

## FOREST ECOSYSTEM SERVICES AND THE MANIQ PEOPLE'S SETTLEMENT ROTATION PATTERN IN SOUTHERN THAILAND

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**Abstract:** Maniq people are indigenous hunter-gatherers who, from past to present, have lived by rotating their settlements in the forest due to their reliance on the abundance of forest ecosystem services. This dependence is crucial for their continued existence with the traditional way of life. In the past, they settled and moved their habitats according to food sources, water sources, seasons, local conditions, and duration of residence at that location. They prefer to build temporary accommodation. Currently, forest reduction and deterioration have resulted in the settlement rotation pattern changes and adaptation to rely more on communities outside the forest. Being helped by external communities causes reduced migration and increased potential for permanent settlement, meaning they gradually lose their uniqueness and traditional way of life. Governments and agencies need to take this matter seriously and find measures to help maintain the availability of forest ecosystem services to prevent this indigenous identity from disappearing.

Keywords: Indigenous people, Maniq, Negrito, local ecological knowledge, hunter-gatherers.

### Introduction

Globally, only a few hunter-gatherers ethnic groups can still preserve their ancient traditions. Studies of indigenous people worldwide confirmed that their way of life is tightly knitted directly with nature, reflecting their ecological knowledge about plants and animals, and their existence is complicatedly linked socially, culturally, and spiritually with nature (Sangha *et al.*, 2011; Ouédraogo *et al.*, 2014; Pert *et al.*, 2015; Sangha *et al.*, 2015a; Robinson *et al.*, 2016a; Lyver *et al.*, 2017; Pascua *et al.*, 2017). Their reliance on nature makes them good earth stewards by allocating responsibilities to preserve nature while receiving ecosystem services (Altman, 2004). Forests, in particular, are sources flowing with abundant food and necessities for local hunter-gatherers, especially those in the pre-historic age who survived without planting (Headland, 1987). Some studies by anthropologists from southeast Asia reported the dependence on food plants and animals as major food sources for Negritos in

Southeast Asia (Headland, 1987; Greaves & Kramer, 2014).

Maniq people are part of the Negrito group, distributed in various parts of Asia, especially the Malay Peninsula and the islands of northern Malaysia, Indonesia, Philippines, including the Andaman Islands of India (Brandt, 1961; Maneenoon *et al.*, 2008). In Thailand, they live in the southern provinces of Trang, Phatthalung, Satun, Yala, and Narathiwat (Brandt, 1961). The Maniq people in the tropical rainforests of southern Thailand have lived in this area for a long time and are one of “the last remaining practising hunter-gatherer communities in the world” (Göllner *et al.*, 2022). Their characteristics resulted in a mix of Mongoloid and Australoid (Brandt, 1961; Maneenoon *et al.*, 2008). They have a distinctive physique that is unique and well-proportioned. They are good at trekking up trees, with a cheerful disposition and easy smiles, and are kind and outspoken. They prefer living in the forest and never store food and materials more than they use (Duangchan, 2006;

Hamilton, 2006; Maneenoon *et al.*, 2008). Their identity is built upon their uniqueness in many aspects: Social, cultural, traditions, and rituals passed down from generation to generation. They are born, live, and consider themselves members of the forest. Such perception makes them relate to the forest as a tiny organism in a vast, connected habitat, expressed through their respect for nature.

The Maniq people's respect for nature leads them to co-exist with the forest: They use only basic forest ecosystem services for their subsistence, with no wealth or material accumulation. Ecosystem services are usually defined as benefits that humans receive from nature. They are categorised into four groups: Provisioning, cultural, regulating, and supporting services (Millennium Ecosystem Assessment: MA, 2005). Forests, in particular, provide a wide range of services locally, regionally, and globally (United States Department of Agriculture, 2022).

Forest ecosystem services (FES) here refer to the various benefits that humans receive from forest ecosystems, including provisioning services such as water, food, medicines, vegetation, and animals; cultural services such as recreation, spiritual values, beliefs, rituals; regulating services such as carbon sequestration, climate control, soil erosion control, and supporting services such as balancing water cycles, circulating nutrients, being a habitat for animals. Jenkins and Schaap (2018) reported the need to sustainably manage FES for millions of people who depend on them for sources of food, medicine, drinking water, and immense recreational, aesthetic, and spiritual benefits. Therefore, how much more are the FES critical to the vulnerable indigenous groups of people whose total survival relies almost exclusively on them. Khunweechuay *et al.* (2022) reported exhaustively how the Maniq people rely on cultural services for their whole well-being, which confirms that their lives depend not only on provisioning services but also on other categories of ES for their entire well-being.

Since they do not accumulate food or materials for themselves, the Maniq people depend on the fertility of the ecosystem to generate the flow of continued ecosystem services, which underlies the habit of rotating around the forest to minimise the footprint and leave the minimum impact on the ecosystem by allowing nature to regenerate. However, the Maniq people's traditional way of life is currently under threat as the forest ecosystem continuously deteriorates by land-use change and encroachment from outside society.

Diminishing forest ecosystem services are now causing the rotating pattern to differ from the traditions. The alteration of their custom rotation may result in the future loss of their identity and uniqueness as a hunter-gatherer tribe. This research thus aims to document the recent rotation pattern of Maniq people in southern Thailand, analyse the change factors, and present the need to manage the forests for these last indigenous hunter-gatherer groups. Understanding their course and dependence on forest ecosystem services is vital for policymakers to devise plans to help preserve the Maniq people's identity, which is now their most critical concern about this significant lifestyle change.

## Methods

This research used a mixture of qualitative research and ethnographic research methods:

- a. In-depth interviews and focus group discussions consisting of 30 Maniq representatives.
- b. Surveys and mapping of rotation and settlement at each location. This process started with surveys of the settlement sites dating back from 2012 to 2019 with Maniq representatives while capturing the location coordinates to create a map and inquire about the settlement sites and rotation.
- c. Observation. The researchers used the ethnographic research process, especially participatory observations, including the

interpretation of gestures, behaviours, and lifestyles of the Maniq people.

Qualitative data from the interviews, focus group discussions, surveys, and observations in which audio recordings were taken were analysed by transcribing, classifying, categorising, and summarising according to the theme of the research (Creswell, 2014). The data from the location coordinates were imported using a computer program to generate a detailed map of the rotation and settlement areas.

