animal as it tries to move forward. Another type of metal string trap is sometimes used illegally. The animals targeted for the traps are deer, wild boar, muntjac, and mountain goats. Aside from such hunting activities in the forests, rats are also captured by certain ethnic groups in the croplands near their settlements.

Spear hunting

In chase hunting, a single hunter or hunting party searches for the game in a forest

or hunting ground. As one of the authors has pointed out before, hunters go out when they have foreknowledge of the presence of game at the hunting ground (Nobayashi 2002). The use of hounds can be effective when chase hunting with the knowledge that the prey is already there. The traditional hounds bred by the indigenous people are black, medium-sized dogs. These dogs' external features include short body hair, a pointy muzzle, and short erect ears. Their body length is about 1 m, their shoulder height is 50 cm or less, and most have a slender build. Packs of these dogs (sometimes as many as a dozen or more) are used for hunting activities. Beagles, which have an excellent sense of smell, are sometimes used in combination with these dogs.

In chase hunting, the dog finds the game and, after cornering it, the hunter kills the animal with his gun or spear. The guns and spears they use are all handmade. Making hunting gear is considered an important skill for a hunter. However, because of the limited availability of equipment for making guns, it is difficult to make one with a long shooting range, like a rifle. Their guns have a range of only a few dozen metres at most. Therefore, it is necessary for the hunter to approach the game and finish it off after the dogs have already cornered it. The spear is made from an iron bar with a sharpened tip attached to a wooden shaft (figure 5). The spear tip and the wooden shaft are tied together with a string, which can be thought to resemble a harpoon. If the spear is stuck in the prey, but the prey escapes without dying, the spear tip will dislodge from the shaft, which will catch on a tree in the forest, rendering the prey immobile. The hunter can then locate and finish off the animal.

Hunting for squirrels and flying squirrels is similar to chase hunting in that it



Figure 5 A spear of the Paiwan people (H10735). The iron spearhead is attached to a wooden handle with a braided rope, which can be detached.

is done after the presence of the game has been confirmed. Firewood that produces smoke is lit in a cavity connected to the den, and the prey is driven out and captured.

Other hunting methods

Although no longer practiced by indigenous peoples today, historical documents and ethnography show that a variety of hunting methods were practiced by Taiwan's indigenous peoples. Driven hunting, where herds of game are rounded up by people and driven out of a forest, seems similar to chase hunting with dogs, but can be classified as different type of hunting method in that it is a form of group hunting conducted by a large number of people, and a large number of game are captured at once. For example, once every three years, the Amis used to set fire to the forest, drive their game out of it, and capture the animals. This type of hunting could not be done frequently because of the organisational requirements for such a large-scale, collective endeavour, as well as the need to manage ecological resources.

Ambush hunting was practiced by hunters who were able to take advantage of animals' behavioural habits. The hunter would wait for an animal at a specific location, then ambush it and kill it when it arrived. Paiwan hunters would wait around their fields in the evening or early morning to capture wild boars that ruined their crops, and the Amis would capture deer that came in search of ashes left over from field burning or the sprouts of plants that would grow there. Hunters would also capture animals as they came out of their burrows using their bare hands.

OTHER CASES OF HUNTER-GATHERERS IN ASIA

1) The Andaman Islanders

The Andaman Islands are located next to the Malay Peninsula, broadly separated into two areas known as Great Andaman and Little Andaman. According to Radcliffe-Brown's (1948) description, bows and arrows are the primary tools used for catching animals, including fish. The target animals for hunting with a bow and arrow on land include wild boar, snakes, rats, and birds. At sea, bows and arrows are usually used for large fish and shellfish. Spears and harpoons are also used for hunting, but only in certain regions. The spear is a relatively new tool for hunting and not commonly used in most areas. However, in the northern zone, it is used for hunting together with dogs. Other references to blade-tools such as axes or knives can be found, but there is little description of their use.

