

Eco-Material Culture Study of Fish Traps in the Mekong Basin of Lao PDR<Special Theme : Material Cultural Studies on Boats and Fishing Tools Based on the Museum Collections and Fieldwork>

| メタデータ | 言語: eng |
|-------|-----------------------------------|
| | 出版者: |
| | 公開日: 2022-12-07 |
| | キーワード (Ja): |
| | キーワード (En): |
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| URL | https://doi.org/10.15021/00009965 |

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ラオス・メコン盆地における筌漁の生態物質文化研究

辻 貴志

In Lao PDR, fishing is conducted by farmers in paddy fields and in rivers to obtain the necessary animal (mainly fish) protein to support everyday life. Fish traps are the most common fishing gear used among the farmers. The kind of fish trap that is used depends on the type of fish and the ecological environment. This study was undertaken to investigate the characteristics of fish traps found in the Mekong Basin in southern Laos and to describe the investigation of the related fish trap collections of the National Museum of Ethnology, Japan (Minpaku) from a viewpoint of eco-material culture. The research is based on ecological anthropological methods used in southern Laos, where a total of 12 fish traps were accounted for as of 2008-2009. These 12 fish traps are classifiable into two types based on their structure and function: open-weave upright basket traps and horizontal cylinder traps made of bamboo. As of 2020, there were no fewer than 24 fish traps in the Laos fish traps collections of the Minpaku. These fish traps were produced during the 1980s to the 1990s, mostly in southern Laos. Half of them were made of rattan. Comparative analysis of both samples revealed several similarities beyond time and space in terms of (1) the ecological environment, (2) seasonality, (3) materiality, (4) ecological knowledge, and (5) peasant fishing. Along with such results, this paper presents a discussion of the characteristics of the fish traps used by the Laotian farmers and how the fish traps are adaptive to their given ecological environment.

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Key Words: eco-material culture, farmer, fish traps, Lao PDR, Mekong Basin キーワード: 生態・物質文化, 農民, 筌, ラオス, メコン盆地

ラオスでは、農耕で不足する日常生活で必要な動物性タンパク源(おもに魚 類)を補うため、水田や河川を利用した農民による漁撈活動が盛んにおこなわ れている。筌は農民にとって主要な漁具のひとつである。さまざまな形態の筌 が、漁獲対象の魚種の習性や生態環境に応じて使いわけられている。本稿は、 ラオス南部のメコン河流域でみられる筌の特徴について明らかにするとともに. 国立民族学博物館(みんぱく)に収蔵されている類似の筌のコレクションにつ いて、生態・物質文化の視点から検討した。ラオス南部での生態人類学的手法 にもとづいた調査を 2008 年から 2009 年にかけて実施し、調査の過程で 12 種 類の筌を確認した。これらの筌は、その機能と構造による形態から、タケ製の 直立型と水平筒型の2種類に分類できた。いっぽうで、2020年におこなった国 立民族学博物館でのラオスの筌に関する調査では、総計24種類の筌を確認し た。これらの筌は 1980 年代から 1990 年代におもにラオス南部で製作されたも のである。それらの半分はラタン製であることを確認した。以上の比較分析に より、ラオスの筌には時空を超えた共通性がみられることが判明した。つまり、 (1) 生態環境, (2) 季節性, (3) 物質性, (4) 生態学的知識, (5) 農民漁撈の要素 が共通する。これらの結果に沿って、本稿は、ラオスの農民がもちいる筌の特 徴と, 筌が所与の生態環境においていかに適応的であるかについて議論する。 1 Introduction 4 Fish Traps Used in Southern Laos 2 Outline of Fieldwork 5 Comparative Morphological Analysis of the Minpaku Fish-Trap Collections 3 Fishing Activities Practiced in Southern

6 Discussion and Conclusion

1 Introduction

Laos

Material culture includes human behavior, ideas and technology, especially in the field of anthropology and archaeology fields, although it is technically an interdisciplinary domain (Hicks and Beaudry 2010). Material culture study is intended to consider what materials can do for human beings (Hodder 2012). It is also important to elucidate human–artifact relations (Haudricourt 1987). Material culture study investigates relations between specific people and things by specifically examining the choices people make in inventing, developing, replicating, adapting, and using their technologies (Skibo and Schiffer 2008; Skibo et al. 1995). However, those earlier studies reveal material culture from a viewpoint of anthropocentrism. This study is fundamentally an ecological anthropological study of material culture from the perspective of eco-material culture composed of material, subsistence life, ecology, and the environment emphasizing fish traps in the Mekong Basin of Lao PDR. "Eco-material culture" herein denotes the symbiotic relationships among people, ecology and material culture on objects that people

produce from natural materials for sustaining their livelihoods (Tsuji 2019).

In Lao PDR, a landlocked country surrounded by Thailand, Vietnam, Cambodia, Myanmar, and China, fishing is important for farmers both economically and nutritionally (Interim Committee for Coordination of Investigations of the Lower Mekong Basin 1992). Farmers in southern Laos rely heavily on the rich aquatic resources as their main source of food and livelihood (Baird et al. 1999). Fishing is an important source of subsistence for farmers because rice production is insufficient to sustain a family in the Mekong Basin throughout the year (Santasombat 2011). The Laotian people are versatile farmers who rely on diverse animal resources such as fish, shell, amphibians, reptiles, crustaceans from the Mekong River, and the associated tributaries, floodplains, paddy fields and pounds to obtain the necessary animal (finfish) protein needed in their everyday lives. The farmers have developed several fish traps based on the available resources and the environment. The fish traps are of an eco-material culture that consists mostly of natural materials such as bamboo and rattan obtained from their given ecological environments. Farmers adapt their fish traps based on the habits of the targeted fish and differences of the trapping grounds, therefore making them part of a common and typical eco-material culture for life and subsistence among the farmers.

In general, fish traps must be primary fishing devices used to trap fish easily and with high probability. Once a fish enter the trap, it cannot escape because of barbs set at the trap entrance. The materials used for the traps are mostly prepared from the ecological environment and are appropriate in terms of cost-benefit, although their shapes mutually differ according to the habits and habitats of the target. Human beings have had a keen sense of the structure and function of fish traps.