## Results

In 2022, there were 13 groups of Maniq people in the Banthat Mountain Range and nearby areas (Figure 1). They could be divided into three types of settlement patterns as follows:

- (1) Maniq people with no permanent settlements. Two groups belong to this type: The Nokram Waterfall group in Phatthalung Province and the Wangkhrum group in Satun Province. These groups moved around the forest according to food sources and settled in deep forests far away from the community.
- (2) Maniq people with no permanent settlements moved less frequently and settled in the forest area near the community. There were five groups: the Thungnaree group in Phatthalung Province, the Phuphaphet group and the Raopla group in Satun Province, the Khaonamtao group in Trang Province, and the Boriphat Waterfall group in Songkhla Province.
- (3) Maniq people with permanent settlements. There were six groups: Those who built a dwelling between the boundary of the Khao Banthat Wildlife Sanctuary (KBWS) and villager's farms, including the Wangsaithong group in Satun Province and the Khaohuasum group in Trang Province; those who were now engaged in agriculture which was the Klongtong group in Trang Province; those who worked as rubber tapping and lived in the rubber plantations

of the villagers, including the Thungnui group and the Chonghup group in Satun Province; and a group where the female members married to villagers and sold herbs obtained from the forest.

Three groups were thus selected as case studies (Figure 1): Those who continued to migrate according to food sources and had no permanent settlements even though they sometimes moved to set a camp near the community. They were the Phuphaphet group in Manang District, Satun Province; the Wangsaithong group in La-Ngu District, Satun Province; and the Thungnari group in Pabon District, Phatthalung Province.

### *Settlement Rotation Pattern of the Phuphaphet Group*

The study of their route from 2013 to early 2019 (Figures 2 and 3) showed that the Phuphaphet group usually migrated to 3-4 locations in one year. They usually returned to the original locations again in the following year, except for some sites that they would return to in 2-5 years. However, in 2018, they relocated five times, as described in more detail.

- (1) Location 18, "Cha-Ngaen 1" was the campsite early in 2018. It was located on the boundary of the KBWS, which is responsible for the Phuphaphet Forest Protection Unit in Manang District, Satun Province. This location was close to sources of drinking water, tubers, and some wild fruits that the Maniq people call "Yabai" [*Willughbeia angustifolia* (Miq.) Markgr.]. The settlement is similar to the next location described below.
- (2) Location 19, "Cha-Ngaen 1" (Figure 4) was between the boundary of the KBWS and the rubber plantations belonging to villagers in Manang District, Satun Province. The Maniq people settled in the area because it was close to sources of drinking water, tubers, medicinal plants, and wildlife. They usually settled at this location in the summer to early rainy season between