The structures of the tips for arrows, spears, and harpoons are similar to each other, but vary in size and shape. Three types of arrows were described in Radcliffe-Brown's ethnography. The most common one employed for fishing is found in Great Andaman. Its shaft and foreshaft are made from bamboo and wood, and its total length is between 85 and 150 cm. Its iron point looks very short in contrast to the long shaft, and it has a short barb. However, there are no data on

the precise lengths of these points and barbs. A similar arrow can also be found on Little Andaman, but it is longer and bigger, as described by Radcliffe-Brown. This type of fishing arrow is also used to hunt snakes, rats, or sometimes even birds, all of which are quick-moving and nimble like fish (see Table 3 for details).

The arrows used for boar hunting are narrower than those used for fishing, but with a detachable head like a harpoon. The cord for binding the point and barbs is much stronger, reflecting the boar's relative strength. On Little Andaman, the boar hunting arrow only has a barb on one side, and is longer than arrows found on Great Andaman. The arrow's shape in the two regions can be regarded as basically the same in terms of mechanism, while the differences in size and shape can be considered regional variations. After the bow and arrow, the harpoon is the second most used tool in hunting and fishing for the people of Great Andaman. The shaft is made from bamboo and has a long iron head attached with barbs on both sides (again, no data are shown). This long weapon is used for capturing dugongs, turtles, porpoises, and large fish, which are all of a similar size to a wild boar.

Given the features and differences among these target animals, the shape of the foreshaft seems key in determining hunting/fishing targets. For hunting/fishing larger and physically strong animals, a detachable head or foreshaft is used, and thicker or stronger materials are chosen for the shaft.

Table 3 The hunting tools and target animals of the Andaman Islanders (Created by the authors from Radcliffe-Brown 1948)

Method	Complexity of tool(s)	Target animal	Animal rank (by body mass)	Ecological environment
Spear	3-4	wild boar	middle	land
Harpoon	6	turtle	middle, low	maritime
		dugong	high	maritime
		porpoise	high	maritime
		large fish	middle, high	maritime
Bow/arrows	2 (bow) 3-6 (arrow)	wild boar	middle	Land
		rat	low	Land
		snake	low	Land
		birds	low	Land
		large fish	middle	maritime
		large shellfish	low	maritime

2) The Orang Asli people (Negritos)

In the case of the Orang Asli people, the data were mainly gathered from Evans (1968), with some additional data on bow-and-arrow use from Schebesta (1929). There are several ethnic groups referred to as the Orang Asli or Negritos on the Malay Peninsula, the island of Borneo, and the Philippine Islands. In this paper, we chose people from ethnographies referred to as 'Orang Asli' or 'Negrito' who live

in the forests of Southeast Asian islands, but we do not differentiate between them according to region, language, or any ethnic identity; just their respective ecological environments such as land, land aquatic, or maritime, as mentioned at the beginning of the paper.

The Orang Asli people use several types of traps. Digging sticks are the most popular for catching animals such as bamboo rats. Spears and harpoons are used for catching large fish, while small fish and shellfish are usually caught using a basket scoop. Bows and arrows are used for hunting wild boar. Blowpipes and darts are also common tools among the Orang Asli people, and are employed to hunt monkeys and birds.

Orang Asli arrows do not have a detachable head according to Schebesta (1929, in Evans 1968 [1937]: 92). The 5.5-cm long blade of the arrow has one or two barbs at the end. The arrow's shaft is made from bamboo and has a feather attached at the end for balance. It is generally used to target animals at a range of up to about 23 to 30 m, but the arrow itself can fly for up to 150 m. The blowpipe, including the inner tube and dart, are usually made from bamboo. The dart length varies among different groups, but is between 30 to 40 cm, and poison (poisonous juice collected from a specific tree) is usually applied before shooting. The potential effective range of the dart is up to 45 to 55 m, but in practice, it is only fired from about 30 m away. Malay farmers introduced spears, daggers, knives, and choppers to the Orang Asli people. An example of a spear from a museum has an iron head 1,307 mm long and 25 mm thick. However, there is no description or even a note from the collector about the spear.