Fish traps are found worldwide. For example, the fish trap collections of the National Museum of Ethnology, Japan (Minpaku) comprise 489 materials from Japan, China, Taiwan, Thai, Malaysia, Indonesia, Philippines, Laos, Cambodia, India, Nepal, Fiji, Caroline Islands, Papua New Guinea, Australia, New Zealand, Finland, Germany, Arab, Madagascar, Botswana, Brazil, Venezuela, Columbia, and Mexico.¹⁾ This fact indicates that fish traps are a universal component of material culture for the life of modern humans (*Homo sapiens*). Fish traps have generally simple structures that can be produced similarly to basketry. They are made from natural materials such as bamboo and rattan.

In terms of the ecological and the material cultural aspects of the fish traps in Lao PDR, systematic studies about the locality and utilization of fish traps found in the river and paddy fields are remarkable. Results of this study reveal the general fishing activities in the country. Regarding the fish traps, the local names, installation, and utilization technology are described in detail (Claridge et al. 1997). Trapping technologies and material culture of traps among the Kammu in northern Laos are investigated in the context of hunting and fishing. Results of this study

show both animal and fish traps, including coops for the targets in nature (Tayanin and Lindell 1991).

Regarding other fish trap studies in the world, Japanese folklore studies generally examine fish traps as a material cultural study by devoting attention to the distribution, trapping ground, time use, agent, target, purpose, producer. Those studies give some form and structure to investigate farmers' subsistence activities (Nishitani 2011; Yasumuro 2005). Comparative ecological studies of fish traps in Satawal and other islands of Micronesia by Akimichi (1989) examined their seasonality, targeted fish species, total volume of the respective fishing types, fishing methods, distribution, morphology, and production. Ecological anthropological studies conducted off of the eastern coast of Africa by Tamura (2019) investigated a innovations by fishermen for fish traps to enhance the productivity, aside from catching bait and the related fishing grounds. This study is beneficial for consideration of the relations between body and materials. Fish traps are free from involvement of human body technology, but non-body technology is necessary. Fish traps in the Philippines are also controlled strongly by natural phenomena such as tides (Tsuji 2007; 2013a). Fish traps in India have elements of play aside from their subsistence purposes (Remesan and Ramachandran 2008). Consequently, fish trap studies generally have been conducted from ecological and material cultural aspects to investigate the subsistence importance of fish traps.

Based on these discussions and earlier studies of fish traps in the world, this study investigates the relations between the fish traps and the ecological environment from the perspective of eco-material culture in a village of Phu Tai, who are an ethnic minority people mainly distributed throughout Savannakhet (Sawannakhet) province in southern Laos. As described herein, the author specifically examines the fish traps as a source of animal protein procurement among the farmers and fish traps. Regarding aspects of material culture, the author conducted a morphological analysis of fish traps that were observed and collected during fieldwork in the village (n=12). Then these materials were compared with fish trap materials collected from Lao PDR in the Minpaku (n=24). Finally, this paper presents an exploration of the characteristics of fish traps based on basic information such as locality, artisan, material, technology, target animals, and the ecological environment.

2 Outline of Fieldwork

Fieldwork was conducted at village L of Savannakhet province in southern Laos, about 500 km south of Vientiane, the Lao PDR capital (Figure 1). The village is located along a Mekong River distributary.

Residents of village L are the Phu Tai, an ethnic minority people classified as among the Tai-Kadai language group. The population (as of 1999) was approxi-



Figure 1 Research area (Prepared by the author)

mately 128,000, distributed in the provinces of Khammuan, Savannakhet, and Salavan in southern Laos (Schliesinger 2003). The village had approximately 700 households according to the author's survey in 2009 (Figure 2). The main subsistence activity in the village was farming of glutinous rice in irrigated paddy fields. The people were fundamentally farmers (Figure 3). Fishing, animal husbandry with water buffaloes, cows, goats, pigs, chickens and ducks, weaving, and gathering animals and plants, aquaculture, vegetable cultivation, and mushroom production are conducted secondarily. Weaving and dying clothes with indigo, conducted as women's work, is a significant cultural characteristic of the village (Figure 4). Not a few farmers go to work in Thailand. The local economic activity occurs at a morning market in the village. Farmers trade food and simple daily necessities every day (Figure 5). Farmers make a living by displaying the products of their subsistence activities. Fishing is practiced next to agriculture, weaving and handicraft making, and animal husbandry in the village (Table 1), although these data were collected during the dry season and not during the rainy season, when fishing activity is greatest.²⁾ In Lao PDR, agriculture and fishing are connected heavily with the aquatic environment, especially paddy fields (Tsuji 2013b; Tsuji et al. 2013, 2018).

The weather in southern Laos, where the village is located, has distinct characteristics in the dry and rainy seasons. The dry season extends approximately from October through April, whereas the rainy season is May–September (Table 2).³⁾ The natural environment changes drastically during the rainy season because of river flooding (Figure 6). Flooding creates fishing grounds. Many fish gather in the river, floodplains, paddy fields and ponds. Farmers rely strongly on fishing activities during the rainy season using various fishing gear including fish traps (Tsuji 2022; Tsuji and Hirota 2021). The research periods in the village were May 1–18, August 1–17 in 2008, and December 20, 2008 to January 18, 2009. Research methods included participatory observations and interview to gather information about the form, use, environment, installation, targeted fish and production technique of fish traps. The research language used was Lao. Research permission was issued by the Lao Tropical and



Figure 2 Village L (Prepared by the author)



Figure 3 Harvesting rice in village L (Photo by the author on May 11, 2008)



Figure 4 Phu Tai women wearing their traditional costume in village L (Photo by the author on May 3, 2008)



Figure 5 Woman selling catfish at a morning market in village L (Photo by the author on June 23, 2009)