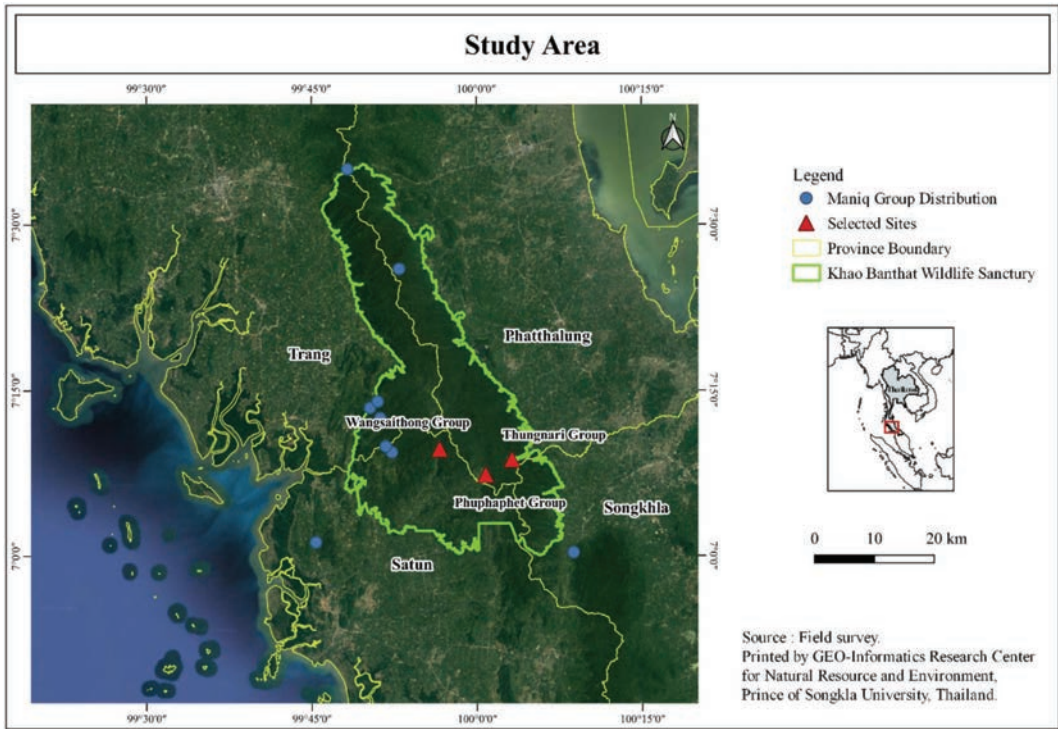


Figure 1: Distribution of the three selected Maniq groups in the study area

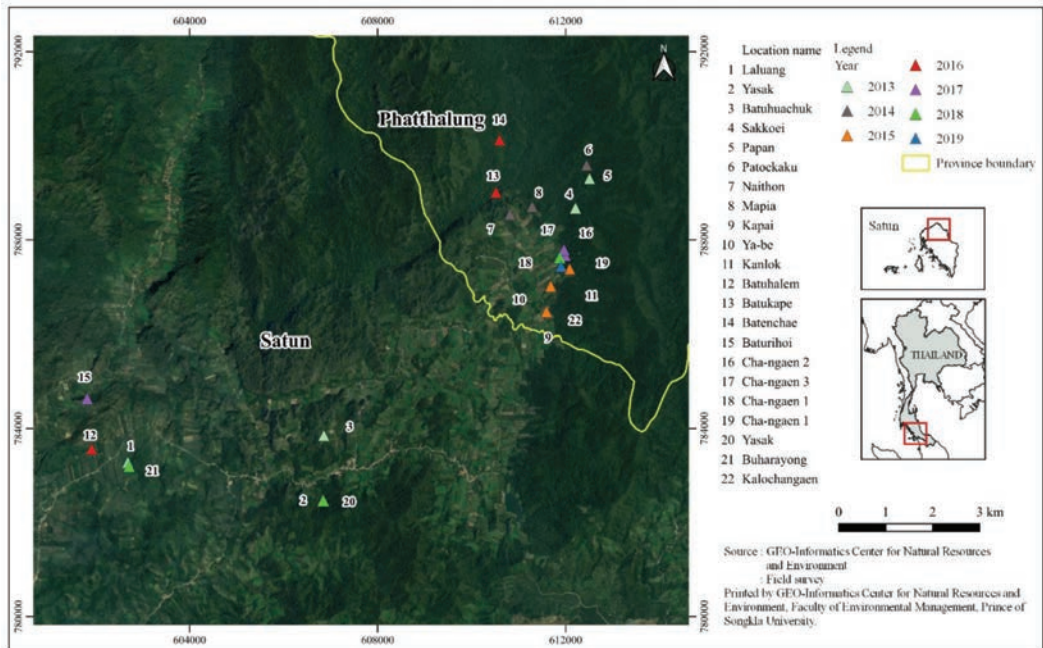


Figure 2: Settlement rotations of the Phuphaphet group between 2013 and 2019



Figure 3: Rotation of the Phuphaphet group

January and May, depending mainly on food and water availability. This location was close to the route to the Thungnari group in Pa Bon District, Phatthalung Province, where they could visit each other by walking. The construction of shelters at this location appeared like a temporary hut, “Chanam or Sa-o” and was more stable than other shelters because they would stay there the longest of the year. Since the location was near the water channel, the shelter floors must be lifted off the ground to avoid flooding during the rainy season. The pillars of the hut were made of 3-5 cm in diameter wood. The walls were made of small logs or pounded-flat bamboo. The thatch roof was made from different kinds of trees, including ‘mak-pon’ (*Orania sylvicola* Moore), Arenga palm [*Etlingera littoralis* (Koenig) Giseke], and *Oncosperma tigillaria* (Jack) Ridl. The floor was made of small round wood sticks or bamboo tied tightly with vine ropes.

- (3) Location 20, “Yasak” (Figure 5) was in the forest area of Manang District, Satun Province. Maniq people settled in this area during August-October’s fruiting season. This location was close to many wild fruits and animals sources, particularly wild rambutan (*Nephelium lappaceum* L.), “Yabai” [*Willughbeia angustifolia* (Miq.) Markgr.], plum mango [*Bouea oppositifolia* (Roxb.) Meisn.], monkeys, lemurs,



Figure 4: Location 19 (Cha-Ngaen) was close to rubber plantations, where Chanam or Sa-o shelters that were more stable than other forms were built

squirrels, and birds. These fruits and animals were the staples and necessary food for the livelihood of the Maniq people. They constructed a temporary shelter known in the Maniq language as “Haya,” built simply with wooden structures embroidered into the ground. The roof was made of leaves such as wild banana (*Musa acuminata* Colla), *Licuala peltata* Roxb., *Oncosperma horridum* (Jack) Ridl., or other leaves lay overlapping. When the leaves dry out, they put new leaves on top of the old ones. They lived in this temporary shelter for no more than three months and moved when the rainy season arrived.

- (4) Location 21, “Buharayong” (Figure 6) was located in a mountainous area in Palm Phatthana Sub-district, Manang District, Satun Province. A rock shelter, “Wa” was selected during the rainy season between November and January to shield them from heavy rains and flooding. The selected rock shelter must be on a slightly high slope and large enough to accommodate all members of the tribe. Another reason for choosing this location was food sources, such as wild *Dioscorea* tubers and hog badgers (*Arctonyx collaris*). The type of shelter was also Haya, like at location 20, but some people chose to build even more simply, which is to set up only a temporary sleeping bed slightly



Figure 5: Location 20 (Yasak) was in the forest with temporary shelters, Haya, made by overlaying leaves on a simple structure

wider than the size of the body. The “Pa-nong” bed was made of wood or bamboo 3-5 cm in diameter and arranged in a row with a campfire. The head side of the bed was raised to 45 degrees, using a rock shelter as a roof. When the rainy season ended, the group moved back to location 19.

- (5) Location 22, “Kalochangaen” (Figure 7) was near location 19 between the KBWS and a villager’s rubber plantation. The



Figure 6: Location 21 (Buharayong) was on a high slope with Haya and Pa-nong shelters

Maniq people settle here from February to August. They moved back to this location because it was closer to water sources than at location 21, and there was a greater amount of tubers and herbs. Another reason was that the number of badgers (*Arctonyx collaris*) in location 21 decreased. The property style is a combination of both Haya and Chanam or Sa-o. The materials from location 19 were used in building shelters here. Table 1 presents a summary and comparison of each settlement location in 2018.

From the map, it can be seen that most of the settlement locations of the Phuphaphet group were on the east side of the map, where they were still fertile forests, with only some rotation further to the west when the fruits and badger seasons started. The group understood that they had to depend on forest products and services. They even appreciated other categories of services, i.e., regulating and supporting services. Some examples of the services they received are presented in Table 2. Note that every location was related to provisioning services, and supporting services were related to the whole forest.



Figure 7: Location 22 (Kalochangaen) was close to rubber plantations, where Haya and Chanam or Sa-o shelters were built

Table 1: Summary of settlement and rotation of the Phuphaphet group in 2018

Location No.	Location	Area Characteristic	Season and Length of Stay	Type of Shelters
18 Cha-Ngaen 1	In the forest close to the boundary of KBWS	Slightly slope	Summer: January to April	Chanam or Sa-o
19 Cha-Ngaen 1	Between the boundary of the KBWS and rubber plantations	Slightly slope	Early rainy: January to May	Chanam or Sa-o
20 Yasak	In the forest	Flat	Fruiting: August to October	Haya
21 Buharayong	In the forest	High slope	Rainy: October to January	Haya and Panong
22 Kalochangaen	Between the boundary of the KBWS and rubber plantations	Slightly slope	Early summer: February to August	Haya and Chanam or Sa-o

Table 2: Example of forest ecosystem services the Phuphaphet group received from settlement locations

Forest Ecosystem Services	Location	Detail			
<b>Provisioning services (All locations provide this type of FES, only some examples are given)</b>					
Food	Maniq Name	Local Name	Common Name	Scientific Name	
Plants	18 Cha-Ngaen 1, 19 Cha-Ngaen 1, 20 Yasak, 22 Kalochangaen	Suna	Manpun	-	<i>Dioscorea daunaea</i>
		Bayae	Manyaeng	-	<i>Dioscorea calcicola</i>
		Lantak	Mantamrak	-	<i>Dioscorea glabra</i>
		Takop	Mansom	-	<i>Dioscorea orbiculata</i>
		Yabai	I-khui	-	<i>Willughbeia angustifolia</i> (Miq.) Markgr.
		Tako	Ngo	Rambutan	<i>Nephelium lappaceum</i> L.
		Tang-khoi	Mamuangpa	Plum mango	<i>Bouea oppositifolia</i> (Roxb.) Meisn.
Animals	2 Yasak, 20 Yasak	Ai	Khang	Langur	<i>Presbytis femoralis</i>
		Bawat	Ling	Monkeys	<i>Macaca mulatta</i>
	1 Laluang, 21 Buharayong	Kaaop	Mudin	Hog badgers	<i>Arctonyx collaris</i>
		4 Sakkoei, 5 Papan, 6 Patoekaku	La-ngue	Phueng	Bees