Table 4 The hunting tools and target animals of the Orang Asli (Created by the authors from Evans 1968 [1937]; Carey 1976; Schebesta 1929)

Method	Complexity of tool(s)	Target animal	Animal rank (by body mass)	Ecological environment
Spear	2-3	large fish	high, middle	land aquatic
Harpoon	4	large fish	high, middle	land aquatic
Bow/arrow	2 (bow) 2-3 (arrow)	wild boar	middle	Land
Blowpipe/darts	2-3	monkey	low	Land
		birds	low	Land
Trap		others		Land

In sum, and as shown in Table 4, descriptions of the hunting and fishing technology of the Orang Asli focus more on their traditional tools, such as bows and arrows, blowpipes, and darts. Compared to their other hunting/fishing methods (namely traps and baskets), bows and arrows and blowpipes and darts are more portable, which make them convenient options when moving around and exploring in the forest.

DISCUSSION

1) Hunting Tools and Target Game

We discovered a notable relationship between hunting tools and target game, and summarised these findings in Table 5. First, while a group of tools may share the same name, they are not necessarily the same in either size or shape. Occasionally we were unable to identify any actual differences between some spears, arrows and harpoons. Spears are possibly the largest hunting tool discussed in ethnographic cases. However, among some ethnic groups, their bows and arrows are as big as their spears. Thus, the size of each type of tool can vary. On the other hand, the morphologies of the same category of tool (i.e., so-called ‘spear’ or ‘bows and arrows’ in different ethnographies) are also diverse.

Specific features of hunting tools do not seem to be determined by the rank of target animals, but certain tendencies do emerge from our tables. Spears are normally used for larger game, such as wild boar and elephants, while bows and arrows are occasionally employed to catch smaller game and fish. Traps are the preferred choice for capturing small game living land. Animals with a high degree of regularity in their behaviour or range of movement are also usually caught with traps. However, this requires a greater knowledge of the target animals.

There is an interesting difference among tools when focusing on the behavioural features of target game. Due to their specific functionality, bows and arrows and guns are used for catching distant animals. Furthermore, those target animals tend to display a higher speed of movement (e.g., they are particularly nimble), and it is difficult to track their routes or get close to them. This means that bows and arrows and guns are regarded as efficient tools for hunting nimble, distant animals (e.g., fish, birds, monkeys).

2) Hunting Methods and the Ecological Environment

Oswalt (1976) proposed a system for measuring a tool’s complexity, which is calculated from its components; this technique is considered useful for quantitative analysis when discussing human activities and material culture. Some researchers have employed it to analyse the correlation between a tool’s complexity and the risk of hunting and gathering in different ecological environments. Torrence (2001) showed that there was a higher proportion of the use of complex tools in high-latitude regions, and a lower proportion in low-latitude regions.

However, as the ethnographic descriptions have demonstrated in this paper, in the actual lives of hunter-gatherers, tools are not used alone. Thus, the tendency indicated by Torrence should not necessarily be seen as practical. While they always have hunting plans thought out in advance, in the case of both the Baka and Taiwan’s indigenous people, they prefer to use several tools in combination to deal with unforeseen situations, such as the sudden appearance of an animal or an unexpected animal caught in a trap. As illustrated by the case of Taiwan, when dealing with larger game in particular, hunters normally use different tools or sets

of tools at distinct stages of the same hunting activity. Hence, even in low-latitude regions (e.g., central Africa and Taiwan), while each individual tool has a lower degree of complexity, people use them in diverse ways, and the combination of tools is varied.

Moreover, the varied usage of a tool, the unique combinations of tools, and the tools and skills for producing new tools are all essential variables that impact human hunting behaviour. From this point of view, humans (namely *Homo sapiens*) distinguished themselves from other predatory animals by developing their adaptability through the production and use of tools. Thanks to these tool use strategies, humans were able to exploit the resources available to them in their ecological environments more thoroughly and on a greater scale.

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