Public Health Institute (TPHI, formerly, the National Institute of Public Health [NIOPH]) in Vientiane through the Research Institute for Humanity and Nature, Japan (RIHN), where the author worked for the project during the research period.

| | Behavior | Frequency | % |
|----|-------------------------------|-----------|------|
| 1 | Leisure | 11,542 | 35.6 |
| 2 | Eating and drinking | 4,756 | 14.7 |
| 3 | Agriculture | 4,133 | 12.8 |
| 4 | Weaving and handicraft making | 2,797 | 8.6 |
| 5 | Housework | 1,902 | 5.9 |
| 6 | Hygiene | 1,664 | 5.1 |
| 7 | Animal husbandry | 1,284 | 4.0 |
| 8 | Fishing | 892 | 2.8 |
| 9 | Public work | 881 | 2.7 |
| 10 | Religious and social activity | 812 | 2.5 |
| 11 | Schooling | 733 | 2.3 |
| 12 | Absent | 463 | 1.4 |
| 13 | Hunting and gathering | 359 | 1.1 |
| 14 | Business | 84 | 0.3 |
| 15 | Sick | 57 | 0.2 |
| | Total | 32,359 | 100 |

Table 1 Time use of 125 people in village L with duration of 12 hr from January 15 to February 5, 2009

(Prepared from the author's fieldwork in village L)

| | Average tem | perature (°C) | Average rainfall | Average rainy | | |
|-----------|-------------|---------------|------------------|---------------|--|--|
| | Minimum | Maximum | (mm) | days | | |
| January | 14.9 | 29.3 | 3.7 | 1 | | |
| February | 17.7 | 31.4 | 17.3 | 3 | | |
| March | 21.3 | 33.8 | 31.9 | 3 | | |
| April | 23.9 | 35.0 | 90.8 | 7 | | |
| May | 24.6 | 33.3 | 168.3 | 14 | | |
| June | 24.8 | 32.0 | 262.5 | 16 | | |
| July | 24.2 | 31.3 | 219.0 | 18 | | |
| August | 24.0 | 30.6 | 343.4 | 19 | | |
| September | 23.5 | 31.1 | 219.0 | 14 | | |
| October | 21.4 | 30.5 | 86.6 | 8 | | |
| November | 17.6 | 28.8 | 6.8 | 2 | | |
| December | 14.7 | 27.7 | 2.4 | 1 | | |

 Table 2
 Average weather of southern Laos

Data: World Weather Information Service

(http://www.worldweather.org: accessed on July 20, 2022)



Figure 6 Seasonal changes of river at village L A: dry season, B: rainy season (Photo by the author: A on December 30, 2008, and B on May 10, 2008)

3 Fishing Activities Practiced in Southern Laos

Fishing activities are conducted busily during the rainy season, when the fish migrate to the river at village L, although they are conducted year-round. The river becomes flooded during the rainy season. As a result, the fish enter paddy fields, ponds, and floodplains. Here, farmers conduct fishing activities concurrently with agricultural activities. The reason animal proteins are obtained from the fish is the ecological adaptation of farmers living in the aquatic ecological environment.

Various fishing activities are found using hook and lines, nets and fish traps, and other devices in paddy fields and rivers. Boats are used for fishing in rivers and floodplains (Figure 7). Fishing activities start at around 5 am and last until around 7 pm. Fish trapping is conducted twice a day, with setting of traps and catching of fish (Figure 8).



Figure 7 Fishing boat

A: body of boat at village L, B: men paddling a boat at village L (Photo by the author: A on August 12, 2008, and B on August 8, 2008)

| Environment | Fishing methods | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|--------------|-------------------------------------|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|
| De data Gald | Fish trap for swamp eel (toum eian) | | | | | | | | | | | | | | | |
| Paddy neid | Hook and line (bhet) | | | | | | | | | | | | | | | |
| | Fishing with rod (bhet) | | | | | | | | | | | | | | | |
| | Gill net (mong) | | | | | | | | | | | | | | | |
| Disco | Casting net (sum he) | | | | | | | | | | | | | | | |
| River | Drag net (gneng) | | | | | | | | | | | | | | | |
| | Fish trap (lop sikum) | | | | | | | | | | | | | | | |
| | Fish trap (lop) | | | | | | | | | | | | | | | |

Figure 8 Fishing environment, methods and time found in village L (Observed by the author during May–August, 2008)

Over 1,200 fish species are known in the Mekong River (Food and Agriculture Organization of the United Nations 1996). Fish of many kinds are also caught in the river of the research village. Groups of *Channa*, or snakeheads, (Figure 9A) are the most caught in the river and paddy fields. *Monopterus albus* (Figure 9B) or swamp eels are also caught frequently in paddy fields. Generally, fish in the river and paddy fields are the main targets. They comprise the Cyprinidae family overwhelmingly. The author identified the fish frequently found at a morning market with the use of references (Baird et al. 1999; Food and Agriculture Organization of the United Nations 1996; Mekong River Commission 2008; Smith 1945) (Table 3). In Lao PDR, fish are classified into three categories: "white fish" such as Cyprinidae and Pangasiidae, which live in rivers and move long distances; "black fish" such as Clariidae (Figure 9C), Bagridae and Anabantindae (Figure 9D), which