Forest Ecosystem Services	Location	Detail			
Medicine	18 Cha-Ngaen 1, 19 Cha-Ngaen 1, 22 Kalochangaen	Pa-ti-ka-o	-	-	<i>Luvunga</i> sp.1
		Ya-ngu	-	-	<i>Dracaena umbratica</i> Rild.
		Dok-dok-ka-sa	Kho-kio	-	<i>Scindapsus hederaceus</i> Schott
Materials	18 Cha-Ngaen 1, 19 Cha-Ngaen 1, 22 Kalochangaen	Ka-yang	Toei-pa	-	<i>Pandanus</i> sp.
		Ka-yo	Wai-khring	-	<i>Calamus palustris</i> Griff.
		Hatok	Wai-lek	-	<i>Calamus javensis</i> Blume
		Bahut	Thao wan priang	-	<i>Dischida bengalensis</i> Colebr.
		Pa-sui	Tao-rang	Burmese fishtail palm	<i>Caryota mitis</i> Lour.
		Ka-che	Mak-pon	-	<i>Orania sylvicola</i> Moore
		3 Batuhuachuk, 20 Yasak	Ka-che	Mak-pon	-
	Bo-lao		Phai-sang	-	<i>Dendrocalamus membranaceus</i> Munro B.
	La-ngo		Phai	Bamboo	<i>Bambusa arundinacea</i> Willd.
			Chet	Kluay-thuean	Wild banana
		Yamai	Ching	-	<i>Licuala peltata</i> Roxb.
Drinking water	4 Sakkoei, 5 Papan, 19 Cha-Ngaen 1	All locations must be able to access water sources though the distance may vary. The locations given here are those which are close to the water sources.			
Water use for other purposes	18 Cha-Ngaen 1, 19 Cha-Ngaen 1, 22 Kalochangaen				
<b>Regulating services</b>					
Air control	5 Papan, 6 Patoekaku, 14 Batenchae	These areas are in a deep forest where they feel the fresh air.			
Erosion control	14 Batenchae, 15 Baturihoi, 21 Buharayong	The areas are high slopes which can avoid erosion problems.			



<b>Forest Ecosystem Services</b>	<b>Location</b>	<b>Detail</b>
Windbreak	13 Batukape, 15 Baturihoi, 21 Buharayong	The areas are in the forest and near the hill where many large trees can protect them from strong wind.
Water retention	4 Sakkoei, 5 Papan, 19 Cha-ngaen 1	They are watershed areas where the water flows.
Flood protection	15 Baturihoi, 21 Buharayong	The areas are on the hillside with a high slope that can protect them from flooding.
Disease control	5 Papan, 6 Patoekaku, 14 Batenchae	These are in a deep forest where the disease from outside cannot reach.
<b>Cultural services<sup>1</sup></b>		
Ritual	18 Cha-ngaen 1, 21 Buharayong	‘Lawas’ ritual: An expression of respect for certain animals hunted for food.
	18 Cha-ngaen 1	‘Pakkam’ ritual: Declare a prohibited area and claim ownership of a tree or a tree bearing fruit.
Belief	18 Cha-ngaen 1	Beliefs that prohibit cutting ‘pa-dong’ trees.
Myths	19 Cha-ngaen 1	‘Kon-yang-pen’: A special non-human living in large kampong trees that cannot be felled.
Aesthetic	16 Cha-ngaen 2	Musical instruments: ‘Bong-hoot’.
	18 Cha-ngaen 1	Musical instruments: ‘Ya-hong’.
Spiritual	6 Patoekaku, 8 Mapia, 14 Batenchae	These are examples wherein the fear of the power of spirits is everywhere in the forest.
Wisdom	3 Batuhuachuk, 20 Yasak	Wisdom in building hunting tools.
	19 Cha-ngaen 1	Wisdom in using herbal medicine.
	21 Buharayong	Wisdom in using wild animals as medicines.
Recreation	16 Cha-ngaen 2, 18 Cha-ngaen 1	They built a ‘Som’ in the hardwood treetops to eat fruit while listening to bird songs and enjoying the scenery.
<b>Supporting services</b>		
	5 Papan 6 Patoekaku 14 Batenchae	These locations are in deep forests where they are still fertile and abundant, generating supporting services such as nutrient cycle, habitat function, and the water cycle.

Source: Data were from the present study, except the details of cultural services were from Khunweechuay *et al.* (2022)

**Settlement Rotation Pattern of the Wangsaithong Group**

The study of their route from 2014 to early 2019 (Figure 8) showed that the Wangsaithong group

usually migrated to 3-4 different locations in one year and returned to the original locations again in 1-3 years. However, in 2018 and 2019, the group relocated twice a year only. The settlement rotation of both years will be described here.

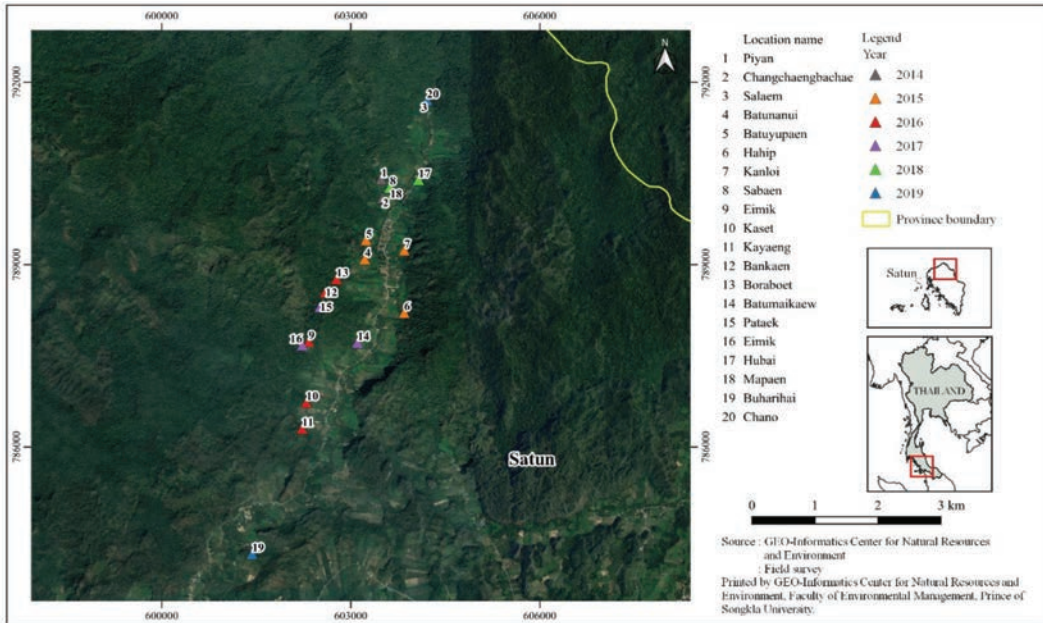


Figure 8: Settlement rotations of the Wangsaithong group between 2014 and 2019

- (1) Location 17, “Hubai” (Figure 9) was located in a villager’s mangosteen farm adjacent to the forest in Khao-Banthat Wildlife Sanctuary, Namphut Sub-district, La-ngu District, Satun Province. This location was close to sources of tubers and medicinal plants. They stayed at this location between December-March because the farm owners allowed them to as they were familiar with the Maniq people and constantly helping them. Additionally, this location was close to the road near tourist attractions, where tourists could visit and give things to the Wangsaithong group. The shelters here were also of a Haya.
- (2) Location 18, “Mapaen” (Figure 10) was located in a forest of Khao-Banthat Wildlife Sanctuary, near La-ngu River and a villager’s mangosteen farm, in Namput Sub-District, La-ngu District, Satun Province.