Figure 9 Fish called "black fish" frequently caught with fish traps in village L
A: Channa spp., B: Monopterus albus, C: Clarias batrachus, D: Anabas testudineus (Photo by the author: A on August 3, 2008, B on August 1, 2009, C on May 11, 2008, and D on May 12, 2008)

| | Family | English Name | Local Name (Scientific Name) | Total |
|----|---------------|--------------------|---------------------------------------|------------|
| 1 | Channidae | Snakehead | Pa kor (Channa spp.) | 48 (20.6%) |
| 2 | Synbranchidae | Swamp eel | Eian (Monopterus albus) | 20 (8.7%) |
| 3 | Cyprinidae | Swamp barb | Pa khao (Puntius brevis) | 15 (6.5%) |
| 4 | Clariidae | Walking catfish | Pa dug (Clarias batrachus) | 15 (6.5%) |
| 5 | Notopteridae | Bronze featherback | Pa tong (Notopterus notopterus) | 14 (6.0%) |
| 6 | Cyprinidae | Silver barb | Pa pak (Barbonymus gonionotus) | 13 (5.6%) |
| 7 | Cyprinidae | Smith's barb | Pa sakang (Puntioplites proctozysron) | 12 (5.2%) |
| 8 | Anabantidae | Climbing perch | Pa keng (Anabas testudineus) | 12 (5.2%) |
| 9 | Cyprinidae | Bonylip barb | Pa eethai (Osteochilus hasselti) | 9 (3.9%) |
| 10 | Cyprinidae | Eye-spot barb | Pa sood (Hampala dispar) | 8 (3.5%) |
| 11 | Bagridae | Bagrid catfish | Pa kot (Hemibagrus filamentus) | 7 (3.0%) |
| 12 | Siluridae | Giant sheatfish | Pa kh'ao (Wallago attu) | 6 (2.6%) |
| 13 | Pangasiidae | Basa fish | Pa yang (Pangasius bocourti) | 6 (2.6%) |
| 14 | Siluridae | Silurid catfish | Pa koeb (Belodontichthys truncatus) | 6 (2.6%) |
| 15 | Cyprinidae | Barb | Pa keeram (Labiobarbus lineatus) | 5 (2.2%) |
| 16 | Cyprinidae | Paled barb | Pa ta say (Albulichthys albuloids) | 5 (2.2%) |
| 17 | Cyprinidae | Unidentified | Pa langnam (unidentified) | 4 (1.7%) |
| 18 | Cyprinidae | Unidentified | Pa chin (unidentified) | 4 (1.7%) |
| 19 | Cyprinidae | Common carp | Pa nai (Cyprinus carpio) | 3 (1.3%) |
| 20 | Cyprinidae | Mrigal carp | Pa nuanchan (Cirrhinus cirrhosus) | 3 (1.3%) |
| 21 | Siluridae | Unidentified | Pa nang (Micronema micronemia) | 3 (1.3%) |
| 22 | Cyprinidae | Unidentified | Pa kabok (unidentified) | 2 (0.9%) |
| 23 | Cyprinidae | Mekong giant barb | Pa joke (Cyclocheilichthys furcatus) | 2 (0.9%) |
| 24 | Cyprinidae | Black shark minnow | Pa piya (Morulius chrysophekadion) | 2 (0.9%) |
| 25 | Cyprinidae | Mud carp | Pa kaeng (Cirrhinus molitorella) | 2 (0.9%) |
| 26 | Cyprinidae | Giant barb | Pa gamun (Catlocarpio siamensis) | 2 (0.9%) |
| 27 | Cyprinidae | River carp | Pa goom (Thynnichthys thynnoides) | 2 (0.9%) |
| 28 | Cyprinidae | Rasbora | Pa siew (Rasbora sp.) | 1 (0.9%) |
| 29 | Cyprinidae | Unidentified | Pa wen (unidentified) | 1 (0.9%) |
| 30 | Pangasiidae | Giant catfish | Pa yorn (Pangasius macronema) | 1 (0.4%) |
| | | | | 231 (100%) |

 Table 3
 Fish frequently caught in village L

(Researched by the author for three times in all during December 2009 - February 2010)

live in floodplains and pools; and "gray fish," which lay eggs in the floodplains in the rainy season and which return to the river during the dry season (Akimichi 2007; 2008). Farmers catch these fish according to their habits and habitats.

4 Fish Traps Used in Southern Laos

In village L, fish trapping is a common subsistence activity. Fish traps are fre-



Figure 10 Miniature fish traps used as a lucky charm hung in the house of village L (Photo by the author on May 6, 2008)

quently found under eaves. Fish traps constitute not only a few aspects of a farmer's life and culture. As a symbol for obtaining much money and good fortune, they are displayed frequently in houses or cars (Figure 10). Small fish traps are generally called *toum* or *sai*. Larger ones are *lop*.

Various fishing methods aside from fish traps include hooks and lines (*bhet*), fish and shrimp gathering large bamboo-made colanders that include tree branches (*kha*), fence and filter traps (*tone*), scoop baskets (*kheung*), fish coops (*soum*), scoop nets (*sawing*), lift nets (*kadung*), gill nets (*mong*), cast nets (*sum he*), drag nets (*tong*), and harpoons (*lem*) in addition to fish traps. Above all, fish traps are used as elaborate material culture items in terms of production and utilization technology. In a broad sense, *kha* (Figure 11), *tone* (Figure 12) and its variant (*lop sikum*), and fish coops might be included as fish traps in terms of capturing fish with the bamboo-woven fishing gear. Particularly, *kha* and *tone* are stationed gear, especially *tone*, which is used with fish traps for capturing fish. However, this report does not include *tone* in the category of fish traps.

Bamboo is used mainly as a material for fish traps at present because of overexploitation of rattan resources, which are traditionally used (Paul and Garrison 2009). In addition, pieces of polypropylene band and nylon are used today to reinforce the main parts of fish traps, especially, the barbs for which bamboo and rattan were probably used traditionally (Figure 13). Producing fish traps is a man's work

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Figure 11 *Kha* used for capturing fish and shrimp during the rainy season in village L (Photo by the author on January 13, 2010)



Figure 12 *Tone* stationed at a stream in village L (Photo by the author on October 9, 2009)

(Figure 14), while weaving cloth is a woman's work. Fish traps are produced from the bamboo obtained from the ecological environment using a hatchet. Skills and sketches are incorporated along with the farmer's body and mind to determine the proportions of the fish traps. Frog and shrimp traps are also produced in addition to fish traps. Traps are selected in accordance to the farmer's needs (Figure 18).⁴⁾

In village L, open-weave upright basket traps for frogs (Figure 15), swamp

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Figure 13 Fish traps reinforced with polypropylene bands at village L (Photo by the author on August 5, 2008)



Figure 14 Old man producing a fish trap for swamp eel at village L (Photo by the author on August 13, 2008)

eels (Figure 16), and catfish (Figure 17) are used eminently, irrespective of the season. These traps are used mainly in irrigated paddy fields. Another horizontal cylinder trap is set at the ridge between paddy fields (Figure 18). Fish trapping is a daily routine for the village farmers.