This location was closer to a water source than location 17 and was near a source of wild tubers and herbs. This group moved to this location in March and stayed until the rainy season in August started. The shelter type was also a Haya.

- (3) Location 19, “Buharihahi” was at a rock shelter in Palm Phatthana Sub-district, Manang District, Satun Province. When the rainy season starts between August and January, the Wangsaithong group moves to this location almost yearly. The shelter type at a rock shelter was the same as the Phuphaphet group and not far from each other. They built a simple Haya shelter and a temporary Pa-nong sleeping bed.
- (4) Location 20, “Chano” (Figure 11) was in the KBWS in Namphut Sub-district, La-ngu District, Satun Province. The site had been their primary settlement since 2019



Figure 9: Location 17 (Hubai) was on a villager’s mangosteen farm



Figure 11: Location 20 (Chano) was near La-ngu’ river with a stable and solid Chanam shelter



Figure 10: Location 18 (Mapaen) was near La-ngu’ river and a villager’s mangosteen farm

as KBWS officers permitted them. This location was close to the La-ngu River, so they had easy access to water. There was a road to their campsite where tourists and the public often visited and brought food and utensils. The shelter type was built in the stable and solid Chanam style, the same as the Phuphaphet group. The only difference was that this group used a large, durable plastic sheet given to them by visitors to cover the roof to prevent leaking during the rainy season. Table 3 summarises each seasonal settlement of the Wangsaithong group in 2018-2019.

Table 3: Summary of settlement and rotation of the Wangsaithong group (2018-2019)

Location No.	Location	Area Characteristic	Season and Length of Stay	Type of Shelters
(17) Hubai	On a villager’s farm close to the forest of KBWS	Slightly slope	Rainy to early summer: December-March	Haya
(18) Mapaen	In the forest of the KBWS	Flat	Early rainy: March-August	Haya
(19) Buharihai	In the forest	Highly slope with a rock shelter	Rainy: August-January	Haya and Panong
(21) Chano	In the forest of KBWS	Flat	From 2019 until now	More solid Chanam

Most of the settlement locations of the Wangsaithong group were along the La-ngu river, and they moved to different locations according to fruits, animals, and flooding seasons. It may appear that the Maniq people settled alongside the communities on the map, but this is not true. The Maniq people had traditionally chosen locations near the river,

and their settlement locations had long existed before outside people set up their homes and built a road along the river in later years. Table 4 shows some examples of the services they received. Like the Phuphaphet group, every settlement location was related to provisioning services, and supporting services were related to whole forests.

Table 4: Example of forest ecosystem services the Wangsaithong group received from settlement locations

Forest Ecosystem Services	Location	Detail			
<b>Provisioning services (All locations provide this type of FES, only some examples are given)</b>					
	Food	Maniq Name	Local Name	Common Name	Scientific Name
Plants	3 Salaem, 20 Chano	Bang-haeng	Mafai	Burmese grape	<i>Baccaurea ramiflora</i> Lour.
		Yang-kam	Ra-kam	Salacca	<i>Salacca wallichiana</i> Mart.
		Yabai	I-khui	-	<i>Willughbeia angustifolia</i> (Miq.) Markgr.
		Kungkwat	Man-mu	-	<i>Dioscorea stemonoides</i>
		Yaraex	Man-sai	-	<i>Dioscorea wallichii</i>
Animals	1 Piyan, 7 Kanloi, 3 Salaem, 20 Chano 19 Baturihoi	Ai Bawat	Khang Ling	Langur Monkeys	<i>Presbytis femoralis</i> <i>Macaca mulatta</i>
		Kaaop	Mudin	Hog badgers	<i>Arctonyx collaris</i>
		Medicine	3 Salaem, 20 Chano	Ka-ching-dok-diao	Ching-dok-diao
Dok-dok-ka-sa	Kho-kio			-	<i>Scindapsus hederaceus</i> Schott
Pa-ti-ka-o	-			-	<i>Luvunga</i> sp.1
Ra-waeng	Ai-waeng			-	<i>Neolitsea</i> sp.
Materials	3 Salaem, 17 Hubai, 18 Mapaen, 19 Baturihoi, 20 Chano	Ka-yang	Toei-pa	-	<i>Pandanus</i> sp.
		Ka-yo	Wai-khring	-	<i>Calamus palustris</i> Griff.

Forest Ecosystem Services	Location	Detail			
		Ka-che	Mak-pon	-	<i>Orania sylvicola</i> Moore
		Pa-sui	Tao-rang	Burmese fishtail palm	<i>Caryota mitis</i> Lour.
		La-ngo	Phai	Bamboo	<i>Bambusa arundinacea</i> Willd.
Drinking water	3 Salaem, 18 Mapaen, 20 Chano	All locations must be able to access water sources though the distance may vary. The locations given here are those which are close to the water sources.			
Water use for other purposes	6 Hahip, 18 Mapaen, 20 Chano				
<b>Regulating services</b>					
Air control	3 Salaem, 20 Chano	The reasons are similar to the Phuphaphet group.			
Erosion control	19 Baturihoi				
Windbreak	19 Baturihoi				
Water retention	3 Batuhuachuk, 12 Batuhalem, 13 Batukape				
Flood protection	19 Baturihoi				
<b>Cultural services<sup>1</sup></b>					
Ritual	19 Baturihoi, 20 Chano	‘Lawas’ ritual: An expression of respect for certain animals hunted for food.			
Aesthetic	20 Chano	Musical instruments: ‘Ya-hong’.			
Spiritual	1 Piyan	These are examples wherein the fear of the power of spirits is everywhere in the forest.			
Wisdom	3 Salaem, 20 Chano	Wisdom in building hunting tools.			
	20 Chano	Wisdom in using herbal medicine.			
	19 Baturihoi	Wisdom in using wild animals as medicines.			
Recreation	20 Chano	They built a ‘Som’ in the hardwood treetops to eat fruit while listening to bird songs and enjoying the scenery.			
<b>Supporting services</b>					
	3 Salaem, 20 Chano	These two locations are a watershed for La-ngu River, so they generate the water cycle service.			