A large trap (Figure 19) is used actively in a river when the rainy season starts



Figure 15 Frog traps A: toum kop, B: ngep, C: sai kop at village L (Photo by the author: A on December 30, 2009, B on May 11, 2008, and C on June 23, 2009)



Figure 16 Man going to a paddy field to trap swamp eels at village L (Photo by the author on August 9, 2008)

to target big fish migrating from the main stream of the Mekong River. At the same time, traps for shrimp (Figure 20) are set in the river.

The photographs above show that farmers in the village use fish traps of various types for the several aquatic animals they need. Fish traps must be used not only for obtaining animal proteins and for cash income but also for enjoyment, for

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Figure 17 Catfish traps under the eaves A: *toum laan*, B: *toum laan* used chemical fibers at village L (Photo by the author on May 4, 2008)



Figure 18 Fish traps set at a ridge between paddy fields at village L (Photo by the author on August 13, 2008)



Figure 19 Men setting a big fish trap in a river at village L (Photo by the author on August 6, 2008)



Figure 20 Lop sikum used in rainy season A: lop sikum stationed at fishing ground, B: shrimps caught by lop sikum in village L (Photo by the author on August 7, 2008)

eating the animals, and trapping for the fleeting pleasure of freeing them from their agricultural duties. Aquatic ecological environments of the Mekong Basin might have necessitated development of the fish trapping activities, or the farmers might have had no other choice than to expand their subsistence activities to sustain their livelihood. However, fish traps are clearly unavoidable for farmers living in such environments in the Mekong Basin.

In terms of fish trap variety, traps of 12 kinds were spotted in the village (Table 4). They comprise five open-weave upright basket traps (41.7%) and seven horizontal cylinder traps (58.3%). They mostly have a barb on the body so that fish would not escape once trapped. The materials are fundamentally bamboo, but wood (unidentified) is used for a large horizontal cylinder trap or *lop* (Figure 19). Chemical fibers are partly used for convenience to avoid spending time for reinforcement or knitting of the trap body.

The trapping grounds are paddy fields and rivers. Especially, open-weave upright basket traps are used in paddy fields (Figures 16 and 17). Horizontal cylinder traps tend to be used in rivers. Open-weave upright basket traps are used to supply animal protein for daily needs during paddy field cultivation, irrespective of seasonality; horizontal cylinder traps are used mainly during the rainy season when river fish resources are abundant during flooding (Figures 19 and 20). Open-weave upright basket traps target fish in paddy fields such as swamp eels or catfish. Horizontal cylinder traps target migrating fish in rivers. Open-weave upright basket traps target migrating fish in rivers. Open-weave upright basket traps target migrating fish in rivers. Open-weave upright basket traps tend not to use bait because fish flow automatically into them. Consequently, fish traps in the village are made with full consideration of the given ecological environment and habits of the target. These bipolar roles and morphological differences are the significant characteristics of fish trap utilization in the village.

| No. | English Name | Local Name | Barbs | Main Materials | Trapping Ground | Seasonality | Target | Bait |
|-----|-------------------------------------|---------------|-------|------------------------|--------------------|--------------|--------------|------------|
| 1 | Open-weave upright basket trap | ngep | + | bamboo | paddy field | whole year | frog | earthworm |
| 2 | Open-weave upright basket trap | toum kop | + | bamboo | paddy field | whole year | frog | earthworm |
| 3 | Open-weave upright basket trap | sai kop | + | bamboo | paddy field | whole year | frog | earthworm |
| 4 | Open-weave upright basket trap | toum eian | + | bamboo | paddy field | whole year | swamp eel | earthworm |
| 5 | Open-weave upright basket trap | toum laan | + | bamboo, chemical fiber | paddy field | whole year | catfish | rice grain |
| 6 | Horizontal cylinder trap | lop | + | wood (unidentified) | river | rainy season | general fish | - |
| 7 | Horizontal cylinder trap | lop sikum | - | bamboo, chemical fiber | river | rainy season | shrimp | - |
| 8 | Horizontal cylinder trap | sai (1) | n.d. | bamboo | paddy field | rainy season | n.d. | - |
| 9 | Horizontal cylinder trap | sai (2)? | + | bamboo | n.d. | n.d. | n.d. | n.d. |
| 10 | Horizontal cylinder trap | sai (3)? | + | bamboo | n.d. | n.d. | n.d. | n.d. |
| 11 | Horizontal cylinder trap sai (4)? - | | + | bamboo | n.d. | n.d. | n.d. | n.d. |
| 12 | Horizontal cylinder trap | lan | - | bamboo | river | whole year | swamp eel | - |

Table 4 Traps counted in village L

(Prepared by the author)

5 Comparative Morphological Analysis of the Minpaku Fish-Trap Collections

The author's investigation and analysis of the fish trap collection from Lao PDR in the Minpaku was conducted on September 9–10, 2020 (obtained permission from the museum). The investigation confirmed a total of 24 items of fish traps collected from Laos in the Minpaku collections (Table 5). Among them, 20 of the 24 fish traps (83.3%) originate from southern Laos: Champasak (9) (37.5%), Savannakhet (4) (16.7%), Xe Kong (4) (16.7%), Salavan (3) (12.5%). The remainder are from northern Laos: Luan Prabang (3) (12.5%), and unknown (1) (4.2%), but probably from central Laos near the border with Thailand. The ethnic groups using the fish traps are classified into seven categories: the Lao (11) (45.8%), the Lawen (4) (16.7%), the Taoi (3) (12.5%), the Alak (3) (12.5%), the Taliang (1) (4.2%), the Ngeh (1) (4.2%), and the Thai Dam (1) (4.2%). The Lao are the majority. The other groups are indigenous minorities of the nation. Irrespective of ethnicity and area, fish traps are used widely as one device of eminent fishery culture in Lao PDR.