Source: Data were from the present study, except the details of cultural services were from Khunweechuay *et al.* (2022)

**Settlement Rotation Pattern of the Thungnari Group**

The settlement rotation from 2012 to 2019 is shown in Figure 12. The Thungnari group moved to several sites, for example, 5-7 locations from 2012-2017. However, they have moved less frequently since 2018, and most locations were not distant from each other. In 2018-2019, there were only two rotations.

- (1) Location 29, “Bakoen” (Figure 13) was located at the top of Pabon Reservoir and the boundary between KBWS and a villager’s rubber plantations in Thungnari

Sub-district, Pa Bon District, Phatthalung Province. This group settled in November 2018 because of its proximity to water and food sources and the route to the Phuphaphet group. In addition, this location was close to the villagers who helped them. The shelter type was Haya, the same as the Phuphaphet and the Wangsaithong groups, with the roof often made of “ching” and “mak-pon” leaves mixed with other leaves as they were abundant in this area. When the rainy season started in 2019, members of the group who had families built a Chanam or Sa-o shelter while young men made a Haya.

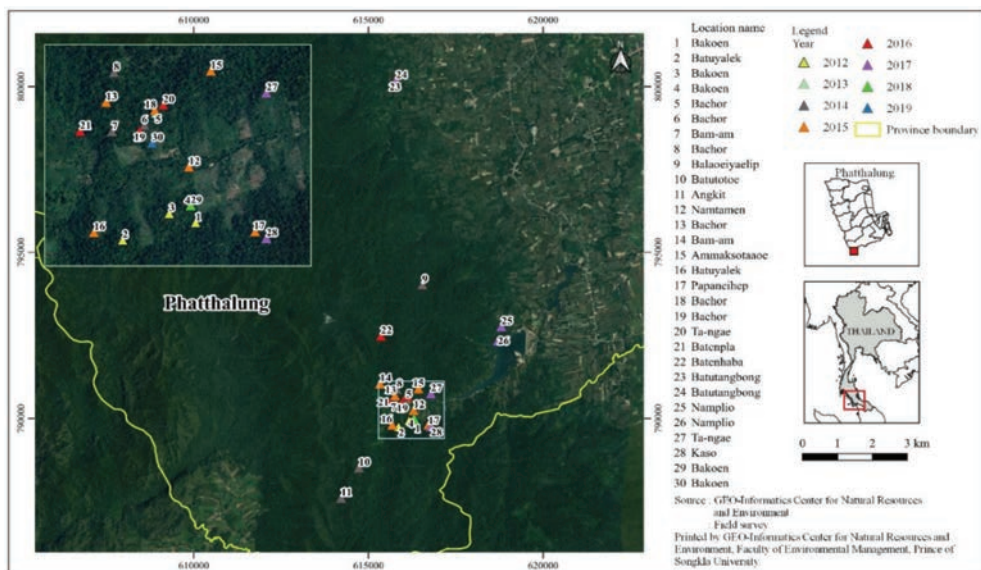


Figure 12: Settlement rotations of the Thungnari group between 2012 and 2019



Figure 13: Location 29 (Bakoen) was located at the top of Pabon Reservoir, where mixed shelters of the Chanam and Haya were built

- (2) Location 30, “Bakoen” (Figure 14) had the same name as location 29 because it was on the opposite side of the Bakoen Canal. This location was at the boundary of the KBWS and a villager’s rubber plantation and was not far from location 29. They moved to this area in December 2019-2021 because they felt insecure as the old location was on a villager’s land, so they moved to the opposite side to still be close to a drinking water source. The type of shelter was the stable and solid Chanam style for both single and married. The construction and materials used were similar to those of the



Figure 14: Location 30 (Bakoen) was located near location 29, with stable and solid Chanam-style shelters

Phuphaphet and the Wangsaithong groups. Table 5 summarises the two locations.

The Thungnari group’s settlement locations were concentrated at the Waterhead of Pabon Reservoir. They only moved a short distance to a new location because wild plants and animals were nearby; only honey was located far. The main difference from the other two groups was that they tended to settle their camp close to the people who lent them assistance. Their dependence on FES is shown, for example, in Table 6. Again, every settlement location was related to provisioning services, and supporting services were related to whole forests.

Table 5: Summary of settlement and rotation of the Thungnari group (2018-2019)

Location No.	Location	Area Characteristic	Season and Length of Stay	Type of Shelters
(29) Bakoen	Between KBWS and rubber plantations	Flat	Rainy to summer: November 2018-November 2019	Haya
(30) Bakoen	At the boundary of KBWS, on the opposite side of location 29	Slightly slope	Rainy to summer: December 2019-the present	More stable Chanam

Table 6: Example of forest ecosystem services the Thungnari group received from settlement locations

Forest Ecosystem Services	Location	Detail			
<b>Provisioning services</b>					
Food	Maniq Name	Local Name	Common Name	Scientific Name	
Plants	5 Bachor,	Takop	Mansom	-	<i>Dioscorea orbiculata</i>
	6 Bachor,	Yabai	I-khui	-	<i>Willughbeia angustifolia</i> (Miq.) Markgr.
	18 Bachor,	Soe	Man-khan-khao	-	<i>Dioscorea pentaphylla</i> L.
	19 Bachor,	Cha-ka	Lak-khoei-lak-kuea	-	<i>Diospyros sumatrana</i> MIQ.
	20 Ta-ngae, 30 Bakoen	Bang-haeng	Mafai	Burmese grape	<i>Baccaurea ramiflora</i> Lour.

Forest Ecosystem Services	Location	Detail			
Animals	9 Balaoeyaelip, 10 Batutotoe, 11 Angkit, 22 Batenhaba	Ai	Khang	Langur	<i>Presbytis femoralis</i>
		Bawat	Ling	Monkeys	<i>Macaca mulatta</i>
		La-ngue	Phueng	Bees	<i>Apis dorsata</i> Fabricius
Medicine	5 Bachor, 6 Bachor, 18 Bachor, 19 Bachor, 20 Ta-ngae, 29 Bakoen, 30 Bakoen	Pa-ti-ka-o	-	-	<i>Luvunga sp.1</i>
		Ma-tang-ka-la	Da-ngo	-	<i>Zingiber spectabile</i> Griff.
		Chak-ra-pon	Lekdam	-	<i>Gomphostemma scortechinii</i> Prain
		Pan-yao	Aueang-mai-na	-	<i>Cheilocostus speciosus</i> (Koenig) Specht.
Materials	5 Bachor, 6 Bachor, 18 Bachor, 19 Bachor, 20 Ta-ngae, 29 Bakoen, 30 Bakoen	Ka-yang	Toei-pa	-	<i>Pandanus sp.</i>
		Ka-che	Mak-pon	-	<i>Orania sylvicola</i> Moore
		Chet	Kluay-thuean	Wild banana	<i>Musa acuminata</i> Colla
		Yamai	Ching	-	<i>Licuala peltata</i> Roxb.
		Pa-sui	Tao-rang	Burmese fishtail palm	<i>Caryota mitis</i> Lour.
		Ba-ke	Nao trees	-	<i>Arenga pinnata</i> (Wurmb) Merr.
Drinking water	30 Bakoen	All locations must be able to access water sources though the distance may vary. The locations given here are those which are close to the water sources.			
Water use for other purposes	16 Batuyalek, 21 Batenpla, 29 Bakoen				