The names of fish traps collected in the Minpaku are numerous, but they can be classified roughly as *sai, tum (toum)*, and *lan*. These must be basic categories of fish traps in Lao PDR (Claridge et al. 1997). The fish traps in the Minpaku collections were produced during 1980–1991, approximately 30–40 years before the time of this description. Also, 12 fish traps (50%) are made of rattan although no rattan-made fish traps are used in the research village. However, nylon, cotton thread, yarn and brick are used for the parts in addition to natural plant materials such as bamboo, rattan and vine (unidentified) at the time of production. Trapping grounds

are also copious: paddy fields, swamps, river, streams, waterways and floodplains. Snakeheads, catfish, swamp eels, shrimps, and shellfish are caught.

Based on morphological aspects, the collections consist of 8 open-weave upright basket traps (33.3%), 14 horizontal cylinder traps (58.4%), and 2 drop-door basket traps (8.3%). Open-weave upright basket traps are similar in shape and utilization of the research village. They trap frogs (Figure 21A), swamp eels (Figure 21B), and catfish (Figures 21C and 21D) with barbs. These photographs show the fish trap structure to be universal although the shapes and the areas of origin differ.

Horizontal cylinder traps are classifiable into two types: with barbs (Figure 22) and no barbs (Figure 23). Mostly, the traps have a barb, but an item (Figure 22B)



Figure 21 Open-weave upright basket traps with barbs A: H0178813, B: H0179134, C: H0178793, D: H0178877 (Item number on Table 5) (Minpaku collections. Photo by Isao Hirota on September 9, 2020)



Figure 22 Horizontal cylindrical traps with barbs A: H0178890, B: H0178828 (Item number on Table 5) (Minpaku collections. Photo by Isao Hirota on September 10, 2020)

| No. | Item No. | English Name | Local Name | Area | Ethnic Group | Year of Production |
|-----|----------|--------------------------------|------------------------|---------------|-----------------|-----------------------|
| 1 | H0175184 | Horizontal cylinder trap | n.d. | n.d. | Thai Dam | 1990 |
| 2 | H0178734 | Open-weave upright basket trap | son, nu | Champasak | Ngeh | 1991 |
| 3 | H0178791 | Horizontal cylinder trap | kalo | Champasak | Lao | 1991 |
| 4 | H0178792 | Horizontal cylinder trap | sai | Champasak | Lao | 1991 |
| 5 | H0178793 | Open-weave upright basket trap | lan, lon tu | Champasak | Lao | 1991 |
| 6 | H0178794 | Open-weave upright basket trap | lan khang | Champasak | Lao | 1991 |
| 7 | H0178813 | Open-weave upright basket trap | khong loi | Savannakhet | Lao | 1991 |
| 8 | H0178816 | Drop-door basket trap | chan | Savannakhet | Lao | 1991 |
| 9 | H0178817 | Drop-door basket trap | chan | Savannakhet | Lao | 1991 |
| 10 | H0178828 | Horizontal cylinder trap | sai | Savannakhet | Lao | 1991 |
| 11 | H0178877 | Open-weave upright basket trap | tum, pong | Champasak | Lawen | 1980 |
| 12 | H0178890 | Horizontal cylinder trap | sai, sarung | Champasak | Lawen | 1987 |
| 13 | H0178899 | Horizontal cylinder trap | sai, aroi | Salavan | Taoi | 1989 |
| 14 | H0178900 | Horizontal cylinder trap | sai, aroi | Salavan | Taoi | 1989 |
| 15 | H0178901 | Horizontal cylinder trap | sai, aroi | Salavan | Taoi | 1987 |
| 16 | H0178938 | Open-weave upright basket trap | tum | Champasak | Lawen | 1990 |
| 17 | H0178941 | Horizontal cylinder trap | son, chok lok | Champasak | Lawen | 1991 |
| 18 | H0178954 | Horizontal cylinder trap | son, tchorok | Xe Kong | Alak | 1991 |
| 19 | H0178955 | Horizontal cylinder trap | son, tchorok | Xe Kong | Alak | 1990 |
| 20 | H0178956 | Horizontal cylinder trap | son, tchorok, um roue | Xe Kong | Alak | 1990 |
| 21 | H0178970 | Open-weave upright basket trap | naeo, son pla, naen lu | Xe Kong | Taliang | 1990 |
| 22 | H0179134 | Open-weave upright basket trap | fum yean | Luang Prabang | Lao | 1991 |
| 23 | H0179190 | Horizontal cylinder trap | sai ian | Luang Prabang | Lao | 1991 |
| 24 | H0179191 | Horizontal cylinder trap | sai ian | Luang Prabang | Lao | 1991 |

 Table 5
 Traps in Lao PDR collected by the Minpaku

| Size (cm/g) | Barbs | Materials | Trapping Ground | Seasonality | Note |
|---------------------------------|-------|---|---|--------------|--|
| $20\times 34\times 20/138$ | + | bamboo | n.d. | n.d. | _ |
| $29 \times 59 \times 29/220$ | - | rattan | n.d. | n.d. | _ |
| $17 \times 18 \times 145/1,060$ | + | bamboo, rattan | paddy field | n.d. | _ |
| n.d. | - | bamboo | paddy field | n.d. | _ |
| $26 \times 26 \times 31/378$ | + | bamboo, rattan | swamp, stream | rainy season | Rice or bread crumbs are used for bait |
| $30 \times 30 \times 39/521$ | + | bamboo, rattan | swamp, stream | n.d. | Rice or bread crumbs are used for bait |
| 28 × 51 × 33/498 | + | bamboo, rattan, nylon, cotton thread | river | whole year | Fish of any type are trapped |
| $22 \times 58 \times 53/985$ | _ | bamboo, vine, piece of brick, yarn | swamp, river | n.d. | Big fish such as catfish or snakehead are trapped |
| $20 \times 47 \times 47/1,020$ | _ | bamboo, vine, piece of brick, yarn | swamp, river | n.d. | Big fish such as catfish or snakehead are trapped |
| 22 × 21 × 173/1,070 | + | bamboo, rattan | paddy field | rainy season | Two barbs are found on the body |
| $30\times29\times51/744$ | + | rattan | swamp | dry season | _ |
| $24\times91\times29/802$ | + | bamboo, rattan | waterway | dry season | |
| $17\times 46\times 16/121$ | + | bamboo, rattan | river, stream | whole year | Fish, shrimp and shellfish are trapped |
| $20\times47\times19/166$ | + | bamboo, rattan | river, stream | whole year | Fish, shrimp and shellfish are trapped |
| $19\times52\times18/151$ | + | bamboo, rattan | river, stream | whole year | Fish, shrimp and shellfish are trapped |
| 39 × 38 × 36/672 | n.d. | bamboo | n.d. | n.d. | By contrast, Nevertheless, however, used for bait |
| $26\times26\times125/979$ | - | bamboo | n.d. | dry season | _ |
| 16 	imes 84 	imes 16/182 | - | bamboo | river | whole year | _ |
| $11\times 8.8\times 111/589$ | - | bamboo | river | whole year | _ |
| $28\times22\times192/1,\!350$ | - | bamboo | river | whole year | |
| $33 \times 32 \times 60/483$ | - | bamboo, rattan | n.d. | n.d. | |
| $13 \times 13 \times 13/99$ | + | bamboo | paddy field, stream | n.d. | Swamp eels are trapped. Earthworms are used for bait |
| $10 \times 44 \times 11/80$ | + | bamboo | paddy field, river, stream, floodplain | n.d. | Swamp eels are trapped. Earthworms are used for bait |
| $10 \times 45 \times 11/85$ | + | bamboo | paddy field, river, stream, floodplain | n.d. | Swamp eels are trapped. Earthworms are used for bait |

(Prepared by the author)

of the Lao in Savannakhet province has two barbs at the front and the back. Another one (Figure 23B) of the Alak in Xe Kong province reaches 192 cm length and 1,350 g weight. These provinces are mutually close, including the research village, but the fish trap morphology is uniquely different from the utilization and ecological environment.

Open-weave upright basket traps and horizontal cylinder traps are major collections of the Minpaku, and are also found in village L. Other important fish traps of the collections are the drop-door basket traps (Figure 24). Although they are



Figure 23 Horizontal cylindrical traps with no barbs A: H0178941, B: H0178956, C: H0178955 (Item number on Table 5) (Minpaku collections. Photo by Isao Hirota on September 10, 2020)



Figure 24 Drop-door basket trap H017781 (Item number on Table 5) (Minpaku collections. Photo by Isao Hirota on September 10, 2020)

used widely in Lao PDR (Claridge et al. 1997), the Minpaku has a pair of traps called *chan* (*jun*) of the Lao in Savannakhet province. They resemble the open-weave upright basket traps at a glance, but differ in terms of function. It is rather more like a snare trap than common fish traps. In general, the fish go into traps, but these drop-door basket traps need the actions of the fish. Once the fish touches the device, the door would drop down and trap the fish. This trap targets snakeheads and catfish, which are somewhat large fish that are also able to trigger the device. The targets must work the trap. Then they are trapped (Oswalt 1976). These traps are important for examination of the evolution of traps.

Open-weave upright basket traps and horizontal cylinder traps were found at the research village in Lao PDR and drop-door basket trap in the Minpaku collections. Although drop-door basket traps are described in an earlier report (Claridge et al. 1997), checking the real items is indispensable to deepen an understanding of its culture: most especially its material culture. The fish traps in the collections are mostly of those in southern Laos, but the morphology is uniquely different because of locality, ethnicity, materiality, ecological environment and biological resource utilization. The museum collections enable connections of these aspects beyond time and space.

The various morphologies of the traps are attributable to the fact that the shapes have been adopted according to familiarity with the biological habits of the targeted animals and the characteristics of the environment in which the traps are used. The tendency is a process by which many technological products over time are gradually integrating into a balanced form; increasingly, their form fits their function (Leroi-Gourhan 1965).

6 Discussion and Conclusion

This study mainly investigated the fish traps used at village L of Savannakhet province in southern Laos based on the author's fieldwork, referring to fish traps of Lao PDR collected by the Minpaku. First, in terms of ecological environment and seasonality, the aquatic environment in Lao PDR reflects the diversity deriving from rivers, paddy fields, ponds, aqueducts and wetlands emerging during the rainy season and being used for fish trapping. Fish traps are mainly set in rivers, paddy fields and aqueducts. Most especially, rivers and paddy fields are fished because these hold important spaces for supplying daily food. In the rainy season, these environments are fully used to trap many fish as a part of subsistence complex. Consequently, trapping in the environments is not merely simple food procurement or recreation, but also an important role in maintaining the social networks of people in the community (Akimichi and Hashimura 2007).

In the Mekong River ecosystem, some fish species migrate during river flooding (Akimichi 2007, 2008; Mekong River Commission 2001). Various fish traps are used depending on the season (Hashimura 2004; 2005). Weather in Lao PDR includes a rainy and dry season. The water level of the river increases drastically during the rainy season. People set large fish traps all at once and especially set fish traps at the point of a strong current (Burton 2005). In accordance with fish species and habitats, one must be sure that farmers have adapted to ecological environments with their considerable knowledge about seasons and places in which fish traps are set. The author's fieldwork also confirms that the current fish traps in village L in southern Laos are generally tools to catch fish. The fieldwork also reveals that the shapes and sizes of fish traps have formed in accordance with the seasons and habits of fish.

Specifically in terms of materiality, fish traps are strongly connected with the ecological environment. They are actively used in river and paddy fields in the research village and other areas, judging from results of author's research (Tsuji 2022; Tsuji and Hirota 2021) and earlier studies (Claridge et al. 1997; Goto and Hashimura 2007; Tayanin and Lindell 1991). The shapes of traps are unique, reflecting a farmer's ecological knowledge such as the habits of targeted fish or water flow. Today, fish traps are mainly made of bamboo, a natural product, and reflect the biodiversity that can be applied to catch fish of various kinds (Mekong River Commission 2003). Fish traps are also woven carefully. The level of skill at crafting of the farmers should also be evaluated to preserve their traditions. Technical sophistication of eco-material culture among the farmers is similarly needed. Investigating their attachment to fish traps and their relation with nature is necessary for additional research.