<b>Forest Ecosystem Services</b>	<b>Location</b>	<b>Detail</b>
<b>Regulating services</b>		
Air control	10 Batutotoe, 11 Angkit, 22 Batenhaba	The reasons are similar to the Phuphaphet group.
Erosion control	2 Batuyalek, 10 Batutotoe	
Windbreak	22 Batenhaba	
Water retention	13 Bachor, 16 Batuyalek, 21 Batenpla	
Flood protection	10 Batutotoe, 11 Angkit	
Disease control	10 Batutotoe, 11 Angkit, 22 Batenhaba	
<b>Cultural services<sup>1</sup></b>		
Ritual	22 Batenhaba	‘Lawas’ ritual: An expression of respect for certain animals hunted for food.
Aesthetic	29 Bakoen, 30 Bakoen	Musical instruments: ‘Ya-hong’.
Spiritual	10 Batutotoe, 11 Angkit, 22 Batenhaba	These are examples wherein the fear of the power of spirits is everywhere in the forest.
Wisdom	13 Bachor, 30 Bakoen	Wisdom in building hunting tools.
	8 Bachor, 15 Ammaksotaae, 30 Bakoen	Wisdom in using herbal medicine.
Recreation	22 Batenhaba, 30 Bakoen	They built a ‘Som’ in the hardwood treetops to eat fruit while listening to bird songs and enjoying the scenery.
<b>Supporting services</b>		
	10 Batutotoe, 11 Angkit, 22 Batenhaba	These locations are in deep forests where they are still fertile and abundant, generating supporting services such as nutrient cycle, habitat function and the water cycle.

Source: Data were from the present study, except the details of cultural services were from Khunweechuay *et al.* (2022)

**Settlement Rotation and Site Selection Factors**

The three groups of Maniq settled in the Khao-Banthat Wildlife Sanctuary, moved to 3-5 locations for food sources, and returned to the original locations every 1-5 years. The settlement rotation patterns of the three groups differed

slightly. The Phuphaphet group moved to at least three locations within a year. In contrast, the Thungnari group moved less frequently and the Wangsaithong group has started to establish permanent settlements and reduced mobility since 2019 after the government unofficially

allocated residential areas for them. The researchers speculate that the Thungnari and the Phuphaphet groups will also likely settle permanently soon.

The Maniq people selected the types of their shelters and settlement locations according to at least five critical factors. These are: (1) Food and water sources, (2) the physical of the area, (3) the season, (4) the length of stay and (5) the assistance from villagers and agencies. Because food sufficiency per member is a critical factor for survival, Maniq people move to find a new source of sufficient food when food and water are depleted. Thus, they stay short in each location for 1-3 months. In turn, the type of foods depends on the season. They moved closer to where wild fruits and animals are abundant seasonally, as these sustain their lives. The season thus determines the location and the type of shelters. They build shelters near the rock shelter during the rainy season to avoid flooding. The length of stay also determines shelter type: The longer the stay, the more stable the shelter.

Since the communist era in the 1970s, Maniq people began receiving assistance, but it was not until 2003 that they began relocating closer to the community because of the ecotourism policies in Satun and Phatthalung provinces. Recently, some Maniq people tend to settle in forested areas near the community for convenient access to help from villagers and authorities, changing the traditional patterns. This reliance on outside help has become one of the factors affecting settlement choice more than before. Analysing the three groups' patterns suggests that the mobility decrease is based on decreasing wild food and animals. Since the range of food availability of the Maniq people has been greatly limited and the food from the forest is insufficient by forest encroachment and land-use change, they turn to villagers for trade and exchange, of which they are often taken advantage.

In the case of the Wangsaithong group, they started to settle permanently with the Chanam style, which they gained knowledge from the

villagers and modified. Another reason for permanent settlement comes from the Khao-Banthat Wildlife Sanctuary's permission to settle permanently in an allocated area. However, some members still forage for about three days or one month while others care for the camp. The decision to settle permanently rests primarily with the group leader, although some members, especially the elderly Maniq people, want to continue a traditional lifestyle, saying: *"If the forests were as abundant as before, we would have lived in the forests. But now, the food from the forest is limited, and our children are growing in number"*.

Because this group has had a relationship with the villagers and received continuous assistance in various matters, they absorb and adjust to modern life better than the other two groups. Since they receive much help, when the villagers ask the Maniq people to help welcome tourists, they cannot deny it, as the Maniq people are considerate and want to show their gratitude. A Maniq informant reflected on this issue: *"These people always help us in difficult times. When they want us to help them do something, we cannot deny it because we have consideration for them"*.

Similarly, the Thungnari group settled more and rotated less because of reduced wild food availability. This food limitation forced them to receive assistance from villagers in the area, such as necessities provision, agricultural advice, building improvement, or even employment opportunities. Meanwhile, KBWS allowed this group to grow vegetables nearby the campsite. They then began to rotate less frequently in the forest. Nevertheless, they would temporarily move close to the resources and stay for 1-2 months during the wild honey and fruit season.

It is interesting to note that the Maniq people did not decide to settle permanently independently. The process of obtaining permission from the KBWS was carried out by the villagers or community leaders who had continuously contacted and helped the Maniq people. This gesture came from the villagers' reasoning that the Maniq people should be

helped to develop a good quality of life like other citizens in the society, including having well-being, a secure place to live, land to grow, an income, and formal education for their children. However, this good wish does not always align with the real needs of the Maniq people or the kind of life that the Maniq people want to live. There is a division of opinions among the Maniq people on this issue. Those young to middle-aged Maniq who can coordinate with outside communities, and now play a key role in leading the group, seemed to welcome the change, stating: *"The villagers tried to help us so that we will not starve and suffer. Besides, our children can study so they will not be easily deceived by others"*. The elderly, on the other hand, revealed that *"We want to live in the forest if they were as natural as before"*.

The Phuphaphet group is the only group that still moves when nature compels. It is because they do not have land for permanent settlements allowed by the government, and there are no villagers to help like the other two groups. Although still moving, it is noticeable that some settlement locations are not very far from the community. When this group learned that the Thungnari group had started a permanent settlement, some young Maniq wanted to follow suit with the ability to maintain their hunting gatherings as before. The permanent settlement was for them to get access to government welfare when food was scarce and for children to have the opportunity to go to school in the future. One Maniq people said: *"We want the Wildlife Sanctuary to allow us to live on a piece of land. We do not want to live on the villagers. Only one spot is enough to let our children have an education there because their mothers still worry about them going to school and being bullied by their friends. Yet, we still would gather wild food and hunt as we usually do"*.

It is worth noting that the Maniq people's resource utilisation is deeply governed by their spiritual values, myths, beliefs, and rituals; thus, they use forest resources only for necessities and sustenance, never stockpiling or accumulating. They never hunt for entertainment, pleasure, or possession. Since they do not have storage,

the abundance of the forest is vital to the life of Maniq.

## Discussion

The Maniq people's settlement rotation patterns are directly related to their dependence on ecosystems. The rotation is cyclical according to the seasonal abundance of forest ecosystem services used as foods, raw materials, and medicines, particularly wild fruits, herbs, honey, and wildlife. This reliance is similar to other indigenous hunter-gatherers, such as the Gourounsi indigenous peoples of Burkina Faso, West Africa (Kristensen & Balslev, 2003), the 'Rainforest Aboriginal peoples' from the Wet Tropics, Australia (Pert *et al.*, 2015), Tuawhenua Māori in New Zealand (Lyver *et al.*, 2017), the Soliga and Kattunayaka in the Western Ghats of India (Balasubramanian & Sangha, 2021), northern Thailand's Karen and Lawa people (Junsongduang *et al.*, 2013), Indonesia's Tau Taa Wana indigenous peoples (Himmi *et al.*, 2014), and Malaysia's Orang Asli indigenous peoples (Nik *et al.*, 2011; Talaat *et al.*, 2013; Bartholomew, 2017; Loke *et al.*, 2020).

Resource availability is thus the first consideration for the Maniq people in determining when and where to move. Their settlement rotation does not lean on the exhaustion-then-leave but can be considered a co-existing sustainable practice as the Maniq people leave a location to allow the resources to renew before returning to the original spot every 1-5 years. Khunweechuay *et al.* (2022) reported an example of such practice that the Maniq dig tubers by not exhaust the whole plant. They carefully chose the right-sized tubers and left the young ones to grow and replenish. The way they constructed the shelters proved to be sustainable as well. Since the Maniq settled temporarily for a short period, everything used to build a shelter can easily decompose naturally. The sustainable practice was also present in the way they hunted. The Maniq people did not hunt large animals such as tigers, elephants, and bears, for food because they believed that doing so would negatively affect the hunters (Khunweechuay

*et al.*, 2022). Thus, their hunting gears were not large or fierce, which could not be dangerous to themselves and those around them. They could not hunt animals for massive sales with such a tool. In addition, the Maniq people do not hunt animals that are not food, i.e., beautiful and rare, such as tapir, deer, and “Nok Wa” (*Argusianus argus*), because these animals are for recreation and at risk of extinction (Khunweechuay *et al.*, 2022). These regenerative practices reflect the Maniq people’s respect and understanding of the intricating natural system as they recognise that their existence ultimately depends on the forest ecosystems and that they will have to return to the same place to receive these services again.

However, current situations force the Maniq people to face various challenges in the Banthat Mountains Forest ecosystem (Kricheff & Lukas, 2015). A decrease in wild plants, animals, and medicine caused them to receive and increase assistance from external communities and reduce their rotations (Wiriyaromp *et al.*, 2015). From following where nature guides to settling more near outside communities: This change in rotation pattern has brought many problems to the Maniq people. For example, the donation of instant food alters the Maniq people’s diet, making them susceptible to disease. Various clothes donated as goodwill, such as office clothes, are unsuitable in the forest. This large amount of clothes burdened the Maniq people when they had to rotate their settlement. Additionally, Maniq’s love for privacy was disturbed when settling near the communities, and villagers brought tourists to visit the Maniq campsite as an attraction. Most importantly, their altered lifestyle and migratory patterns have slowly affected their well-being, and their identity as an ancient and unique tribe of forest survivors will be at risk of extinction. It is worth noting that the Maniq people originally lived in the forest long before the KBWS was established. Logically, therefore, the KBWS grant them permission to live and utilise the forest. However, this action has not yet been supported by laws or regulations. Additionally, some government helps are too general and not based on what is appropriate for the Maniq

people. No clear policy to preserve the forest area on which the Maniq are dependent is currently in place (Khunweechuay, 2022).

This happened earlier to indigenous hunter-gatherer groups of Negritos, especially the Semang in Peninsular Malaysia (Higham, 2013; Talaat *et al.*, 2013; Bartholomew, 2017) and the Agta in the Philippines (Headland, 1987), similar to the Maniq people. They lost their cultural identity as the expansion of agricultural areas decreased the forests and the ecosystem services that these groups entirely depended on. They were forced to migrate deeper into the rainforest, and some had to adapt to external pressures to survive (Headland, 1987; Higham, 2013). These conditions put them at greater risk of starvation and malnutrition, especially among children of Maniq, who are highly prone to undernutrition. Likewise, in the study by Yee *et al.* (2021), the nutritional status of Orang Asli children in Terengganu, Malaysia was found to be poor nutritional status which environmental factors, socioeconomic status, and infections might influence.

If it persists, the alteration of their settlement frequency and locations in adjustment for survival will undoubtedly threaten their identity and existence as a unique tribe. They will soon be swallowed and lose their ancient traditions to modern society. The decline in plant and animal species related to cultural species also threatens their well-being because the hunter-gatherers are cultural people (Garibaldi & Turner, 2004; Kuhnlein *et al.*, 2013). This situation is not well understood and is rarely discussed in Thai society. Generally, people do not recognise how the Maniq people can co-exist with nature without destroying it. There is an urgency for the government and general people to take an interest in this last group of hunter-gatherers in Thailand.

## Conclusion

The Maniq people’s settlement and rotation patterns in the forest are directly related to ecosystem services and most strongly characterise and describe Maniq’s existence.

The dependence on forest products is a prime factor in the settlement rotation pattern, but this natural movement has recently changed. The pattern alteration is a consequence of decreasing forest areas and fertility, which causes the Maniq people to rely on help from villagers and various agencies. Their dependency on assistance from outsiders leads to several problems that threaten their existence as a unique tribe. Understanding what natural lifestyle best suits them, relating government agencies should act immediately to preserve the forest habitats where the Maniq people settle, protect and increase using ecological knowledge of the food and material habitats where the Maniq forage, ensure forest fertility, and efficiently prevent further forest encroachment.

Furthermore, educating local and general people to respect and understand that the Maniq people have the right to choose how they want to live would help them maintain their dignity tremendously. However, how to protect and preserve this last hunter-gatherer group to continue their survival in this changing world remains urgent. Further research should also cover all Maniq groups to manage the forest for this special group of people systematically. It will also be helpful to study the Maniq people in neighbouring countries such as the Malaysian Orang Asli group, to compare aspects such as the way of life, DNA, resource dependency and government management.

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