Fish traps are connected deeply with the indigenous life of the farmers in Lao PDR. Research on fish traps occupies the domain of subsistence fishing activity composed of living technology to obtain animal protein from the trapped fish. Ecological knowledge about fishing grounds and seasonality for fish trapping is also useful to understand farmers' views of the natural world. In Lao PDR, trapping fish is a necessary livelihood strategy for the farmers. Fish traps are part of an eco-material culture that is indispensable for survival in their ecological environment. Reliance on primary fish traps is also evidence that farmers are restricted from accessing modern fishing gear because of poor household conditions (Baird and Shoemaker 2008).

The eco-material culture study in southern Laos and Minpaku by author clarified that the Minpaku collections are important to understand the basic types of fish traps used throughout southern Laos, with some information about the ecological environment, seasonality, and materiality. They mostly correspond with the author's fieldwork in southern Laos. However, descriptions of ecological knowledge and subsistence use are insufficient to investigate the cognigrams (Haidle 2009)⁵⁾ or the perception-and-action sequences of fish traps. Further systematic studies particularly addressing fish traps from an eco-material cultural viewpoint are necessary to

pursue the deep ecological, historical, and cultural aspects with reference to the Minpaku collections.

Furthermore, fish traps provide an important perspective for human history. They are tools found in aquatic environments all over the world. To support efficient trapping, fish traps have been used in combination with installed fishing gear (Connaway 2007): a combination trap (tone) was found in village L (Figure 12). Fish traps are also passive tools (Mauss 1967; Tamura 2019; Tayanin and Lindell 1991; Tsuji 2007, 2013a, 2022; Tsuji and Hirota 2021) for which a lookout is unnecessary, but they must be installed in a correct place (Oswalt 1976). The location at which to set fish traps is dependent largely on the ecological knowledge of the farmers. It is also an ethnoscience issue to identify the profound indigenous knowledge. Fish traps are one aspect of the material culture in which the tools themselves remain simple by increasing their physical and natural knowledge (Shinohara 2005), although similar processes produce similar results (Ingold 2015). Tools must be verified not only from a material culture perspective that involves cooperation in physical movement among humans, tools, and materials (Ingold 2013), but also from materials, and not materiality or material culture (Ingold 2011), and from a connection with nature and skills developed through an eco-material culture.

As described above, this study demonstrated clearly that fish traps have been used fully by the farmers under their ecological environment, revealing that fish traps among the farmers of Lao PDR are eco-material culture that embraces the relation between humans and nature. In mainland Southeast Asia, trapping animals is linked intimately with agriculture (Tayanin and Lindell 1991). However, fish traps in Lao PDR are recently being replaced, less by bamboo and more by plastic materials because of convenience (Akimichi et al. 2008).⁶⁰ Because the rural society in Southeast Asia is being transformed by changes arising from the technical, economic, and political contexts (Santasombat 2008), changes in the life and environment of the rural society must also be studied simultaneously based on changes of fish traps. Diverse information is expected to be incorporated into fish traps, from which much can be learned.

Acknowledgments

This work was supported by JSPS KAKENHI Grant Numbers JP23530667, JP26380683, JP19K01200, and "Environmental changes and infectious diseases in tropical Asia" Project of the Research Institute for Humanity and Nature [RIHN] (Representative: Dr. Kazuhiko Moji, an ex-project leader of the RIHN, presently a professor of School of Global Humanities and Social Sciences, Nagasaki University, Japan). Dr. Isao Hirota, an associate professor of the Faculty of Applied Biological Sciences, Gifu University, Japan supported the research work at the National Museum of Ethnology, Japan (Minpaku). Dr. Rintaro Ono, an associate professor of Minpaku gave me the opportunity to conduct further analysis of the Minpaku collections and my task of the Info-Forum Museum Project to

editing the database of the collections related to fishing and seafaring in Southeast Asia enabled me to combine my fieldwork results with the collections. Anonymous referees provided useful feedback on an earlier draft. Mrs. Alessandra Javier-Tsuji, a lecturer at the Miriam College in the Philippines, checked the draft carefully. Many people in village L and staff members of the National Institute of Public Health (NIOPH) in Lao PDR supported my research work kindly. I deeply express my sincere gratitude to all of these people.

Notes

- 1) National Museum of Ethnology, Japan n.d. Artifact catalog. (in Japannese) https://htq.minpaku. ac.jp/databases/mo/mocat.html (accessed on September 3, 2021)
- 2) These data were collected using a spot-check method of time allocation study. Researchers visit some houses per some hours at a predetermined time and check behaviors of people. The bundles of behaviors are calculated and listed to elucidate the structure of time use among the people. This method was invented by Allen Johnson (1975) and was developed further by Kazuhiko Moji (1985).
- 3) Before the rainy season, a festival is held in village L. Men use gunpowder to launch homemade rockets to the sky, or explode gunpowder in bamboo tubes to make loud noises and plead for rain. Women enjoy dancing in groups.
- 4) Bamboo used for fish traps are identified taxonomically in northern Laos and Bambusa blumeana, B. nana, B. tulda, Cephalostachyum pergracile, Dendrocalamus hamiltonii, and D. menbranaceus, D. spp. are used for fish traps because of their strength and thickness (Hirota 2019).
- 5) Cognigrams is a process of combining the problem–solution distance approach with chaîne opératoire methodology, and of recording the data they produce in a cognigram. A mean can be found for analyzing and coding tool behavior (Haidle 2009).
- 6) At the transformation from the rainy season and the dry season, the number of fish traps set at a footpath between paddy fields to catch fish is decreasing gradually in southern Laos (Goto and Hashimura 2007). This change must be influenced by changes in the lives of people in rural societies.

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